NATIONAL THERMAL POWER CORPORATION

A Maharatna Company

1X800 MW NTPC SIPAT STPP, STAGE-III

CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-520-600-C001

SECTION - C

Technical requirement/Specification specific to the CONTRACT

Maharatna Company

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

SECTION – C covers the following:

1. TECHNICAL SPECIFICATION SECTION-VI, PART-B
2. TECHNICAL SPECIFICATION SECTION – VIB,PART-D, ERECTION CONDITIONS OF CONTRACT
3. TECHNICAL AMENDMENTS AND CLARIFICATIONS
4. ERRATA TO SECTION VI TECHNICAL SPECIFICATIONS

NTPC Limited

(A Government of India Enterprise)

SIPAT SUPER THERMAL POWER PROJECT
STAGE-III (1x800 MW)

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

PART – B

(BOOK 4 OF 5 – CIVIL WORKS)

SECTION - VIB

BIDDING DOCUMENT NO.: CS-8003-001-2

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D-1-1 GENERAL

1.01.00 This specification is to cover, survey works, site leveling works, design, preparation of general construction and fabrication drawings, supply of labour & materials and structural and architectural works by the Bidder.

This specification is to cover, survey works,.....
Detailed geotechnical investigation in the proposed area has been carried out by the Owner and the bore-log data is furnished in Annexure 'C'.
.....
The Bidder shall make the layout and levels of all structures from the general grid of the plot and the nearest GSI benchmark or other acceptable benchmark of Government department / **NTPC Ltd**.....

tems of work under this specification and nature of work in detail are complete work under this scope is referred to as civil works. Various lant and systems, facilities, etc., covered under the scope is given in

formed under this specification consists of design, engineering, construction, erection and providing all labour, materials, consumables, equipment, temporary works, temporary storage sheds, temporary colony for labour and staff, temporary site offices, constructional plants, fuel supply, transportation and all incidental items not shown or specified but per functioning of the plant, all in s d amendments thereto as may be

Bidder understands that FQA building and testing laboratory is same building. Please confirm. Also kindly clarify the following: 1. FQA building/testing laboratory is permanent structure or temporary structure. 2. In case of permanent structure, please furnish the detailed specification, layout drawings and finishing schedule etc.	FQA building and testing laboratory are separate buildings. 1. FQA building is permanent building. Testing laboratory is temporary structure.

All eel, coarse & fine aggregate, stru y the Bidder.

The scope shall also include setting up by the Bidder a complete testing laboratory in the field to carry out all relevant tests for structural steel, reinforcement steel & reinforced concrete (RCC) works.

Preliminary geotechnical investigation in the proposed area has been carried out by the Owner and the bore-log data is furnished in Annexure 'C'.

The work shall be carried out according to the design/drawings to be developed by the Bidder and approved by the Employer. For all buildings, facilities, systems, structures, etc., necessary layout and details are to be developed by the Bidder keeping in view the statutory and functional requirements and providing enough space and access for operation, use and maintenance. The Bidder's work shall cover the complete requirements as per IS codes, fire safety norms, requirements of various statutory bodies, International Standards, best prevailing practices and to the complete satisfaction of the Employer.

The Bidder shall make the layout and levels of all structures from the general grid of the plot and the nearest GSI benchmark or other acceptable benchmark of Government department. As per the directions of the Engineer. The Bidder shall be solely responsible for the correctness of the layout and levels and shall also provide necessary instruments, materials, access to works, etc., to the Engineer for general checking of the correctness of the civil works.

All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to.

The Bidder shall fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site-specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications.

In case of any conflict between stipulations in various portions of the specification, most stringent stipulation would be applicable for implementation by the Bidder without any extra cost to the Employer.

Wherever there is an anomaly in the design concept between the data furnished in the General Design Criteria & Design Concept of Buildings, the data furnished in the design concept of buildings shall be treated as final.

Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for powerhouse structures or steel plant or Industrial structures like Petro/ Chemical/Refinery/Cement etc.

D-1-2 SCOPE OF WORK

The scope of work for the EPC contractor shall include the analysis, design, construction, erection of all civil, structural & architectural works and all other items mentioned in Part-A of this Specification.

2.01.00 **Construction Facilities**

For details of construction facilities refer to Part-A of this specification.

2.02.00 **Exclusions:**

The details of exclusions and terminal points, refer to Part-A of this specification.

D-1-3 **SUBMISSIONS**

3.01.00 The drawings included in the Bidding Document provide a general idea about the work to be performed under the scope of this contract. These are preliminary drawings for bidding purposes only and are by no means the final drawings or show the full range of the work under the scope. Work has to be executed according to drawings prepared by the contractor. The following documents and drawing shall be submitted and got approved before commencement of detailed engineering. The list given below is not exhaustive but indicative only.

a) Project design intent, design criteria which shall cover all design aspects, design parameters, material of construction and its specifications, structural idealization including framing system for gravity loads and lateral loads(wind and seismic), load cases, load combinations, assumptions, references, basis of analysis & design of all buildings, machine foundations, facilities, systems and structures etc.

b) Survey drawings indicating spot levels for the area under the scope of work.

c) Plants 'General Layout Plan' drawing with coordinates of roads, boundary wall, buildings and facilities, pipe/cable corridors, railway lines, Green Belt etc..

d) Geotechnical investigation scheme

e) Geotechnical Investigation report including foundation system recommendations.

f) Typical design of pile, if applicable, in terms of type, rated capacity, length, diameter and the termination criteria to locate the founding level.

g) Scheme for initial and routine load test of Pile foundation high strain dynamic load test and pile integrity test methodology.

h) Details of corrosion protection measures for all structures, foundations etc.

i) Architectural concept designs which shall cover all concept plans and elevations, finishes and area statements of all buildings and facilities

j) The following sequence of submission of drawings/ documents is to be followed:
- Architectural drawings, wherever applicable
- Relevant GA drawings & loading document
- Analysis & design of structures/ buildings/ facilities with drawings.
- Analysis & design of foundations with drawings.

3.02.00 Detailed construction drawings and design calculations for all civil works for static as well as dynamic analysis shall be submitted for approval prior to undertaking construction work.

3.03.00 Design calculations shall be done in M.S. Office (latest version) and Drawings shall be prepared in Auto Cad (latest version). The analysis shall be done by using STAAD PRO / ANSYS/SAP2000 (latest version). However, design may be carried out manually, using computer work sheets or by using suitable software programs, as mutually agreed by Employer. Final calculations and drawings shall be submitted as mentioned in General technical specification.

3.04.00	Civil Task drawings indicating various equipment loading and supporting arrangement and floor loads shall be submitted along with design calculations. Soft copies of all STAAD/Other Softwares input and output files shall be submitted along with the design calculations for all revisions.
3.05.00	Structural steel fabrication drawings to be prepared by the contractor will not be approved by the Employer. However, the Contractor shall submit all fabrication drawings for Employer's reference. Copy of detailed bar bending schedule as prepared by contractor shall also be submitted to Engineer in charge for the reference.
3.06.00	Approval of construction drawings prepared by the contractor shall not relieve the Contractor of his responsibility regarding the safety and adequacy of design and correctness of the drawing.
3.07.00	~~"As-built" drawings in AutoCad & PDF format shall be prepared and submitted to owner by the Contractor after completion of construction / erection, incorporating changes, if any.~~ "As-built" drawings in AutoCad & PDF format shall be prepared and submitted to owner by the Contractor after completion of construction / erection, incorporating changes, if any. **Final executed quantities of RCC and structural Steel shall be incorporated in the As-Built drawing.**

D-1-4 GENERAL LAYOUT PLAN

4.01.00 The preliminary layout plan proposed for the project is shown in the drawing no titled "General Layout Plan".

It shall form the basis for further elaboration by the Bidder for the plant facilities, which are in his scope. Area identified for facilities remain same as indicated in GLP, however, minor modification of location of building may be done to optimize layout.

Bidder shall prepare the detailed layout of the plant facilities which are in his scope and shall submit the same for Owner's approval.

While preparing the detailed layout, planning his facilities and deciding upon the transportation and erection strategy he shall ensure the following aspects.

a) All Statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local bye-laws are met.

b) Face of the buildings and facilities are located in such a way so as to have an offset of minimum 15m with respect to center line of double lane road and 12 meter with respect to center line of single lane road.

c) The entire construction activity shall take into account the commissioning of the unit in phases matching with the phased commissioning of the plant.

d) The interface requirements with the plant construction/erection activities of other contracting agencies engaged by Owner. These agencies engaged will be working simultaneously with the Bidder within the plant premises.

e) Available Area for laydown, preassembly and batching plant have been earmarked on the General Layout Plan.

f) No permanent facility shall be located within the safety zone limit around the fuel Oil storage tanks etc., except those permitted by Owner.

g) Transportation of all equipment and materials shall be by road as envisaged. Any other mode envisaged by the bidder may be proposed.

h) All parts of the buildings and facilities shall be approachable by fire tenders.

i) Main roads /peripheral roads are only shown in GLP and road layout tender drawing. Approach made of heavy-duty paving/passage to buildings/structures/facilities in the scope of bidder from nearby plant road/peripheral road/grid road/internal access road shall be provided. Multiple numbers of access to different parts of any building /facility

Statement of Prebid Queries & Clarification	NTPC's Clarification
Subject to suitability of earth, Bidder can consider surplus available excavated earth from within the plant boundary for filling purpose. Please confirm	Bidder's understanding is correct. Further, Bidder to refer amendment Sl. No. D2-57.

4.02.00

4.03.00 Site Levelling and Slope Protection Work

4.03.01 Complete levelling of entire plant area as shown in drawing Titled 'Site Levelling Plan' shall be done by the Bidder.

Bidder shall carry out the topographical survey before he commences detailed design and site leveling. This survey shall cover the entire plant area including the areas earmarked for ash based units, ash silos, railyard, raw water pump house & associated facilities and the diversion drains in Bidder's scope of work. Based on field observations the contractor shall prepare and submit the survey maps of the surveyed site on suitable scale, indicating grid lines, contour lines and demarcating all permanent features like roads, railways, water-ways, buildings, power lines, natural streams, trees etc. For each area survey maps shall be prepared and submitted, one showing the spot levels and contours with grid lines and the other showing the grid lines, contours and permanent features.

Established methods of surveying like triangulation, traversing, fly leveling etc. shall be adopted for the survey work. Spot levels shall be taken at 25 meter interval and at closer intervals where pits, undulations etc. are met with. These levels shall be taken in two orthogonal directions. Contours shall be plotted at 5m interval.

It is proposed that for the purposes of site leveling the entire plant and associated areas will be divided into various blocks as defined in the drawing titled, "Site Levelling Plan". Each block shall be finished to the formation level as specified in drawing. Bidder shall deploy adequate number of experienced site leveling contracting agency(s) with requisite earth moving and compacting equipment to complete the work as per schedule.

Preparation of leveling & grading as per proposed finished ground level (FGL) is in the Bidder scope.

Bidder shall ensure that road access and drainage facilities for each block is available when site leveling in that block is completed. Unless otherwise mentioned, all roads and drains within a block shall be constructed by the bidder within a month from the date of completion of site leveling of that block.

The specified formation level(s) shall be achieved either by excavation where the existing ground levels are higher than the specified formation level or by raising by controlled filling with borrowed earth where the existing ground levels are lower than the specified level.

The excavation shall be in all types of soils or rock or a mixture of these. Bidder should assess and satisfy himself about the actual nature of soil present at site, before submitting his bid.

All natural materials arising out of site clearance and excavation shall be the property of owner. They shall be dealt with in the manner specified by the Engineer. Earth / boulders / rock etc. excavated and useful portion (serviceable materials) of trees cut shall be stacked at suitable places within Owner's acquired land for the plant in a manner as directed by the engineer. Woods, branches, trunks of trees shall be termed as serviceable material. Other materials like twigs, leaves, roots, vegetable and organic matters etc. shall be termed as unserviceable material and shall be sorted out from the serviceable materials before disposal. They shall be cleared from the area and disposed off at places within Owner's acquired land for the plant in a manner as directed by the engineer.

If the excavated material is suitable and accepted by the Engineer as fill material, the same can be used for filling in other areas were raising by filling is required. Otherwise, the same shall be taken and stacked at places(s) within the plant boundary as directed by the Engineer.

Filling with rock shall be done only after the written permission of the Engineer in the following manner:

For filling the areas involving water bodies, dewatering, removal of much, dismantling of existing slope protection of water including all other scope of work required for filling of area to be done by the bidder.

- Filling with rock shall be done only in areas identified for laydown and preassembly and ash based units.
- Maximum size of rock used for filling should not be more than 150mm in all direction.
- Original ground after removal of all organic and vegetable matters shall be consolidated by rolling as directed by the engineer subject to a minimum of six passes of 8-10 tonne roller.

- Over the compacted layer of rock (300mm), soil shall be filled in horizontal layers not exceeding 300mm in compacted thickness. The soil shall be compacted as specified elsewhere.
- It shall be ensured that the top soil layer is in minimum 3 layers of 300 mm each. To achieve this the thickness and number of rockfill layers below can be suitably adjusted.

Contour map and spot levels of the area based on the preliminary survey carried out by Owner is enclosed for the purpose of guidance of Bidder. Refer tender drawing titled Topographical survey. However, Owner does not lake any responsibility about the accuracy of the survey details furnished and any variation of the said data shall not constitute a valid reason for changing the terms and conditions of the contract. Bidder is requested to carry out his independent assessment of the existing ground levels before furnishing his bid. Detailed survey shall be carried out by Bidder after award of work and all findings as stated earlier shall be submitted for Owner's review.

4.03.02 All existing drains/channels in the plant and other areas associated with the plant except those proposed to be constructed by the Owner shall be suitably diverted by the Bidder before taking up any construction. These diversions shall be so designed as to ensure effective disposal of water without any accumulation or flooding within the limits of overall land acquisition line and in adjoining areas.

4.03.03 Before commencement of cutting/filling, all organic and vegetable matters like grass, plants, shrubs bushes, weeds, trees etc. in the areas to be filled, shall be completely removed along with their roots and disposed off. It shall also be ensured that the area to be filled is clear of any water, slush etc. Original ground shall be compacted by rolling as directed by the Engineer subject to a minimum of six passes of 8 to 10 tonne roller. The earth shall then be spread in horizontal layers not exceeding 300 mm in compacted thickness. Each layer shall be watered and compacted with proper moisture content and with such equipment as may be required to obtain a compaction of 95% or more of Standard Proctor's maximum dry density. The moisture content of the fill material shall be controlled to obtain near optimum moisture content during compaction. The fill material shall be tested for determining optimum moisture content and maximum dry density by Standard Proctor Test as per IS: 2720 (Part-VII). The fill material shall also be tested for determining moisture content before compaction as per IS: 2720 (Part-II). For each of the above tests, one sample for every 10,000 cubic metre of fill material shall be tested. Additional samples shall be tested, whenever there is a change in the source or type of fill material. The compacted soil shall be tested for its dry density as per IS: 2720 (Part-XXIX) or Part-XXVIII). Samples shall be taken at the rate of one sample for every 10,000 sq.m. area for each compacted layer. In addition, random checks shall be carried out in compacted soils by means of Proctor needle penetration. Bidder shall submit to the Engineer, the test results immediately after completion of the tests. A sample shall be deemed to have passed the test when the in-situ dry density is equal to or more than the specified percentage of maximum dry density. If a sample taken from a layer fails to pass the test, the layer shall be further compacted till two samples taken and tested from this layer pass without any negative deviation. Only after this. spreading of further layers shall be taken up.

4.03.04 Before start of filling, the Bidder shall submit to the Owner his proposal for the methodology to be adopted for compaction for each type of fill material. The Bidder shall also carry out compaction trials to establish the proposed methodology. The Bidder

shall start the compaction work only after approval of the methodology by the Owner

4.03.05 The surface of the cut/filled up areas after reaching final level shall be dressed to the required levels and slopes. The difference in levels shall not be more than +/- 10cm locally.

4.03.06 The borrow areas outside the overall plant boundary limits for obtaining suitable fill material which is required over and above the earth available after cutting high grounds within the plant area, for site levelling shall be arranged by the Bidder himself and all expenses in respect of royalties, taxes, duties, etc. for borrow areas/fill material shall be borne by him. He shall also obtain and submit to the Owner the necessary clearances/permission from the concerned authorities for the borrow areas/fill material.

4.03.07 Material suitable for filling shall be loaded and transported to the filling site by the Bidder. Any coarse grained or fine grained low plastic soil, free from shingle, salts, organic matter, sod or any other foreign substances, may be used for filling. The Bidder shall test the fill material to establish its suitability and submit its results to the Owner. Fill material shall be approved by the Owner. The following types of materials shall not be used for filling:

a) Material from swamps, marshes and bogs.

b) Expansive clays

c) Peat, logs, stumps, sod and perishable materials.

d) Materials susceptible to combustion

e) Any material or industrial and domestic produce which will adversely affect other materials in the work.

a) Materials from prohibited areas

4.03.08 Bidder shall include in his offer any extra filling that may be required on account of subsidence of the original ground due to overburden of filling above and/or compaction works for site levelling.

4.03.09 After levelling, the contractor shall establish concrete pillars at the intersection points of the grid lines for future reference. These pillars shall project at least 450 mm above the formation level and shall be labelled permanently with their respective coordinates and reduced levels.

~~4.03.10 Filling upto the specified formation level shall extend at least 2.0 m beyond the outside face of boundary wall/fence. Thereafter, it shall be finished at a suitable slope (not steeper than 1 Vertical: 2 Horizontal).~~

4.03.11 For site levelling of railway siding area (as marked in site levelling drawing) shall also comply to Railway Design & Standards Organisation (RDSO) guidelines.

Filling upto the specified formation level shall extend at least 2.0 m beyond the outside face of boundary wall/fence. Thereafter, it shall be finished at a suitable slope (not steeper than 1 Vertical: 2 Horizontal) **with Rip-Rap**. **For slope steeper than 1:2 encountered anywhere, slope protection shall be provided at slope with gabion wall/RCC retaining wall as per the requirement.**

D-1-5

SALIENT FEATURES & DESIGN CONCEPT

This section of specification covers salient features and design concepts of Civil, Structural and architectural works pertaining to Power Plant components as detailed below.

5.01.00 **Architectural Concepts &Design:**

a) All the Architectural design works shall be carried out by professionally qualified architects having adequate experience (minimum five years) in the design and detailing of architectural work of power plant buildings. Bidder may have in-house Architects with the required experience for the above or engage Architect Consultant having similar experience.

b) Power plant buildings shall be architecturally treated, based on functional requirements, in such a way that they retain the desired scale, and present a pleasing composition of mass and void. The overall impact of the buildings shall be one of aesthetically unified architectural treatment having a comprehendible scale, blending colour scheme with the surroundings.

c) All buildings and structures shall be architecturally treated in such a way so as to be in complete harmony with the main plant building, surrounding structures and environment. Due considerations shall be given to orientation, landscape design, and interior design. All finishes for floors, walls, ceiling, structural elements, partitions for offices and industrial areas shall be suitable for their aesthetics, durability and functional requirements and shall include the latest building material & technology. Consideration shall be given for achieving standardization & fast track construction.

d) Overall colour scheme of the buildings shall be designed judiciously and in a comprehensive manner taking into account the mass and void of buildings, its facade, equipment, exposed structural elements, piping, trestles, bus ducts, and other service elements. Architectural design of all power plant buildings shall be suitable for installation of photovoltaic panel on rooftop for renewable energy purpose.

e) For adequate light and ver be followed. All buildings havi lators.

Please furnish the following details: 1. Detailed specification for Civil, structural, architectural works for SOLAR PV plant on 'roof top of buildings. 2. List of buildings/facilities on which roof top Solar PV plant is to be installed.	Refer clause 6.02.09 (I) of section VI part B- sub section D-1-6 of technical specification for loading deatails. Other detailes to be developed by bidder during detailed engineering.

f) Architectural design of all Power Plant Building shall be suitable for installation of solar photovoltaic panels on roof tops for renewable energy purpose.

g) All the buildings shall be architecturally designed to meet the National Building Code requirement & Fire Safety Regulations.

h) All public buildings shall be designed incorporating the provision of barrier free environment for physically disabled persons.

Please provide the detailed specification, scheme and requirement of water storage pond/capacity for the rain water harvesting in main plant area and other buildings/facilities/structures.	Development of rainwater harvesting scheme for the project and obtaining approval of the scheme from Central Ground water board is in bidder's scope

i) All the buildings and site development including landscaping shall be designed to take care of rain water harvesting & ground water recharging. Development of rainwater harvesting scheme for the project and obtaining approval of the scheme from Central Ground water board is in bidder's scope

Bidder understands that landscaping is excluded from bidder's scope. Please confirm.	Bidder understanding is correct. Landscaping is not in bidder's scope.

j) For Control Rooms, CER, UPS Charger Room area in MPH dry wall construction technology shall be incorporated. Control room shall be designed as designer control room with ACP Cladded wall paneling for housing LVS.

Bidder understands that the said provision is to be incorporated only for internal walls of the mentioned rooms, which is an air-conditioned area. Please confirm. Further, it is requested to give detailed specification for dry wall construction technology.	Bidder shall follow the Technical specfication. Refer Amendment no. D1-23

k) Full glass wall partition with aluminium frame [illegible] high to be provided between CCR and CER of AHP CR, WS CR & CHP control room and MPH Control room.

l) All control room shall be provided with air lock lobby.

m) The development of green belt is not in bidder scope. However, bidder has to plan the facilities leaving the space for green belt as indicated in "General Layout Plan". In addition to that laydown areas and other vacant land of the plant will be used by owner for the development of green belt.

n) All floor areas indicated in subsequent pages shall be total floor area required.

5.02.00 **Main plant Buildings/Structures shall comprise of:**

a) Mill Bunker Building

b) Transfer Points, Conveyor Galleries & Trestles

c) Machine Foundations in Main Plant

d) Boiler Structure

e) Compressor House

f) ESP Structure

g) ESP Control Building

h) Pipe & Cable Gallery

i) Main Power House

The Main Power House, Bunker building, transfer points, conveyor galleries and trestles, boiler supporting structure, compressor house, ESP supporting structures including inlet and exhaust duct support structures, Pipe cable Galleries & trestles shall have structural steel framed super structure.

All other buildings may have either RCC or structural steel framework.

Brief description of the above mentioned Main Plant Buildings is furnished herein:

5.02.01 **Mill and Bunker building**

i. Salient Features

The mill bunker building shall house coal mills, feeders, Cylindrical Coal Bunker & Conical Hopper, Tripper Conveyor & its drive and monorails. All columns, main beams and secondary beams shall be made of structural steel. The RCC floor slabs (supporting the Feeder and Tripper Conveyors) shall comprise RCC slab supported on profiled metal deck sheet (to be used as permanent shuttering) not to be considered for design of RCC slab as composite slab) and shear anchor studs welded to the top flange plate of secondary & main structural steel beams, (which supports the RCC slab & metal deck sheet).

Bidder shall integrate the Mill & Bunker Building with boiler supporting structure.

Access platforms shall be provided at minimum one (1) level above bunker supporting level for inspection and testing of bunker and hopper connections. Minimum (1) Nos. of man hole/ access window shall be provided for maintenance of silo.

The bottom level of base plates of columns shall be 1.20 m below the finished paving level in the Boiler Area. The columns of Mill-Bunker building shall consist of built up structural steel I-sections. Rolled sections with additional cover plates on column flange shall not be acceptable for column sections.

The cylindrical coal bunker and conical hopper shall be made of structural steel. The inside surface of hopper shall be lined with stainless steel plates the details of which are mentioned hereafter in this specification.

Structural steel brackets with PTFE bearings shall be provided at the end columns to support the external gallery of the Tripper Conveyor

THE MILL-BUNKER BUILDING ROOF SHALL BE PROVIDED WITH PRE-FABRICATED INSULATED METAL SANDWICH PANELS. COMPOSITION OF INSULATED METAL SANDWICH PANELS SHALL BE AS DESCRIBED IN CLAUSE 9.08.00, PART-B (CIVIL) OF TECHNICAL SPECIFICATION. ADEQUATE SLOPE SHALL BE PROVIDED FOR QUICK DRAINAGE OF RAIN WATER.

The RCC floor supporting the Tripper Conveyor shall be fully covered up to the Roof level with single skin metal sheet (& structural steel runners).

ii. Design Concept

The Mill Bunker Building shall be conceptualized as moment resisting frames in transverse direction and braced in longitudinal direction. In the transverse direction the bracings may be provided, wherever feasible, in order to meet the deflection requirement specified elsewhere in this section. Bracing member shall be connected to column flange plate through gusset plate (minimum 12mm thick).

Minimum thickness of structural steel Bunker plates shall be 12mm inclusive of 4mm corrosion allowance. Minimum wall thickness of Hopper shall be 8mm. Minimum thickness of stainless steel liners on the entire inner surface of hopper wall shall be 4mm conforming to ASTM A240 S304 (Type 304) with Mill finish 2B cold rolled, annealed, descaled (pickled) and skin passed. To ensure smooth flow of coal, the hopper surface shall be provided with minimum angle of 73^{o} with the horizontal plane.

The top of the cylindrical bunker shall bear no load/ reaction from the tripper floor and accordingly neoprene bellow strap shall be provided at the interface between the two structures to allow free deflection of the tripper floor. Neoprene bellow strap shall be provided all-round the bunker to effectively seal the gap between top of bunker and sealing plate below bunker.

For all other design methodology, refer to Design Criteria specified hereafter in this specification.

iii. Architectural Features

The Mill & Bunker Building shall be a structural steel framed structure having RCC floors and prefabricated insulated metal sandwiched panel sloped roof. The tripper floor side cladding shall be Single skin Metal cladding with steel louvered windows and fixed windows with poly carbonate sheet glazing. Area of windows shall be minimum 10 % of floor area. Rainwater down comer shall be of galvanized MS pipes and shall be located at every column location.

5.02.02 **DELETED**

5.02.03 **Machine Foundations in Main Plant Area**

A. SG Area

i. Salient Features

The scope of work of the Bidder shall be design and construction of all Civil & Structural Works of Machine Foundations including supply of all materials.

PA/ FD/ID Fan and Mill foundations:

PA/ FD/ ID Fan and Mill foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round.

ii. Design Concept:

a) For the foundations of Fans (ID, FD and PA), Mills, etc. detailed static and dynamic analysis shall be done.

b) Wherever block foundation is adopted by the bidder, suitable provisions to be ensured by the bidder in their General Arrangement and design to prevent transmission of vibration from these machine foundations to other nearby structures / foundations.

c) The bidder or his consultant should have adequate prior experience in design of machine foundations and the machines should be in successful operation for at least one year prior to the date of submission of bid.

B. STG Area

i. Salient Features

The scope of work of the Bidder shall be design and construction of all Civil & Structural Works of Machine Foundations including supply of all materials, springs & viscous dampers.

Turbo-Generator (TG) foundation:

Alternative-1

The TG foundation shall comprise of RCC top deck supported on steel helical springs & viscous dampers (called herein as the Vibration Isolation System – VIS) and shall be located in the Turbine bay of Main Power House. The springs-cum-viscous dampers shall be placed on a group of RCC/ Structural Steel columns. These TG columns can be interconnected to the Main Power House Building frame either rigidly or connected through PTFE bearings on corbels/ brackets of the TG Columns. The general arrangement & details of springs/ viscous dampers and supporting group of columns and beams shall be based on TG Equipment detail of the Bidder.

Alternative-2

The TG foundation shall be conventional machine foundations comprising of RCC top deck directly supported on substructure comprising of columns and beams without any steel helical springs and viscous dampers. The columns shall be rigidly connected to the RCC deck at top and shall rest on open / pile supported foundation at bottom. The entire foundation system (including deck, columns and raft) shall be isolated from the main plant building structural system and no connection between the main plant structure and TG foundation is permitted.

Bidder has the option to choose either Alternative -1 or Alternative-2 based on his design philosophy and practice. However in case Alternative-2 is adopted by bidder, then the bidder has to furnish extended warranty of five years for satisfactory static and dynamic performance of the foundation system.

TDBFP & MDBFP foundations:	Bidder understands that for alternative-2 i.e foundation without VIS, additional warranty is only for the foundations and not for the equipment coming over it. Please confirm.	Extended warranty of five years for satisfactory static and dynamic performance of the foundation system is applicable for the foundation.

Alternative-1

TDBFP&MDBFP foundations shall consist of RCC top deck supported on steel helical springs & viscous dampers inside Main Power House. In case the top deck is located at operating floor/mezzanine floor level, the springs/ viscous dampers shall be supported on a group of structural steel columns-beam grid which shall be rigidly integrated with the Main Power House Structural frame.

Alternative-2

TDBFP&MDBFP foundations shall consist of RCC top deck directly supported on RCC/ structural beams and columns without any steel helical springs & viscous dampers inside Main Power House. The structural columns and beams supporting the TDBFP / MDBFP shall be independent of the Main Power House Structural frame and shall also have independent foundation without any connection to other nearby foundations. Further each TDBFP / MDBFP shall have independent supporting structural arrangement without any interconnection among themselves.

Bidder has the option to choose either Alternative-1 or Alternative-2 based on his design philosophy and practice. However in case Alternative-2 is adopted by bidder, then the bidder has to furnish extended warranty of five years for satisfactory static and dynamic performance of the foundation system.

BFPs in ground floor

In case the MDBFP/TDBFP foundation is envisaged to be located at ground floor of Main Power House, then these shall be designed as block foundations directly resting on soil / pile. Vertical facing of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/Cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round.

ii. Design Concept:

a) For the foundations of Turbo-generator, Boiler feed pumps, etc. detailed static and dynamic analysis shall be done.

b) The vibration isolation system (where ever applicable) supplied shall be of proven make and shall be in successful operation supporting machines like steam turbo-generators, BFPs, etc.,

c) Wherever alternative-2 is adopted by the bidder for TG or BFPs, suitable provisions to be ensured by the bidder in their General Arrangement and design to prevent transmission of vibration from these machine foundations to other nearby structures / foundations.

d) The bidder or his consultant should have adequate prior experience in design of machine foundations for the respective alternative to be adopted by the bidder and the machines should be in successful operation for at least one year prior to the date of submission of bid.

For detailed specification of steel helical springs and viscous dampers refer General Specification Chapter.

5.02.04 **Boiler Structure**

i. Salient Features

The Boiler supporting structure shall be structural steel framed superstructure adequately braced in vertical planes in both the orthogonal directions. The general arrangement & details of structural steel columns, beams, bracings, ceiling girders etc shall be as per the Bidders Boiler Structure design and detailed engineering scheme.

The bottom base plates of Boiler structure columns shall be 1.20m below the finished paving level in the Boiler area. The RCC pedestals supporting the column base plates shall be extended in order to provide RCC encasement to the structural steel columns up to at least 350mm above the top of the paving RCC slab. Steam Generator roof (pent house)/canopy/side cladding shall have single skin troughed profile permanent colour coated sheet. Cladding for Boiler elevator enclosure except its machine room shall be with single skin troughed profile permanently colour coated sheet.

Bidder shall integrate the boiler supporting structure with Mill & Bunker Building Structure.

Waterless Bio Urinals with enclosure are to be provided by the contractor on each floor elevation of each boiler. Maintenance of toilet in hygienic condition till COD of the unit shall be the responsibility of the bidder.

ii. Design Concept

Boiler supporting structure shall be designed by the Bidder based on provisions of IS 800 for structural steel and IS: 456 for RCC works.

Boiler Elevator Machine Room

Floor of Machine Room shall be provided with profiled metal decking sheet. Trough shall be filled with Insulating Material (glass wool or rock wool) and thereafter finished with Minimum 50 mm thick wooden flooring, consisting of 37 mm thick hardwood planks, finished with 11mm thick laminated wooden flooring (of 'pergo' or equivalent) with plank size 193x1195mm (material class shall be 34 as per EN13329), over 2 mm expanded polystyrene foam and polythene sheet under laying.

Roof and Side enclosure of Machine Room shall be provided with Prefabricated Insulated Metal Sandwich panels. Technical Requirements of prefabricated insulated metal Sandwich Panels/decking sheets shall be same as given elsewhere in this specification. For Elevator Machine Room other than Boiler Elevator Machine Room, Technical requirements shall be same as specified in Clause no 9.14 of Sub Section D-1-9, Section VI Part B of this specification

Doors of Machine Room shall be Double Plate Steel flush doors of thickness 45 mm with steel sheets of 18 gauge with necessary stiffeners. Space between two sheets shall be filled with mineral wool insulation. Frame of doors shall be pressed steel sheets of 16 gauge. All necessary fittings for the doors shall be provided by the Bidder. Rubber sealing, for making the Doors airtight shall also be provided.

Windows/ventilators shall be of standard extruded anodised Aluminium Sections of minimum 2 mm thickness with 24 mm hermitically sealed double glazing consisting of two 6 mm thick toughened glass separated by 12 mm. gap.

Technical requirements of prefabricated insulated metal sandwich panels/decking sheets shall be same as given elsewhere in this specification.

5.02.05 **Compressor House**

i. Salient Features:

The compressor house shall be a structural steel framed superstructure with a overhead crane as per requirements specified in Part-A Sub Section IIA-19 and Part-B Sub Section A-25 of Technical Specification. The gantry girder for the crane shall have walkway with chequered plate on both rows and cage ladder access.

The roof shall comprise minimum 40mm thick RCC slab (with additional water proofing) supported on profiled metal deck sheet and purlins. The ground floor slab shall comprise of all RCC block foundations, cable trenches and pipe trenches. The building shall be completely covered with vertical cladding and roof.

Design Concept:

The Design of Compressor House steel structure shall be based on provisions of IS 800 & IS 456 for RCC works. The structural frame shall be moment resisting sway frame in the lateral direction and longitudinally braced in the longitudinal direction. Design shall also be based on the Design Criteria specified elsewhere in this specification.

ii. Architectural Features

This building shall be steel framed structure with brick wall up to window sill height & Single Skin Metal Panel cladding above it. The roof system shall be as per the detail furnished in the salient features of this building

Cut-outs and opening shall be provided in floors and walls as per requirements.

Metal Panel cladding shall be composed of different colour shades to match with the existing surroundings. External finish shall be of Premium Acrylic Smooth Paint with Silicone additives

The size, height, door/window/rolling shutter details and building size shall be as per the approved equipment layout plan of the bidder.

5.02.06 **ESP Structure**

i. Salient Features

The ESP structure shall be a structural steel superstructure with vertical bracings in the required vertical planes in both longitudinal and transverse directions, the details of which shall be as per the approved ESP equipment GA & details of the bidder.

The bottom of base plate for ESP structure columns shall be 300mm above the finished paving level in ESP area. The RCC pedestals supporting the column base plates shall be extended accordingly above the top of the paving RCC slab. Further, the gusset plate / base plate shall be encased in concrete up to the top of bolts. ESP roof (pent house)/canopy/side cladding shall be single skin troughed profile permanently colour coated sheet.

ii. Design Concept

Design of ESP structure shall be based on provisions of IS 800 for structural steel and IS 456 for RCC works. It shall be an axially braced structure in both orthogonal directions. The ESP supporting columns shall be suitably strengthened about the minor axis for sliding movement of the base plate of ESP due to thermal movement.

5.02.07 **ESP Control Building**

i. Salient Features

ESP Control Building can either be structural steel superstructure or RCC framed structure with RCC floors at ground floor level and upper levels. The RCC floors at

upper levels shall support the Switchgears, cable galleries and Control Room. The RCC floors at upper levels shall be cast in situ RCC slabs.

For steel framed building the RCC floors shall be supported on profiled metal deck sheet and structural steel beams and roof of the building shall comprise of minimum 40mm thick RCC slab supported on profiled metal deck sheet and structural steel beams.

The rainwater down comers shall be as per specification and shall be suitably concealed.

The external Transformer Yard of the building shall comprise the transformer foundations and cable slit below ground level.

The building shall have Lift structure with lift pit below ground level and staircase at each gable end of the building.

ii. Design Concept

The Design of ESP Control Building shall be based on provisions of IS 800 for Structural Steel & IS

Air washer units and UAF units if placed on the roof shall be kept open without any shed. Technically there is no requirement of steel Shed over the Air Washer and UAF units. Please confirm.	Steel Sheds (open) have been envisaged for UAF/AWU units placed on the roof for sunlight/rain protection. Bidder to comply with specification requirements.

iii. **Architectural Featu**

This building shall concrete blocks on all four sides except for the portion in front of the external Transformer Yard and toilet and pantry block. Provision for glazed/ fire proof doors & windows shall be included. Minimum 345mm thick brick wall shall be provided for the external brick wall facing the adjacent transformer yard and the brick wall height shall be 600mm above the highest point of the transformer. Inside the building, AHU rooms, UAF Room& Battery rooms shall have brick masonry of one brick thickness. The internal walls of air-conditioned area shall be finished with 2 hour fire rated Aluminum Composite Panel Cladding.

Entire transformer yard, which shall be adjacent to the building, shall be provided with metal fencing with gates.

The building shall accommodate cable vault, toilet, staircase, switchgear rooms, control rooms and AHU room. An auxiliary transformer yard with fencing and gate shall be provided adjoining to the building. Control room and VFD room shall be air-conditioned and shall have false ceiling. Windows& Ventilators all shall be provided with Aluminium sections. All doors, windows in air conditioned area shall be provided with hermetically sealed toughened glass glazing in Aluminium frame work Steel doors and Fire proof doors shall be provided as per requirements. Internal columns in Control Room shall be encased with Aluminium Composite Panel cladding.

Minimum 2 Nos. of stairs and 2 Nos. of Toilets shall be provided as per requirement. Cut-outs and opening shall be provided in floors and walls as per requirements.

External finish shall be of Aluminum Composite Panel Cladding except Transformer area where premium smooth Acrylic Paint shall be provided.

5.02.08 **Pipe & Cable Galleries**

i. Salient Features

The Pipe- Cable Gallery shall be Structural Steel Superstructure with Steel Truss (Lattice Girder) having a general span of 15.0m/20.0m. The steel truss shall be supported on 2 legged/ 4 legged trestles the arrangement of which shall be developed by the Bidder. Trestles for pipe and cable galleries shall also be of structural steel.

The width of the Gallery shall vary depending on the functional requirement. A walkway

of minimum width 600mm shall be provided along the Cable Trays supporting floor of the gallery. The walkway shall comprise 40mm thick MS grating and 1.0m high handrail made of 32NB MS pipes. For pipe cable galleries carrying ash pipes, galvanized MS grating shall be provided over entire width of the gallery.

Plan bracings shall be provided at all chord levels of the cable gallery truss. Minimum gusset plate thickness shall be 8mm for all connections.

The level of the bottom chord (bottom of steel) of the gallery shall be at least 3.0m above the finished paving level in general. However, at all road/rail crossings, the level of bottom of steel of the gallery shall be at least 8.0m from the top of road surface and 8.5 m from top of rail track. Before and after the road/rail crossings, a barrier of suitable height shall be constructed so as to prevent the approach of cranes (having height more than 8 m) up to the pipe/cable racks/trestles.

The Caged structural steel ladder shall be provided at an interval of 200m for access to the Pipe-Cable Gallery Walkway.

At the inter-connection of Pipe/Cable gallery with Plant buildings, Pipe/Cable gallery shall be terminated at a maximum distance of 1.50m from the building. The foundation of the Pipe/Cable Trestle shall be constructed at a distance of 4.0M from center line of the plant building. Cantilever of 2.50m shall be taken from pipe-cable gallery/ trestle structure.

The foundation for Pipe-Cable gallery trestles shall be open foundation or pile foundation depending upon bearing capacity requirements. For specification regarding open and pile foundations, clause. 7.00.00 is to be referred. The grade of concrete for RCC footing/pilecaps & pedestals shall be M25. The structural trestles shall not be supported on paving RCC slab.

ii. Design Concept

The pipe-cable structure shall be designed as a 3-dimensional space frame for all the relevant load cases mentioned in the design criteria chapter.

The gallery being an unclad building, wind load shall be evaluated based on the projected frontal area of the structural members and cable tray depth.

The end portals shall be designed as rigid frames hinged (pinned support) at the base plate level (on top of the trestle column). Deflection of end portal due to wind shall be evaluated at the portal column-rafter joint. The gallery vertical truss shall be designed as simply supported girders on trestles and detailing of end portals shall be done accordingly.

Suitable expansion gap shall be provided in the gallery structure by providing twin two-legged trestles at the expansion gap. The expansion gap shall be provided at an interval of 100 to 120m. Expansion gap shall also be provided at location where changes in plan dimensions (gallery width) take place abruptly.

5.02.09 **Main Power House**

Please inform where these PTFE bearing is to be installed. On Boiler Side or Powerhouse Side.

PTFE bearing is to be installed on Main Power House side

(i) Salient Features:

Main Power House shall consist of the Turbine bay, adjacent Deaerator Bay, electrical bay & common control room building (CCR Building) (as stipulated elsewhere in this specifi and shall b per design ling Heater The RCC f as perma ab).

Bidder understands that space for office are required above Control Room in MPH Building in addition to other facilities specified. In the past practice CCR located at 17.00m and as per this specification required office space will be envisaged above CCR i.e. at 24 m or above level. Please confirm.
The required area for office space is limited to 350 sqm only.
Please provide details about the type of material for noise reduction and dust isolation.

Bidder understanding is correct. However, final location of office area shall be decided during detailed engineering Stage.
Refer amendment no. D1-34

Shear anchor studs shall be provided through metal deck at regular interval on all top flange / flange plate of structural beams. However, steel gratings, chequered plate flooring as well as precast RCC covers shall be provided as per the functional requirements. All RCC pits & trenches below ground floor slab (including Condensate Extraction Pump (CEP) pit) shall be covered with minimum 40 mm thick MS grating supported on structural steel beams. The RCC pits shall also be provided with a sump at the corner for dewatering with submersible pumps. Staircases & ladders shall be provided for access to these pits. Electrically Operated Travelling (EOT) cranes shall be placed in the turbine bay with the gantry girders (supporting crane wheel loads) supported on structural steel brackets on A & B row columns). Walkway with chequered plate shall be provided at crane girder level at both 'A' row & 'B' row side with caged ladder access from the operating floor.

All main columns & beams of Main Power House shall be of structural steel girder (open web or solid web) with base plate level of columns 1.20m below ground floor slab level in general except for other pit areas where structural steel column shall be extended below upto a depth lower than the pit top surface such that the column base plate & stiffeners are concealed below the pit raft level are concealed below the pit raft level. Auxiliary columns in main power house shall be either of structural steel construction.

The roof system in turbine bay shall comprise a structural steel girder (open web or solid web) for the entire bay width. The roof slab shall consist of 40mm thick (min. above the crest of metal deck sheet) RCC slab supported on profiled metal deck sheet. The metal deck sheet shall be supported on structural steel purlins. The purlins shall be in turn be supported on turbine bay roof girder top chord at regular interval. Additional waterproofing shall be provided above the roof RCC slab as per details mentioned elsewhere in this specification. 1 in 100 slope shall be provided for the turbine bay roof sloping downwards towards the A-row (towards transformer yard). Minimum 150mm dia. galvanized mild steel pipes shall be used at A-row & C-row as Rainwater Down comers. Staircases in main power house shall be of structural steel. Treads of each staircase shall be 40mmthick MS grating and handrail/ hand post shall be 32mmNB circular hollow sections unless specified otherwise in architectural section of the specification. All staircases in turbine Bay and Deaerator Bay shall be enclosed with minimum 230 thick brick masonry wall with fireproof doors at all floor landing levels. The parapet wall shall be of minimum 1m height and shall be provided all the around roof of main plant building.

All edges of openings shall have edge protection angles (minimum ISA 75x75x6) and handrails with hand posts (Hand post spacing 1m maximum).

ii. Design Concept:

Main Power House shall be designed as moment resisting sway frame in the transverse direction and braced in the longitudinal direction. However, due to functional requirement, vertical bracings to the column in CCR Building not to be provided at (& above) the operating floor level and CCR Building frames shall be designed as moment resisting frames in both transverse and longitudinal directions.

All beam column moment connections shall be designed for adequate ductility. The building shall have connectivity with walkways from Boiler through sliding bearing only. The connectivity with cable gallery shall be as specified in Pipe &cable gallery section of this chapter. Floor level acceleration spectra shall be generated during seismic analysis for design of pipe supports / equipment located at the elevated floors. Adequate number of thermal expansion gap (minimum 2.00m) between adjacent structural frames at expansion joint and minimum 50mm between RCC slabs at expansion joint) shall be provided between the units and Common Control Building.

In the RCC floor/ roof slabs, the spacing of shear anchor studs on structural beams shall be minimum of the spacing required for

i) Restraining the compression flanges of beams and

ii) Transfer of the horizontal shear at floor/roof to the supporting beams.

The roof girder in Turbine Bay shall be provided with a camber to take care of deflection due to dead weight.

The Main columns in A, B &C rows of Main Power House Building shall be built-up I sections. Rolled sections/ I sections with additional flange plates shall not be acceptable for main columns & auxiliary columns. The roof girder (open web or solid web) to column connection shall be bolted connection using high strength bolts (grade 8.8/ IS 1367). The roof girder of Turbine Hall shall be adequately braced in plan using Tie level and rafter level bracings. The longitudinal bracing shall comprise a pair of members connected to the column flanges and detailing shall be adequate to restrain the entire column cross-section. Minimum gusset plate thickness for bracings shall be 12mm.

Common Control Room at operating floor shall have minimum 60% free space for movement, control room to be free of any auxiliary/stub columns other than the C-row central column with minimum depth as possible

For all other design methodology, refer to Design Criteria specified elsewhere in this specification.

iii. Architectural Features

iii. Architectural Features This building shall be of Structural Steel Framed structure and shall be completely covered with external cladding and RCC roof…… Glazing for A Row & gable end shall be reflective 6mm thick clear toughened glass with Aluminium frame. Hermetically sealed double glazing shall be provided between air condi-tioned & non air conditioned areas. Internal glazed partition inside CCR/CER/Offsite Control Room and B-Row at operat-ing floor level shall be of fire resistant glass having 2 (Two) hour fire rating and with suitable frame. Light weight aer-ated concrete panels over that 50 mm thick mineral wool insulation with Single Skin Metal Panel cladding shall be provided in exterior of UPS Battery room area and Con-trol Equipment Room area.All internal side of Aerated con-crete panel and columns in air-conditioned areas other than CCR in MPH shall be encased with Aluminium Composite panel cladding from inside

amed structure and shall be completely
The external vertical face (herein stated as
t to) the transformer yard and also the two
rtical cladding comprising 3.0m high brick
iled vertical metal sheet for the remaining
operating floor &gantry girder bracket level
provided.

de the A-row (part/full), there shall be a
steel structure supporting the bus duct to
cladding shall be designed to suit the

rier wall shall be provided as per functional
he above mentioned RCC wall shall be
al face.

inside the turbine hall shall be concealed
ating floor level to crane girder bracket top

row) facing (& adjacent to) the Boiler area
erator floor level with vertical cladding
loor followed by either single skin metal sheeting with runners or brick wall sandwiched with single skin metal sheeting on external face (for all floors requiring 2 hours of fire rating e.g. cable spreader room, ventilation/ air washer room, AHU Rooms and air conditioned areas)

The internal vertical interface plane between Turbine bay & Deaerator bay (herein stated as 'B' row shall have brick masonry Wall from RCC roof slab level of turbine bay (AB bay) upto specified floor level below such that Turbine bay & Part of Deaerator bay below the Deaerator supporting floor level is completely covered on all sides.

Glazing for A Row & gable end shall be reflective 6mm thick clear toughened glass with Aluminium frame. Hermetically sealed double glazing shall be provided between air conditioned & non air conditioned areas. Internal glazed partition inside CCR/CER/Offsite

Control Room and B-Row at operating floor level shall be of fire resistant glass having 2 (Two) hour fire rating and with suitable frame. Light weight aerated concrete panels with Single Skin Metal Panel cladding shall be provided in exterior of UPS Battery room area and Control Equipment Room area. All internal side of Aerated concrete panel and columns in air-conditioned areas other than CCR in MPH shall be encased with Aluminium Composite panel cladding from inside.

Inside the main power house building, brick masonry wall (and fire proof doors) shall be provided for switchgear rooms, cable spreader rooms, MCC rooms, AHU rooms, Air Washer room & Oil rooms and all other rooms where fire protection is envisaged.

Cut-outs and opening shall be provided in floors and walls as per functional requirement.

All door, windows in air conditioned area and all windows glazing shall be provided with Aluminium frame work Steel door and Fire Proof doors shall be provided as per requirements.

Stairs in BC Bay and on A-Row shall be provided as per functional requirement and as per National Building Code and Factories Act.

All stairs in BC Bay lift lobby Area shall be in RCC. Stainless steel railing shall be provided at TG floor level for all cut-outs/ openings, walkways, cut-outs at lower level that are visible from TG floor level and stairs near lift lobby. M.S. railing shall be provided for all other locations. All peripheral edges of floor cut-outs / openings at T.G floor level and covered with gratings/ chequered plates, expansion joints along T.G deck, structural expansion joints shall be covered with minimum 2mm thick stainless steel plate of grade SS 316.

For each unit minimum one no. gent's toilet with adequate facilities including drinking water space and janitor's space shall be provided at each level of power house building, in addition one no ladies toilet shall be provided in each unit at 0.00M and mezzanine floor level and CCR level. A separate ladies and gent’s toilet and pantry shall be provided for CCR approachable from CCR / CER / Offsite Control Rooms.

B Row portion in TG Hall fronting Control Room & CER and glazed partitions in CER/ CCR/Offsite Control room shall be of **30 mm thick** Hermetically sealed double glass of Fire resistant of min 14mm thick clear, toughened, interlayered 120 minute fire rated for both integrity & radiation control and 6 mm thick toughened tinted glass with **10 mm** gap and with suitable fire resistant frame of 1.6 mm thick powder coated steel sheet. The partitions shall be up to false ceiling level and wall above up to the soffit of floor slab above control room and shall be finished with Aluminum Composite panels cladding and shall also have FRP mural of theme matching to local art and Culture.

Glass partition between AC areas in CCR/CER and other areas in associated with CCR/ CER shall be single Fire Resistant glass in line with technical specs as per fire zoning requirement. It shall be single toughned glass minimum 10 mm thick if not within fire zone.

In CCR, EIC Room, Conference Room, Programmer’s Room and Visitors Gallery etc. a theme based coordinated false ceiling shall be provided with latest state of art design.

In CCR, EIC Room, Conference Room, Programmer’s Room and Visitor’s Gallery etc., vitrified flooring shall be designed with theme and color coordination in line with the designed false ceiling.

Mullion-less glass wall with motorized curtain shall be provided in between the control room and the Visitor’s gallery.

The fire resistant glass partition in between CER/PADO room & control room (control room left hand side wall) and shift in-charge room/Conference room & control room (control room right hand side wall) shall have motorized blinds (with provision of remote

control from Unit in-charge desk) with central metallic panel column having NTPC signature icon.

The rest of the walls including LVS wall shall have coordinated design keeping in mind the overall theme of the control room using metallic panels with calcium silicate boards.

The control room gates shall have biometric physical security feature with double layer of sliding doors with air lock lobby.

Control room interiors shall be designed and executed by M/s EVANS / M/s Pyrotech or equivalent vendor who are specialized in control room interior design.

Bidder has designed and successfully executed control room interiors of several national and international power projects. Hence bidder understands that bidder is deemed as equivalent vendor specialized in control room interior design. Please confirm.	Bidder shall engage the interior design firm specialised in Control room interior design.

Control room/ Control Equipment Room / Offsite Control Rooms, entire area, False Ceiling shall have Cat Walk Way above for service/ maintenance.

Main power house building shall be provided with passenger lift in BC way as specified elsewhere in technical specification.

Adequate partitioning as per functional requirement above false ceiling in control Room & CER shall be provided for Inert Gas zoning.

Internal steel columns in Air Conditioned Area of Main Power House Building (CER, UPS charger room, SWAS room, etc.) shall be encased with Aluminium Composite Paneling up to false ceiling.

Functionally the very heart of Power House Building is its Control Rooms. Special attention shall be given for conceptualization of interior design of the Control Rooms. Control rooms design shall be both functional and ergonomic for ensuring reliable and error free operation of the plant. Control room shall have metallic panels with calcium silicate boards cladded video wall housing large video screens and a separate visitor viewing gallery. A walk through view of the control rooms shall be submitted along with bill of quantity to illustrate the design scheme.

Metal Panel Cladding shall be composed of Different Colour shades to match with the surroundings. External finish of Masonry wall shall be premium acrylic smooth exterior paint with silicon additives finish.

Air Conditioned Office for 25 persons (Including 5 cabins for Senior persons) with Pantry, Toilet block(Ladies and gents toilet separately), conference room for 25 persons, shall be provided in MPH building in addition to other facilities specified . This area shall have access to natural light on three sides minimum. It shall have air lock lobby at entrance with auto sliding doors.

Minimum area of office area shall be 350 sq.m. This area shall be positioned over the CR with good aesthetic view and noise reduction and dust isolation.

5.02.10 **Deleted**

Bidder understands that space for office are required above Control Room in MPH Building in addition to other facilities specified. In the past practice CCR located at 17.00m and as per this specification required office space will be envisaged above CCR i.e. at 24 m or above level. Please confirm. The required area for office space is limited to 350 sqm only. Please provide details about the type of material for noise reduction and dust isolation.	Bidder understanding is correct. However, final location of office area shall be decided during detailed engineering Stage. Refer amendment no. D1-34

5.02.11 CPU CIVIL WORKS

5.02.11.01 **Design Concepts for Buildings/ Shed**

i. All Buildings shall have RCC framed structure with cast-in-situ RCC roof slabs with brick cladding.

ii. Equipment/facilities with shed shall have structural steel superstructure with permanently colour coated metal sheeting at roof and side open. However, kerb wall shall be provided all around the plinth/ floor area above the Finished Floor Level (FFL). For other buildings brick wall cladding on exterior face shall be provided.

iii. Unless specified, the wall cladding for buildings shall be with minimum one brick thick on exterior face. However, brick wall for buildings adjacent to transformers shall be minimum 345mm thick.

5.02.11.01.01 Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.

5.02.11.01.02 The load and load combinations and design criteria shall be as specified elsewhere in the specification.

5.02.11.01.03 All liquid retaining structures shall be designed for following load conditions.

Underground structures:

a. Water filled inside up to design level and no earth outside.

b. Earth pressure with surcharge of 2.0 T/m2 and ground water table up to FGL outside and no water inside.

c. Stability against uplift shall be checked for completed structure and under construction stage with no water inside and ground water table up to FGL, with a minimum factor of safety of 1.20 against uplift. Installation of pressure relief valves shall not be permitted in the base slab of any liquid retaining / conveying structure.

d. The structure shall also be checked for normal working condition with water filled inside up to design level and earth pressure outside with no effect of surcharge and ground water table.

For design of over - ground liquid retaining structures appropriate load cases shall be considered.

5.02.11.01.04 All liquid retaining and conveying structures shall be designed by working stress method as given in clause 4.5 of IS 3370(Part2).

In the wall of liquid retaining structures with cylindrical shape such as clarifiers, vertical reinforcement shall be checked assuming the walls were fully fixed at the base, and the horizontal reinforcement shall be provided to resist horizontal (hoop) tension assuming hinged condition at the junction of the base slab & wall.

Wherever sandwich slabs are provided in liquid retaining structures to take care of stability against uplift, only well graded sand shall be used as fill material. The sand compaction shall be done with plate / disc compactors in such a manner that the bottom slab is not structurally damaged.

Clear free board of at least 300 mm above design (total) water level shall be provided in all liquid retaining / conveying structures.

Coefficient of active earth pressure shall be considered for design of free standing retaining walls and coefficient of earth pressure at rest shall be considered for design of top propped retaining walls.

The minimum grade of concrete for all RCC structures shall be M30.The minimum concrete clear cover to reinforcement bars in all RCC structures shall be as per IS:456(2000) and IS:3370(Part II) for water retaining structures. Durability of concrete shall conform to severe exposure conditions as per Table-3 of IS 456 except noted specifically otherwise.

5.02.11.01.05 Factor of safety against overturning and sliding

The structure shall be checked for minimum factor of safety of 1.5 against overturning conditions (ratio of stabilizing moment to overturning moment) and 1.4 against sliding conditions as per IS: 456.

5.02.11.01.06 For detailing of Reinforcement IS 5525, IS 13920, IS 4326 and SP 34 shall be followed.

Two layers of reinforcement (on both faces) shall be provided for RCC sections having thickness of 150 mm and above.

Minimum diameter of main and distribution Reinforcement bars in different structural elements shall be as follows:

Sl. No.	Structural Element	Main Reinforcement	Distribution Reinforcement / Stirrups/ ties/ Anchor Bars
a)	Foundation	12 mm	12 mm
b)	Beams	12 mm	8 mm
c)	Columns	12 mm	8mm

Spacing of reinforcement bars in walls and slabs of liquid retaining / conveying structures shall not be more than 200 mm.

Suitable shrinkage reinforcement shall be provided at top face of foundations. Minimum shrinkage reinforcement shall be 10 mm dia. @ 200mm c / c.

Minimum Reinforcement in all elements of liquid retaining / conveying structures shall be 0.24 % of cross sectional area.

Minimum tensile Reinforcement in each direction for all foundation slabs / rafts shall be 0.2% of cross sectional area.

5.02.11.01.07 Minimum thickness of foundation slab / raft and base slab of all liquid retaining tanks / pits shall not be less than 250 mm.

Minimum thickness of all other elements of RCC liquid retaining / conveying structures (except effluent drains, launders and aerator waste slab) shall be 200mm. Effluent drains (depth more than 500mm), aerator waste slab and launders shall have minimum element thickness of 150mm.

5.02.11.01.08 All Insert plates (except edge protection angles) provided in liquid retaining structures shall be 12 mm thick GI with lugs not less than 12 mm diameter rods or 6 mm flats.

Edge protection angles shall be provided as specified elsewhere.

5.02.11.01.09 All water retaining structures shall be tested for water tightness as per provisions of IS: 3370 and IS: 6494.

5.02.11.01.10 2.0m wide walkway with M25 grade concrete paving over an under bed specified elsewhere shall be provided connecting all structures, buildings and facilities. The top of walkway shall be minimum 200mm above FGL Reinforcement of the RCC paving shall consist of minimum 8mm diameter bars @ 200 mm c / c in both directions at the centre of the slab.

5.02.11.02 **Coating on RCC water retaining structures (other than drinking water)**

Epoxy phenolic coating shall be applied on (i) internal surfaces of the RCC water retaining structures and (ii) external surfaces of RCC Neutralisation-pit which is in contact with earth, as per details specified below:

a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free.

b) Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an

interval of minimum 24 hours (from the application of primer coat) by airless spray technique.

5.02.11.03 **Coating on RCC water retaining structures (drinking water)**

Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free.

5.02.11.04 **Architectural Concepts and Finishing Schedule**

Architectural concepts and finishing schedule shall be as specified elsewhere in architectural specification.

5.02.11.05 **Acid / Alkali Resistant Treatment:**

Acid / alkali resistant lining treatment shall be provided in different areas as follows:

Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick Acid Resistant (A.R.) bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable pilasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification.

The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R. bricks layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted.

The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron).

Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. The floor shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 1.0M high with above treatment shall also be provided if applicable in case of walls nearby.

The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer.

Basket of Alum Solution Preparation tank: 5mm thick epoxy lining over a coat of epoxy primer.

Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks.

Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns.

Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns.

Guarantee

The Contractor shall give a guarantee for satisfactory functioning of the lining for a period of 36 months from the date of completion of the work or date of handing over the site to the Engineer, whichever is later.

The Contractor shall replace / rectify defects is any, observed in the lining to the satisfaction of the Engineer without any extra cost during this period.

5.02.11.06 **Foundation of Over Ground Steel Circular Water Storage Tanks**

General Requirements

The tank foundation shall be as per IS 803 and as specified in relevant clause of foundation chapter.

Sub Grade Preparation

The surface of natural soil shall be thoroughly compacted by rolling or other means, as directed by Engineer, to obtain 95% of max. laboratory dry density for the soil, as per IS:2720 (Part-VII).

Anti Corrosive Layer

Anti-corrosive layer shall consist of screened coarse sand, mixed with 80/100 bitumen or equivalent 8% to 10% by volume.

Bitumen shall be heated to a temperature 175^0C to 190^0 C, with 3% kerosene, if required. Sand shall be thoroughly mixed with it in a mixing drum to obtain uniform mixture and shall be laid over the compacted surface, laid in line, grade and levels and as directed by the Engineer. Bitumen shall not be heated beyond the temperature limits given above.

The premix carpet shall be laid in two layers of 3 cm and 2 cm respectively. After compacting and laying the first layer of 3cm, a tack coat of hot bitumen at the rate of 1 Kg. per Sq.m. shall be uniformly applied to the surface, by means of Sprayer and the Second layer of 2cm thick shall be laid, tamped and compacted to the satisfaction of the Engineer.

Sand shall be spread on the final surface at the rate of 0.5 Cu. m per 100Sq.m.

5.02.11.07 **Premix**

Materials

Sand

Sand shall be clean, dry, coarse, hard angular, free from coatings of clay, dust and mix of vegetable and organic matters and shall conform to IS 383 (Grade -III).

Stone Chippings

Stone chippings shall be hard black trap or granite or locally available stone and shall conform to IS 383. The grading shall be of normally 12mm down size and 6mm down size, in the ratio of 3:2 respectively.

Bitumen

Bitumen required for the work shall be 80/100 grade or its equivalent quality.

Laying

Areas on which the premix is to be laid shall be thoroughly cleaned of all dust and loose materials. On the cleaned surface, a tack coat at the rate of 1.0 Kg. per Sq.M. of hot Bitumen shall be uniformly applied by Sprayers. The applied Binder shall be evenly brushed.

The Binder bitumen 80/100 shall be heated to the temperature of about 190^0 C with 3% kerosene, if required and mixed with stone chippings of size, as mentioned above, at the rate of 400 KG, with Six (6) Cu. M. of stone chips, for 100 Sq.M. of surface. The total mixed quantity, as mentioned above, is the quantity required for the total 50mm thick for 100 Sq. m. of area. Mixing shall continue until the aggregate is well coated.

5.03.00 CHIMNEY

	1.05.22.01	Transition duct inside the chimney and chimney flue liner shall be painted with cor-rosion resistant paint for Borosilicate Lining and insulated for Titanium/C-276 cladding irrespective of surface temperature	Bidder understands that only outer surface of chimney flue liner is to be painted with corrosion resistant paint for borosilicate lin-ing. Inner surface of flue liner shall be pro-vided with borosilicate lining so there shall be no exposed surface. Kindly confirm.	The specification clause is intended for the complete exposed surface to be painted with corrosion-resistant paint in case of borosilicate lining.
	1.05.22.01	For Borosilicate lining, top portion of the flue can shall be fitted with stop bar of 8 mm thick capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining.	For Borosilicate lining, bidder proposes to provide 8mm thick (minimum) mild steel flue with Borosilicate Glass Block Lining of minimum 38 mm thickness for the top flue liner above the roof slab. This is proposed to avoid creation of welding joint between two different materials. It is not feasible to weld MS liner with solid titanium due to non-availability of suitable electrode for weld-ing. External surface of chimney flue liner projecting over the chimney roof shall be wrapped with 2 mm thick Titanium / C-276 sheet. Kindly confirm.	Bidder's proposal is not acceptable. The specification requirement is clear in this regard. Bidder to comply with technical specification requirements.
	1.05.22.01	For Borosilicate lining, top portion of the flue can shall be fitted with stop bar of 8 mm thick capping of Titanium / C-276 sheet to avoid any damage in between flue can and borosilicate lining. The minimum length of the capping inside the chimney shall be atleast equal to 150mm.	For Borosilicate lining, bidder proposes to provide 2mm thick titanium sheet over the top portion of the flue can to avoid any damage in between flue can and borosilicate lining. Bidder proposes to provide the 100mm length of the capping from the top portion of the flue inside flue liner as a standard practice of bidder. Kindly confirm.	Bidder's proposal is not acceptable. The specification requirement is clear in this regard. Bidder to comply with technical specification requirements.

Configuration and height of chimney(s) shall be as specified in mechanical portion of technical specification. There shall be one flue (liner) for each unit.

The chimney shell (windshield) shall be constructed using slip form shuttering. Internal platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase & around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size 100x6 thick shall be provided in the hand railing.

The flue duct outside the chimney shall be suitably connected to the vertical flue liner inside the chimney as per EPRI Wet Stack Design Guidelines. Expansion Joint shall be provided at the interface between the flue liner and the absorber outlet duct as per design.

The expansion joint in the flue liner shall comprise of non-metallic material suitable for wet stack operations, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. If required as per design or as per the recommendation of expansion joint manufacturer, the space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable for wet stack operations and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters & operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh. Design of expansion joint shall comply EPRI guidelines to avoid contact of condensate with expansion joint material and to ensure drainage of condensate.

Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be upto the platform just below roof platform and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch.

The other components of the chimney include liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, all finishing works, electrical power distribution boards, lighting panels, power & control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects.

Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the

platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance.

The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation & erection of flue segments.

5.03.02 Design Concept

Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in Indian Standard, reference shall be made to ACI, BS, CICIND and other international standards.

In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail.

Imposed loading for design of all chimney components shall not be less than 5 kN/ Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load.

The min. thickness of web for plate girders shall be kept as 12 mm.

Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document.

Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document.

The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings.

5.03.03 Wind Shield

The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The load calculation and load combinations shall be as detailed in IS 4998. The wind shield shall be analysed for cases with and without flue liner loads.

Forces/stresses in the wind shield due to eccentricity effects of local loadings, insolations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered.

Seismic response of the chimney shall be computed by the response spectrum method. Dynamic modulus of Elasticity shall be considered for calculating natural frequencies of the chimney. At least, the first five modes of vibrations shall be used for this analysis.

The across wind analysis of the chimney shall be carried out as per the provisions of IS 4998. Across wind loads shall be combined with co-existing along wind loads.

The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm.

The minimum vertical reinforcement shall be 0.3% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 250 mm on each face. The minimum circumferential reinforcement shall be 0.2% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm.

There shall be a continuous ring of concrete shell without any opening for a height of atleast 5m below the soffit of flue duct openings.

There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a sudden change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level.

The diameter of the reinforcing bar for the main vertical reinforcement of shell shall not be less than 25mm for a shell height up to the top level of flue duct opening.

Shell thickness between any two 10m reference levels shall not vary more than 150mm.

The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm.

Grade of concrete for chimney shell, and other super structure shall be minimum M30. Only OPC cement shall be used for Chimney shell and other super structure.

The final design shall be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located upto distance of 20 times diameter at 2/3rd height of subject chimney in the area or in the future expansion stage of the project, as envisaged by the owner at the time testing, shall be determined along with the other topographical features of the local area through model test.

5.03.04 Flue Liners

The flue gas parameters & various operating conditions for selection of flue liner material, material specification for flue liner and the criteria of flue gas exit velocity for sizing the flue liner shall be as specified elsewhere in the specification.

For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations. The thickness of any clad metal/coating/block lining etc. provided on the base metal shall not be considered for computing the structural strength of flue liner. The minimum thickness of the mild steel base metal shall, however, not be less than that specified elsewhere in the specification.

Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels.

The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.

5.03.05 Internal Platforms

The platforms shall be designed for dead, imposed (live), erection work and other possible loadings and temperatures effects. These platforms shall provide support and lateral restraint to the steel liners and provide access for inspections and maintenance. Forces imposed on the floors due to lateral restraint of flues shall be enhanced aptly for impact effects. These platforms shall also be designed suitably for the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000.

5.03.06 Internal Staircase

The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm.

5.03.07 Foundation

The chimney foundation shall be designed as per limit state method as per IS 4998 for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation/piles for any loading condition. Since chimney is a wind sensitive structure no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. The foundation diameter to depth ratio shall not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 30.

5.03.08 **Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner)**

The insulation shall be semi-rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 64 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The coefficient of thermal conductivity of insulation shall not be more than 0.52mW/cm/^{o}C at a mean temperature of 100^{o}C.

The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanised wire mesh using MS galvanised pins and speed washer.

5.03.09 **Chimney Painting**

(i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case ot envisage provision of thermal insulation on the exterior surface t surfaces of steel wind strakes shall be painted as specified in n clause of this specification.

Bidder understands that no painting is required on inner surface of concrete chimney shell below roof.
Kindly confirm.

The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, etc shall be painted with epoxy phenolic coating system having total 220 microns DFT. Further, no painting is envisaged on inner surface of concrete chimney shell below top portion.

(ii) bedded in concrete like Strake embedment assembly including bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes.

(iii) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab, etc shall be painted with epoxy phenolic coating system having total 220 microns DFT.

a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% ±2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free.

b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.

c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This

coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.

(iv) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iii) above in alternate bands of 'signal red' and 'bright white' colours.

Bidder understands that a rack and pinion elevator shall be provided for travel from the grade level up to the platform just below the roof platform. Kindly confirm.	Bidder's understanding is in order. Elevator shall be provided for travel from the grade level up to the platform just below the RCC roof platform.

5.03.10 Rack and Pinion Elevator

A rack and pinion elevator, [illegible] per cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.).

A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25% and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual.

5.04.00 DELETED

5.05.00 ASH HANDLING SYSTEM

5.05.01 The civil works for Ash handling system shall comprise of bottom ash and fly ash handling systems, which includes Ash slurry pump house and their related sumps/tanks, Ash water pump house, Bottom Ash (BA) slurry transportation pump pit and their related sumps/tanks Slurry trench (In case of SCC system), Transport/instrument Air Compressor house, Conveying air compressor house, Switchgear /Control/RIO rooms, , AHP Control room building, Ash classifier, Ash silo, supporting structures and foundations for Bottom ash hopper, Buffer hoppers, dewatering bins, bottom ash overflow tank, Settling tanks and Surge tanks, Seal water tank, Bagging plant Complex, Silo Utility Building complex including development of silo area (i.e. paving, fencing/boundary-wall, access roads, office block and watchman cabin), miscellaneous equipment foundations, trenches, pipe racks, pedestals/thrust blocks for Ash disposal pipe supports (inside the plant boundary) including bridges/ culverts for road/rail/drain/nallah as required. For the ballast-less rail track under silo area complex a 4.0m wide area (2.0 m either side of centre line of railway track) shall be left unpaved along the rail track in complete silo area complex same shall be constructed by railway siding agency. RCC peripheral drains, crossing rail track shall be covered with permanent RCC slab (minimum 150 mm thk.) & construction of these RCC drains such that it will not create any hindrance in construction of rail track. Top of paving level in balance silo area complex shall be governed by the top level of rail track in silo area complex. Steel gates of minimum 6.0m width for entry & exit of railway wagons in silo area complex shall be provided in boundary wall/ fencing of silo area complex. For the hindrance free movement of railway rack on the rail track under Silo following shall be provided however necessary approval shall be taken from the railway authority by successful bidder.

*Horizontal clearance: A minimum clearance of 3.5m shall be maintained between centre line of the Railway track to face of the crossing structure.

*Vertical clearance: A minimum vertical clearance of 8.5m shall be maintained between Rail top level and bottom of structure.

5.05.02 Transport air compressor houses, Conveying air compressor houses, Ash slurry Pump House, shall have steel shed building with side sheeting and Silo utility building, shall have RCC framed structure, with RCC columns and profiled metal deck sheet roofing (filled with RCC) supported on steel purlins & truss / girders. Other buildings like MCC /switchgear rooms, control room, etc. shall have RCC framed structure with cast-in-situ RCC roof slabs. Bagging plant Complex building shall be closed steel shed. All RCC buildings shall have brick cladding. Crane girders or monorails shall be provided as per requirement and the same shall be of structural steel construction.

5.05.03 THE DOCUMENTS AND DRAWINGS AS LISTED BELOW ARE TO BE SUBMITTED FOR THE APPROVAL OF THE EMPLOYER UNLESS SPECIFIED OTHERWISE. THE LIST GIVEN BELOW IS NOT EXHAUSTIVE BUT INDICATIVE ONLY.

a) Project design intent document giving the basis of design, which shall cover all the design philosophy aspects, parameters, assumptions, references, loading cases, load combinations, analysis and design of all buildings, structures, facilities etc. shall be furnished for approval, before commencement of detailed engineering.

b) Structural analysis, design calculations and drawings of substructures and super structures for all buildings/structures, facilities like pump houses/shed, compressor houses, sumps / tanks, channels, pipe support structures, culverts/ bridges, pedestals, thrust blocks transformer yards, etc. shall be submitted for approval of the owner.

c) The design and drawings for the equipment and their supporting structures like bottom ash hopper, buffer hopper/collector tanks, surge tank/settling tank, silos/bins, etc. associated with Ash Handling System, shall be submitted to the Owner for information only. However, the structural design criteria and basis of design as mentioned at (a) above, for these structures also shall be approved by the Owner.

d) Top of RCC pedestal of foundation for bottom ash hopper, fly ash silo, other columns etc. shall be 300 mm above paving level or surrounding finished ground level (FGL).

5.05.04 **DELETED**

5.05.05 The Silo area complex shall be fenced with chain linked fencing, if placed inside the plant boundary and shall be confined with boundary wall if placed outside plant boundary. Gates shall be provided for rails, truck movement and transformers. The boundary wall shall be of one brick thick of height 2.4 m with a 600 mm high galvanized concertina at top, such that total height is 3.0 m above formation level. The fencing shall be PVC coated G.I. Chain link of minimum 4 mm thickness (including PVC coating) of mesh size 75mm x 75 mm and of height 2.4 m above toe wall. The toe wall shall be 1 brick thick, minimum 200 mm high above paving/formation level and 300 mm below paving/formation level on 75 mm thick PCC (1:4:8) bedding. Entire area in the silo area complex shall be paved and have a peripheral RCC drain of adequate capacity & slopes covered with perforated precast RCC slabs of minimum 150 mm thickness with provision of openable galvanized steel grating covers of 1.0 m at every 4 m interval .The complex shall be provided with a sump for collection of ash water. In addition to the outer confinement, additional fencing with gates should be provided for all transformers in the complex. A watchman cabin with a minimum area of 5 Sq.m shall also be provided in this area.

5.05.06 Pipe supports shall be provided for ash slurry pipes—pipes, dry fly ash(FA) pipes including RCC thrust blocks and any other supports required to complete the system. Over-ground pipes shall be supported on RCC pedestals except for FA pipes which shall be on elevated steel trestles. Unless noted otherwise, the top of concrete pedestals shall be minimum 500 mm

above surrounding ground level/paving level. Pipes shall be suitably anchored with RCC pedestals to resist lateral and vertical movements as per system requirement.

5.05.07	**DELETED**	Please furnish High Flood level (HFL) of the plant area.	High Flood level (HFL) of the plant area is RL(+) 272.6M

5.05.08 Where the pipes are crossing the road through RCC box culverts, the culvert top generally, shall not be not more than 100 mm above the road top and a hump with slope of 1:35 shall be provided on the road. all other road crossings inside the plant area can be either underground or overhead road crossings with necessary headroom clearance. for any boundary wall crossings, pipe shall be laid through casing pipe / RCC culvert. after laying the pipe, the boundary wall shall be restored. for other water body crossings, such as local nallah / canal, local water bodies, local drains etc. suitable structural arrangement with 800 mm wide walkway shall be provided. minimum clearance of the bottom of pipeline for all such locations shall be 1.50 m above the high flood level (HFL). bidder to take all statutory clearance from concerned authorities for crossing his pipe/trestles over road / rail / culverts / nallah etc. at his own cost and initiative, without any commercial implication to the owner. for any other additional works, bidder have to make their own assessment too of the quantity/ number of culverts, existing pipe pedestal crossings, nallah crossings etc., based on their site visit before quoting.

5.05.09 All ash handling system pipe crossings with railway lines including MGR lines shall be laid by method accepted by concerned railway authorities for existing rail lines & by cast in situ RCC box culvert for future envisaged rail lines. the railway track crossings are to be designed in accordance with railway standard/RDSO guidelines and all necessary approvals from the concerned railway authorities shall be obtained by the bidder, without any financial implications to th

33	VI/B	D-1-5	24 of 69	5.05.11	All liquid retaining structure shall be designed by working stress method as per is 3370 (part-1&2):2009. the thickness of base slab in liquid retaining/ carrying structures shall be minimum 150mm. minimum grade of concrete for liquid retaining structures like sumps/tanks/drain sumps etc shall be m-30.	The referred clauses are contradictory. Bidder understands that the Minimum grade of reinforced cement concrete for all foundations and super structure shall be M25 except for the structures where M30 is exclusively specified. Please confirm.	As referred in clause 8.02.01 b) Minimum grade of reinforced cement concrete for all foundations shall be M25 unless noted otherwise.
34	VI/B	D-1-6	4 of 20	8.02.01 b)	Minimum grade of reinforced cement concrete for all foundations shall be M25 unless noted otherwise. Minimum grade of concrete for other structures/areas (other than machine foundations) shall be M25 for all superstructure and substructure unless noted otherwise elsewhere in this specification.		

5.05.10 **DEL**

5.05.11 All liquid retaining structure shall be designed by working stress method as per is 3370 (part-1&2):2009. the thickness of base slab in liquid retaining/ carrying structures shall be minimum 150mm. minimum grade of concrete for liquid retaining structures like sumps/tanks/drain sumps etc shall be m-30.

5.05.12 For liquid retaining structures, the minimum reinforcement in each direction shall not be less than 0.24% of the gross cross-sectional area.

5.05.13 All liquid retaining structures shall be tested for leak proofness with full water level in accordance with clause no.12 of is 3370(part 1):2009 and is 6494.

5.05.14 All pump houses and other substructures shall be checked for stability as per the following guidelines:

a) Stability of structure against sliding during construction as well as operating conditions for various combinations of applied characteristic loads. In case where dead load provides the restoring moment, only 0.9 times the characteristic dead load shall be considered. Factor of safety against sliding shall not be less than 1.4 under most adverse combination of applied characteristic loads.

b) Stability of structure as a whole against overturning. It shall be ensured that the resisting moment shall be not less than the F.O.S. times the maximum overturning moment. Factor of safety against overturning shall not be less than 1.2 due to characteristic dead load and shall not be less than 1.4 due to characteristic imposed load.

c) Stability of structure against uplift due to the ground water table at finished ground levels during construction and after construction stages. Minimum factor of safety of 1.2 against uplift shall be ensured considering 0.9 times dead weight, empty condition inside and ignoring the superimposed loadings. Inclined wedge action shall be limited to 15 degree with vertical plane. Provision of pressure relief valve / flap valves etc. shall not be permitted to counter the uplift. Also FOS against uplift, to be taken as 1.0

The civil works for FGD system shall comprise of civil, struc-tural and architectural works below and above ground level of ball mill building, ball mill foundations, FGD control room building, slurry re-circulating pumps & oxidation blowers shed, tank foundations, absorber tower foundation, mcc building, gypsum dewatering building, transformer founda-tion, equipment foundations, pipe & cable gallery/ trestles, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD sys-tem specified elsewhere in this specification. Bidder may also refer terminal points & exclusions in this regard.

projections, if any, in dered in this case.

5.05.15 **ARC GS**

a utters / ventilators.

b e provided for pump ystem requirements.

c ith silicon additives.

d ealed double

e and cage ladder

f y.

5.06.00 FGD SYSTEM

5.06.01 The civil works for fgd system shall comprise of civil, structural and architectural works below and above ground level of ball mill building, ball mill foundations, fgd control room building, slurry re-circulating pumps & oxidation blowers building, tank foundations, absorber tower foundation, mcc building, gypsum dewatering building, transformer foundation, equipment foundations, pipe & cable gallery/ trestles, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete fgd system specified elsewhere in this specification. Bidder may also refer terminal points & exclusions in this regard.

5.06.02 **Buildings for FGD System**

FGD System may comprise of various buildings based on the functional requirement viz. Ball Mill Building, MCC/Control room building, Gypsum dewatering building, re-circulating pumps & oxidation blowers building, Gypsum storage shed etc.

5.06.02.01 **Control building, M. C. C. Buildings**

These shall be steel/RCC framed building with RCC roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Cladding shall be of brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations. All air - conditioned areas, shall be provided with false ceiling system (details specified elsewhere) with under deck insulation.

5.06.02.02 **Limestone Grinding System building/Ball Mill building:**

This shall be steel framed building with R. C. C. roof and floor. For steel building roof /floors shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only over structural beams). Cladding shall be of single skin metal sheeting or brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification.

5.06.02.03 **Gypsum Dewatering Building**

This shall be steel framed building with R. C. C. roof and floor. For steel building roof /floors shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only over structural beams). Cladding shall be of single skin metal sheeting or brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification

5.06.03 **Booster Fan and Ball Mill foundations**:

Fan foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round.

Design Concept:

a) For the foundations of Fans, Mills etc. detailed static and dynamic analysis shall be done.

b) Wherever block foundation is adopted by the bidder for Mill or FAN foundations, suitable provisions to be ensured by the bidder in their General Arrangement and design to prevent transmission of vibration from these machine foundations to other nearby structures / foundations.

The bidder or his consultant should have adequate prior experience in design of machine foundations and the machines should be in successful operation for at least one year prior to the date of submission of bid.

5.06.04 Pipe and cable gallery/ trestles shall be as per details given in clause no. 5.02.08.

5.06.05 **RCC Floors, Paving & Grade Slab details**

Passages shall be provided inside the FGD area connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the equipment lay down area, unloading & maintenance area, storage area with 50 mm thick metallic hardener topping.

Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving. However, corridors below pipe/cable trestle gallery where no traffic movement is envisaged and in the area over the buried fire water pipes shall be provided with interlocking concrete blocks of minimum M35 grade and minimum 80 mm thickness underlain by 20mm thick layer of sand followed by 200mm thick 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil.

All facility/buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand.

An area of minimum 7.5m width all around the tank foundations and other facilities/buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings.

Wherever multiple FGD facilities are located in a cluster in the areas proposed for FGD, the entire extent of the cluster shall be provided with area paving maintaining minimum 7.5 m width around the facility buildings. Paving shall be extended up to nearest road for easy access to

FGD facilities. Any functional requirement of paving for FGD facility not specifically mentioned in this document is also in scope of bidder.

GRADE SLAB OF BUILDINGS AT GROUND FLOOR

In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at unloading & maintenance area, gypsum storage shed stone soiling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided.

Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping.

5.06.08 Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner.

Roads shall be of concrete as per IRC standards, with minimum thickness of pavement (PQC) as 250mm (in M 35 grade) and DLC of 150 thick (in M 10 grade). Double lane road (width 12m having 7.5m wide pavement & 2.25m wide shoulders on both sides) shall be provided.

5.07.00	Bidder request to give information regarding number of users for the design of sewage treatment plant.	As mentioned in the refered clause - "The capacity of the Decentralized Sewage Treatment' units should be as per the design requirements, subject to minimum combined capacity of 75 Cum/day."

Complete sewerage system including Sewage Treatment Plant for facilities within the plant is in bidder's scope. Bidder shall provide 'De-centralized Sewage Treatment' units. The capacity of the Decentralized Sewage Treatment' units should be as per the design requirements, subject to minimum combined capacity of 75 Cum/day.

Design of Sewage treatment plant shall be as per CPHEEO manual. Primary, Secondary and Tertiary treatment to be provided. Treated sewage water shall be used for horticulture purpose as per quality requirement of CPHEEO manual.

Cement concrete pipes of class NP-3 as per IS 458 shall be used below ground level for sewage disposal in all areas other than main plant area. However, for pressure pipes and in main plant areas, and under roads spun Cast Iron pipes conforming to IS 1536 of required class shall be used. RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS 4111.

Sewage pump stations shall be provided as per IS 4111.

Bidder shall have to provide complete arrangement for sewage disposal up to the sewage treatment plant including pumping facilities.

5.08.00 Plant Storm Water Drainage System

Comple	Bidder understands that Boundary wall, patrol road along boundary wall and associated drains is not in bidder's scope. Please confirm.	Bidder understanding is correct. However, Layout of drain shall be as per layout given in tender drawing "Layout of drain'.

drain
shall b
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area, d
alues
shall be
RCC
Cast-in
RCC

Cast-In-Situ drains and M30 for RCC Pre-cast drains.The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be

5.23.18	All open RCC drains shall have removable steel gratings designed for loads as specified under loading clause.	Referred clauses are contradictory. Please specify areas where drains shall have removable steel grating/precast covers. For all other areas, open drains with no cover will be provided.	This clause is for aplicable for COAL, BIO MASS, LIMESTONE & GYPSUM HANDLING SYSTEM area.
5.08.00	Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains.	Please Clarify.	This clause is for aplicable for plant strom water drainage system

Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations whichever is higher for drains upto depth of 1m from formation level. For depth of drain more than 1m from formation level, the thickness of side walls and bottom slab of RCC drains shall be minimum 200mm or as per design considerations whichever is higher.

The drains shall be provided on both sides of the double lane roads and single lane roads. The drains shall be provided on one side of the patrol roads along boundary wall. These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings.

L

Watch towers shall be RCC construction with all-weather en-closure at 6m height. watch towers shall be provided at 600 m interval along the boundary as well as at corner turning points of the plant boundary. watch towers shall be provided with MS STAIRCASE.

C rea.

5.08.01 **W**

~~Watch towers shall be RCC construction with all-weather enclosure at 6m height. watch towers shall be provided at 600 m interval along the boundary as well as at corner turning points of the plant boundary. watch towers shall be provided with MS ladders.~~

5.08.02 Deleted

Bidder understands that watch towers along the existing boundary wall are already constructed. Hence watch towers are excluded from bidder's scope. Please confirm.	Watch tower (04 nos.) along exisitng boundary wall is in bidder's scope. Bidder to refer amendment no.D1-35 also.

5.08.03 Deleted

5.09.00 **TRANSFORMER FOUNDATION**

Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Solid RCC block foundation shall be provided for the main transformer block. Alternatively, transformer shall be supported on a RCC foundation comprising of common raft for rail supporting walls up to rail-cum-road along with pedestals for jacking pad, roller lock etc. Tie beams connecting roller lock pedestals at rail level shall also be provided. Common raft/solid RCC block shall be supported on soil or pile based on requirement specified elsewhe5.09re in the specification.

Oil soak pit / oil water separation pit for transformer shall be provided as envisaged elsewhere in the specification.

The oil soak pit shall be provided for each transformer and shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store one-third (1/3) of the oil volume of transformer/reactor considering only 40% of the volume as available voids between gravel filling. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit. Oil soak pits sump of individual transformers shall be connected to common oil retention /oil water separation pit through hume pipes and manholes.

Separate common oil retention pit/oil water separation pit shall be provided for a group of transformers in transformer yard area of each generation unit of plant.

The Oil-water Separation pit shall be designed for an effective capacity of complete oil of one transformer having highest volume of oil along with 10 minutes of firewater. For calculating effective capacity of oil-water separation pit, effective depth excluding 200 mm freeboard below invert level of inlet pipe shall be considered. Plan area and depth of oil-water separation pit shall be decided based on above consideration.

Oil-water Separation pit shall be provided with five separate chambers interconnected by pipes.

First chamber shall be for collecting oil-water mix from transformers' soak pits in case of fire. After entering into first chamber, oil being the lighter in density floats above the water. The water from lower elevation flows in to subsequent chambers interconnected through

galvanized MS pipes. The accumulated oil in the first chamber to be pumped out for subsequent usage or disposal. Water collected in the last chamber to be pumped out for subsequent disposal after treatment. Invert level of inlet Hume pipes (of NP-3 grade and adequate capacity), carrying oil and water from transformers soak pits, shall be designed for gravity flow. Freeboard of 200 mm shall be provided below the invert level of inlet pipes. Invert levels of interconnecting pipes of subsequent chambers shall be decided accordingly.
Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/reactor foundations.
RCC Firewall shall also be provided between the transformers wherever required.
300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for firefighting system shall be provided up to top of gravel filling. However, the supply and erection of Pylon supports with anchor fasteners for HVW spray system are not under the scope of this package. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.

5.10.00 **Roads**

All roads shall be of rigid pavements unless oth-erwise specified. Rigid pavements shall be con-structed with either conventional cement concrete or with Geopolymer concrete. Con-crete road/pavement or rigid pavement, men-tioned in specification, shall mean road /pave-ment constructed with either Cement Con-crete (CC) or Geopolymer Concrete. All con-crete roads shall be unreinforced jointed plain concrete pavement having dowels in transverse joints and tie bars at longitudinal joints……

All roads shall be of rigid pavements unless otherwise specified. Rigid pavements shall be constructed with Geopolymer concrete. Concrete road/pavement or rigid pavement, mentioned in specification, shall mean road /pavement constructed with Geopolymer Concrete. All concrete roads shall be unreinforced jointed plain concrete pavement having dowels in transverse joints and tie bars at longitudinal joints.

A 40mm bitumen mastic wearing course over concrete pavement shall be provided with industrial bitumen of grade 85/25 conforming to IS : 702, prepared by using mastic cooker and laid to required level and slope, including providing antiskid surface with bitumen fine grained hard stone chipping of approved size at the rate of 0.005 precoated cum per 10 sqm and at approximate spacing of 10 cm centre to centre in both directions, pressed into surface protruding 1 mm to 4 mm over mastic surface, including cleaning the surface, removal of debris etc. all complete. (Considering bitumen using 10.2% as per MORTH specification).
This 40mm bitumen mastic wearing course shall be laid after completion of construction activities i.e at the time of handover.

All the road shall again be repaired/made good as per IRC : SP :83 after completion of construction activities i.e at the time of handover.

All service and utility lines like fire water line, sewerage line, electric cables line etc. crossing the road shall be taken through NP3 class RCC Hume pipe. Hume pipe shall be laid before road work so that the road shall not be damaged.

Turning Circle radius adequate for 16 Wheel Truck shall be provided at all relevant points including approach (Entry/Exit) and access road for Truck movement at loading/unloading/weighment facilities of Limestone, Gypsum, Ash, Biomass for efficient and safe movement of tru

For road to be constructed with Conventional Cement Concrete or Geopolymer Concrete

Construction of road
Drawing'.

For road to be constructed with Geopolymer Concrete:

The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. The design traffic load shall be a minimum value of 4

million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab.

The road construction including its shoulders, base, sub base and concrete pavement shall be as per MORTH. The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Laying /placing of Concrete DLC and PQC manually with hand-guided means or by semi-mechanized methods may be permitted around BTG area provided acceptance criteria as per MORT&H specification is achieved. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete pavement shall be provided with 125 micron polythene sheet below it. Concrete pavement shall also be provided with contraction and expansion joint with MS dowel bars and as per Ministry of Road Transport and Highways (MORTH) specification.

The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level.

All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed.

Unless otherwise specified, all roads (excluding access roads to all buildings / facilities / structures, patrol road along boundary wall and road inside the switchyard) shall be double lane roads.

5.10.00.02 Geo-polymer concrete road shall be constructed over soil sub-grade/embankment. Road section shall comprise of Granular Sub base over soil sub-grade, Dry Lean Concrete of M10 Grade (DLC) base and Pavement Quality Concrete of M35 grade (PQC) top layer. Thickness of different layers of pavement section shall be as per design. However, minimum thickness shall be 150 mm for DLC and 250 mm for PQC. Provisions of Clause 5.10.00.01 in respect of design, construction and other requirement shall also be applicable for Geopolymer concrete road. In addition, specific information pertaining to geopolymer concrete is provided in Chapter D-1-8.

Conventional Cement Concrete or Geo-pol-ymer concrete road……. is provided in Chapter D-1-8.

5.10.01 **DOUBLE LANE ROADS**

The double lane roads shall be (12 metre wide) with 7.5 metre wide concrete pavement and 2.25 metre wide raised shoulders on both sides of the roads as given in tender drawing “Details of road” .

5.10.02 **SINGLE LANE ROADS**

All access roads to all buildings / facilities / structures, road approaches / connections, access roads to liquid fuel storage areas and other equipment areas where access is necessary from inspection, operation and maintenance point of view and all roads inside the switchyard shall be single lane roads as given in tender drawing “Details of road”.

5.10.03 **PATROL ROADS**

All patrol roads along the boundary wall shall be single lane roads with 3.75 metre wide concrete pavement and 1 metre wide shoulders on one side of the road. as given in tender drawing “Details of road”.

5.10.04	**INTERMEDIATE ROAD:**	Bidder understands that patrol roads and associated drains are not in bidder's scope. Please confirm.
		Patrol road is not in bidder's scope. Drain shall be ae per Layout of drain drawing.

The intermediate lane roads shall be (8 meter wide) with 5.5 meter wide concrete pavement and 1.25 meter wide raised shoulders on both sides of the road as given in tender drawing Details of Road.

*Concrete roads anywhere mentioned in specification shall be read as Geo-polymer concrete road.

5.11.00 **DELETED**

5.12.00 **Fuel Oil Handling system**

The civil works are to be provided for following fuel oil handling system areas as mentioned below:

a. Fuel Oil pressurizing pump house.

b. Pedestals and foundations to support the interconnecting piping between LDO tanks to the pressurizing pumps as well as piping from tanker unloading area to the Unloading pump house and further on to the LDO tank.

c. Oil water separator pit.

5.12.01 **FUEL OIL PRESSURISING PUMP HOUSE**

Salient Features:

This building shall be a single storeyed framed superstructure with RCC columns, structural steel roof truss (with rafter and tie level plan bracings), purlins and roof slab. The roof slab shall comprise minimum 40 mm thick (above the crest of metal deck sheet) RCC slab supported on profiled metal deck sheet connected through shear anchor studs. Waterproofing of Roof slab shall be done as per architectural specifications. The building shall be completely covered with 230mm thick brick wall with provisions for fire proof doors, windows, rolling shutters. The basement RCC slab and RCC wall shall be designed as for uplift and external surcharge load as per the design criteria specified elsewhere. All pump foundations shall be designed for both static and dynamic loading. The building shall have separate enclosures for the control room and the switchgear room. All rainwater down comers shall be concealed with brick wall. The minimum floor area of this building shall be as per the equipment layout plan of the bidder/ EPC contractor.

Design Concept:

The grade of concrete shall be M 25 for all columns, beams, footing and slabs. The building shall be designed as per IS: 456, IS 800, IS 1893, IS 13920 (for ductility detailing).

5.12.02 **DELETED**

5.12.03 **DELETED**

5.12.04 **DELETED**

5.12.05 **OIL WATER SEPARATOR PIT**

The Oil-Water Separator RCC structure (pit) shall be designed as an underground structure. The sizing of the separator shall be based on the total surface run-off from the Fuel Oil Handling area and Hydraulic design for the oil separation. Surcharge load and ground water table up to ground surface shall be considered in addition to other functional loads for structural design of RCC wall for the separator pit.

Drainage trenches with proper bed slopes towards the oil-water separator pit shall be provided around the tank foundation. The entire area outside tank foundation shall have slope towards the drain trenches

Foundation for trestles and pedestal foundations, for supporting the pipes, shall be provided wherever required, at appropriate spacing. At pipe bends, necessary thrust resisting arrangement shall be provided.

The entire fuel Oil Handing area shall be fenced all round with minimum 1.50m high metal fencing with provision for gates at key locations.

Seismic design shall be carried out for the Fuel Oil Storage Tank foundation, Fuel Oil Unloading Pump House & the Oil water separator.

5.12.06 **ARCHITECTURAL FEATURES OF FUEL OIL HANDLING BUILDINGS**

Spaces for Pump Rooms, MCC Rooms, Control Rooms etc. shall be provided as per functional requirement. One Toilet block with drinking water facility shall be provided in each building.

External finishing shall be of Premium Acrylic Smooth Paint with Silicone additives over suitable primer of water proof cement.

5.13.00 AREA PAVING

RCC paving of minimum 150 mm thick with M25 grade concrete, over an under bed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thickness for normal duty paving and 400mm compacted thickness for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm diameter bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm diameter bars @ 200 mm c / c in both directions at the centre of the slab.

Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification.

Passages shall be provided inside the main plant block connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the complete Mill bunker building and handling areas for PA/FD/ID fans with 50 mm thick metallic hardener topping.

Ground floor area in the boiler shall be provided with normal duty paving and shall be finished with 50 mm thick metallic hardener topping.

Ground floor area in the ESP envelope shall be provided with normal duty paving with neat cement punning. Wherever paving is envisaged to be provided, RCC paving shall be provided. However, corridors below trestle where no traffic movement is envisaged and in the area over the buried fire water pipes shall be provided with interlocking concrete blocks of minimum M35 grade and minimum 80 mm thickness underlain by 20mm thick layer of sand followed by 200mm thick 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil.

All other areas inside the Main plant block shall be provided with normal duty paving without metallic hardener topping.

Suitable open RCC drains shall be provided to dispose off storm water drain. Separate open RCC drains shall be provided to dispose off floor wash and plant effluents into RCC sump pits. Separate RCC sump pits shall be provided for different types of effluents. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. All drains/pits shall be provided with Heavy duty electro forged GI grating cover.

Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from main plant block.

For the purpose of area paving, Main plant block is defined as the entire area enclosed between peripheral roads encompassing the Transformer yard area, Main Plant Building area, Service building, Boiler area, ESP area, Chimney area & FGD area.

5.13.01 **GROUND FLOOR SLAB OF BUILDINGS**

In all buildings including main plant building, the ground floor slab shall consist of minimum 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm diameter bars @ 200 mm c/c at top & bottom of the slab in both directions. However, at passages, unloading & maintenance bays, stone soiling of minimum 400mm thick and minimum 10mm diameter bars @ 200 mm c/c at top and bottom in both directions shall be provided.

Further, top surface of ground floor slabs shall be finished with 50mm thick metallic hardener topping.

5.13.02 **CIVIL WORKS FOR FIRE DETECTION & PROTECTION SYSTEM IN GROUND FLOOR/ PAVING**

Fire water pipes shall be provided with either RCC trench/buried underground/on pedastal.

Fire water trenches shall be open RCC type trench with removable RCC cover. RCC valve pit alongside trenches and RCC fire trenches crossing drains shall also be provided as per requirement.

Interlocking concrete block paving shall be provided over the buried fire water pipes as specified elsewhere in the specification.

At road/ drain crossings, NP3 class hume pipe encased in RCC shall be provided as per requirement at a depth of minimum 1m from FGL for routing of fire water pipes.

In case of rail crossings, NP4 class hume pipe encased in RCC shall be used instead of NP3 class hume pipe.

Each of the outdoor deluge valve and accessories shall be provided with housing comprising of Brick wall and RCC roof.

5.14.00 DELETED

5.15.00 DELETED

5.16.00 DELETED

5.17.00 Induced Draft Cooling Towers

The civil , structural and architectural works for cooling towers are related mainly to following areas, but not limited to:

5.17.00.01 Cooling Tower Basin

The basin of the cooling tower for collection of cold water shall be made of Reinforced Cement Concrete (RCC M - 30 grade as per IS: 456). The floor of the basin shall be sloped to minimum 1 in 80 towards the sludge drains. The required slope shall be achieved by screed concrete of grade M-15 as per IS:456 having minimum thickness at edge as 25 mm. Drainage arrangement of basin shall be as specified elsewhere in the Technical Specifications. If the cooling tower basin and sludge sump is below ground level, FRP hand railing shall be provided all around the cooling tower basin and sludge sump pit. The bottom 500 mm of hand railing shall also have FRP/PVC wire mesh with opening size of 50mm grid to avoid ingress of leaves, vegetation, and debris into the basin. The basin shall be tested for water tightness as per IS:3370.

Bottom of the lowest level beam shall be at least at free board level. In case, the beams are provided into the water, the same shall be designed for un-cracked section as per IS:3370.

The outlet channel shall be covered on top with removable precast concrete slabs for about 5m length from cooling tower basin and the entire length of cold water outlet channel shall be provided with 32 NB (Medium) G.I pipes. Hot water duct around cooling towers, if placed below ground shall be encased with min. 500mm thick PCC (M20 grade).

a) Foundation of Cooling Tower

The foundation of the Cooling Tower shall be as detailed out elsewhere in the specifications.

b) Super Structure of Cooling Tower (applicable in case of RCC cooling tower)

Columns, beams and other structures like tie beams, slabs etc. shall be of reinforced cement concrete of grade M-30 (minimum) as per IS : 456. Uniform concrete grade shall be used for the entire cast-in-situ reinforced concrete superstructure.

The fan deck slab shall be properly sloped so that rain water does not accumulate over the deck slab. The slope shall be 1 : 120 (min.). The slope shall be provided with screed concrete of grade M-15 (minimum) as per IS : 456.. Fan Deck slab and all other over ground platforms shall be provided with FRP handrailing. Suitable arrangement for drainage of rain water to be provided. However, there is no specific requirement of Rain Water down comers.

c) Cells, Distribution System and Stack (applicable in case of RCC cooling tower)

Cooling tower cells shall consist of RCC columns, beams and walls. The spacing of columns shall be minimum 4000 mm c/c. Inclined bracings shall not be provided between the columns. Hot water distribution channel shall also be of RCC. Cell division partition walls shall be of precast solid concrete blocks with provision of pilasters for walls, if required. The peripheral wall shall be Cast-in-Situ RCC wall and shall have two layers of reinforcement on either faces in both directions with minimum dia of reinforcement bars as 8 mm and maximum spacing as 150 mm c/c. Minimum thickness of Cast-in-Situ RCC peripheral walls shall be 200 mm.

Hot water channel shall be covered with suitably designed precast / cast - in - situ concrete slab. Wherever flow control valves are located over hot water basin, these shall be placed over precast concrete covers / concrete slab and designed for specified load. The minimum thickness of RCC fan stack shall be 150 mm. The fanstack shall have two layers of reinforcement on either faces in both directions with minimum dia of reinforcement bars as 8mm and maximum spacing as 200mm c/c.

d) Stairs

RCC staircase for approach to fan deck for each cooling tower shall be provided. The stairs shall have 1000 mm clear width and FRP hand railing. The riser shall be

maximum 175 mm & treads 250 mm (minimum). Edge protection angle (min 35X35X6, made of aluminum) shall be provided to the treads with the lugs.

e) Steel Structures

All mild steel parts of structures used in cooling towers shall be hot dip galvanized or

k) Coating

All concrete surfaces subject to water/ water spray/moist air including cold water basin, inner faces of peripheral walls, all faces of cell partition wall, all faces of columns, all faces of beams (both cast in situ and precast), bottom surface of fandeck slab for counter flow tower and both surface of fandeck slab for cross flow tower, inner face of fanstack, all faces of hot water basin (for cross flow tower), etc. **except exterior surface** shall be applied with High build heavy duty polyurethane coating having formulation of 100 % solids, solvent free over proper cleaned and complete dried concrete surface. Thickness of polyurethane coating shall be 2.0 mm. Suitable primer as per standard Practice/manufacturers' recommendation shall be used. The detailed specification of polyurethane coating is given in **ANNEXURE-III**.

Exterior surfaces of cooling tower shall be coated with one coat of High Performance Moisture Compatible Corrosion Resistant Coating System of minimum 150 micron as per **Annexure-G** followed by finish coat of two pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT.

size shall be minimum 2100 mm high (clear) & 1200 mm wide (clear). Door shall have locking facility.

k) Coating

All concrete surfaces in direct contact with water/ water spray/moist air shall be applied with Moisture Compatible Corrosion Resistant Coating System or its equivalent as specified in Annexure-G. All concrete surfaces subject to water/ water spray/moist air upto and including Fan Deck slab level including basin slab, inner faces of peripheral walls, all faces of cell partition wall, all faces of columns, all faces of beams (both cast

in situ and precast), bottom surface of fandeck slab for counter flow tower and both surface of fandeck slab for cross flow tower, inner face of fanstack, all faces of hot water basin (for cross flow tower), etc as applicable shall receive the said coating after cleaning and drying of the concrete surface. The detailed specification of the coating system on concrete surfaces is given in Annexure-G.

External surfaces of Cooling tower peripheral walls and fanstack shall be painted with two or more coats of waterproof cement paint of approved shade, make and color.

l) Paving

Paving shall be provided for a minimum clear width of 5.0 m from the outer face of the HW pipes all around the cooling tower basin. Paving shall also be provided in between the hot water pipes and space available between HW pipes and CT basin wall spray catcher. The minimum total width of paving around CT basin shall be atleast 8.5 m from outer edge of the spray catcher or basin wall. Paving shall consist of reinforced concrete base slab laid over 75 mm thick PCC of grade M-10 as per IS:456 sub-base and 200 mm thick stone soling. The sub-base shall be laid on the compacted and suitably prepared sub-grade. The degree of compaction of sub-grade shall be as specified elsewhere in the specification. The thickness of the RCC base slab of grade M - 25 shall be suitably designed considering a superimposed load intensity of 5T / Sq.m. However the minimum thickness of base slab shall be not less than 150 mm having double layered reinforcement in both directions both top and bottom. The maximum spacing of the reinforcement bars shall be 150mm c/c and minimum dia of reinforcement bars shall be 8mm.

RCC peripheral drain of minimum cross sectional dimensions 300mm X 300mm to dispose storm water shall be provided around area paving and shall be connected to nearest Owner's storm water drain.

RCC paving all around cooling towers shall be connected to the existing road so as to provide approach to both cooling towers and switchgear & control room building as indicated in tender drawing. The clear width of this approach road shall be 5.5M and top of approach road shall be 350 mm above FGL.

m) Walkways

Permanent walkways at least 1000mm clear width shall be provided at hot water distribution level and at drift eliminator level for counter flow type cooling towers. The clear working height available above these walkways shall be at least 2.0 meters. The walkway and its supporting structure shall be of RCC M - 30 grade. Suitable RCC guards rails 300 mm high shall also be provided on both sides of these walkways. Over the guard rails FRP hand railing shall be provided. The vertical post of handrail shall be 700 mm high and at an interval of 1500mm c/c. There shall be two levels of horizontal pipes for hand railing spaced equally in vertical plane.

Permanent walkways at least 1000 mm clear width shall also be provided for access to fan and around gear box with FRP gratings of clear opening size not more than 50 MM x 50 mm and grating thickness of 50 mm on RCC supports at fan deck Level.

05.17.00.02 Design Criteria

R.C.C. Structures

(a) The design of all liquid retaining/conveying structures like of cooling tower like C.W. basin, sump, hot water distribution channel/basin, sludge drain and pits shall be designed by working stress method as outlined in Clause 4.5 of IS 3370 (Part 2) : 2009. These structures shall be designed for following conditions :-

(a) The design of all liquid retaining/ conveying structures of cooling tower like C.W. basin, sump, hot water distribution channel/basin, sludge drain and pits shall be designed **as per IS 3370 with limiting crack width to 0.1mm.** These struc-tures shall be designed for following conditions 1. Water filled inside upto the designed level and no earth outside. 2. Earth pressure plus 2.0 T / M2 surcharge (Vertical direc-tion) plus ground water table at Finished Graded ground Level (FGL) outside and no water iside.

1. Water filled inside upto the designed level and no earth outside.
2. Earth pressure plus 2.0 T / M^2 surcharge (Vertical direction) plus ground water table at Finished Graded ground Level (FGL) outside and no water inside.

(b) The design of all structures other than liquid retaining/conveying structures of cooling tower above CW basin slab such as columns, beams, fins, walkways, slabs, cladding/partition wall, fan stack, precast beams etc. as applicable shall be carried out by limit state method as outlined in Clause 4.4 of IS: 3370 (Part 2): 2009. Further, for limiting the crack width, the stress for the reinforcement steel shall be limited to 130 MPa (on all faces) as per clause 4.4.3.1 of IS: 3370 (Part 2): 2009 using the partial safety factor for serviceability condition as per clause 4.4.1.3.

Wherever, the foundation raft of cooling tower is same as CW basin slab, the foundation shall be designed by working stress method as outlined in Clause 4.5 of IS 3370 (Part 2): 2009 (all faces). However, if the cooling tower foundation is not the same as the CW basin slab and a separate foundation for the cooling tower is provided below the CW basin slab due to founding level requirements, the basin slab shall be designed as a structural slab resting on grid of beams taking support from columns or as a flat slab taking support from columns. Arrangement with providing walls between the columns and the periphery to support the structural basin slab is not permitted. The CW basin slab (both faces, including beams at CW basin slab level) shall be designed as structural slab by working stress method as outlined in Clause 4.5 of IS 3370 (Part 2): 2009 and the structures below CW basin slab shall be designed as per IS:456 (2000). However, the size of the column below CW basin slab upto foundation shall be maintained same as the size of the columns just above CW basin slab.

(c) The design of staircase, switchgear building, control room/RIO room, transformer and trestle foundation, storm water drain shall be as per IS: 456 (2000).

(d) The Cold Water basin shall be checked against uplift for basin empty condition with ground water table at FGL. Stability against uplift shall be ensured both for construction & operating stage with no water inside. The provision of flap valve / pressure release valves is not permitted. The factor of safety against uplift shall be as per IS: 3370.

(e) Fan deck shall also be designed for rolling loads due to movement of equipment during Installation / maintenance operation.

Minimum Clear cover for all RCC structures/elements of cooling towers to meet durability requirements shall conform to severe exposure condition as per IS: 456 (2000).

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(b) The design of all structures other than liquid retaining/con-veying structures of cooling tower above CW basin slab such as columns, beams, fins, walkways, slabs, cladding/partition wall, fan stack, precast beams etc. as applicable shall be car-ried out **as per IS 3370 with limiting crack width to 0.2mm.** Further, for limiting the crack width, the stress for the reinforce-ment steel shall be limited to 130 MPa (on all faces) as per clause 4.4.3.1 of IS: 3370 using the partial safety factor for serviceability condition as per clause 4.4.1.3. Wherever, the foundation raft of cooling tower is same as CW basin slab, the foundation shall be designed by working stress method **as per IS 3370** with limiting crack width to 0.1mm (all faces). However, if the cooling tower foundation is not the same as the CW basin slab and a separate foundation for the cooling tower is provided below the CW basin slab due to founding level requirements, the basin slab shall be designed as a structural slab resting on grid of beams taking support from columns or as a flat slab taking support from columns. Arrangement with providing walls between the columns and the periphery to support the structural basin slab is not permit-ted. The CW basin slab (both faces, including beams at CW basin slab level) shall be designed as structural slab **as per IS 3370 with limiting crack width to 0.1** and the structures below CW basin slab shall be designed as per IS:456 (2000). However, the size of the column below CW basin slab upto foundation shall be maintained same as the size of the col-umns just above CW basin slab

Dynamic Analysis

(a) Free vibration analysis

A free vibration analysis of the fan supporting structure including the intermediate supporting structure for motor, gear box and pillow block (if applicable) shall be carried out to calculate the natural frequency of the fan supporting structure and its fundamental natural frequency shall be at least + 20% away from the operating speed of the fan and motor.

(b) Forced vibration analysis

Forced response analysis shall be carried out on the fan supporting structure including the intermediate structure supporting the motor, gear box and pillow block to calculate the vibration amplitudes for the following unbalance condition: -

1. For unbalance load corresponding to G16 as per ISO 1940-1: 2003
2. For unbalance load corresponding to one blade failure condition.

The amplitude derived shall be within the permissible values as specified by the fan manufacturer or IS: 2974 (Part - IV), whichever is more stringent.

Mid Bearing Supporting Structure

The intermediate supporting structure for motor, gear box and pillow block if provided shall be so arranged that it does not cause any torsional moments on the beams / pedestals on which the intermediate support rests. The intermediate supporting structure shall be orthogonal to the grid of beams on which it rests. The motor shall be supported on a base frame. The concrete block supporting the fan/gear reducer shall be connected to immediate lower level of beam column junctions by means of at least four diagonal columns.

Fan Stack

The fan stack shall be made of RCC with minimum 150 mm thickness. With reinforcement provided on both faces in either direction. Design of the fan stack shall be made on the basis of relevant stipulations of IS : 11504 for Natural Draught Cooling Towers. The fanstack shall have two layers of reinforcement on either surfaces in both directions with minimum dia of reinforcement bars as 10mm and maximum spacing as 150mm c/c.

Steel Structure

These structures shall be designed, fabricated and erected as per IS: 800 (latest revision).

All mild steel parts or structural steel works used in the cooling towers shall be hot dip - galvanised as per IS: 4759 with 610gm/sq.m. coating or seal spray zinc coated as per BS:5493 (for a very long period of maintenance of more than 20 years). Nails and all components coming in direct contact with water shall be of stainless steel of SS 316 or equivalent.

For all steel structures, other than hot water pipes, sludge pipes and hot water distribution pipes, which are outside cooling tower painting shall be as specified in corrosion protection clause. However, for painting of hot water pipes, sludge pipes and hot water distribution pipes, relevant clause for painting specified elsewhere in the technical specification shall be referred.

The minimum cement content as specified in subsequent clauses of this specification shall be applicable for all structures of cooling towers.

Test for water tightness

The water tightness of C.W. basin, outlet channel, CW channel and all other water retaining structures shall be tested for water tightness as per the provisions of IS : 3370.

5.17.00.03 **Stoplog gates and Trash racks for Cooling Tower**

Stoplog gate and trash rack/screen shall be provided in the outlet channel of each cooling tower. The design criteria and material specification for Stoplog gates and Trash racks shall be as specified for Circulating Water Pump House.

5.18.00 **CW SYSTEM, RAW WATER SYSTEM CIVIL WORKS**

5.18.01 **Circulating Water Pump House (CWPH), Existing Stage-I Raw Water Pump House (RWPH)**

5.18.01.01 A circulating water pump house (CWPH) for housing circulating water pumps and civil works associated with installation of one number pump in existing Raw water pump house (RWPH) for housing raw water pumps shall be provided. Separate bays shall be provided for each pump by providing intermediate dividing piers of RCC between the pumps.

a) The pump houses shall be provided with minimum two sets of stop-logs for each opening sizes along with electrically operated hoisting arrangements. Steel embedments required for stop-logs shall be provided for all the bays.

b) All bays of pump houses shall be provided with a removable trash rack including electrically operated hoisting arrangements and cleaning arrangements. Moreover, one spare trash rack for each opening sizes shall also be supplied. Steel embedments required for trash-racks shall be provided for all the bays.

c) Stop-logs, trash-racks and hoists shall be supplied in accordance with the specifications covered elsewhere.

d) The steel structure shall be provided to carry EOT crane of the CW Water pump houses. The over ground portion of CWPH including maintenance bay shall be framed structure of structural steel work with permanently colour coated metal sheeting at roof and side open. However 4m high steel sheet side cladding shall be provided at the top under the roof for protection against rain. At the ground level, brick cladding of 0.9m height above the finished floor level, plastered on both sides shall be provided for all pump houses.

e) The pump house including its forebay shall be of RCC with M-30 grade of concrete conforming to IS 456. The CWPH pump house shall be structurally separated from forebay by providing an expansion joint. The pump house shall be provided with separate maintenance bay

f) Civil works associated with existing Stage-I Raw Water Pump House with required modification with all necessary arrangement & precautions. Further, associated structure for & including supply of valves/gates are also to be provided for isolation of the connection.

f) Civil works associated with addition/alteration/ modifi-cation as required in existing Raw Water Pump House (RWPH for installation of raw water pumps as necessary for commissioning of system

5.18.01.02 Each pump house shall be provided with a separate maintenance bay for maintenance of various equipment. Length of maintenance bay shall be adequate for one pump maintenance or minimum dimension indicated in the tender drawing, whichever is higher. Hand-rail with 32

NB (medium) pipes shall be provided around the operating floor on the forebay side in the stoplog and trash rack area.

For Raw Water Pump House (RWPH), suitable connection shall be provided to meet the flow requirement to the existing concrete lined by cutting & making of concreting works including dewatering and under water works with all necessary arrangement & precautions. During construction it should be ensured that in any case running operation of water channel/ RCC conduit of Stage-I&II shall not be hampered. Further, associated structure for & including supply of valves/gates are also to be provided for isolation of the connection.

All raw water pipe crossings with railway lines including MGR lines shall be laid by method accepted by concerned railway authorities for existing rail lines & by cast in situ RCC box culvert for future envisaged rail lines. The railway track crossings are to be designed in accordance with railway standard/rdso guidelines and all necessary approvals from the concerned railway authorities shall be obtained by the bidder, without any financial implications to the owner.

5.18.01.03 **Sump model study for CWPH**

Sump model study for circulating water pump house shall be carried out as specified elsewhere in the specification.

5.18.01.04 **Design requirement for CWPH**

Design of substructure shall be divided into two parts, namely,

(a) Stability analysis, and

(b) Structural analysis and design.

For the design of substructure, a surcharge load of 2.0 T / Sq.m shall be assumed at the finished ground level for nearby vehicular movement.

(a) Stability Analysis

The Pump House sub structure shall be analyzed and designed for following load combinations: -

1. **Under Operation Stages**

   Maximum load from super structure + equipment load + load from sub structure + no water in the pump chambers + earth pressure at rest from outside with surcharge and maximum ground water pressure.

2. **Condition (1) + earthquake/ wind**

3. **Under Construction Stages**

   No load from super structure and deck slab, load from sub structure with no water in the pump chambers, pump units not installed, earth pressure at rest from sides with surcharge and maximum ground water pressure.

4. **Condition (3) + earthquake**

Following stability checks will be made for the above load combinations:

i) Check for overturning

Factor of safety against overturning, i.e, the ratio of stabilizing moment to overturning moment shall be as per IS: 456.

For the above condition, uplift due to maximum Ground water table (GWT) acting on the base slab and side pressures on the walls due to earth and ground water shall be

considered as destabilizing forces. In order to have no tension condition at tip of the base slab, resultant of all the forces acting on the pump house under different conditions of loading as listed above shall fall within middle one third of the base width provided. Maximum compressive stress at other end of the base slab shall be within the safe bearing capacity of soil / rock.

Under earthquake condition, resultant of all the forces including earthquake force shall fall within middle three fourth of the base width provided. An increase of 25% shall be allowed in the safe bearing capacity of soil when earthquake forces are considered.

ii) Check for Sliding

Factor of safety against sliding under static condition, i.e. ratio of horizontal frictional resistance to horizontal sliding force shall be as per IS:456. For this condition, earth pressure at rest and the maximum GWT pressure from sides shall be taken as de - stabilizing forces. Keys shall be provided, if found necessary, to increase the factor of safety against sliding.

To ensure an adequate factor of safety under earthquake condition, the factor of safety against sliding shall not be less than 1.2.

iii) Check for Uplift

Right from construction to operating stage, minimum factor of safety against uplift due to ground water shall be 1.2. Installation of pressure release valves shall not be permitted in the base slab (raft) of the pump houses to counter the uplift due to ground water.

(b) Structural Analysis

1) Base Slab

Base slab of the pump houses shall be designed as a raft foundation supported at locations of piers. Following load cases shall be considered:

i. Maximum water level in the sumps with maximum GWT.

ii. No water in the sumps and maximum GWT.

iii. Alternate bays of sumps filled with water with maximum GWT.

iv. Same as in (iii) above but with minimum water level.

2) Intermediate Piers

Intermediate piers shall be designed by working stress method as per IS: 456 (latest), with limiting crack width of 0.2mm for the worst combination of maximum water pressure on one side and no water in the adjacent sump. These shall be designed as RC walls fixed at base and supported (hinged) at top by the deck slab. Since a breast wall may be provided for stop logs and back wall is provided connecting all the piers at the rear end, additional restraints for the pier due to breast walls and back wall may also be accounted for.

Intermediate piers are also to be checked for the combined action of direct load due to superstructure and bending due to water pressure from one side.

3) End Piers

Design of end piers will be similar to the intermediate piers. The end piers shall be designed for the following conditions:

I. Soil pressure + maximum GWT + surcharge of 2 Ton / Sq.m. at FGL from outside or design surcharge load at floor level with no water in the sumps.

II. Only maximum water level in the sump.

End piers shall be designed by working stress method as per IS: 456 (latest), with limited crack width of 0.2mm on water face and the outside, i.e., earth side shall be designed as cracked section as per IS : 456. Since end piers are fixed at base and supported (hinged) at top by deck slab, there will be negligible yielding of the wall at top. This will give rise to earth pressure at rest and therefore an earth pressure at rest, Ko = (1 - Sin f) is considered where f =angle of internal friction of soil.

End piers shall also be checked for the combined action of direct load due to super structure and bending due to earth pressure with surcharge and ground water pressure.

4) Back Wall

Back walls shall be designed as fixed at bottom of the base slab and on two vertical sides by the piers and supported at top by the deck slab. Since back walls are also of the unyielding type, earth pressure at rest, Ko, shall be considered for design.

Back walls shall be designed by working stress method as per IS: 456, with crack width limited to 0.2 mm on water face and as cracked section on outer face as cracked section as per IS : 456.

Following load combinations shall be considered:

i. Soil pressure + maximum GWT + surcharge of 2 T / sq.m. at FGL from outside with no water inside the sump.

ii. Only maximum water level inside the sump.

5) Operating Floor Slab

Operating floor slab or deck slab shall be designed for loads of the pumps and other equipment, which may be placed on it. A live load of 1.5 ton / Sq.m. shall be considered on the deck slab. The deck / slab shall have monolithic construction with the piers and shall be designed as a continuous RC slab supported on piers. Design of bottom face shall be by working stress method as per IS: 456, with crack width limited to be 0.2 mm. Floor slab of maintenance bay may be designed as slabs on grade. A live load of 3 T / Sq. m. may be considered for the maintenance bay floor slab. Dynamic analysis shall be carried out to ensure proper separation of natural frequency of the structure and pump operating frequency

5.18.01.05 **C.W. Ducts**

CW ducts shall be concrete encased steel lined ducts. The concrete encasement shall be of minimum 500mm thick with square shape outside. Generally, M20 grade PCC encasement shall be provided. At locations of duct crossing road, rail in transformer yard or any other facility, RCC encasement of grade M25 shall be provided. Minimum two layers of reinforcement (On both faces) of 12 mm diameter bars @ 200 mm c/c shall be provided for RCC encasement of CW Duct. Top of CW duct encasement shall be minimum 1.5 m below finished ground level.

The minimum thickness of steel pipes shall be as follows including corrosion tolerance of 2 mm:

a.	For pipes above 1800 mm upto and including 2300 mm dia.	-	12 mm
b.	For pipes above 2300 mm upto and including 3200 mm dia.	-	14 mm

c. For pipes above 3200 mm upto and including 3750 mm dia. - 16 mm

d. For pipes above 3750 mm upto and including 4000 mm dia. - 20 mm

However, for ducts running below rail line in transformer yard/road, minimum thickness of CW liner shall be 20 mm.

Suitable tap-offs shall be provided in the duct to connect CW blow down, ACW tapping etc. Based on the transient analysis, sufficient number of stub connection shall be provided in the duct to fix air release valves.

All duct installation & jointing shall be strictly in accordance with the stipulation given elsewhere in the specification for structural steel work. All the joints of liners shall be butt welded joints. The circular deformation of liner shall be less than 1% of diameter of liner while handling, transportation, erection & construction. If required, temporary bracings may be provided, during handling, transportation & concreting to reduce the deformation.

The completed duct shall be tested for water tightness, for the pressure equal to twice the working pressure or 1.5 times the design pressure whichever is higher and shall be generally water tight to Engineer's satisfaction. The testing pressure shall be held for minimum period of 30 minutes without any signs of leakage or failure of weld. Any in flow / leakage of water from the duct shall be sealed / repaired at Contractor's cost. However, tests in part of length of duct may be permitted with prior approval only.

Wherever required anchor / thrust blocks shall be provided with RCC M25 grade concrete. Suitable RCC chambers shall be provided with precast covers to install flow measurement devices and valves in the duct.

Manholes of minimum 1000mm clear opening shall be provided in each CW duct at a spacing of 200M (approx.) to facilitate maintenance / dewatering of CW ducts. At least one manhole shall be provided at the deepest point for both intake & discharge duct.

Following shall be considered for design of C.W. ducts:

a. Maximum design water pressure

b. Surge or water hammer pressure of 5.0 Kg / Sq.cm.

c. Expected vacuum conditions as arrived from transient analysis

d. Soil overburden

e. Surcharge Pressure of 2T/Sq.m

f. The effect of concrete encasement shall not be considered in the design of CW duct

Painting as per Cl. 6.04.03 shall be carried out on machined faces, flanges and external exposed surfaces of CW ducts. For external surfaces of CW ducts encased in concrete, painting shall be as specified in Cl. 6.04.02(a).

5.18.01.06 **CW Channel**

The channel shall be of RCC section with vertical wall projecting minimum 300mm above finished ground level. Hand rails with 32 NB (medium) pipe shall be provided on both walls of the channel where height of channel wall is less than 1200 mm above finished ground level.

The channel shall be designed to carry the required discharge with minimum water level in cooling tower basin and considering minimum value of rugosity coefficient (n) of 0.018 for concrete surface. However, the maximum velocity in CW channel shall be restricted to 1.8m/sec.

The channel shall be designed by working stress method with crack width limited to 0.2 mm on water face and as cracked section on outer face as per IS: 456 considering (i) no water inside the channel, with earth pressure of soil upto FGL, ground water table upto FGL and surcharge load of 2.0 ton / Sq.m from outside, and (ii) with water inside the channel upto maximum level in the forebay / channel and no earth pressure, ground water pressure and surcharge load from outside. Right from construction to operating stage, minimum factor of safety against uplift due to ground water shall be 1.2.The channel shall be checked against uplift due to 50% of the total water head considering ground water table upto FGL. In addition pressure relief valves with under drainage arrangement in the channel shall be provided to prevent uplift of the channel as per relevant IS Codes. Minimum wall thickness shall be 250 mm.

Forebay Structure

Forebay consists of retaining wall and foreba
wall for stability against overturning and s
Pressure relief valves and under drainage a
slab to prevent uplift of the forebay slab. Si
designed by the Bidder to take care of the u
centre spacing of PRV shall not exceed 500
uplift due to 50% of the total water head cons
slab shall be minimum 250 mm thick. The fo
retaining walls and water stops shall be pr
Minimum thickness of retaining wall at top s
pipe shall be provided on both walls of the f

Forebay Structure

Forebay consists of both side retaining walls and bottom slab. The side walls shall be analysed as isolated retaining wall for stability against overturning and sliding. The forebay bottom slab shall be structurally separated from the side walls and water stops shall be provided at the junction of bottom slab and retaining wall. Minimum thickness of forebay slab shall be 250 mm.

Pressure relief valves and under drainage arrangements shall be provided below the forebay slab to prevent uplift of the forebay slab. Size and spacing of pressure relief valves shall be designed by the Bidder to take care of the uplift due to ground water table. However, centre to centre spacing of PRV shall not exceed 5000mm.

Minimum thickness of retaining wall at top shall be 250 mm. Hand rails with 32NB (medium) pipe shall be provided on both walls of the forebay.

5.18.01.07 **DELETED**.

5.18.01.08 **Stop-logs and Trash Racks for CWPH**

5.18.01.08.01 **Stop-log gates**

Clear size of the stop logs shall be equal to the clear opening size of water inlet opening below breast wall. Number of segments of the stop log shall be decided to match the capacity of the electrically operated monorail hoist provided to handle it. Structural design of stop log shall conform to IS: 5620 and IS: 4622. Maximum water level for designing the stop logs shall be taken as maximum water level of the forebay. Top and bottom unit of stop log gates shall be designed for their respective water head, whereas the remaining interchangeable units shall be designed for the water head corresponding to the lower most interchangeable unit. The stop logs shall be operated under balanced water head and they are not to be designed for operating under flowing water. Filling valves shall be provided in the stop logs to balance the water pressure before lifting the stop log. These stop logs are used only during maintenance / inspection of pumps. The stop logs shall be operated by means of an electrically operated hoist. Suitable lifting beam shall be provided to operate the stop logs.

5.18.01.08.02 **Trash Racks**

Bar screen trash rack is to be provided at inlet of the sump of the pump house in order to prevent ingress of timber & other floating particles which could damage the Pumps.

Each bay of pump sump shall be provided with Type - 1 trash rack (removable section rack), conforming to IS: 11388. Centre to centre spacing of trash rack bars shall be 100mm (max). The trash racks shall be provided with number of interchangeable segments, to facilitate easier

handling by means of a lifting beam and electrically operated hoist. Trash rack bars shall be designed for a differential water head of 2.0m. and other structural members shall be designed for a differential water head of 1.0m. Minimum thickness of trash rack bars shall be 10mm. Suitable size of horizontal members and end members shall be provided as per design requirements, for efficient operation of trash rack.

All trash racks should be capable of being lowered in the associated stop log groove to enable drawal of clean water while a particular trash rack is raised for cleaning purpose.

Suitable arrangement for storing all the stop logs and stand by trash rack shall be provided by the Bidder, to keep them in good working condition.

5.18.01.08.03 **Lifting Beams**

Separate lifting beams (automatic) shall be designed & fabricated with guide shoes, hooks, links and counter weights etc. complete for automatic operation to engage and disengage the stop logs and trash racks in the required position.

5.18.01.08.04 **Leakage Tests of Stop logs**

Leakage tests shall be carried out with the stop logs lowered onto the sill. Before observation for leakage, the stop log shall be raised and lowered about one meter several times in order to dislodge any debris that might have lodged in the side and bottom seals, The leakage shall then be measured and it should not be more than 5 litres / minute / meter of length of seal under maximum head.

5.18.01.08.05 **Material Specifications of Stop logs & Trash racks**

All material used in the fabrication of stop log or trash rack shall be of high grade, free from defects and imperfections and shall be of the highest standard commercial quality suitable for the intended use. Radiographic examination or magnetic particle testing or other comparable tests shall be carried out for determining the soundness of steel castings and shall be conducted by the Bidder, if asked for by the Employer.

5.18.01.08.06 **Materials for the various components of Stop logs**

Sl. No.	Component Parts	Recommended materials	Reference
1.	Stop log Leaf	Structural steel	IS 2062
2.	Stop log Frames, 1st stage embedded parts and structural steel members	Structural steel	IS 2062
3.	2nd stage embedment	Stainless steel	SS316L or IS:1570 (part-5)
4.	Wheels (the hardness of wheel track surface shall be kept 50 points higher than that of wheel tread)	Cast steel	IS : 1030
5.	Wheel axles, wheel track	Corrosion resistant steel.	IS 1570
6.	Seals	Rubber	IS 11855
7.	Bearings	SKF or equivalent	04Cr19Ni

Sl. No.	Component Parts	Recommended materials	Reference
8.	Seal seats	Stainless steel	SS316L or IS 1570 (part-5)
9.	Lifting pin	Stainless steel	SS316L or IS 1570 (part-5)
10.	Guide	Corrosion resistant steel	IS 6603
11.	Guide shoe	Structural steel	IS 2062

5.18.01.08.07 Materials for various components of Trash Rack:

Sl. No.	Component Parts	Recommended	Reference Materials
1.	Trash rack and 1st stage embedded parts	Structural steel	IS 2062
2.	2nd stage embedment	Stainless steel	SS 316L or IS 1570 (Part–5)
3.	Slide Block	Structural steel with bronze padding	IS 2062 & IS 305
4.	Track base	Stainless steel	SS 316L or IS 1570 (Part–5)
5.	Track	Stainless steel	SS 316L or IS 1570 (Part–5)
6.	Guides	Corrosion resistant steel.	IS 6603

5.18.01.08.08 **Painting Specification for Structural Steel parts for Stoplog Gates and Trash Racks**

(i) All structural steel surfaces shall be cleaned by shot blasting.

(ii) All MS structural parts shall be galvanised to minimum coating of Sealed Zinc spray (250 Micron) as per BS 5493.

(iii) Over zinc coating one coat of zinc Phosphate Epoxy primer having minimum 30 micron DFT and three coats of coal tar Epoxy paint having minimum 75 micron DFT / coat shall be provided. Total DFT of epoxy paint including primer shall be minimum 250 microns.

5.18.01.09 **CONSTRUCTION REQUIREMENT AND ACCESS TO WORK AREAS**

Contractor shall notify to the Engineer before start of work well in advance about the method of construction for crossing road, pipeline, cable, railway, canals, utility lines and other existing obstacles.

Contractor shall not commence work on such crossings before having obtained approval from the authorities and land owners concerned to the satisfaction of the Engineer. The work at crossings shall meet at all times requirements and conditions of the permit issued by the authorities concerned. In the absence of any specific requirements by authorities, Bidder shall comply with Engineers' instructions.

Where the work areas come within the area of influence of high voltage electrical installations, contractor shall propose and provide adequate safety measures for all personnel working. He shall obtain necessary permission/permit from the concern authority. No work is allowed in such areas without Engineer's prior approval.

5.18.01.10 **Switch Gear / Control Room/ Remote IO room for CWPH, RWPH and MUWPH**

It shall be single storied building, framed RCC structure with beams, columns, floor and roof. It shall have non-load bearing brick wall cladding. It shall house the switch gear and MCC of respective Pump house & associated cable trenches. The architectural features shall be as specified elsewhere in the specification.

Bio Toilet shall be opted for make up water facility area outside the plant boundary. Specifications of same shall be as mentioned elsewhere in technical specifications.

5.18.02.00 **DELETED**

5.19.00 **WATER TREATMENT PLANT-DM Plant, PT Plant, ETP and CW Chemical Treatment Civil Works, CSSP etc**

5.19.01.00 **Design Concepts for Buildings/ Shed**

i. All buildings shall have framed super structure.

ii. Equipment/facilities with shed shall have structural steel superstructure with permanently colour coated metal sheeting at roof and side open. However, kerb wall shall be provided all around the plinth/ floor area above the Finished Floor Level (FFL). For other buildings brick wall cladding on exterior face shall be provided.

iii. Unless specified, the wall cladding for buildings shall be with minimum one brick thick on exterior face. However, brick wall for buildings adjacent to transformers shall be minimum 345mm thick.

5.19.01.02 Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.

5.19.01.03 The load and load combinations and design criteria shall be as specified elsewhere in the specification.

5.19.01.04 All liquid retaining structures shall be designed for following load conditions.

Underground structures:

a. Water filled inside up to design level and no earth outside.

b. Earth pressure with surcharge of 2.0 T/m2 and ground water table up to FGL outside and no water inside.

c. Stability against uplift shall be checked for completed structure and under construction stage with no water inside and ground water table up to FGL, with a minimum factor of safety of 1.20 against uplift. Installation of pressure relief valves shall not be permitted in the base slab of any liquid retaining / conveying structure.

d. The structure shall also be checked for normal working condition with water filled inside up to design level and earth pressure outside with no effect of surcharge and ground water table.

For design of over - ground liquid retaining structures appropriate load cases shall be considered.

5.19.01.05 All liquid retaining and conveying structures shall be designed by working stress method as given in clause 4.5 of IS 3370(Part2):2009.

All liquid retaining and conveying structures shall be designed by working stress method as per IS 3370 with limiting crack width to 0.1.

5.19.01.06 In the wall of liquid retaining structures with cylindrical shape such as clarifiers, vertical reinforcement shall be checked assuming the walls were fully fixed at the base, and the horizontal reinforcement shall be provided to resist horizontal (hoop) tension assuming hinged condition at the junction of the base slab & wall.

5.19.01.07 Wherever sandwich slabs are provided in liquid retaining structures to take care of stability against uplift, only well graded sand of approved quality shall be used as fill material. The sand compaction shall be done with plate / disc compactors in such a manner that the bottom slab is not structurally damaged.

5.19.01.08 Clear free board of at least 300 mm above design (total) water level shall be provided in all liquid retaining / conveying structures.

5.19.01.09 Coefficient of active earth pressure shall be considered for design of free standing retaining walls and coefficient of earth pressure at rest shall be considered for design of top propped retaining walls.

5.19.01.10 The minimum grade of concrete for all RCC structures associated with DM plant, PT plant, ETP and CW chemical treatment and CSSP shall be of grade M30.The minimum concrete clear cover to reinforcement bars in all RCC structures shall be as per IS:456(2000) and IS:3370(Part II) for water retaining structures. Durability of concrete shall conform to moderate exposure conditions as per Table-3 of IS 456 except noted specifically otherwise.

5.19.01.11 Factor of safety against overturning and sliding

The structure shall be checked for minimum factor of safety of 1.5 against overturning conditions (ratio of stabilizing moment to overturning moment) and 1.4 against sliding conditions as per IS: 456.

5.19.01.12 For detailing of Reinforcement IS 5525, IS 13920, IS 4326 and SP 34 shall be followed.

5.19.01.13 Two layers of reinforcement (on both faces) shall be provided for RCC sections having thickness of 150 mm and above.

5.19.01.14 Minimum diameter of main and distribution Reinforcement bars in different structural elements shall be as follows:

Sl. No.	Structural Element	Main Reinforcement	Distribution Reinforcement / Stirrups/ ties/ Anchor Bars
a)	Foundation	12 mm	12 mm
b)	Beams	12 mm	8 mm
c)	Columns	12 mm	8mm

5.19.01.15 Spacing of reinforcement bars in walls and slabs of liquid retaining / conveying structures shall not be more than 200 mm.

5.19.01.16 Suitable shrinkage reinforcement shall be provided at top face of foundations. Minimum shrinkage reinforcement shall be 10 mm dia. @ 200mm c / c.

5.19.01.17 Minimum Reinforcement in all elements of liquid retaining / conveying structures shall be 0.24 % of cross sectional area distributed equally over top and bottom faces.

5.19.01.18 Minimum tensile Reinforcement in each direction for all foundation slabs / rafts shall be 0.2% of cross sectional area.

5.19.01.19	Minimum thickness of foundation slab / raft and base slab of all liquid retaining tanks / pits shall not be less than 250 mm.
5.19.01.20	Minimum thickness of all elements of RCC liquid retaining / conveying structures (except effluent drains, launders and aerator waste slab) shall be 200mm. Effluent drains (depth more than 500mm), aerator waste slab and launders shall have minimum element thickness of 150mm.
5.19.01.21	All Insert plates (except edge protection angles) provided in liquid retaining structures shall be 12 mm thick GI with lugs not less than 12 mm diameter. Edge protection angles shall be provided as specified elsewhere.
5.19.01.22	All water retaining structures shall be tested for water tightness as per provisions of IS: 3370 and IS: 6494.
5.19.01.23	2.0m wide walkway with concrete paving shall be provided connecting all structures, buildings and facilities. The top of walkway shall be minimum 200mm above FGL.
5.19.02.00	**Architectural Concepts and Finishing Schedule** Architectural concepts and finishing schedule shall be as specified elsewhere in architectural specification.
5.19.02.01	**Acid / Alkali Resistant Treatment:** Acid / alkali resistant lining treatment shall be provided in different areas as follows: Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable pilasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification. The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.bricks layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted. The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron). Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. The floor shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 1.0M high with above treatment shall also be provided if applicable in case of walls nearby. Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing. Alum solution preparation tank: The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer. Basket of Alum Solution Preparation tank: 5mm thick epoxy lining over a coat of epoxy primer.

Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks.

Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns.

Lime tank: Two coats of bitumen paint conforming to IS : 9862, with total DFT 150 microns.

Guarantee

The Contractor shall give a guarantee for satisfactory functioning of the lining for a period of 36 months from the date of completion of the work or date of handing over the site to the Engineer, whichever is later.

The Contractor shall replace / rectify defects is any, observed in the lining to the satisfaction of the Engineer without any extra cost during this period.

5.19.02.02 DM Tank Foundation

5.19.02.02.01 General Requirements

The tank foundation shall be as per IS:803 and as specified in relevent clause of foundation chapter.

5.19.02.02.02 Sub Grade Preparation

The surface of natural soil shall be thoroughly compacted by rolling or other means, as directed by Engineer, to obtain 95% of max. laboratory dry density for the soil, as per IS:2720 (Part-VII).

5.19.02.02.03 Anti Corrosive Layer

Anti-corrosive layer shall consist of dscreened coarse sand, mixed with 80/100 bitumen or equivalent 8% to 10% by volume.

Bitumen shall be heated to a temperature 175^0 C to 190^0 C, with 3% kerosene, if required. Sand shall be thoroughly mixed with it in a mixing drum to obtain uniform mixture and shall be laid over the compacted surface, laid in line, grade and levels and as directed by the Engineer. Bitumen shall not be heated beyond the temperature limits given above.

The premix carpet shall be laid in two layers of 3 cm and 2 cm respectively. After compacting and laying the first layer of 3cm, a tack coat of hot bitumen at the rate of 1 Kg. per Sq.m. shall be uniformly applied to the surface, by means of Sprayer and the Second layer of 2cm thick shall be laid, tamped and compacted to the satisfaction of the Engineer.

Sand shall be spread on the final surface at the rate of 0.5 Cu. m per 100Sq.m.

5.19.02.02.04 Premix Materials

Sand

Sand shall be clean, dry, coarse, hard angular, free from coatings of clay, dust and mix of vegetable and organic matters and shall conform to IS 383 (Grade -III).

Stone Chippings

Stone chippings shall be hard black trap or granite or approved locally available stone and shall conform to IS 383. The grading shall be of normally 12mm down size and 6mm down size, in the ratio of 3:2 respectively.

Bitumen

Bitumen required for the work shall be 80/100 grade or its equivalent quality.

Laying

Areas on which the premix is to be laid shall be thoroughly cleaned of all dust and loose materials. On the cleaned surface, a tack coat at the rate of 1.0 Kg. per Sq.M. of hot Bitumen shall be uniformly applied by Sprayers. The applied Binder shall be evenly brushed.

The Binder bitumen 80/100 shall be heated to the temperature of about 190^0 C with 3% kerosene, if required and mixed with stone chippings of size, as mentioned above, at the rate of 400 KG, with Six (6) Cu. M. of stone chips, for 100 Sq.M. of surface. The total mixed quantity, as mentioned above, is the quantity required for the total 50mm thick for 100 Sq. m. of area. Mixing shall continue until the aggregate is well coated.

5.20.00 Switchyard Civil Works

5.20.01 Civil works for switchyard includes:

a. Towers, girders, lightning masts and equipment supporting structures including proto type assembly etc.,

b. Foundations and supporting pedestals for towers, lightning masts, equipment supporting structures etc.,

c. Control room/Auxiliary building as required for switchyard, foundation for AC Kiosks etc.

d. Foundations for transformers and reactors including oil pit, stone filling, laying and fixing of rails for movement of Transformers / reactors, rail track, jacking pad and fire walls as required, arrangement for cabling etc. all complete

e. Earthing mat, single lane roads and R.C.C. drains in switchyard area including road/drain/trench crossings etc.,

f. All necessary embedments, inserts, supporting structures & supporting members as required etc.

g. Cable trenches in switchyard and inside Control room/Auxiliary building including civil works for panel fixing etc.

5.20.02 Design Criteria

5.20.02.01 Gantry structure, which consists of open web towers connected by girders, shall be made of structural steel conforming to IS 2062 and duly galvanized conforming to IS: 2629 and IS 4759. All joints shall be bolted connections. All bolts for connections shall be of 16mm dia conforming to IS 12427 and of property class 5.6 as per IS 1367 (Part 3). Nuts shall conform to IS 1363 (Part 3) of property class 5. Foundation bolts shall conform to IS 5624 and property class shall be 4.6 as per IS 1367 (Part-3). Butt splice shall be used for splicing the main members and splice shall be located away from the node point. IS 802 “Code of practice for use of structural steel in overhead transmission line towers” shall be followed for design of structures. Height & type of towers shall be established based on electrical requirements. A provision of ± 30 degree angle of deviation of line in horizontal plane and ± 20 degree deviation in vertical plane is considered and the resulting worst combination of forces shall be considered for design. For all outgoing and incoming feeders, the conductor span shall be taken as 200m for design purpose.

The analysis of towers and gantries shall be carried out with combined model of critical configurations of towers and gantries using any established structural analysis software like STAAD Pro. etc.

5.20.02.02 Switchyard structures shall be designed for the worst combination following loads:

1) Dead loads (load of wires/conductors, insulator, electrical equipment and structural

members),

2) Live loads,

3) Wind loads

a. Switchyard gantries, towers, equipment supporting structures and lightning mast shall be designed as per IS 802. The wind load calculations shall be made as per IS: 802 except the parameters basic wind speed (Vb) and terrain category as stipulated in "Criteria for wind resistant design of structures and equipment".

b. All other structures shall be designed as per IS 456 / IS 800. The wind load calculations to be made as per IS: 875 shall be with the parameters as stipulated in "Criteria for wind resistant design of structures and equipment".

4) Seismic loads,

5) Loads due to deviation of conductor (gantries shall be checked for ± 30 deg. deviation in horizontal plane and ± 20 degree deviation in vertical plane),

6) Loads due to unbalanced tension in conductor/wire,

7) Torsional load due to unbalanced vertical and horizontal forces,

8) Erection loads,

9) Short circuit forces including snap in case of bundled conductors, etc.

Note:

i. The occurrence of earthquake and maximum wind pressure is unlikely to take place at the same time. The structure shall be designed for either of the two. However, temperature stresses can be ignored, as these towers are freestanding structure in open space.

ii. Short Circuit forces and Wind pressure shall be considered to act together for design of switchyard structures

iii. Direction of wind shall be assumed such as to produce maximum stresses in any member for the combination of wind load with conductor tensions. The wind acting perpendicular and parallel to bus conductor and shield wire shall be considered separately.

iv. The conductor tension shall be assumed as acting on only one side of the gantry for the analysis and design of switchyard gantries.

v. The distance between terminal and dead end gantry shall be taken as 200 meters.

5.20.02.03 **Factor of safety:**

The factor of safety for the design of members shall be considered as 2.0 for normal condition and broken wire condition, 1.5 for combined short circuit and broken wire condition. Foundation shall be designed for a factor of safety of 2.2 for normal and broken wire condition and 1.65 for combined short circuit and broken wire condition.

5.20.02.04 **Design consideration for switchyard equipment support:**

The supporting structure for B.P.I., LA, CVT & Isolator equipment's shall be comprised of GI (ERW) pipe of grade YST:210 or of higher grade conforming to IS: 1161 & shall be designed as per IS 806 "Code of Practice for use of steel tubes in general building construction".

Minimum diameter of the pipe type support for 765kV structure shall be 300NB, 400kV structure shall be 250NB, for 220kV & 132kV structures shall be 200NB and that for 66kV & 33kV shall be 150 NB.

The supporting structure for CT, CSE & Wave Trap equipment shall be comprised of lattice structural steel conforming to IS 2062 and shall be designed as per IS: 802.

Common raft foundation shall be provided for each pole of isolator.

5.20.02.05 Special design consideration for lightning Mast:

Diagonal wind condition shall be considered for lightning masts. Diagonal wind shall be taken as 1.2 times the wind calculated on Longitudinal/Transverse side. Lightning mast shall be provided with minimum two nos. of platforms as per requirement and an\ ladder for climbing purpose shall be provided up to platform at top level. Top of platform shall have grating, railing and toe guard plates. The minimum width of platform shall be 900mm. Live load of 300kg/m2 above platforms shall be considered for design of Lightning Mast.

5.20.02.06 Design Criteria for structures not covered under Cl. 5.20.02.01 to Cl. 5.20.02.05

The Switchyard Control Room building shall have RCC framed super structure with one brick thick wall cladding on exterior face. The Control room building shall consist of rooms/facilities/ equipment/ monorail as per system requirement. An open space of one meter width (minimum) shall be provided on the periphery of the panel rows and equipment to allow easy operator movement and access for maintenance purposes.

The design of RCC structures shall generally be carried out using limit state method of design as per IS 456. The minimum grade of concrete shall be of RCC M25 as per IS 456.

5.20.03 The architectural features including roof water proofing, rain water down comers and RCC parapet walls etc. shall be as specified elsewhere in the specifications.

5.20.04 The fabrication and erection of the switchyard works shall be carried out generally in accordance with IS 802 and IS 800. All materials shall be completely shop fabricated and galvanised.

5.20.05 All structural steel members including stub members, bolts, nuts, spring washers, etc., shall be hot dip galvanised after fabrication. Minimum section thickness should not be less than 4 mm. Weight of zinc coating shall be at least 0.610 kg/m2 and foundation bolts shall have heavier zinc coating at least 0.80 kg/m2.

5.20.06 Cable Trenches

Cable trenches shall be provided for routing of cables as required and shall be of adequate size. The trenches located within switchyard shall project at least 300 mm above the finished formation level so that no storm water shall enter into the trench. The bottom of trench shall be provided with a longitudinal slope of 1:500. The downstream end of cable trenches shall be connected to sump pits. The precast covers shall not be more than 300mm in width and shall not be more than 65 kg. Lifting hooks shall be provided in the precast covers. Trenches shall be given a slope of 1:250 in the direction perpendicular to the run of the trenches. Angle of size 50x50x6 mm (minimum) with lugs shall be provided in the edges of RCC cable trenches and any other place where breakage of corners of concrete is expected. All cable trenches shall be provided with suitable insert plates for fixing support angles of cable trays. All internal cable trenches shall have minimum 6mm thick (o/p) chequered plate covers while external cable trenches shall have pre - cast RCC covers. However, the portion of the cable trench behind and sides of control panel / MCC shall be provided with suitable chequered plate covers as directed by the Engineer. Cable trenches inside switchyard, having depth more than 500mm, shall have wall thickness of minimum 150mm with two layer reinforcement.

5.20.07 PCC Layer & Gravel Filling:

PCC Layer and Gravel filling shall be provided as specified elsewhere in the specifications.

Before laying of PCC layer, the subgrade shall be properly compacted and the top layer of the soil shall be treated for anti-weed considering the type of weeds found in the vicinity. The anti-weed - soil sterilization details such as manufacturer's name, their specification, test certificate, etc. shall be furnished for Owner's approval. Any modification if required in the proposed anti-weed treatment chemical shall have to be done by the contractor at no extra cost to the Owner. The contractor shall be required to furnish a performance guarantee of three years for the anti-weed treatment. This guarantee shall be commenced from the date of completion of work or date of handing over, whichever is later. Stone/gravel shall be chemically inert, hard, strong durable against weathering, of limited porosity and free from deleterious materials. It shall be properly graded and shall meet the requirements of IS: 383.

5.20.08 Transformer/reactor foundations

Foundations of transformers/reactors shall be designed for seismic and wind loads in addition to other applicable loads. Solid RCC block foundation shall be provided for the main transformer/reactor block. Alternatively, transformer shall be supported on a RCC foundation comprising of common raft for rail supporting walls up to rail-cum-road along with pedestals for jacking pad, roller lock etc. Tie beams connecting roller lock pedestals at rail level shall also be provided. Common raft/solid RCC block shall be supported on soil or pile based on requirement specified elsewhere in the specification. Oil soak pit / oil water separation pit for transformer/reactor shall be provided as envisaged elsewhere in the specification. The oil soak pit shall be provided for each transformer and shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store one-third (1/3) of the oil volume of transformer/reactor considering only 40% of the volume as available voids between gravel filling. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit. The Oil-water Separation pit shall be designed for an effective capacity of complete oil of one transformer having highest volume of oil along with 10 minutes of firewater. For calculating effective capacity of oil-water separation pit, effective depth excluding 200 mm freeboard below invert level of inlet pipe shall be considered. Plan area and depth of oil-water separation pit shall be decided based on above consideration. Oil-water Separation pit shall be provided with five separate chambers interconnected by pipes. First chamber shall be for collecting oil-water mix from transformers' soak pits in case of fire. After entering into first chamber, oil being the lighter in density floats above the water. The water from lower elevation flows in to subsequent chambers interconnected through galvanized MS pipes. The accumulated oil in the first chamber to be pumped out for subsequent usage or disposal. Water collected in the last chamber to be pumped out for subsequent disposal after treatment. Invert level of inlet Hume pipes (of NP-3 grade and adequate capacity), carrying oil and water from transformers soak pits, shall be designed for gravity flow. Freeboard of 200 mm shall be provided below the invert level of inlet pipes. Invert levels of interconnecting pipes of subsequent chambers shall be decided accordingly.

Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/reactor foundations.

RCC Firewall shall also be provided between the transformers wherever required.

300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of Stone filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.

5.20.09 The switchyard roads, drains, fencing and gate shall be as specified elsewhere in the specification.

5.21.00 **CIVIL WORKS FOR FIRE PROTECTION SYSTEM**

Salient Features:

The scope of the Bidder shall be design and construction of Civil, Structural, Architectural, Water Supply, Plumbing and Sanitary Works of Fire Water Booster Pump House including supply of all materials.

The Fire Water Booster Pump House shall be structural Steel Shed superstructure with provision for a structural steel monorail. Switchgear/MCC room (if applicable), battery room & Control room shall have RCC framed structure with cast-in-situ RCC roof slabs with brick cladding. . The shed and building shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and ventilation fans.

Fire water pipes shall be provided with either RCC trench or buried underground as per requirement.

Fire water trenches shall be open RCC type trench with removable RCC cover.

Interlocking concrete block paving shall be provided over the buried fire water pipes as specified elsewhere in the specification.

At road/rail/ drain crossings of fire water pipes, the fire water pipes shall be provided with minimum 200mm thick PCC encasement all around the pipe.

5.22.00 **DELETED**

5.23.00 **COAL, BIO MASS, LIMESTONE & GYPSUM HANDLING SYSTEM**

5.23.01 Deleted

Tubular sections have been allowed in various structures of coal handling plant but not mentioned for other areas like power house, mill bunker building etc. Bidder would like to use tubular sections wherever feasible. Please confirm.	Tubular sections to be used only where specifically mentioned. Bidder to comply with specification.

5.23.02 **Overhead / Ground Conveyor Galleries and Trestles**

Overhead conveyors for trough belt conveyor shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder**.** Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure.

The maximum span of overhead gallery shall be limited to 25 meter unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made. Contractor can also use tubular steel sections for roof truss of conveyor galleries only. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall conform to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005.

Seal plates under the conveyor galleries shall be provided in such a way that complete gallery

bottom shall form a leak proof floor.

Grade slab with brick toe wall and plinth protection along with drains shall be provided throughout the length of the ground conveyors. Top of pedestal for ground conveyor portals shall be 300mm above FFL. Bottom of the base plate of the columns of the trestles in Main Plant Block Area shall be kept 1.2m below the finished floor level of ground floor of Main Power House.

For double stream conveyor gallery, two side and one central walkway of minimum width 800 mm and 1100 mm respectively shall be provided. The minimum width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than 10^{o}, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates (suitably stiffened) and other drainage arrangements as specified elsewhere.

Trough belt conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However, in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center alternatively on both slopes, shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification.

Cross - over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 90m intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location.

For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However, at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.5m above the road crest / rail top shall be provided.

For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc.

Thus material load per unit length of each moving conveyor shall be

1.6

X Rated Capacity of Conveyor system X

---------- F

Conveyor Belt Speed

Where, F = 1100/800 for coal, 1700/1400 for lime, 1000/600 for Biomass & 1250/900 for gypsum

It should be noted that for structural design, unit weight of lime shall be considered as 1700 kg/cu. m, unit weight of gypsum shall be considered as 1250 kg/cu. m.

It should be noted that for structural design, unit weight of coal shall be assumed as 1100 kg/cu. m.

Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously.

Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways.

a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with PTFE bearings to allow both rotation & longitudinal movements.

OR

b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with PTFE bearings to allow both rotation & longitudinal movements.

End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa.

5.23.03 For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and underground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. ~~Base plates of trestle columns shall be kept 300 mm above the finished ground level.~~

…Base plates of trestle columns shall be kept 300 mm above the finished ground level. Encase-ment of the pedestal shall be done the top of the stiffener plate.

5.23.04 **Transfer Houses**

The over ground portion of all transfer houses shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and RCC floors comprising of RCC slab over profiled metal deck sheets (to be

used as permanent shuttering without considering any composite action effect of metal deck sheet) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams.However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with brick cladding of 0.9 m height, plastered on both sides shall be provided for all transfer houses. Bottom of the base plate of the columns of the transfer houses in Main Plant Block Area shall be kept 1.2m below the finished floor level of ground floor of Main Power House.

Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting.

The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Pre-Fabricated Insulated Metal Sandwich Panel for Roofing shall be laid to specified slope. Composition of Insulated Metal Sandwich Panels shall be as described in relevant section of Technical Specification. Adequate slope shall be provided for quick drainage of rain water.

5.23.05 **Deleted**

5.23.06 Deleted

5.23.07 **Control building, M. C. C. Buildings**

These shall be steel or RCC framed building with RCC roof and floor. For steel framed building roof/floor comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Cladding shall be of brickwork/concrete block work with plastering on both sides. Bidder has also the option to supply and construct pre-engineered buildings. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations.

All air - conditioned areas, shall be provided with the false ceiling system(details specified elsewhere) with under deck insulation.

Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing.

5.23.08 **Pump Houses**

These shall be framed structure of structural steel work with permanently colour coated profiled steel sheet roof, grade slab and RCC foundations etc. Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water.

~~Brick wall cladding (1m height above FFL) shall be provided all around the periphery of pump houses~~

5.23.09 **Deleted**

……Brick wall cladding (1m height above FFL) and sheeting shall be provided all around the periphery of pump houses.

5.23.10 **Gypsum Storage Shed**

The Gypsum storage shed shall be RCC framed structure with RCC wall (upto Tripper floor) and structural steel shed with permanently colour coated profiled steel sheet roof and side cladding (above Tripper floor). Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water. At grade level Heavy duty paving as detailed elsewhere in the specification shall be provided inside the shed.

Finished floor level of Gypsum storage shed shall be kept at least 500mm above the finished ground level. The building shall be provided with 750 mm wide plinth protection all around as detailed elsewhere in the specification.

5.23.11 **Toilets**

Toilet with potable water line facilities shall be provided in each of the following locations:

(A) In CHP/LHP/GHP Control Room building – (Gents and Ladies Toilets-1 No. each)

Each Gents toilet shall have brick enclosure, and the following fittings.

i)	Wall mounted glazed vitreous china European water closet with low flush having flow rate of 6.0 litres and 3.0 litres of water per flush, dual flush adopters for standard flushing for solid waste and a modified smaller flush for liquid waste flushing valves shall be provided.	1 no.
ii)	White glazed vitreous china flat back lipped urinal 390x375x610 mm (approx.) fitted with photovoltaic controls for flushing system and all requisite fittings.	1 no.
iii)	Wash Basin 450x550 mm (approx.) mounted over 18 mm thk granite beveled edge counter fitted with photovoltaic control system for water controls, bottle trap with two taps and all requisite items.	1 no.
iv)	Mirror 600x900x6mm thk. with beveled edges (Superior sheet glass) mounted with teak wood beading and minimum 12 mm thk. plywood backing.	1 no.
v)	C.P. Brass Towel Rod 600 x 20 mm	1 no.
vi)	Liquid Soap Container	1 no.
vii)	Washing Tap (CP Brass)	1 no.

viii)	Overhead Polyethylene water tank (min. 500 litres capacity)	1 no.
ix)	Suitable provision for installation of drinking water cooler.	1 no.
x)	Space for Janitor room	1 no.

Ladies toilet shall be similar to gent's toilet as detailed above, except item at s.no. ii and ix (urinal and provision for drinking water cooler). Package type STP shall be to be provided.

No other facilities shall be provided below toilet block except toilet. Toilet facilities shall be provided at control room floor level.

5.23.12 **Staircases**

All floors of transfer houses and roof/floors of all multistoried MCC/Control room buildings shall be accessible through staircase and mumty of staircase of mcc/control room shall be accessible through cage ladder. Cage ladders (min. 450mm wide) shall be provided for access to roof of MCC/control room (with only ground floor).

All stairs of over ground portion of transfer houses shall be of steel (minimum 1200 mm wide) and maximum rise should not be more than180 mm and minimum tread width 275 mm. Stringers shall be of rolled steel channel (minimum ISMC 250) and tread shall be of electro forged steel gratings. Stairs shall be provided with 32 mm dia nominal bore medium duty M. S. pipe hand rail.

Handrails (for staircases, around openings, in walkways etc.) shall be of standard weight steel pipe of flush welded constructions, ground smooth using 32 mm nominal bore medium class pipe provided with double rail, top rail about 1.0 metre, minimum above platform level (upto height of 12m the height handrail shall be 1.0 m and above 12m height the height of handrail on staircase landing and around cutouts and openings shall be 1.2 m) and pipe posts spaced not more than 1.5 metres apart. Angle handrail post may be provided when specifically called for in drawings approved by Engineering. Toe guard of size 100mm x 6mm shall be provided along the railing for all steel platforms/landings and RCC staircases.
Smooth uniform curves and bends shall be provided at stair returns and also where so ever required. Posts connected to curb plates shall have a neat closure at the bottom and a 6 mm thick plate neatly welded to posts for attachment to curb plate. All necessary fittings including inner dowels at splices, brackets, belts, bends, flanges and chains, where required shall be plugged and welded. A minimum radius of 3 times the pipe diameter shall be provided at all points of direction changes in the handrail.

Treads and landing shall be suitable for the prescribed loading. The maximum width of openings in gratings shall not exceed 40 mm. The minimum size of main bars shall be 25 x 6 mm and cross bar shall be 6mm. The usual span of grating will not generally exceed 1.5 meters. Stair case gratings shall be galvanized to grade 610g/m^2. All gratings shall be electro forged types.

Treads and landing shall be suitable for the prescribed load-ing. The maximum width of openings in gratings shall not ex-ceed 40 mm. The minimum size of main bars shall be 40 x 6 mm and cross bar shall be 6mm. The usual span of grating will not generally exceed 1.5 meters. Stair case gratings shall be galvanized to grade 610g/ m2. All gratings shall be electro forged types.

Outside stairs to transfer points shall be open type. However, sheeting shall be provided at the top.

Stairs of MCC/control room shall be of RCC construction. The minimum width of stairs for

MCC/Control room shall be 1200 mm. Maximum rise should not be more than 180 mm and minimum tread with 250 mm..

Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. External fire escape staircase along with internal staircase shall be provided multi- storied MCC cum control room building. Minimum headroom in all staircases and all levels shall be 2200mm from floor finish level.

5.23.13 **Trenches**

All trenches for cables or any other underground facility as detailed out elsewhere shall be of RCC Cable trenches shall be provided with pre - cast RCC covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles. Lifting hooks shall be provided for all pre - cast RCC covers. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. At road crossings & entry locations, RCC trench covers designed for 10 T wheel load at centre shall be provided. Pre - cast covers shall be designed for central point load of 75 Kgs. RCC cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast RCC covers. For cable trenches outside buildings, top level shall be 200 mm above G.L and sand filling shall be overlaid with 50 thk. PCC.

Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting grating/precast RCC covers, edges of RCC trenches supporting pre - cast covers, supported edges of pre - cast cover.

5.23.14 **Cable gallery/trestles**

Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8. Glavanised gratings shall be provided for walkways as per approved electrical drawings. Ladders shall be provided for access from ground to cable galleries at maximum 100m intervals.

5.23.15 Deleted

5.23.16 Lime stone and **Biomass Storage Silo**

The supporting structure for silo shall be of structural steel. Enclosure with side metal cladding is to be provided above Limestone/biomass Storage Silos for limestone/biomass handling equipment. Side metal cladding is also to be provided for outgoing conveyors below limestone/biomass storage silos.

Stored Limestone/biomass load shall be treated as dead load for analysis and design of silo supporting structure.

5.23.17 **Drainage & Water Supply Works**

5.23.17.01 Drainage System:-

The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the conveyor galleries, transfer points etc. with water periodically.

Minimum 4 nos. down comers shall be provided in each transfer house. In case of conveyor galleries, the down comer shall be provided at every trestle location.

For all coal Conveyors, each down comer shall lead the water / coal slurry to RCC pit (of 2 Cu.M capacity) to allow settling of coal. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into coal slurry settling pond.

For transfer house each down comer shall lead the water / coal slurry/lime slurry into the peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / coal slurry to water / coal slurry to RCC pit (of 2 Cu.M capacity) to allow settling of coal. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally to the coal slurry settling pond.

Suitable kick plates/Curb beams shall be provided around the floor openings, stair case landings, in the transfer points and other buildings.

Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / IRC standards and approval of Railway culverts from concern Railway authorities.

5.23.18 **Internal and external water supply, drainage etc.:-**

~~The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc~~. as required and as described here or elsewhere in these specifications.

The scope for service water supply and dust control water supply shall be as described elsewhere in these specifications.

For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be

The scope for pota-
ble.....
Minimum size of main bar of steel grating (Galvanised to 610 gm/m^2) shall be 40mm x 5mm and cross bars 6mm.....
~~Galvanizing shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 360 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629.~~
All rain water down.....
.....

be more than 90 mm x 35 mm. All drains as well as pre - cast covers shall be provided with edge protection angles and lifting hooks.

The scope for foul water from toilets shall include layout and laying of sewers for sewerage system together with all fittings and fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers within the building and from the building to the terminal point.

For rain water down comer and those to be used for conveying water / coal slurry generated from cleaning of walkways/floors, Galvanized MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be provided for MCC buildings, control rooms and Galvanized steel ERW pipes (273mm OD, 4mm thk) of steel grade Fe330 conforming to IS: 3589 with welded joints shall be provided for all TP's, and Conveyor galleries.

~~Galvanizing shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than **360** gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629.~~

All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti-corrosive painting over a coat or primer.

For design of building drainage system IS: 1742 shall be followed.

For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints.

For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing RCC box culvert to be provided.

For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.

5.23.19 **Roof Details**

Roof slabs for CHP, LHP and GHP buildings shall be minimum 150 mm thick(in case of metal decking thickness shall be measured from crest top) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.

1000 mm high and minimum 100 mm thick RCC parapet wall shall be provided over roofs of all buildings. However, for mummty, 600mm high parapet wall shall be provided. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings.

Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet.

Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster.

Roofs of all M. C. C./control rooms,and TP(if applicable) etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as mentioned else where in specification.

Roof of pump house shall be provided with single skin troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water.

5.23.20 Floors and Grade level details

5.23.20.1 DELETED

5.23.20.2 The floor slabs shall be minimum 150 mm thick(in case of metal decking thickness shall be measured from creast top) and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. The RCC slab shall be designed without considering any composite action effect of metal deck sheet (ie the structural strength of metal deck sheet shall not be considered for RCC slab design).

Floors of transfer points shall have cross slope of not flatter than 1: 80, towards the floor washing drainage outlets, for efficient drainage. For ground conveyor slope shall be 1:100.

Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick o/p or as indicated on drawings. The chequered plate pattern shall be approved by Employer / Engineer. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates to restrict deflection within span/200. Chequered plates shall be fixed by staggered welding of suitable size.

Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided.

All along the periphery of RCC floors (where no brick masonry walls are provided) 100 mm thick 300 mm high RCC wall and 900 mm high steel hand rails all around over this RCC wall shall be provided.
The grade slab shall consists of 230 mm thick rubble soling (63 mm downgraded hard stone aggregate as per IRC specification, watering and compaction to minimum of 90% Standard Proctor density, including filling the interstices of stone aggregates with sand), over well compacted earth, overlaid by 75 mm thick P. C. C. M-7.5 and 100 mm thick RCC of grade M-25 with minimum 8 mm dia bars placed at 200 mm C / C in either direction respectively. There will be minimum 50 mm thick metallic hardener finish over the RCC slab.

All buildings (including truck hopper, MCC rooms, pump houses, transfer houses) and ground conveyors shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-25 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand.

An area of 5 m width all round the water tanks near pump house and transfer houses. Gypsum storage shed, truck tippler area, lime storage silo shall be paved. This paving will be in addition to plinth protection. The paving construction shall be as per specifications for the grade slab at ground level. However, 50 mm thick metallic hardener finish is not required to be provided in paved area. Paving shall also be provided in HGTU and VGTU area.

Heavy duty paving shall be provided inside the building(Gypsum storage shed) if any vehichular movement is envisaged.

Finished Floor level of all buildings shall be kept at least 500 mm above the finished grade / formation level.

5.23.21 Brickwork and allied masonry works

Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be provided at a maximum spacing of 3m and suitably encased with plaster or 1:2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness.

50 mm thick Damp proof course shall be provided at plinth level for all brick wall.

5.23.22 CONCRETE

Refer General Specification.

5.23.23 De-watering of Deep Excavations

For deep underground structures requiring open excavation with extensive de - watering, completely dry working conditions during excavation, shuttering, placement of reinforcement, concreting, water proofing of structures, backfilling and any other operation shall be maintained by suitable de - watering method of suitable capacity.

5.23.24 Galvanising

All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising.

Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 (latest edition).

The weight of the zinc coating shall be at least 610 Gms. / m^2 unless noted otherwise.

5.23.25 CHEMICAL INJECTION GROUTING

Minimum, 12 mm dia (NB) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete.

For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using repercussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes.

After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm^2. Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer

should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer.

5.23.26 **Deleted**

5.23.27 **Miscellaneous**

5.23.27.1 Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings.

5.23.27.1 Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders.

5.23.27.1 Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided.

Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / mm^2 unless higher strength requirement is specified by the equipment supplier or the grout manufacturers.

The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground.

Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.

5.23.28 **DELETED**

5.23.29 **DELETED**

5.24.00 **DELETED**

5.25.00 **DELETED**

5.26.00 **DELETED**

5.27.00 **DELETED**

5.28.00 **DELETED**

5.29.00 **DELETED**

Bidder understands that FQA building and testing laboratory is same building. Please confirm.
Also kindly clarify the following:
1. FQA building/testing laboratory is permanent structure or temporary structure.
2. In case of permanent structure, please furnish the detailed schedule etc.

FQA building and testing laboratory are separate buildings.
1. FQA building is permanent building. Testing laboratory is temporary structure.

5.30.00 PARKI

30 nos be provided in addition

Amendment 08 to Technical Specifications (Section VI)

S. No.	SPECIFICATION REFERENCE				Existing	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
DB-1	VI / B	D-1-5	5.31.00	67 of 69	FQA BUILDING FQA building shall be RCC construction of single or double storey ..... and pantry has to be provided as per specifications mentioned elsewhere in the technical specifications.	DELETED
DB-2	NTPC's Clarification at (i) of Sl. no. 703 of Clarification 02 for FQA lab building				(i) Bidder's understanding is not correct. FQA lab is in bidder scope. FQA lab is permanent building.	(i) DELETED

onstruction of single or double storey. Total area shall be decided based in QA chapter, however, minimum area shall not be less than 800 Sqm. Apart from space required to accommodate and operate all the equipments mentioned in the equipment list, office space for 5 executives, one meeting room, spectroscope room, NDT lab, storage room, welding booth, welding simulator area, platforms for instruments/equipments, ladies and gents toilets, space for water cooler and pantry has to be provided as per specificat

Sheds for Construction workers and O&M Workers
Sheds for Construction workers and O&M Workers shall be permanent structure with truss roof provided with insulated sheeting with common rest room, cooking area, Food serving kiosk, drinking water facility, toilet and bathing area along with covered verandah for easy approach to facilities. The sheds should be well ventilated. The sheds to be scattered as per work locations and suitably located. Minimum 6 nos of sheds shall be constructed.
External finishes shall be Premium smooth Exterior Paint with silicone additives over Texture Coat. Bidder to refer Tender Drawings 1150-999-POC-A-020.

Please furnish the layout drawings of safety control room.

Bidder shall follow the Technical specfication. The detialed layout shall be developed by bidder during detailed engineering stage.

5.33.00 SAFETY CONTROL ROO

Safety control room shall b
accommodate equipment
Additionally, it shall have

5.34.00 BIO TOILET

Bio-Toilet shall b
Besides these are
a Bio-toilet.
Bio-toilets shall be
decomposition an
shall be: colorless, odorless , devoid of any solid particles and shall have pathogen inactivation by 99%. The water thus obtained shall require no further treatment / waste

i) SUB-SECTION-D-1-5
ii) SUB-SECTION-D-1-9
iii) SUB-SECTION-D-1-5

i) 67 of 69
ii) 29 of 33
iii) 67 of 69

i) 5.31.00
ii) Table A INTERIOR FINISHING SCHEDULE
iii) 5.30.00

i) FQA BUILDING
ii) Vehicle parking sheds
iii) PARKING

i) Owner to please confirm location and scope for FQA Building as same is not mentioned in Section VI / Part A (Sub-Section-IID Civil Works)
Bidder understands that same is not in the scope of work and temporary FQA lab will be provided during construction period.
Incase permanent FQA building is envisaged, request owner to furnish necessary details such as size of FQA building, location in plot plan etc.
Owner to also confirm.
ii) Location in plot plan & Size of vehicle parking sheds, capacity etc.
iii) Location in plot plan & Size of open car/scooter parking, capacity etc.

i) Bidder's understandingis not correct.FQA lab is in bidder scope. FQA lab is permanent building
ii) GLP is to be further developed by bidder during detailed Engineering stage. Accordingly vehicle parking shed shall be located in GLP by bidder
iii) GLP is to be further developed by bidder during detailed Engineering stage. Accordingly car/scooter parking shall be located in GLP by bidder

European water closet and flushing valve system, water faucet, toilet paper holder as per IS:2556

or

One number white glazed vitreous China Orissa pan (580 x 440 mm) and flushing valve system, toilet paper holder as per IS:2256

b) One number colour (excluding premium colors) glazed ceramic oval shaped wash basin 450x 550 mm (approx.) mounted over 20mm thick granite beveled edge counter fitted with photo-voltaic control system for water controls, bottle trap as per IS:2556. For common toilets, number of washbasins shall be as per requirement. However, for Pump Houses the same shall be provided without photo voltaic control system for water control.

c) For Male Toilets Urinal as per requirements, with all fittings with photovoltaic control flushing system as per IS: 2556.

d) One number looking mirror 600 x 900 x 6 mm, edge mounted with teak beading and

minimum 12 mm thick plywood backing, one number stainless towel rail 600 x 20 mm, one number liquid soap dispenser

Bio toilet/Bio digester shall be comprised of four compartments and a soak pit. The size of the tank shall be as per the number of users. This four-compartment tank shall be constructed underground and shall be made of FRP with required strength as stipulated by DRDO norms. The bio-toilet constructed shall have S-trap and ball valve for ease of operation and maintenance. It shall have all necessary arrangement and fixture for future operation and maintenance as per manufacturer guidelines.

In addition to this permanent sample collection provision(tap/alternate arrangement) to be made before reaching of treated effluent to soak pit. This is to ascertain the quality of effluent at all periods of time and this would also help in the seeding requirement of bacteria.

Kindly clarify the following: 1. Worker's Accommodation building is permanent structure or temporary structure. 2. In case of permanent structure, please furnish the detailed specification, finishing schedule etc.	Worker's Accommodation building is temporary structure.

5.35.00 DELETED

5.36.00 **WORKER'S ACCOMODATION BUILDINGS**

~~Worker's Accommodation shall be provided as per NBC requirement and Local factory act. The Building design shall be as per Tender Drawing~~ Toilet, bathroom and washing area. It shall hav~~structure having sandwich panel roof sheeting.~~

WORKER'S ACCOMODATION BUILDINGS

Accommodation for Workers & staff colony in adequate numbers as required for the project peak demand shall be made in the form of temporary structures which shall be removed after completion of the project. It shall have

5.37.00 **OCCUPATIONAL HEALTH CENTRE WITH CRE**

Occupational Health Centre shall be R.C sq.m. This building shall have following faciliti
Waiting Lobby cum Reception
Doctor's Chamber with attached toilet (Two N
First Aid Room
Two bedded patient Room
Driver's Room with attached bath and toilet

ection VI)

Bidder understands that First aid centre with creche facilities and Occupational health centre with creche is same building. Please confirm. Please furnish the layout drawings of Occupational health centre with creche.	Confirmed. All facilities of Occupational Health Centre with creche facility shall be as per technical specification. The detailed layout and drawing shall be developed by bidder during detailed engg stage.

hysically handi
n & toilets for c
bulance in R.C

facilities for drinking water & sanitation, approach road, dust suppression, drainage, sewage treatment plant, solid waste collection & disposal, fuel for cooking, medical healthcare, creches, Occupational Health Center etc.The Occupational health centre shall be a single storyed RCC framed building of minimum area of 300 sqm. meeting the statutory requirements.

5.3

Kindly clarify the following: 1. O & M worker's shed is permanent structure or temporary structure. 2. In case of permanent structure, please furnish the detailed specification, layout drawings and finishing schedule etc.	1. O & M worker's shed (Sheds for Construction workers and O&M Workers) is permanent structure. 2. Refer amendment no. D1-59

vith insulated sheeting catering to 20. rea) with common rest room, cooking area, drinking water facility, toilet and bathing area along with covered verandah for easy approach to facilities. The rest rooms should be well ventilated. The rest rooms to be scattered as per work locations and suitably located in GLP.

External finishes shall be Premium Smooth Exterior Paint with silicone additives.

5.39.00 OTHER BUILDINGS

For all other buildings mentioned in the scope of work but requirement not furnished in this chapter, the Bidder shall develop the details of such buildings based on the functional and statutory requirements.

HARD CRUSTING

Hard crusting in preassembly area and any other areas shall be done with 63mm to 45mm graded stone aggregate, watering and compacting each layer (not exceeding 200mm in thickness) to minimum of 85% of original volume of stone stack including filling the interstices of stone aggregate with moorum/locally available non-expansive soil. The minimum compacted thickness of stone aggregate layer shall be 200mm. The compacted subgrade below stone aggregate shall be 85% of standard proctor density

D-1-6 DESIGN CRITERIA

6.01.01 **General**

The design criteria given herein is applicable for all sub-structure, super-structure works/ buildings/ facilities and various other works included in the scope of the Bidder.

6.01.02 Structures shall be designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, piping loads (static, friction and dynamic), earth pressure & surcharge loads, hydrostatic & hydrodynamic loads, wind loads, seismic loads and temperature loads. In addition, Erection loads, loads and forces developed due to differential settlement shall also be considered.

6.01.03

i) All the buildings shall have framed super structure. If the superstructure of building is a steel structure, the framed superstructure shall be moment resisting sway frame in the lateral direction and axially braced in the orthogonal direction. For columns having depth of 1000mm & above, the longitudinal bracings shall comprise a pair of members (spaced) with spacing equal to the column depth. Columns having depth less than 1000mm may have bracing in single plane and at the centerline of column. In both the cases (single bracing or pair of bracing) detailing shall be adequate to restrain the entire column cross-section including both the flanges. Only where axial bracing to one vertical plane is to be waived due to functional requirement, columns in that vertical plane may be allowed to undergo biaxial bending. Beam column joints shall be detailed as per seismic resistant joint with adequate ductility.

All 2-legged structural steel trestles shall be completely braced in the vertical plane. All 4-legged structural steel trestles shall be completely braced in all four vertical planes. In addition, specified horizontal planes shall be completely braced to provide stiffness against torsional sway.

If the superstructure is RCC structure, the superstructure shall be moment resisting sway frame in both orthogonal direction and all the members shall be designed for biaxial bending. Design of RCC structures shall be done as per IS 456. Detailing for ductility shall be followed as per guidelines of IS13920 to be effective against seismic load. Design of liquid retaining structures shall be done as per IS 3370.

ii) The Bunker building, transfer towers, conveyor galleries and trestles, boiler, ESP Control Building, ESP supporting structures, including inlet and exhaust duct support structures, Compressor House, Pipe cable Gallery shall have structural steel framed super structure.

iii) All other buildings may have either RCC or structural steel framework.

iv) All buildings having RCC framing shall have masonry cladding of minimum one masonry unit thickness (not less than 225 mm.) on exterior face.

6.02.00 **Loading**

For consideration of loads on structures IS : 875 - 'Code of practice for structural safety of buildings' shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration), Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design.

6.02.01 **Dead loads**

Dead loads shall include the weight of structure complete with finishes, fixtures and partitions and shall be taken as per IS: 875 (Part-I)

6.02.02 **Imposed loads**

Imposed loads in different areas shall include live loads, erection, operation and maintenance loads. Equipment loads (which constitute all loads of equipment to be supported on the building frame) are not included in the imposed loads furnished below and shall be considered in

addition to imposed loads.

For consideration of imposed loads on structures, IS:875 (Part-2) "Code of practice for design loads (other than earthquake) for buildings and structures" shall be followed. The following minimum imposed loads as indicated for some of the important areas shall however be considered for the design. If actual expected load is more than the specified minimum load, then actual load is to be considered.

Sl.No.	Location	Imposed Loads (T/Sq.m.)
A)	Mill and Bunker Bay	
i)	Ground floor	2.5
ii)	Feeder floor	0.50
iii)	Tripper floor	0.50
iv)	Roof	0.15 (Where no equipment are located) 0.50 (Where equipment are located) 0.075 (For Inaccessible roof)
B)	Turbine Building	
i)	Ground floor (general)	2.50
ii)	Ground floor (heavy equipment storage area)	5.00
iii)	Mezzanine floor	1.00
iv)	Operating floor	
	a) Rotor Removal area	5.00
	b) Equipment lay-down area	3.50
	c) Other areas (corridors, etc.)	1.50
v)	Gratings, chequered floors, walkways, platforms, stairs, etc.,	0.50
vi)	Roof (Where no equipment is located)	0.15
C)	Deaerator and Heater Bay	
i)	H.P/L.P. heater floor	1.00
ii)	Deaerator floor	1.00
iii)	Cable gallery (In addition to this, actual cable load	0.50

shall be considered)

iv)	MCC, switchgear and Control building floors	1.00
v)	Roof (Where no equipment are located)	0.15
	(Where equipment are located)	0.5
vi)	A.H.U Room, Battery Room, Air Washer Room	1.0

D) Coal, Bio mass, ,Limestone and Gypsum handling structures

i)	Roofs	150 kg. / Sq. M. for accessible roofs and 75 kg. / Sq. M. for non - accessible roofs. In addition to this coal dust load (Dead load) of 150 Kg. / sq. m. on flat roofs & 25 kg. / sq. m. on inclined roofs shall also be considered.
ii)	Conveyor galleries	In addition to the live loads, loads due to cable trays, fire fighting / service water pipes shall also be considered @ 125 kg. / m (minimum) on each of the longitudinal girder. Roof-truss members are to be checked for supporting fire fighting pipes/ Service water pipes. Tentative locations and diameter for pipes are shown in Tender Drawing. In addition to this coal/lime/biomass dust load (Dead load) of 50 kg. / sq. m. on walkway way shall also be considered.
iii)	Covers for trenches / channels/ drain	Covers for channels & trenches, shall be designed for a live load of 0.4T Sq. M. and loading as mentioned under clause in trenches, whichever is critical.
iv)	Sumps and tanks and other underground basement type structures/ drain	In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge due to Railway loading whichever is critical for Railway load bearing structures etc.) and sub - soil water pressure etc. These are also to be designed for the following conditions : i) Water / liquid inside and no earth outside (applicable only to such structures which are liable to be filled up with water or any liquid). ii) Earth with surcharge outside and no water / liquid inside iii) For underground (basement) structures protection against buoyancy during execution and after execution shall

be ensured without superimposed loadings with minimum factor of safety of 1.2 against buoyancy.

v) Unit weight of bulk materials

a) For structural design
i) Lime stone 1700 kg. / Cu. M.
ii) Gypsum 1250 kg. / Cu. M.
iii) Coal 1100 kg. / Cu. M.
iv) Bio mass 1000 kg. / Cu. M.

For sizing calculation
v) Lime stone 1400 kg. / Cu. M.
vi) Gypsum 1100 kg. / Cu. M.
vii) Coal 800 kg. / Cu. M.
viii) Bio mass 600 kg. / Cu. M.

E) Boiler/ ESP Support Structures

i. Operating Floors	1.00
ii. Separator Floor	1.00
iii. Elevator Machine Room	1.00
iv. Maintenance Platforms	1.00
v. Equipment Laydown Loads	As per Equipment supplier or 1.00 whichever is more.
vi. Lift Structure	As per Equipment supplier with 100% impact factor

F) Pump Houses
Operating floor 1.50

G) Underground Structures such as Channels, Sumps, Underground Pump House, Tanks, Trenches, Reservoirs, C.W. ducts etc.

In addition to earth pressure and ground water pressure, the surcharge load of 2T/sq.m. shall also be considered for design of all underground structures.

H) Road Culverts/Bridges and its allied structures including RCC Pipe Crossings and Road Crossing of Trenches.

Design for class 'AA' loading (wheeled and tracked both) and checked for class 'A' loading as per IRC Standard.

I) Covers for Channels/trenches	0.40 (General) or central point load of 75 kg whichever is higher As per IRC Standard (at road crossings for vehicular traffic)
H) Railway Supporting Structures, Rail Culverts	As per Railway 'Bridge Rules'

	l)	Conveyor Galleries		In addition to the live loads, loads due to cable trays, firefighting / service water pipes shall also be considered @125kg/m (minimum) on each of the longitudinal girder. Roof-truss members are to be checked for supporting firefighting pipes/ Service water pipes.
	J)	General (Unless Specified Otherwise)		
		i)	Stairs, Landings and Balconies	0.50
		ii)	Toilets	0.20
		iii)	Chequered plates, grating floors, etc.	0.50
		iv)	RCC floors (General)	0.50
		v)	a) Flat Roofs (where no equipment are located)	0.15
			b) Flat Roofs (where equipment are located)	0.50
			c) Inaccessible roof	0.075
		vi)	Inclined Roofs	As per IS : 875 (Part-II)
		vii)	Dust load on roof	0.050
		viii)	Walkways (General)	0.50
		ix)	Walkways of conveyor galleries, DM & PT	0.30
		x)	Floor of control room of switchyard control building	1.00
		xi)	Cable and pipe trestles	0.40 for walkway and in addition, friction loads as applicable
		xii)	Grating covers/ Precast RCC covers for drain, trench, sump pit in Ground floor/ paving of BTG area	2.50 As per IRC standard (at road crossings for vehicular traffic)

Notes:

a) If erection load is higher than the specified imposed loads on any floor or part thereof, then the erection loads are to be considered for the design.

b) Additional load for cable, piping/ducting, shall be considered as applicable. For any other structures, the loads specified for those structures elsewhere in the specification shall be followed.

6.02.03 **Equipment, piping and associated loads**

Equipment loads shall be considered over and above the imposed loads. Equipment loads

shall be considered as given by equipment supplier.

6.02.04 **Crane load**

For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.

6.02.05 **Seismic load**

For design of all structures, the site specific seismic design criteria as attached in Annexure-E shall be followed.

6.02.06 **Wind load**

For design of all structures, the wind loads shall be taken as per the site specific wind data specified in Annexure–D of this specification.

6.02.07 **Temperature Load**

For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.

Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS 800 and IS 456 for steel and concrete structures respectively.

6.02.08 **Differential Settlement Loads**

Structures shall be designed considering an additional load on account of differential settlement of 1 in 1000 between any two adjacent columns, subject to a maximum differential settlement of 8 mm in case of foundations resting on soils & 4mm in case of foundations resting on rock/ pile.

These differential settlement loads shall be taken into consideration for design of footings & structures of Boiler & Mill Bunker, ESP supporting structure and Main Power House building.

Further, in the analysis of differential settlement loads, adjacent columns interconnected with bracings are preferably to be provided with combined footing. In such cases, where rigid combined foundations are provided below braced columns, differential settlement between those columns needs not be considered.

Moreover, when rigid raft is provided, the differential settlement amongst the columns supported on the rigid raft need not be considered. However, the differential settlement between the raft and the adjacent column footing of the same structure are to be considered.

In the structural analysis for differential loads, following approach may be considered: All the alternate columns in structure shall be applied downward displacement as described above and analyzed at a time. The resultant forces/ reactions shall be considered with reversible effects for design of structures and footings.

6.02.09 **Additional Loads**

Following Minimum additional Loads shall be considered in the design of Steam generator structures, Mill & bunker buildings, Coal handling Transfer points and Trestles (in BTG island) and ESP structure.

(a) Cantilever Loads of not less than 2000 kg/m at a distance of 1200 mm from the external face of the columns, on both sides of the ESP, for Cable trays and Walkways.

(b) Cantilever Loads of not less than 500 kg / M at a distance of 1200 mm from the external face of the columns, on both sides of the Steam Generator, for Cable trays and Walkways.

(c) Cantilever Loads of not less than 2000 kg / M at a distance of 2500 mm from the external face of the Mill & Bunker Building columns, CHP transfer point columns/ VGTU columns & conveyor gallery trestles (on one side) for Cable trays and Walkways.

(d) Dry Fly Ash Piping Loads.

(e) Ash Water Piping Loads.

(f) Supply Air and Instrument Air Piping.

(g) Service Water Piping

(h) Loads associated with Coal Handling Plant equipment

(I) Loads for solar installations over roof to be taken not less than 1 KN/sqm. Roof slab to be design for local effect due to wind load at support location for installations

6.03.00 **Civil Design Concepts**

6.03.01 Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.,

6.03.02 The different load combinations shall be taken as per IS: 875 (Part-5) and other relevant IS Codes.

a) Wind and seismic forces shall not be considered to act simultaneously.

b) For the design of main plant structures during seismic condition, the deaerator feed water tank shall be considered full upto operating level. However, for other load combinations, deaerator feed water tank in flooded condition shall be considered.

c) 'Lifted load' of crane shall not be considered during seismic condition.

d) In case two cranes are provided and tandem operation is not envisaged, the load shall be taken as one crane fully loaded and second crane without lifted load but standing idle adjacent to first crane all through the building length (lifted load near to A/B Row).

e) In case two cranes are provided and tandem operation is envisaged then the crane wheel loads shall be taken as both the cranes fully loaded to capacity and travelling side by side al through the building length.

f) Permissible stresses for different load combinations shall be taken as per relevant IS and IRS codes.

g) For the design of pipe/cable supporting structure, the soil weight shall be considered as backfilled up to grade level for the condition of pipe running full/cables in position.

h) Frictional forces between the pipes and supporting structure in longitudinal direction need not be considered along with seismic or wind forces.

i) Paving in crane corridor shall be designed for the maximum load due to movement of crane.

j) In TG bay at crane rail level, chequered plate walkway with handrails shall be provided for entire column sectional depth for full length of the building. Walkway width clearance from the face of the column to the edge of the crane shall be as specified elsewhere in the specification.

k) For checking against uplift / tension case, 90% of Dead Loads with no Imposed Loads shall be considered along with other Loads.

l) The Structures shall be Designed for most unfavourable Combination of Dead Loads, Imposed Loads, Equipment Loads, Piping / Cables / Ducts Loads, Wind / Seismic

Loads, Temperature Loads, Ash Loads, and other applicable Loads without exceeding the Permissible Stresses.

No reduction in equipment loads, piping loads, ash loads and loads due to other permanent facilities shall be considered for calculation of seismic weight of the building/structure and for load combinations thereof.

m) In all Loading Combinations, the Loads that have reduction effect on design condition shall not be taken into account in the Combination concerned.

n) Where wind load is the main load acting on structure, no increase in stresses is to be considered for design of Structure and Foundation bolts. This includes structures like Transfer Points and Conveyor Trestles

i) 8 of 23 ii) 55 of 69 & 61 of 69	i) 6.03.03 ii) 5.23.02 & 5.23.14	i) Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and other relevant IS standards including National Building Code(2016). For design of coal bins and loading hopper IS:9178 (part I to III) shall be followed. ii) The steel structures using tubular sections shall be designed and fabricated as per IS:806 – "Code of Practice for use of steel tubes in general building construction."	NTPC to kindly confirm: Steel section using tubular sections shall be design as per IS:800-2007(Limit state design), and not using IS : 806.	Limit state design philosophy is to be followed for design of steel structures as per IS 800:2007.However, IS : 806 is to be referred for properties of tubular sections. Bidder to comply to specifications requirement.

e effects) are to

6.03.03 Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and other relevant IS standards including National Building Code(2016). For design of coal bins and loading hopper IS:9178 (part I to III) shall be followed

6.03.04 Shop connections will be welded type and all field connections will be bolted. Field permanent bolts wherever provided will be high tensile bolts of property class 8.8(min) as per 1367 for all major connections. However, nominal connections in the field like purlins, stairs, wall beams will be done by means of M.S. black bolts of grade 4.6 conforming to IS-1367. The bolted joints will be designed for friction grip or bearing type. For friction grip type connections, bolts will be tightened to develop the required pretension during their installation.

For bolted Connection, IS 4000, IS: 3757, IS: 6623 and IS: 6649 shall be followed. IS 814, IS 816, IS: 1024, IS 4353 and IS: 9595 shall be followed for welding of structures.

6.03.05 All structures close to railway line shall have clearances conforming to Railway norms.

6.03.06 For calculation of coal load on moving conveyor, a multiplication factor of 1.6 shall be used to take care of inertia force, casual over burden and impact factor, etc. Thus coal load per unit length of each moving conveyor shall be

$$\frac{1.6 \times (\text{rated capacity of conveyor system})}{\text{Conveyor speed}} \times \frac{1100}{800}$$

6.03.07 a) Conveyor gallery structure and trestles shall be designed considering both conveyors operating simultaneously

b) Dynamic analysis of conveyor galleries and conveyor supporting system shall be carried out for spans greater than 25 m.

c) All structures close to railway line shall have clearances conforming to Railway norms.

6.03.08 **Coal, Biomass, Limestone and Gypsum handling structures:**

The steel structures shall be designed and fabricated as per 'code of practice for use of structural steel in general building construction', IS : 800 and other relevant IS Standards. Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6. Minimum weld size shall be 6 mm. The steel structures using tubular sections shall be designed and fabricated as per IS:806-"code of practice for use of steel tubes in general building construction." and EN 1993-1-8:2005. Minimum grade of steel & thickness of Tubular/Hollow sections shall be Yst 240 MPa & 4.0mm respectively. Minimum thickness for rolled/ built up section shall be 6mm.

Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports.

	All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. Peak wind speed method shall be considered for checking the transverse deflection. Longitudinal deflection for all conveyor trestles (along the conveyor direction) shall be Height/500 for peak wind speed. Vertical & horizontal deflection of conveyor gallery shall be restricted to span/500. The transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles. For transfer house monorail loads of two floors having highest capacity of monorails shall be considered in addition to other gravity loads along with wind/seismic load. Wind load/seismic load shall be considered along with Running belt tension for the analysis of transfer house, however monorail load may not be considered. Stresses for all CHP structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method. The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325. Horizontal bracing system shall be provided at floor levels around the openings for plan area greater than 2 sqm. Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement. Contractor can also use tubular steel sections for roof truss of conveyor galleries/cable trestle only. For design of liquid retaining structures, IS : 3370 (Part - I to IV) (latest) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of RCC pipes for culverts, latest editions of IS: 458, IS: 783 should be followed. For foundations of transfer points & trestles, pedestals of isolated footings/pile caps shall necessarily be tied with RCC beams. For all RCC buildings, tie beams shall be provided at lintel level. Design of masonry walls shall be made as per IS : 1905. For metal roofing and side cladding, the spacing of purlins/runners shall be such that the deflection of metal sheet used is limited to span/250 under adverse loading condition. Minimum reinforcement (0.12% of total coss sectional area in each direction) shall be provided at the top face of the footing, even if, no reinforcements are required as per design
6.03.08.01	All liquid retaining structures shall be designed for following load conditions. Underground structures: a. Water filled inside up to design level and no earth outside.

b. Earth pressure with surcharge of 2.0 T/m2 and ground water table up to FGL outside and no water inside.

c. Stability against uplift shall be checked for completed structure and under construction stage with no water inside and ground water table up to FGL, with a minimum factor of safety of 1.20 against uplift. Installation of pressure relief valves shall not be permitted in the base slab of any liquid retaining / conveying structure.

d. The structure shall also be checked for normal working condition with water filled inside up to design level and earth pressure outside with no effect of surcharge and ground water table.

For design of over - ground liquid retaining structures appropriate load cases shall be considered.

6.03.08.02 All liquid retaining structures shall be designed by working stress method as given in clause 4.5 of IS 3370(Part2).

6.03.08.03 In the wall of liquid retaining structures with cylindrical shape such as clarifiers, vertical reinforcement shall be checked assuming the walls were fully fixed at the base, and the horizontal reinforcement shall be provided to resist horizontal (hoop) tension assuming hinged condition at the junction of the base slab & wall.

6.03.08.04 Wherever sandwich slabs are provided in liquid retaining structures to take care of stability against uplift, only well graded sand of approved quality shall be used as fill material. The sand compaction shall be done with plate / disc compactors in such a manner that the bottom slab is not structurally damaged.

6.03.08.05 Clear free board of at least 300 mm above design (total) water level shall be provided in all liquid retaining / conveying structures.

6.03.08.06 Coefficient of active earth pressure shall be considered for design of free standing retaining walls and coefficient of earth pressure at rest shall be considered for design of top propped retaining walls.

6.03.08.07 The minimum concrete clear cover to reinforcement bars in all RCC structures shall be as per IS:456 and IS:3370(Part II) for water retaining structures. Durability of concrete shall conform to moderate exposure conditions as per Table-3 of IS 456 except noted specifically otherwise.

6.03.08.08 Factor of safety against overturning and sliding

The structure shall be checked for minimum factor of safety of 1.5 against overturning conditions (ratio of stabilizing moment to overturning moment) and 1.4 against sliding conditions as per IS: 456.

6.03.08.09 For detailing of Reinforcement IS 5525, IS 13920, IS 4326 and SP 34 shall be followed.

6.03.08.10 Two layers of reinforcement (on both faces) shall be provided for RCC sections having thickness of 150 mm and above.

6.03.08.11 Minimum diameter of main and distribution Reinforcement bars in different structural elements shall be as follows:

Sl. No.	Structural Element	Main Reinforcement	Distribution Reinforcement / Stirrups/ ties/ Anchor Bars
a)	Foundation	12 mm	10 mm
b)	Beams	12 mm	8 mm
c)	Columns	12 mm	8mm

6.03.08.12 Spacing of reinforcement bars in walls and slabs of liquid retaining / conveying structures shall not be more than 200 mm.

6.03.08.13 Buildings shall also comply to IS 4326 requirements.

6.03.08.14 Minimum Reinforcement in all elements of liquid retaining / conveying structures shall be 0.24 % of cross-sectional area.

6.03.08.15 The sizing of foundation, design criteria & clear cover shall conform to IS:1904, IS:456 and other relevant Indian codes. However, minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.

6.03.08.16 Minimum thickness of foundation slab / raft and base slab of all liquid retaining tanks / pits shall not be less than 250 mm.

6.03.08.17 Minimum thickness of all elements of RCC liquid retaining / conveying structures (except effluent drains & launders) shall be 200mm. Effluent drains (depth more than 500mm) and launders shall have minimum element thickness of 150mm.

6.03.08.18 All Insert plates (except edge protection angles) provided in liquid retaining structures shall be 12 mm thick GI with lugs not less than 12 mm diameter or 6mm flats. Edge protection angles shall be provided as specified elsewhere.

6.03.08.19 All water retaining structures shall be tested for water tightness as per provisions of IS: 3370 and IS: 6494.

6.03.08.20 2.0m wide walkway with concrete paving shall be provided connecting all structures, buildings and facilities. The top of walkway shall be minimum 200mm above FGL.

6.03.08.21 Deleted

6.03.09 Horizontal Deflection criteria

The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following:

Sl. No.	Description	Maximum value of
1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)
2.	For ESP Control Building, Compressor House, and all other steel buildings envisaged in this specification	Height /325
3.	Vertical Metal Sheeting in Cladding	Span/250

However, the maximum deflection of Grating / Chequered Plate Shall be limited to 6mm.

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

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

6.03.10

a) Dispersion of load in any direction through soil shall be as per IS 8009 (relevant part).

b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.

6.03.11

a) Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325.

b) The allowable deflection for beams directly supporting drive machinery and equipment shall be restricted to span/500 unless specified otherwise in this specification.

c) The deflection for manually operated cranes & monorail supporting beams shall not exceed span/500.

For electric overhead cranes :

1) upto 50 Tonne capacity : span/750

2) over 50 Tonne capacity : span/1000

d) The vertical deflection of beams supporting LP Heater, HP Heater and Deaerator shall be limited to Span/500.

e) The vertical deflection of metal deck sheet for floor shall be limited to span/250.

f) Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm.

6.03.12

Transverse coal pressure on Bunker/Silo/Hopper walls shall be calculated as per IS: 9178. The Coal Bunker/Silo/Hopper shall be designed for the following conditions

i) The Bunker/Silo/Hopper is full up to its full capacity with top surface nearly horizontal.

ii) The Bunker/Silo/Hopper is partially empty with the top surface of coal at an angle of repose of 37 degrees.

6.03.13

Design criteria for ash silo

1. The pressure due to ash filling on the side wall and the bottom portion of ash bins/silos shall be taken as the maximum of (a) static pressure determined in accordance with the Jansen's formula multiplied by an impact factor of 1.4 and (b) pressure determined as per Walker's formula for static as well as dynamic conditions. The silo shall be designed for the following conditions:

   (a) The silo is full up to its full height / capacity

   (b) The silo is partially empty with top surface of ash, at an angle of repose less than 30 degrees.

2. The following loads are to be considered for design.

   a) Density of bottom ash to be considered for volume calculation shall be 650 kg. /cum.

   b) Density of bottom ash to be considered for load calculation shall be 1600 kg/cum.

   c) Density of fly ash to be considered for volume calculation shall be 750 kg/cum.

   d) Density of fly ash to be considered for load calculation shall be 1600 kg./cum.

   e) Density of dry fly ash, to be considered for the design of supporting structures for dry fly ash conveying pipes, shall be taken as 1000 kg/cum. The pipe shall

	be considered full with dry fly ash. 3. Other requirements are as follows: a) Independent supporting structure shall be provided for each silo. b) The joint between the wall and roof of the silo shall be properly sealed by welding or by any other approved means. c) Operating platform covering total plan area wise in silo structure made of grating shall be provided below the hopper outlet. d) The bracing system shall be provided in such a way that the trucks and closed tankers can have a clear passage to approach the underside of the silos for unloading dry ash from the silos. 4. Trestles supporting ash pipes shall be so proportioned that the transverse deflection of trestles due to wind/seismic load shall not exceed trestle height/325. 5. The corrosion allowance for design of Silo, Buffer Hopper, Bottom ash hopper, tanks etc. shall be considered as per IS9178 considering structure exposed to atmosphere. The corrosion allowance shall be provided in addition to the requirement of minimum thickness of steel plate as per IS9178.
6.03.14	Coal Bunker (inside Mill Bunker Building) shall be of MS while the hopper shall be of MS with stainless steel (grade SS 304) lining. The minimum thickness of MS plate and SS lining in hopper portion shall be as per the design concept of Mill Bunker Building specified elsewhere in the specification. Pre-formed flexible open ended bellow strap of neoprene is to be provided between top of bunker and bottom of tripper floor to avoid coal dust leakage / escape. The bellow strap shall be of minimum 200 mm wide under un-stretched condition and shall be of minimum 2mm thick. The hopper angle with the horizontal plane be as specified elsewhere in the specification.
6.03.15	The live storage capacity of each coal bunker shall be greater of the following: a) Total 10 hours biomass blended coal requirement of the boiler for BMCR duty with worst coal firing, equally distributed over the number of bunkers (i.e. the coal mills) required in service for this duty condition as specified elsewhere. b) Total 10 hours biomass blended coal requirement of the boiler for BMCR duty with design coal firing, equally distributed over the number of bunkers (i.e. the coal mills) required in service for this duty condition as specified elsewhere. c) Total 10 hours biomass blended coal requirement of the boiler for TMCR duty with worst coal firing, equally distributed over the number of bunkers (i.e. the coal mills) required to be in service for this duty condition as specified elsewhere.
6.03.16	For all capacity (volume) calculation and structural design (load calculation) unit weight of biomass blended coal shall be assumed as 760 kg/cum. and 1100 kg/cum respectively.
6.03.16	a) The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever specifically mentioned in this specification. b) For design and construction of steel-concrete composite members, IS: 11384 shall be followed. c) For reinforcement detailing, IS 5525 and SP 34 shall be followed. d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.
6.03.17	a) **Design of Foundation for TG, TDBFP, MDBFP & Fan foundations**

Structural Arrangement of foundations for various machine foundations like TG, TDBFP, MDBFP, Coal Mills and Fans shall be as specified elsewhere in the specification.

Analysis for the foundation

For the foundations of the all equipment, details static and dynamic analysis shall be done. The static analysis shall include all operating condition, load cases and abnormal loads like short circuit, loss of blades & unbalance and seismic forces as per IS1893. The dynamic analysis shall consist of free vibration analysis and forced vibration analysis. A minimum fatigue factor of 2.0 shall be considered for dynamic forces.

The vibration amplitudes shall be calculated at the machine bearing locations and at any other points of interest by a forced response analysis. The unbalance forces used for this analysis shall correspond to the balance quality grade of the machine as per ISO 1940 /IS:11723 or the unbalance forces as provided by the machine manufacturer whichever is higher. It shall be ensured that the calculated amplitudes do not exceed the limits specified by the machine manufacturer and relevant Standards such as ISO 10816/IS:14817.

Bidder to consider the acceleration at the top of the deck for the design of supporting / fixing arrangement of machine.

Design criteria for steel helical springs and viscous dampers

The isolation efficiency for steel helical springs and viscous dampers shall be at least 90%. The ratio of actual spring supported weight to the nominal spring capacity shall not exceed 0.80. At least 5% to 10% of critical damping shall be provided in the form of viscous dampers.

Reinforcement Design

Working stress method as per IS 456 shall be used for reinforcement design. The design shall be done for the worst load combination. Minimum reinforcement shall be provided as per IS 456 and IS2974 (Part-III), if the calculated reinforcement is less than the minimum.

For TG Raft/ Pilecap, minimum percentage of reinforcement at top and bottom faces of foundation shall be same as that stipulated for beam as per IS456.

c) **Block Foundations:**

Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied.

Reinforcement design shall be done by working stress method as per IS 456 and IS 2974 (Part-IV).

For the foundations supporting minor rotating equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably.

6.03.18 If RCC floor/roof is assumed to act as diaphragm, transmitting lateral loads to braced bays, it shall be provided with shear connectors.

The spacing of shear anchor studs on structural beams shall be minimum of the spacing required for
i) Restraining the compression flanges of beams and
ii) Transfer of the horizontal shear at floor/roof to the supporting beams.

	However, whenever large / more number of cut-outs are provided in the floor slab, horizontal floor bracings shall be provided below slab to transfer horizontal force to columns without considering diaphragm action from slab.
6.03.19	All roads shall be rigid pavements specified elsewhere in this specification. The design traffic load shall be a minimum 4 million cumulative standard axle. The design of concrete pavement shall be carried out as per IRC-58.
6.03.20	a) No cable/pipe trench is envisaged in the plant area. However, if required, pipe/cable trench can be provided inside the buildings and inside switchyard or some other localised areas. b) All pipes and cable shall generally be routed above ground. c) A minimum clearance (clear headroom) of 8m shall be kept for all over-ground pipe/cable trestles for all road/rail crossings. For other areas, the requirement of trestle height is specified elsewhere in the specifications. All trestles shall be provided with continuous walkway of minimum 600mm width with hand-rails and toe-guards all along the length of the trestle along with approach ladders near roads, passageways, etc. Before and after the road/rail crossings, a barrier of suitable height shall be constructed so as to prevent the approach of cranes (having height more than 8 m) etc., upto the pipe/cable racks/trestles. d) Within AB bay in Main plant area, generally grating shall be provided for Mezzanine floor except for valve room area, cable spreader floor, air washer units, feed water heaters, equipment foundations, miscellaneous skids, etc. where the floor shall be of RCC. Oil equipment room shall also have RCC floor below the grating floor.
6.03.21	The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings.
6.03.22	Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec. Manual on sewerage and sewage treatment (published by Central Public Health Environment Engineering Organisation, Government of India) shall be followed for design purpose.
6.03.22	Foundations for all tanks shall be designed for as per IS: 803.
6.03.23	Footings shall be so proportioned to as to minimise the differential settlement.
6.03.23.01	Plinth level of all buildings shall be kept at least 500 mm above the finished grade/formation level.
6.03.24	**Boiler/ ESP support structures shall be designed for:** a. Dead load b. Live/Imposed loads c. Static and dynamic loads of piping, movable equipment and maintenance parts. d. Loads from cable trays and walkways supported on columns. e. Ash water piping supported on the outermost row of boiler columns. f. All ESP hoppers filled up with ash upto the top of the hoppers or the bottom of electrodes (whichever is more) using a bulk density of not less than 1350 kg/cu.m. for the ash, along with additional ash build-up from the end of the third field up to the inlet duct bottom level at a natural repose angle (not less than 30 degree to horizontal in any case). g. Ash load at bottom ash hopper and pent house of the boiler shall be as mentioned in

the mechanical chapter of the specifications.

h. Seismic and wind loads as specified elsewhere in the specifications.

i. Temperature Loads.

j. Temperature variations under ESP operating condition.

k. The loads listed above indicate the minimum requirements.

l. For the Design of ESP Supporting Structures for Seismic, Ash Load in Hoppers filled upto to the top of the Hoppers or bottom of the electrode (whichever is higher) shall be considered as permanent Loads along with other applicable Loads.

m. Following Ash density shall be considered for the Design :

Sl. No.	Description	Density (kg/Cu. M.)
a)	Bottom Ash for volume calculations	650
b)	Bottom Ash for Load calculations	1600
c)	Fly Ash for volume calculations (For Boiler)	750
d)	Fly Ash for volume calculations (For ESP)	650
e)	Fly Ash for Load calculations	1350
f)	Dry Fly Ash for dry fly ash Pipeline supporting Structures (Pipe to be considered full)	1000

6.03.25 Boiler supporting structures shall be so configured that the temperature of steel does not exceed 60 °C unless specified otherwise. Brackets shall be provided on both sides of the outermost row of columns of both the boiler and ESP for supporting cable trays and walkways, at a height not exceeding 10.0 m. The exact levels shall, however, be decided during detailed engineering. Each ESP hopper shall be supported at four corners by providing four columns from the ground.

6.03.26 The bracings in boiler structure shall be provided such that under no circumstance normal/convenient access to all points in the boiler is blocked or obstructed.

6.03.27 In design of boiler/ ESP support structures, dynamic piping loads need not be considered acting simultaneously with wind or seismic loads. Increase in permissible stresses shall be allowed in load combinations where dynamic piping loads are considered and shall be as permitted under seismic load conditions.

6.03.28 Design Criteria for foundations and some other facilities/areas are covered separately in this specification.

6.03.29 Plinth level of all buildings shall be kept at least 500 mm above the finished grade/formation level.

Finished floor level of boiler area paving shall be kept about 200 mm lower than the finished floor level of Main Plant buildings.

6.03.30 Joints/Connections in steel structures:

Steel structures shall be detailed and connection and joints provided as per the provisions of IS 800, IS 816, IS 9595, IS 1367, and IS 9178 and as per following requirements.

a) Connection of vertical bracings with connection members and diagonals of truss members shall be designed for full tensile capacity of the bracings unless actual loads are indicated on the drawings.

b) Size of fillet weld for flange to web connection for built up section shall be as follows:

i) For box section weld size shall be designed for full shear capacity or actual shear whichever is more. Where fillet weld is not possible, full penetration butt weld shall be provided.

ii) For built up I section, weld size shall be designed for 80% of full shear capacity or actual shear, (if indicated, in drawings) whichever is more. However, weld size shall not be less than 0.5 times the web thickness. Weld shall be double fillet.

iii) All welds shall be continuous unless otherwise specifically approved. The minimum size of the fillet weld shall be 6mm.

c) Shear connections shall be designed for 60% of section strength for rolled sections and 80% of section strength for built up section or rolled section with cover plates. However, if load is more than above, the connection shall be designed for actual load.

d) Moment connections between beam and column shall be designed for 100% of moment capacity of the beam section.

e) All butt welds shall be full penetration butt welds.

f) The connection between top flange and web of crane girder shall be full penetration butt weld. Bottom flange, connection with web can be fillet weld or butt weld as directed by Engineer.

g) Connection of base plate and associated stiffeners with the columns shall be designed considering the total load transferred through welds. However, minimum weld size (double fillet) shall not be less than 0.6 times the thickness of stiffeners.

h) Splicing: All work shall be full strength. Field splicing shall be done with web and flange cover plates for full strength. Shop splicing for all sections other than rolled shall be carried out by full penetration butt welds with no cover plates. Splicing for all rolled sections shall be carried out using web and flange cover plate.

6.03.31 Pipe Pedestals, pipe supports and other structures for Ash handling system:

a) The design of Pipe Pedestal and pipe supports shall be carried out considering Dead load, live load & seismic load / wind load. In addition to above, longitudinal forces equal to product of Co - efficient of friction (between contact surface of pipe and pedestal) with the load coming on each pedestal shall also be considered for the design of pedestal. In bends, suitable thrust block shall be provided to withstand the thrusts transferred from the pipelines.

b) All RCC pipes carrying water under gravity shall be designed for earth pressure, water and surcharge. Minimum grade of pipe shall be of NP - 2 class or heavier required as per design / specification.

c) The design and construction of RCC structures shall be carried out as per IS: 456. In general, limit state theory shall be followed for the design of RCC structures, however, working stress method shall be adopted for the design, wherever specifically mentioned in this specification.

d) Two layers of reinforcement (on inner and outer face) shall be provided for RCC wall sections having thickness 150mm and above.

6.03.32 **Design Criteria of RCC Floors**

a) For Mill Bunker Building, Main Power House, ESP Control Building, Transfer Houses, and other structural steel framed buildings:

These buildings being steel framed structure, all RCC floors shall comprise RCC slab supported on troughed, profiled metal deck sheet (to be used as permanent shuttering). The RCC slab shall be minimum 150mm thick above the top surface (crest) of the metal deck sheet. The spacing of structural steel secondary beams shall be based on the bending capacity of the metal deck sheet for self-weight of green concrete and additional construction load of 100 kg/m^2.

The permanent metal deck sheets shall be fixed to the top flange of secondary beams by means of drawn arc welding of headed shear anchor studs directly through the metal sheet. The details of shear anchor studs are specified elsewhere in this specification.

The RCC slab shall be designed without considering any composite action effect of metal deck sheet (i.e. the structural strength of metal deck sheet shall not be considered for RCC slab design).

(b) For Service Building & other RCC buildings.

These buildings being complete RCC framed structures, conventional RCC slabs of minimum thickness 150 mm shall be provided. The RCC slabs shall be monolithic with RCC beams and RCC columns

6.03.33 **Design Criteria of RCC roofs**

a) For Main Power House, Compressor House, ESP Control Building and Other Steel framed Buildings:

The roof system shall comprise minimum 40mm thick RCC slab on top of profiled permanent metal deck sheet. The permanent metal deck sheets shall be fixed to the top flange of secondary beams by means of arc welding of headed shear anchor studs to the purlins directly through the metal sheet. The details of shear anchor studs are specified elsewhere in this specification. Water proofing treatment to roof slab shall be provided as per details specified elsewhere in this specification).

The RCC slab shall be designed without considering any composite action effect of metal deck sheet (i.e. the structural strength of metal deck sheet shall not be considered for RCC slab design.

b) For Mill Bunker Building, Transfer Houses.

Insulated sandwiched metal sheet for roofing shall be provided comprising troughed permanently colour coated sheet at top and plain permanently colour coated sheet at bottom with 50mm thick insulation sandwiched between the two sheets, the details of which are specified elsewhere in this specification.

c) Roofing system for Ash Handling Plant Pump Houses and Buildings shall be as specified in relevant clauses

d) Other RCC Buildings.

Cast-in-Situ RCC slab shall be provided using removable plywood shuttering. Water proofing treatment to roof slab shall be provided as per details specified elsewhere in this specification).

6.03.34 **Design Criteria for Foundation**

The founding depth / cut off level of piles shall be decided based on functional requirement.

Where structural steel columns are envisaged, the bottom of the base plate shall be kept suitably below the paving level such that the top level of the gusset plate and foundation bolt remain at least 200 mm below the top level of paving except for Boiler Structure, Bunker Building Columns, TP & Trestle Columns, ESP Control Building Columns for which the requirement of levels for bottom of base plates is specified elsewhere in this specification. Further the gusset plate and foundation bolts are to be encased in concrete up to the top of

the paving level. For outdoor structural steel columns, about 300 mm height of steel columns above the top of paving level shall be provided with at least 125 mm thick encasement with minimum reinforcement to prevent corrosion of the steel columns from surface water

a) OPEN Foundations

For foundations, the minimum founding depth and the minimum size of foundation shall be as per foundation system and geotechnical data specified in the foundation chapter include hereafter in this specification.

For open foundations, the total permissible settlement shall be as per the criteria furnished under the foundation system specified elsewhere in this specification.

The sizing of foundation, design criteria & clear cover shall conform to IS:1904, IS:456 and other relevant Indian codes. However minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement both in case of bottom face and also for tension face of foundation shall be same as that stipulated for beam as per IS:456.

b) PILE Foundations

Minimum centre to centre spacing of the piles shall be as per IS: 2911. Incase single piles are used, these piles are to be interconnected with tie beams along both orthogonal directions perpendicular to each other.

Minimum penetration of piles into Pilecap shall be 75 mm and clear cover to the main reinforcement at the bottom face of the pile cap shall be 100 mm. Structural design of pile cap and reinforcement shall conform to IS:2911 and IS:456. However minimum 0.12% of cross section of the pile cap shall be provided on the top face of the pile cap along two orthogonal directions and minimum percentage of reinforcement at bottom face of pile cap shall be same as that stipulated for beam as per IS:456.

Detailed requirement of pile foundation have been presented in the foundation chapter specified hereafter in this specification.

6.04.00 **CORROSION PROTECTION**

6.04.01 **General**

(a) All Steel structures shall be provided with painting system as mention below in this specification for the Corrosivity category mentioned in Part A-IID-Civil Works

Painting system for steel surfaces embedded in Concrete is given separately.

(b) All Painting shall be done as per Technical Specification. Painting scheme shall submitted by the Bidder.

(c) All steel structures shall be designed by following basic design considerations in ISO 12944 Part 3. Where steel is fully accessible for cleaning and repainting and where it is feasible to follow design criteria given in ISO 12944 part 3, minimum thicknesses of structural members shall be as follows

Structural Sections	Minimum thickness	Minimum Flange thickness	Minimum Web thickness
Plates	6		
Built up Sections		6	6
Angle sections	6		
ISMB /ISMC		6	4.5
NPB/ WPB		6	4.5

RHS/SHS/ Tubular Sections	4		
All dimensions in mm			

Where steel surfaces are inaccessible for cleaning and repainting (such as back to back sections, lap joints etc.) or where it is not feasible to follow design criteria given in ISO 12944 part 3, corrosion allowance of 1.5 mm shall be kept in thickness (over the design thickness or minimum thickness specified above, whichever is more). The minimum thickness consideration shall apply for both web and flange.

However minimum gusset plate thicknesses shall be followed as mentioned else where in the specification and minimum angle section to be used is ISA 50x50x6. Ends of tubular sections to be effectively sealed at both ends. Also tubular handrail thicknesses will be as governed by mentioned clauses in the spec

Minimum thickness of tubular/ hollow steel sections conforming to IS 4923 shall be 4.0 mm, provided the ends of such steel sections are effectively sealed unless higher thickness is specified elsewhere for specific structure.

6.04.02 **Painting of Steel Surfaces Embedded In Concrete**

a) 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 Dry Film Thickness (DFT).

b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. 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.

6.04.03 **Painting of Steel Surfaces (Other Than Those Embedded In Concrete)**

Following painting system corresponding to corrosion category as mentioned in Part A IID Civil Works of this specifications shall be adopted for the project.

CORROSSIVITY CATEGORY (as per ISO 12944-2)	PRIMER COAT	INERMEDIATE COAT	FINAL COAT
C3	All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.	Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% ±2%) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.	Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.
C5	All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% ±2%) of minimum 70	Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum	Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% ±2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D

	micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.	80% ±2%) of minimum 180 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.	4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.

Notes:

1. For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time.
2. The most frequent problem associated when top coating Primer is bubbling/pinholing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required.
3. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required.
4. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate & top coat to be done with specified DFT in scheme.

6.04.04 **Coating for Mild Steel parts in contact with Water**.

a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 g/ Sq.m. for galvanised Structures and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629.

b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified.

6.04.05 **Gratings**

All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 gm/sqm.

6.04.06 **Hand Railings and Ladders**

All Mild steel (MS) handrails and ladders in outdoor locations and in pump valve pits shall be galvanised at the rate of 610 gm/sqm as per IS 4736. All other MS handrails shall be painted as specified in clause 6.04.03 above. However, Stainless steel handrails shall be provided as specified in General Architectural Specification clause 9.00.00.

6.04.07 **Sea Worthiness**

All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti-corrosive Paint before shipment to take care of sea worthiness.

6.04.08 Chequered plate to receive same corrosion protection measures as structural steel unless specified other wise.

6.04.09 **For reinforced concrete work.**

i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts.

ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion.

This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc.,

Bidder shall furnish the details of corrosion protection measures.

7.00.00 FOUNDATION SYSTEM AND GEOTECHNICAL DATA

7.01.00 Soil Data

Owner has carried out detailed geotechnical investigation at the project site. Bore logs data and Bearing capacity for design of foundations are given at Annexure - C of this specification. The detailed geotechnical investigation report comprising of Boreholes, Laboratory tests, Chemical analysis, etc for the sub-strata prevailing at site would be made available for the Bidder's study at the Owner's office, if required. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data lies with the Bidder. **In case, bidder feels that the available data is inadequate, he may carry out his own geotechnical investigation**. **Further, if any change in layout or for any area not covered in the provided geotechnical data, the bidder has to carry out geotechnical investigation in the area at no cost to Owner.** Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.06.00. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. Net allowable bearing pressure shall be limited to Table-1 of Annexure-C. The report shall be submitted for Owner's approval prior to commencement of design of foundation.

Bidder may refer enclosed topographical survey drawing and general layout plan along with borelogs for variation in existing ground level (EGL) / natural ground level (NGL) and finished ground level (FGL). As per borelog data and topographical survey drawing, Natural ground level at few location is approximately 1m to 4.5m below finished ground level. Further, wherever ash/coal deposit/brick-bats etc. is found the same shall be treated as filled up soil.

As per borelog data, water table is varying from 0.0m to 6.2m at the time of field investigation and may fluctuate with season.

7.01.01 The furnished borelog details are specific to the co-ordinates where the boreholes have been carried out and are provided for bidder's information only. Soil profile in the proposed area may vary with respect to the borelogs enclosed for bidder's information. Bidder has to consider all such variations in his estimation, over the extent of the work to be carried out. The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be Payable.

7.01.02 Tank Foundations

a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any.

b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III.

c) Natural sand/ sand manufactured from other than natural sources as specified elsewhere in the technical specification shall be spread in layers not exceeding 30cm

compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%.

d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.

7.02.00 **Foundation System**

The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable open foundation shall be adopted with approval of owner.

7.02.01 General Requirements

a) All structures/equipment shall be supported on suitable open foundations (isolated, combined, raft) depending on type of structures/facilities, sub-strata, topography etc.

b) The roads, ground floor slabs, trenches, pipe pedestals (except thrust blocks), channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil.

c) No other foundation (other than as mentioned in (b) above and (g) below) shall rest on the filled up ground / soil.

d) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards.

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

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

g) Foundation for equipments on ground floor

For equipments of static weight upto 1.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 4T/m2. Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications.

For equipment's of static weight between 1.5 T and 20 T, the equipment may be supported on compacted sand filling from Natural Ground Level (NGL) or excavation level of nearby footing whichever is deeper with the load intensity below the equipment limited to 4T/m2. The minimum depth of foundation is 1.0m below FFL. Other requirements of sand compaction below the foundation shall be adhered, as specified elsewhere in the specifications.

For equipment of static weight more than 20 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 1. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.

7.02.02 Open Foundations

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

a) The minimum width of foundation shall be 1.0 m.

b) In case of soil, minimum founding level shall be 1.0m below Finished ground level (FGL) or, 1.0m below Natural ground level (NGL) whichever is lower.

In case of rock, minimum founding level shall be 1.0m below Finished ground level (FGL) or, 0.3m embedment in rock whichever is lower.
For meeting the bearing capacity and /or functional requirement lower depth to be adopted based on requirement.

c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum.

d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC M7.5 up to designed foundation level.

e) Wherever the intended bearing stratum is weathered rock, but the actual strata encountered during excavation consists of both overburden soil and weathered rock at founding level, under such cases, the overburden upto the weathered rock level, including minimum embedment as per Annexure-C into the rock, shall be removed and built up through PCC M10 upto the designed bottom level of the foundation. The founding level for all the open foundations shall be kept at same level for a structure.

f) The last layer of about 300 mm before reaching the founding level shall be excavated carefully by such equipment so that soil / rock at the required level will be left in its natural condition.

7.03.00 Excavation, Filling and Dewatering

7.03.01 For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.

7.03.02 Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.

7.03.03 **Backfilling in Power House & Boiler Area**

Backfilling around foundations, trenches, sumps, pits, plinths, etc. shall be carried out with natural sand/ sand manufactured from other than natural sources as specified elsewhere in the technical specification in layers not exceeding 300 mm compacted thickness and each layer shall be compacted to minimum 80% of relative density.

Backfilling in other area

Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 00mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non cohesive soils.

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

7.03.04 Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.

7.03.05 CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level.

7.03.06 The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides.

Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.

7.04.00 EXCAVATION IN ROCK

Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out.

7.04.01 Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type).

7.04.02
a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting operation. All blasting shall be done as per the approved blasting scheme & initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert.
b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed.
c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials.
d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations.

7.05.00 Sheeting & Shoring

The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.

7.06.00 **Geotechnical investigation work may be got executed by the Contractor through the following agencies**

1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata

2. Cengrs Geotechnica Pvt. Ltd, New Delhi

3. KCT Consultancy Services, Ahemdabad

4. M.K. Soil Testing Laboratory, Ahemdabad

5. Secon Private Limited, Banglore

6. Soil Engineering Consultants, New Delhi

7. CEG Test House and Research Centre Private Limited, Jaipur

8. Geomarine Consultants Pvt Ltd., Chennai

9. Soiltech India Private Limited, Pune

Annexure-C

SOIL DATA AND FOUNDATION SYSTEM

Employer has carried out geotechnical investigation in the proposed area. Logs of boreholes of proposed area are enclosed with this Annexure.

a) The minimum founding level and the corresponding net allowable bearing pressure shall be as given in Table – 1 below.

Table – 1

Founding Depth/ Stratum	Net Allowable Bearing Pressure T/m2		
	Isolated and combined footings including raft for 25mm permissible settlement in case of soil and 12mm in case of rocky strata	Isolated and combined footings for 40mm permissible settlement in case of soil and 12mm in case of rocky strata	Rafts (width > 6m) for 75mm permissible settlement in case of soil and 12mm in case of rocky strata
	Width upto 6.0m		
In case of Soil			
1.0m below NGL	12	12	12
2.0m below NGL	15	15	15
3.0m or more than 3.0m below NGL	25	25	25
In case of rocky strata			
Minimum 0.30m Embedment in weathered rock	25	25	25
Minimum 0.60m Embedment in weathered rock	30	30	30
Minimum 1.0m Embedment in weathered rock	35	35	35
Minimum 1.5m Embedment in weathered rock	40	40	40
Minimum 2.0m Embedment in weathered rock	45	45	45
Minimum 2.5m Embedment in weathered rock	50	50	50

Minimum 3.5m or more than 3.5m embedment into weathered rock	55	55	55

For Finished ground level (FGL) refer General layout plan (GLP)

To determine the Natural Ground Level (NGL) the tender drawings titled TOPGRAPHICAL SURVEY shall be referred. Further the above tender drawings shall also be referred in conjunction with borelog data attached at Annexure to this chapter.

The NGL for any particular structure/facility shall be the lowest of all the NGLs mentioned in the extent of the building/facility.

The NGL of any point shall be the lowest of the levels at (a) TOPGRAPHICAL SURVEY and (b) Borelog data attached at Annexure to this chapter.

In case any loose/soft pockets is encountered at founding level, the same shall be removed completely upto the hard strata and filled up with PCC M7.5.

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

For open foundations, the total permissible settlement shall be governed by IS: 1904 / IS: 13063 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:

Isolated & Raft (Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil	25 mm
Isolated & Strip (other than Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil	40 mm
Raft (other than Main power house, TG Area Footings, Boiler, Mill, Bunker Footings & Fans) resting on soil	75 mm
Foundations in Weathered rock / rock	12 mm

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

c) Special Requirements:

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

Chemical	Sulphates	Chlorides	pH
Ground Water	12.9-15.5 mg/l	14-64 mg/l	6.80-7.13
Sub-soil	0.05%	0.005-0.007 %	6.38-6.91

D-1-8 **GENERAL SPECIFICATION**

8.01.00 **GENERAL REQUIREMENTS**

8.01.01 **JOINTS IN CONCRETE STRUCTURES**

Construction Joints

All horizontal construction joints shall be provided with a groove (shear key) for transfer of shear force.

For construction joint in concrete wall, the maximum height of any lift should not exceed 2 meters. However, the time interval between the successive lifts should be as small as possible and the wall should be built to its full height in the least possible time.

Expansion joints for all underground structures shall be made watertight by using ribbed PVC water stops with central bulb or of kicker type. The thickness and width of PVC water stops shall be as per the requirement of design. However, the minimum thickness and width shall be 6mm and 225mm respectively.

Expansions Joints

In case of expansion joints, preformed bitumen impregnated fibre board conforming to IS 1838 shall be used as joint filler. The joints shall be sealed with bitumen sealing compound conforming to IS 1834, however in case of liquid retaining/carrying structures, two parts polysulphide sealant conforming to IS 12118 or silicon sealing compound shall be used.

IS 3414 shall be followed for details of joints in buildings. 3 mm thick stainless steel strip in matt or buff finish shall be provided over building expansion joints.

8.01.02 **Miscellaneous General Requirements**

8.01.02.1 All steel sections and fabricated structures, which are required to be transported on sea, shall be provided with anti-corrosive paint before shipment to take care of sea worthiness.

8.01.02.2 Monorails, monorail girders and fixtures shall be provided, wherever required to facilitate erection / maintenance of equipment.

8.01.02.3 Wherever possible all floor openings shall be provided with 100 mm thick 150 mm high RCC kerb all around.

8.01.02.4 Angles 75 x 75 x 6 mm (minimum) with 8mm diameter and 150mm long MS lugs @ 150 c/c shall be provided for edge protection all around cut outs/openings in floor slabs. Angles 50 x 50 x 6mm with effective anchor lugs shall be provided for edges of concrete drains supporting grating/covers, edges of RCC cable / pipe trenches supporting covers/chequered plates/ grating, edges of manholes supporting covers, supporting edges of precast RCC covers and any other place where breakage of corners of concrete is expected.

8.01.02.5 Floor of switchgear room shall be provided with embedded M.S. channel suitable for easy movement of breaker panels.

8.01.02.6 Anti-termite constructional measures and chemical treatment measures shall be given to all vulnerable areas susceptible to termite including column pits, wall trenches, foundations of buildings, filling below the floors, etc., as per IS 6313 and other relevant Indian Standards.

8.01.02.7 All cable & pipe routing shall be done as per system requirement and as stipulated elsewhere in the specification and shall run above ground on elevated trestles or other supporting structures except in some localized area (as approved by Employer) where the same can run in trenches. In case, pipes are to be routed on RCC pedestals, the height should not be less than 500mm above formation level/paving level. All trenches shall be of RCC with removable RCC covers.

Please furnish the list of vulnerable structures, buildings, where anti termite treatment is required.	Anti-termite treatment is to be carried out by bidder in all vulnerable area in consultation with NTPC during project execution.

	All cable trenches located inside buildings shall have minimum 6mm thick (o/p) chequered plate covers.
	Cable trenches, where allowed, located outside the buildings shall project at least 200mm above the finished formation level unless noted otherwise elsewhere in this specification so that no storm water shall enter the trench. The bottom of the trench shall be provided with a longitudinal slope of 1:500.The downstream end of trenches shall be connected through pipe drains to the nearby RCC manholes (to convey water from trenches) of storm water drainage system, but avoiding back flow of storm water. In general, the precast covers shall not be more than 300 mm in width and shall not weigh more than 65 kg. Lifting hooks shall be provided in the precast covers.
	All cable trenches, wherever required, shall be provided with suitable insert plates for fixing support angles of cable trays.
	In Main plant area wherever fire water pipe trenches are envisaged, these trenches shall be of RCC and provided with precast RCC cover flush with finished level of paving in that area.
	R. C. C. cable slits shall be filled with sand after erection of cables, up to top level and covered with 75mm thick PCC cover of minimum M15 grade.
8.01.02.8	All steel platforms above grade shall be provided with 100 x 6 thick kick plates at edge of platform.
8.01.02.9	Duct banks consisting of PVC conduits conforming to IS 4985 for cables shall be provided with proper sealing arrangement consisting of fire retardant sealing compound.
8.01.02.10	Independent network of lines for sewerage and drainage shall be provided. Plant effluent shall not be mixed with either storm water or sewage.
8.01.02.11	The sub-grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor density at Optimum moisture content (OMC.)
8.01.02.12	Detailed scheme for dewatering shall be prepared, wherever required, before starting of deep excavation work. IS 9758 shall be followed as general guidance for dewatering.
8.01.02.13	Structural steel column base plates and bolts, gussets, etc., shall not project above the floor level unless and noted otherwise. These shall be encased by concrete cover up to floor level with concrete grade M 25.
8.01.02.14	Non-shrink flow able grout shall be used for under-pinning work below base plate of columns. Nominal thickness of grout shall be 50 mm. Non-shrink cum plasticizer admixture shall be added in the grout. Crushing strength of the grout shall generally be one grade higher than that of the base concrete. Minimum grade of grout shall be M-30.
	Grouting of all pockets, blockouts, sleeves and the openings around the embedment, inserts, bolts etc. and under pinning below the base / sole plate shall be with non - shrink flow able grout. Grade of grout shall be one grade higher than concrete. However minimum grade of grout shall be M - 30.
	However, for equipment foundations, high strength (minimum characteristic compressive strength of 60 N/sq.mm at 28 days) ready mixed non-shrink, chloride free, cement based, free flowing, non-metallic grout as recommended by equipment manufacturer shall be used.
8.01.02.15	All the buildings and site development including landscaping shall be designed to take care of rain water harvesting & ground water recharging. Development of rain water harvesting scheme for the buildings, structures, facilities in Bidder's scope and obtaining approval of the scheme from Central Ground Water board is in Bidder's scope.
8.01.02.16	As required suitable steel frames shall be provided around openings in the roof and external walls for mounting exhaust fans.

8.01.02.17	750mm wide x 100 mm thick plinth protection in PCC (M-15) shall be provided around all buildings, pits / sumps, clarifiers, tanks, etc.
8.01.02.18	All masonry walls shall be provided with Damp Proof Course at plinth level.
8.01.02.19	All monorail openings in the walls shall be provided with double plate flush steel door shutters with suitable access platform and ladder as required.
8.01.02.20	Hand rail (of minimum 1m height), size and material to be adopted shall be as per general architectural specification.
8.01.02.21	In all buildings, suitable arrangement for draining out water collected from equipment blow downs, leakages, floor washings, firefighting etc. shall be provided for each floor with suitable floor drains.
8.01.02.22	Unless specified all sand filling shall be compacted to minimum 80% of the relative density and backfilled earth shall be compacted to minimum 90% of the Standard proctor density at OMC.
8.01.02.23	All buildings shall be provided with peripheral drains by the side of plinth protection for catering to the rain water from roofs and storm water from adjacent area. Plinth protection drains shall be provided all around the building and to be connected with nearest storm water drain. Minimum size of plinth protection drain will be 300mmx300mm.
8.01.02.24	Minimum 2.0m wide walkway with plain cement concrete (nominal mix M15 grade) paving 150 mm thick laid over 75 mm thick bed of dry aggregate shall be provided connecting all buildings and facilities. The top of walkway shall be minimum 200mm above FGL, unless specified otherwise.
8.01.02.25	For all buildings, finished floor level (FFL) shall be minimum 500mm above finished ground level (FGL).
8.01.02.26	40mm Diameter MS rods as earthing mat, placed at a distance of 1.0m away and at depths between 0.60m and 1.00m shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per approved drawings. Riser of 40mm Dia. MS rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Raiser shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on the outside of the buildings, and minimum 2 (two) numbers for each structures and equipment. The contractor shall also supply and lay necessary number of 3.0 m deep 40 mm diameter MS rods Earthing electrodes and connect electrodes to the Earthing mat, as per the approved drawings and supplying and laying of 40 mm Dia. MS rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately.
8.01.02.27	Hume pipes of required class shall be as per IS: 458. Hume pipe made of Geopolymer concrete may also be used. Details of ingredients for Geopolymer concrete is as per details specified elsewhere.
8.01.02.28	Coefficient of active earth pressure shall be considered for design of free standing retaining walls and coefficient of earth pressure at rest shall be considered for design of top propped retaining walls.
8.01.02.29	Interlocking concrete block confirming to IS:15658, kerb blocks or concrete block specified for various uses shall be precast blocks made of alkali-activated concrete /Geopolymer concrete as per IS:17452- 2020.
8.01.02.30	Rail-track from transformer yard to unloading bay of Main Power House shall be provided with rigid type RCC foundation. Rail weighing 52 kg/m(minimum) shall be used.
8.01.02.31	All opening in floors/roofs/cladding for routing of pipes/cables/ducts shall be suitably sealed by the contractors after completion of erection works.

8.01.03 **Acid/ Alkali Resistant Lining**

All structures receiving acid / alkali resistant lining shall be tested for water tightness and made leak proof before lining work.

The acid / alkali resistant lining shall be provided broadly in the areas identified. The Bidder shall give a guarantee for satisfactory functioning of the lining for a period of 36 months from the date of completion of the work or date of handing over the site to the Engineer, whichever is later. The Bidder shall replace / rectify defects is any, observed in the lining to the satisfaction of the Engineer without any extra cost during this period.

The material for Acid/ Alkali Resistant Lining shall conform to the following:

i) Bitumen primer shall conform to IS: 158.

ii) Bitumastic compound shall conform to IS: 9510. Where the height of bitumastic layer on vertical surface is more than 2.0 m, the bitumastic layer shall be reinforced with diamond pattern expanded metal steel sheets conforming to IS: 412.

iii) A.R. Bricks/ Tiles shall conform to class II of IS: 4860 & IS: 4457 respectively.

iv) Mortar: Potassium silicate & resin type mortars shall conform to IS: 4832 Part-I&II

8.02.00 **C**

8.02.01 **G**

c) The minimum grades of concrete....
Refer Annexure AC-1

a) or

all areas other than lean concrete work and plain cement concrete where nominal/volume mix can be permitted. Design mix shall be carried out as per IS10262. Specific approval of the Engineer shall be obtained regarding degree of quality control to be adopted for design mix.

b) Minimum grade of reinfo ess noted otherwise. Minim an machine foundations) s ess noted otherwise elsewhe

The referred clauses are contradictory. Bidder understands that the Minimum grade of reinforced cement concrete for all foundations and super structure shall be M25 except for the structures where M30 is exclusively specified.
Please confirm.

As referred in clause 8.02.01 b) Minimum grade of reinforced cement concrete for all foundations shall be M25 unless noted otherwise.

c) ~~The minimum grades of concrete for different machine foundations and some of other important structural members shall be as follows~~:

Sl No	Description	Minimum grade of concrete
i)	ID, FD, PA fan & Mill foundations (block foundations)	M-30
ii)	TG top Deck	M50
iii)	TG Raft/ Substructure	M35
iv)	Complete wagon trippler/track hopper, Stacker and Reclaimer foundations, Crusher Deck foundation and other railway load bearing structures.	M35
v)	BFP foundations (in case of springs supported) / (in case of block foundation)	M35 / M30

vi)	Rail load Bearing Structures	M35

Concrete design mix of M50 grade concrete for TG top deck and substructure shall be carried out as per IS 10262 satisfying following conditions /Specification:

i) OPC 43 grade cement shall be used to design M50 grade of concrete mix. However, in case the mix design using OPC 43 grade cement fails to achieve the target strength of M50 grade concrete, OPC 53 grade cement may be used provided adequate precautions for higher heat of hydration and quality assurance measures are in place.

ii) The concrete slump shall be in the range of 150-180mm at pouring point.

iii) Maximum cement content (OPC) shall be limited as stipulated in IS 456.

iv) Free water-cement ratio shall be as per clause 5.1 of IS 10262.

v) PCE type superplasticizers shall be used as high range water reducing admixtures (Type F as per ASTM C494 or equivalent) in the concrete mix. Dosage & mixing methodology of this chemical admixture shall be as per manufacturer's recommendation.

vi) Fly ash shall be not be used as replacement of total cementitious materials.

d) Higher grade of concrete than specified above may be used at the discretion of the Bidder.

e) Unless otherwise specified, 20mm and down aggregates shall be used for all structural concrete works. However, 40mm and down aggregates may also be used under special conditions for mass concreting in foundation.

f) For thin concrete sections such as roof slab over profiled metal deck sheets, 12mm and down coarse aggregates shall be used for coarse aggregates.

g) Minimum 75mm thick lean concrete M-7.5 shall be provided below all other underground structures, foundations, trenches, etc., to provide a base for construction.

h) All structural(reinforced) concrete production shall be done at automated batching plant of suitable capacity, conforming to IS:4925., situated within the area allocated to the contractor. Batching plant shall also have provision to mix fly ash (by weight). The batching plant shall have facility of digitised recording of the materials added along with quantity of concrete produced in each batch and printout of the same. Batch-wise report for each shift shall be submitted to the Engineer.

8.02.02 **Reinforcement Couplers**

Reinforcement couplers (mechanical splicing systems with upset parallel threaded couplers) may be used in reinforced concrete works, subject to following conditions:

a. Couplers shall meet the performance requirements of IS 16172 for class H.
   i. It shall have minimum tensile strength corresponding to Fe550D which is 600 N/mm2 and failure shall take place outside the length of splice as per clause no 9.2.1 of IS 16172.
   ii. Percentage elongation at maximum force in the reinforcing bar outside the length of mechanical splice shall be minimum 3 % before the failure of test piece as per clause no. 9.2.2 of IS:16172.
   iii. Slip test value shall not exceed 0.10 mm. as per clause no 9.3 of IS 16172.

iv. Cyclic tensile test corresponding to Fe550D reinforcement bar as per clause no 9.4 of IS 16172.
v. Low cycle fatigue test as per clause no 9.5.1 of IS 16172.
vi. High Cycle Fatigue test as per clause no 9.5.2 of IS 16172.

b. The manufacturer shall mark the coupler in such a way that all finished reinforcement couplers can be traced to the original cast from which they were made along with date of manufacture.
c. Sampling and other requirements of IS 16172 shall be complied with.
d. Each lot shall be supplied with manufacturer's test certificate (MTC) indicating values of tests in line with IS 16172.
e. The minimum clear cover requirements are to be ensured for reinforcement couplers also.
f. The couplers shall be used only at the locations where joint is required as per standard lapping purpose and couplers shall not be used for joining of several cut pieces of reinforcement in a single bar. As a general guideline, the length of the bars in which coupler is to be provided should not be less than 4m.

Vendors for the reinforcement couplers shall be subject to the approval of Engineer-In-Charge

8.02.03 Special requirements for concreting of major equipment foundations shall be as given below.

a) **Temperature Control of Concrete**

All the machine foundations such as Mills & Fans, top decks of TG & BFPs, the temperature of fresh concrete shall not exceed 25 deg C when placed. For maintaining the temperature of 25 deg C, crushed ice shall be used in mixing water.

b) **Admixture**

Plasticizer /super plasticizer admixture shall generally be added to the concrete for promoting workability. In addition, plasticizer/super plasticizer-cum-retarder shall be added to retard the setting time for mass concreting work as required. In case of pumping, suitable pumping additive shall also be added to avoid segregation and increase flowability. The slump shall generally be in the range given below:

Top decks of TG & BFP	-	150 mm to 180 mm
Block foundations	-	100 mm to 150 mm
TG Column	-	100 mm to 150 mm

Admixtures in concrete for promoting workability, retarding setting, reduction in permeability, facilitating pumping of concrete, etc., shall be used as per the approved mix design after approval from the Engineer. Admixtures shall conform to clause 5.5 of IS: 456. These shall be free from injurious amount of chloride, etc. Addition of admixtures should not reduce the specified strength or durability of concrete and should not have detrimental effect on reinforcement.

The admixtures shall conform to IS: 9103 or ASTM C-494 and shall be proven performance record make and from a reputed manufacturer. Calcium chloride as accelerating admixture is not permitted to be used.

Admixtures shall either be naphthalene based or any other material approved by the Engineer. Ligno-sulphonate based materials shall not be used. Admixtures shall be used in liquid form only, quantity of which shall be as per manufacturer's

recommendation and approved mix design.

c) **Form work**

Plywood with film face form work shall be used for the top decks of all machine foundations

d) **Placing of Concrete**

Base Raft and top deck of machine foundations shall be cast in a single pour.

e) **Scheme for Concreting**

Weigh Batching Plants, transit mixer, concrete pump shall be mobilized. Arrangements for standby Plant and Equipment shall also be made.

f) **Ultrasonic Testing**

Ultrasonic pulse velocity test shall be carried out for TG top deck including TG Columns & BFP top decks (in case of Block type, UPV testing is not required) to ascertain the homogeneity and integrity of concrete. In general, grid spacing of 1.0m to 1.5m may be adopted for carrying out the UPV testing. In addition, additional cubes (at the rate of one cube per 150 Cum of concrete subject to a minimum of six cubes) shall be taken to carry out Ultrasonic Pulse velocity (UPV) testing on the cubes, to serve as reference UPV values. Testing shall be done as per IS13311 (Part-1). In case of any defect, the Bidder shall rectify the defects suitably using cement/epoxy grout, etc.

Wherever block type foundations are provided for machine foundations such as BFPs, UPV testing of foundation concrete is not required.

8.02.04 **Anchor Fasteners**

Anchor Fasteners for use in concrete shall conform to the following:

a. The safe tensile load carrying capacity of the anchors shall be arrived by providing the minimum factor of safety of 2.5 on the characteristic load of the anchor. Minimum size of the anchors shall be M8.

b. All anchors shall be from established and approved makes/ manufacturers.

c. Anchors shall be fixed in position as recommended by the manufacturer and as approved by the engineer.

d. Anchor fastener can be of mechanical type based on working principles such as keying, friction, combined friction- keying or chemical bonding type.

1) Mechanical type: The anchors shall be cold formed stud type torque controlled mechanical expansion fasteners having 3-way expansion sleeve of SS 316 grade with nut and washer and galvanized to minimum 5 microns. For coastal/ corrosive environments, the anchors shall be of Stainless Steel (min grade SS 304) or HCR (High Corrosion Resistance). The anchors shall conform to a minimum grade of 5.8 as per IS: 1367.

2) Chemical type: The anchor shall be adhesive type consisting of slow curing chemical adhesive with a proportion of resin and hardener as per manufacturer's recommendation in a soft foil pack, threaded rod of carbon steel conforming to a

minimum grade of 5.8 as per IS: 1367 and minimum galvanization of 5 microns with associated nut and washer. The chemical shall be dispensed through mechanical dispenser and shall be self-curing type.

e. Capacity of the anchors shall be established after considering the effect of concrete grade, embedded depth, concrete thickness, anchor spacing and edge distance from the concrete.

f. The selection for particular type of the anchors shall be made after considering the concrete grade, available embedment depth, load to be transferred, space available for installing anchors.

8.03.00 **FORMWORK**

Formwork for building RCC Slabs/ Beams & Columns shall be of 2 different types.

Type 1 Formwork: (For RCC slab of Structural Steel Framed Buildings Only)

Troughed colour coated metal deck sheets shall be used as permanent shuttering having minimum thickness ~~of 0.80mm.~~ as per the criteria specified in metal deck roof material clause in Chapter 9. These profiled metal deck sheets shall be fixed to the structural steel secondary beams/ Purlins using Headed shear anchor studs. The detailed material property requirement of metal deck sheet is specified elsewhere in this specification.

The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.

The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.

Type 2 Formwork: (For RCC Buildings)

Plywood with film face formwork shall be used for floor & roof slabs, Columns & Beams of all RCC buildings.

8.04.00 **CULVERTS /RACKS ACROSS RAIL TRACKS**

Design of bridges/ culverts or any other structure crossing the Railway tracks shall be as per Railways/ RDSO guidelines/specifications for Dedicated Freight Corridor (DFC) 32.5 T loads. The Bidder shall obtain necessary approvals from Railways before start of construction work. Construction of these structures is to be done as per Railways guidelines. Any statutory and codal charges payable to Railways/ RDSO for approval & execution of the above crossings shall be borne by the Bidder. Engagement of approved Railway Consultant for the above work by the bidder would be at his own cost.

The levels/clearances of the above crossings are to be finalized by the bidder as per Railway standards and shall be subject to approval of Owner/Owner's Consultant.

However, for design of the above crossings above rail track, the following minimum clearance from Rail track shall be maintained:

A. Horizontal clearance: A minimum clearance of 3.5m shall be maintained between centre line of the Railway track to face of the crossing structure.

B. Vertical clearance: A minimum vertical clearance of 8.5m shall be maintained between Rail top level and bottom of structure. However, a minimum vertical clearance of 6.5m shall be maintained between Rail top level and bottom of structure in case of FA silo.

Bidder has to submit to the Owner two sets of railway approved drawings and two sets of (hard & soft copies) as built drawings.

The construction of rail network inside the plant for transportation of coal, fly ash & POL is in the scope of Owner. The bidder should plan to complete the construction work of all roads/ drainage/ pipe line/ cable crossings etc which are crossing below the rail track well in advance to facilitate owner to undertake the construction work of siding.

8.05.00 **FENCING AND GATE**

Bidder understands that fencing for isolation between existing station and the project is excluded from bidder's scope. Please confirm.

Bidder understanding is correct. Fencing for isolation between existing station and the project is excluded from bidder's scope.

8.05.01 **FENCING**

Fencing with gate shall be provided around fuel oil area, and other areas wherever necessary due to security, safety, and statutory requirements as per following specifications. However for isolation between existing station/township and the project, the total height of fence may be reduced to 2.4m with 450mm barbed wire on top, while other details being same as given below.

The fencing, with gate (unless specified otherwise) shall comprise of PVC coated G.I. welded wire mesh fencing of minimum 4 mm diameter (including PVC coating) of mesh size 75mmX75mm of height 2.4m above the toe wall with a 600mm high galvanised concertina at the top, such that total fence height of 3.0m above the toe wall is achieved. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 2.5 mm.

The PVC coated chain link will be stretched by the clips at 0.5m intervals to three strands of galvanised high tensile spring steel wire (HTSSW) of 2.5 mm diameter interwoven with chain link wire mesh and kept under tension which in turn are attached to the fence post with security nuts and bolts. On every fourth post a clamping strip will be threaded through the links of chain link and bolted to the fence post with the help of security nuts and bolts.

Above the chain link a 600mm high tensile serrated galvanised wire (HTSW) concertina made with wire diameter of 2.5mm will be stretched to 6m and attached to two strands of galvanised HTSSW of 2.5 mm diameter by means of clips at 1m intervals. These two HTSSW strands will be attached to the fence posts with 12 mm security fasteners.

All nuts, bolts, fasteners, clamping strips, clamps, clips, etc., shall be galvanised.

All fence posts shall be of 75 x 75 x 6 MS angles spaced at 2.5m c/c distance. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R.C.C. foundations for the post and stays shall be provided based on the prevailing soil conditions. All posts of fencing shall be painted with chlorinated rubber paint over a suitable primer.

Toe walls either of brick masonry with bricks of minimum 50 kg./sq.cm. Crushing strength or of hollow concrete block masonry shall be provided between the fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200mm above the formation level with 50mm thick P.C.C. coping (1:2:4) and shall extend minimum 300mm below the formation level. Toe wall shall be plastered with cement sand mortar (1:6) on both sides and shall be painted with two coats of textured cement point (Sandtax Matt or equivalent) of approved colour and shade. Toe wall shall be provided with weep holes at appropriate spacing.

8.05.02 **Gate along Fencing**

All gates shall be of structural steel of minimum 3.75 metre width for single lane access road and 8.00 m width for double lane access roads. The height of gate shall be same as that of the fence unless noted otherwise. Each gate shall have provision for wicket gate of size 1.0 m x 2.1 m.

The gate frame and post shall be fabricated from medium class MS pipe of nominal diameter not less than 75 mm. The panel plate shall be of minimum thickness 2.5 mm conforming to IS: 513.

The gate shall be complete with fabricated hinges, MS aldrops with locking arrangement, tempered steel pivot, guide track of MS tee, bronze aluminium ball bearing arrangement, castor wheel, etc.

8.06.00 **GRATING**

All gratings shall be electroforged types. Minimum thickness of the grating shall be 40 mm The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 5 mm or as per design requirement whichever is higher. All gratings shall be hot dip galvanised at the rate of 610 g. per sq.m. after surface preparation by means of shot blasting or cleaned by acid pickling.

8.07.00 **FABRICATION & ERECTION OF STEEL STRUCTURES**

The fabrication shall be done as per fabrication drawing which would clearly indicate various details of joints to be welded, type of weld, length and size of weld.

All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections.

Coal bunkers, Lime storage silo and biomass silo with hoppers and chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For coal bunkers, hoppers and chimney flue liners, to prevent coal dust/flue gas leakages, the applicable field joints shall necessarily be welded.

Note: Steel structures shall mean Plant and Non-Plant building structures, boiler & ESP support structures, CHP structures, AHP structures, chimney flue liners support platforms & stairs, pipe and cable support structures.

Site welding can be permitted in special cases where final inputs are not available before release of fabrication drawings.

Before dispatching the fabricated structural members to site, it shall be ensured that all parts in the assembly fit accurately together by carrying out pre-assembly of fabricated structural members having bolted field joints, in the factory.

All steelwork before and after manufacturing shall be smooth, straight and free of deformations, cracks, twists and burrs. All steelwork shall be cut and fabricated to a tolerance of ± 1.5 mm in its length and location of matching bolt holes for field connections.

8.07.01 **Welding**

a) Welding of Structural steel shall be done by an electric arc process and shall conform generally to relevant acceptable standards viz. IS:816, IS:9595, IS:814, IS:2014, IS:4354 and Indian Standard Hand Book for metal arc welding, and other standards, codes of practice internationally accepted. For welding of any particular type of joint, Bidder shall give appropriate tests as described in any of the Indian Standards - IS: 817, IS: 7307 and international standards as relevant.

b) Submerged arc-welding shall be used for welding longitudinal fillet welds (connecting

flange with web) and longitudinal / transverse butt joints for fabrication of columns, framing beams and crane girders and all other built-up members, unless manual arc welding is specifically approved by the Engineer. Necessary jigs and fixtures and rotation of structures shall be so arranged that vertically down-hand position of welding becomes possible. 'Open-Arc-Welding' process employing coated electrodes shall be employed for fabrication of other welded connections and field welding.

c) Wherever welding is done for assembling the components of structures, the job shall so positioned that down hand welding is possible.

d) Any structural joint shall be welded only by those welders who are qualified for all welding procedures and positions in such type of joint that is welded.

e) All records for entire welding operations such as welders identification marks, the joints welded by the each welder, the welding procedures adopted, welding machine employed, pre and post heating done and any non-destructive test done and stress relieving /heat treatment performed on such joints shall be accessible to the Engineer for scrutiny.

f) In a fabrication of plated columns/beams and built up members all shop splices in each component part shall be done before such component part is welded to other parts of the member. Wherever weld reinforcement interferes with proper fitting between components to be assembled by welding, these welds shall be ground flush prior to assembly.

g) The members to be joined by fillet welding shall be brought and held as close together as possible and in no event shall be separated locally by more than 3mm. If the local separation is 1.5mm or greater, the fillet weld size shall be increased by the amount of separation.

Edge preparation for welding as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.

8.07.01.1 **Electrodes**

a) The electrodes used for welding shall be of suitable type and size depending upon specification of the parent materials, the method of welding, the position of welding and quality of welds desired e.g. normal penetration welds or deep penetration welds. However, only low Hydrogen electrodes shall be used for plate thickness above 20 mm.

b) All low hydrogen electrodes shall be baked and stored before use as per manufacturer recommendation. The electrodes shall be rebaked at 250°C - 300°C for one hour and later on cooled in the same oven to 100°C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.

c) Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME-Sec. Covering shall be heavy to withstand normal conditions of handling and storage.

d) Only those electrodes which give radiographic quality welds shall be used for welds which are subjected to radiographic testing

e) Where bare electrodes are used, these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 Class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.

f) 308L and 309L electrodes / fillers shall be used for welding of stainless steel to stainless steel and stainless steel to mild steel respectively.

g) Specific approval of the Engineer shall be taken by Bidder for the various electrodes proposed to be used on the work before any welding is started.

8.07.01.2 **Preheating inter-pass Temperature and Post Weld Heat Treatment**.

a) Mild steel plates conforming to IS: 2062 and thicker than 20mm, may require preheating of the parent plate prior to welding as mentioned in Table-I.

However, higher preheat and inter-pass temperatures required due to joint restraint etc. and will be followed as per approved welding procedure. In welding materials of unequal thickness, the thicker part shall be taken for this purpose.

b) Base metal shall be preheated, notwithstanding provisions of IS: 9595, to the temperature given in Table-1 prior to welding or tack welding. Preheating shall bring the surface of the base metal to the specified preheat temperature and this temperature shall be maintained as minimum temperature while welding is in progress.

TABLE – 1

MINIMUM PREHEAT and INTER PASS TEMPERATURE FOR WELDING

Thickness of thicker part at point of Welding	**Welding using Low hydrogen electrodes or Submerged arc welding**
Upto and including 20mm	None
Over 20mm and upto and including 40m	$20^{o}C$
Over 40mm and upto and including 63mm	$66^{o}C$
Over 63mm	$110^{o}C$

c) Preheating may be applied by external flame which is non-carbonising like LPG, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance of four times the thickness of the plate on either side of the welding joint is obtained.

d) Thermo-chalk, thermo-couple or other approved methods, shall be used for measuring the plate temperature.

e) All butt welds with plates thicker than 50mm and all site butts weld of main framing beam shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to $600^{o}C$ and rate of application shall be $200^{o}C$ per hour. The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos free pads shall be used for covering the heated areas.

8.07.01.3 **Sequence of Welding**

a) The sequence of welding shall be carefully chosen to ensure that the components assembled by welding are free from distortion and large residual stresses are not developed. The distortion should be effectively controlled either by a counter effect or by a counter distortion. The direction of welding should be away from the point of restraint and towards the point of maximum freedom.

b) Each case shall be carefully studied before finally following a particular sequence of welding.

c) Butt weld in flange plates and/or web plates shall be completed before the flanges and webs are welded together.

d) The beam and column stiffeners shall preferably be welded to the webs before the web and flanges are assembled unless the web and flanges to the beam or column are assembled by automatic welding process.

e) All welds shall be finished full and made with correct number of runs, the weld being kept free from slag and other inclusions, all adhering slag being removed.

f) Current shall be appropriate for the type of electrode used. To ensure complete fusion, the weaving procedure should go proper and rate of arc advancement should not be so rapid as to leave the edges unmelted.

g) Pudding shall be sufficient to enable the gases to escape from the molten metal before it solidifies.

h) Non-uniform heating and cooling should be avoided to ensure that excessive stresses are not locked up resulting ultimately in cracks.

i) The ends of butt welds shall have full throat thickness. This shall be obtained on all main butt welds by the use of run off and run on pieces adequately secured on either side of main plates. The width of these pieces shall not be less than the thickness of the thicker part joined. Additional metal remaining after the removal of extension pieces shall be removed by grinding or by other approval means and the ends and surface of the welds shall be smoothly finished. Where the abutting parts are thinner than 20mm the extension pieces may be omitted but the end be welded to provide the ends with the required reinforcement.

j) The fusion faces shall be carefully aligned. Angle shrinkage shall be controlled by presetting. Correct gap and alignment shall be maintained during the welding operation.

k) All main butt welds shall have complete penetration and back surface of the weld being gouged out clean before first run of the weld is given from the back. However, partial penetration butt weld shall be permitted, when specifically shown in the design drawings.

l) Intermittent welds shall be permitted only when shown in the design drawings.

m) The welding shrinkage shall be minimised by adopting the correct welding procedure and method. In long and slender member extra length should be provided at the time of fabrication for shrinkage.

8.07.01.4 **Testing of Welders**

All the welders to be employed for the job shall have to qualify the appropriate tests laid down in IS: 817 and IS: 1181 and ASME IX/AWS D1.1. All the necessary arrangements required for the testing of welders are to be provided by the Bidder.

8.07.01.5 **Inspection of Welds**

a) **Visual Inspection**

100 percent of the welds shall be inspected visually for external defects. Dimensions of welds shall be checked. The lengths and size of weld shall be as per fabrication drawings. It may be slightly oversized but should not be undersized. The profile of weld is affected by the position of the joint but it should be uniform. The welds should have regular height and width of beads. The height and spacing of

ripples shall be uniform. The joints in the welds run shall as far as possible be smooth and should not show any humps or craters in the weld surface. Welds shall be free from unfilled craters on the surface, under-cuts, stages on the surface and visible cracks.

Such inspection shall be done after cleaning the weld surface with steel wire brushes and chisel to remove the spatter metal, scales, slag, etc., If external defects mentioned above are noticed, there is every possibility of internal defects and further radiographic/ultrasonic examination shall be undertaken.

b) **Production Test Plate**

Test plates shall be incorporated on either side of at least one main butt welds of each flange plate and web plate of every main frame columns and crane girder. The weld shall be continuous over the test plate. The test plate extensions of the main plates and shall be fixed so that metal lies in the same direction as that of the main plate. Test plates shall be prepared and tested in accordance with the accepted Standards, in the presence of the Engineer or his authorised representative. Should any of these tests fail, further radiographic examination of the welds shall be done. These tests for test plates and radiographic examination are additional to those contemplated under inspection and testing.

c) **Non-destructive and special testing**

Radiographic / ultrasonic or other non-destructive examination shall be carried out. All tests of welds shall be carried out by the Bidder at his own cost. The cordoning of radiation zone, while Radiography testing is going on, shall be done.

In case of failure of any of the tests, re-testing of the joints shall also be carried out after rectification is done.

d) **Rectification of defective welding work**

Wherever defects like improper penetration, extensive presence of blow holes, undercuts, cracking, slag inclusion, etc., are noticed by visual inspection/other tests, the welds, in such location shall be removed by gouging process. The joints shall be prepared again by cleaning the burrs and residual matters with wire brushes and grinding, if necessary, and rewelded. The gouging shall as far as possible be done using gouging electrodes.

8.07.01.6 **Inspection and Testing**

a) **Fillet Welds**

Refer clause 11.1.5 of Part B Sub Section E-41 of Technical Specification

b) **Butt Welds**

Refer clause 11.1.5 of Part B Sub Section E-41 of Technical Specification

c) **Dimensional Tolerance and Acceptance Criteria of Welds**

Refer clause 11.1.5 of Part B Sub Section E-41 of Technical Specification

8.07.01.7 **Correction of Defective Welds**

Correction of defective welds shall be carried out without damaging the parent metal. When a crack in the weld is removed magnetic particles inspection or any other equally positive means shall be used to ensure that the whole of the crack and material up to 25mm beyond each end of the crack has been removed.

8.07.02 **Painting**

a) Surface treatment and painting before and after delivery to site shall be in accordance with Clause no. 6.4.0 above. All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance in thickness(over the design thickness) of structural steel members shall be kept.

b) For parts to be bolted, the surfaces in contact shall be provided with ethyl Zinc silicate primer as specified in clause 6.4.3 (a) and shall be free of oil, dirt, loose rust, burrs and other defects, which would prevent proper seating of the parts. For design of friction type bolted joints slip factor for surfaces with ethyl zinc silicate primer as given in IS 4000 shall be considered.

c) Surfaces inaccessible after shop assembly shall receive the full-specified protective treatment before assembly. However, interior surfaces of Box-sections, which are effectively sealed from all ends, need not be painted.

8.07.03 **Bolting**

The threaded portion of each bolt shall project through the nut by at least one thread. High strength friction grip bolts, preferably the type with indicated load, shall be used where specified and shall be tightened strictly in accordance with the manufacturer's instructions and the relevant regulations.

When connections are made using high strength friction grip bolts the relevant standards shall be observed.

8.07.04 **Erection of Structures**

All erection work shall be done with the help of cranes, use of derrick is not envisaged.

Erection Marks

a) Erection marks in accordance with fabrication drawing shall be clearly painted on the fabricated steelwork. Each piece shall be marked in at least on two places. Each piece shall also have its weight marked thereon.

c) The centre lines of all columns, elevations and girder bearings shall be marked on the sections to ensure proper alignment and assembly of the pieces at site.

Erection Scheme

a) The Erection Scheme for the erection of all major structures shall be furnished. The erectability of the structure shall be checked by the Bidder before commencement of fabrication work to avoid future modification. The erection scheme shall indicate the approximate weight of the structural members, position of lifting hook, crane boom length, crane capacity at different boom length and at different boom inclination, etc.,

b) The erection scheme shall also give details of the method of handling, transport, hoisting, including false work/staging, temporary, bracing, guying, temporary strengthening, etc., It will also give the complete details of the number and capacity of the various erection equipment that will be used such as cranes, winches, etc., along with disposition at the time of erection of columns, trusses, etc.

c) The erection of columns, trusses, trestles, portals, etc., shall be carried out in one single piece as far as practicable. No column shall be fabricated and erected in more than 3 pieces. Galleries shall generally be erected as box i.e. the bottom chord and bracings, top chord and bracings, side vertical posts and bracings, end portals and roof-trusses shall be completely welded prior to erection and if required temporary strengthening during erection shall be made. The inside sheeting runners and roof sheeting purlins may be erected individually. When erection joints are provided in

columns, their location shall generally be just above a floor level.

8.08.00 STEEL HELICAL SPRINGS AND VISCOUS DAMPERS UNITS

8.08.01 General Requirement

This part of the specification covers the requirement for the manufacturing, testing, supply, transport to site, pre-stressing erection, supervision of erection by the vendor, release of pre-stress, alignment, commissioning, etc. of Steel helical springs and viscous dampers units.

The Steel helical springs and viscous dampers units supplied should be of proven make.

8.08.02 Codes and Standards

Some of the relevant applicable Indian standards and codes, etc, applicable to this section of the specification are listed below:

DIN : 4024 Machine foundations; Flexible supporting structures for machine with rotating masses.

DIN : EN 13906-1 Cylindrical helical springs made from round wire and bar: calculation & design.

DIN : 2096 Helical compression springs out of round wire and rod; quality requirements for hot formed compression springs.

ISO : 10816 /IS:14817 Criteria for assessing mechanical vibrations of machine.

ISO : 1940/IS: 11723 Criteria for assessing the state of balance of rotating rigid bodies.

8.08.03 Design & Supply of Material

i) **Supply**

Steel helical springs and viscous dampers and associated auxiliaries shall consist of:

(a) Steel helical springs units (fully pre-stressable) and viscous dampers units along with viscous liquid including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads, etc.

(b) Frames for pre-stressing of spring elements.

(c) Suitable hydraulic jack system including electric pumps, high pressure tubes etc. required for the erection, alignment etc., of the spring units. One set of extra hydraulic jacks, and hand operated pumps shall also be provided.

(d) Any other items which may be required for the pre-stressing, erection, release of pre-stress, alignment, and commissioning of the Steel helical springs and viscous dampers.

ii) **Design**

The spring units should have stiffness in both vertical and horizontal directions with the horizontal stiffness not less than 50% of vertical stiffness. However, for projects in high seismic zones, the minimum stiffness in horizontal direction shall be reviewed based on the design requirement and in no case it shall be less than 15% of vertical stiffness.

The stiffness should be such that the vertical natural frequency of any spring unit at its rated load carrying capacity is between 2 Hz to 4 Hz. The damper units or spring-cum-damper units should be of viscous type offering velocity proportional damping. The damper units should be suitable for temperatures ranging from 0 to 50°C. The damping

resistance of individual damper units should be such that the designed damping can be provided using reasonable number of Units.

The Steel helical spring units and viscous damper units and their housings shall be designed for a minimum operating life of 30 years. Steel helical spring units shall conform to infinite life fatigue load calculations as per DIN EN 13906-1.

8.08.04 Manufacturing & Testing

Complete manufacturing and testing of the Steel helical springs and viscous dampers shall be done at the manufacturing shop of the approved sub vendor / supplier. For this purpose the contractor / sub vendor shall submit the detailed quality plan for approval of engineer and take up the manufacturing / testing after approval of such quality plan. The quality plan shall include

(a) Manufacturing schedule and quality check exercised during manufacturing.

(b) Detail of test to be carried out at the manufacturing shop with their schedule.

(c) Special requirements, if any, regarding concreting of top deck.

(d) Complete step-by-step procedure covering the installation and commissioning of the spring system.

(e) Manuals for erection, commissioning, testing and maintenance of the Steel helical springs and viscous dampers.

(f) A checklist for confirming the readiness of the civil fronts for erection of Steel helical springs and viscous dampers.

(g) Checklist for equipment required at each stage of erection.

(h) Bill of materials and data sheet of various elements such as spring units, viscous dampers, with their rating, stiffness etc. included in the supply.

(i) Bill of material and data sheet for frames for pre stressing, hydraulic jack including electric pump, high pressure tubes, hand operated pump etc., with their rating and umbers.

(j) Any other details which may be necessary to facilitate design and construction of the foundations / structures.

8.08.05 The springs shall conform to codes DIN EN 13906-1 and DIN 2096. The quality assurance and inspection procedure shall be finalized on the basis of the above codes and the quality plans be drawn accordingly.

8.08.06 Transportation

Steel helical springs and viscous dampers shall be suitably protected, coated, covered, boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection.

8.08.07 Erection and Commissioning

Complete erection and commissioning of the Steel helical springs and viscous dampers including pre-stressing of elements, placing of elements in position, checking clearances on the shuttering of the RCC top deck, releasing of pre-stress in spring elements, making final adjustments and alignments etc. shall be carried out by a specialist supervisor of vendor.

The contractor shall guarantee the performance of the Steel helical springs and viscous dampers for 24 months from the date of commissioning of each machine which shall be termed as Guarantee Period".

8.08.08 Supervision

The supervision of installation of Steel helical springs and viscous dampers including pre-stressing, placing, releasing and alignment of spring units shall be done by a specialist supervisor of sub vendor / supplier, trained for this purpose.

8.08.09.1 Realignment of Spring System

If any realignment of the Steel helical springs and viscous dampers is required to be done for aligning the shaft or for any other reasons during the first one year of operation from the date of commissioning of the machine, the same shall be done by the contractor.

8.08.09.2 Acceptance Criteria

Stiffness values shall be checked. The permissible deviations shall be as per DIN 2096.

Following acceptance criteria shall be followed:

General workmanship is being good as recommended by the manufacturer and approved by Equipment supplier.

Tolerances are within the specified limit.

Manufacturer's test certificate (MTC) shall be in compliance with the applicable codes / standards.

Bought out material is from the approved manufacturer / vendor.

Bought out material is matching with the approved sample.

8.09.00 **Information on Geopolymer Concrete-**

A) Ingredients: Geo-Polymer Concrete is a special type of concrete where no cement is used unlike conventional cement concrete.

Major ingredients of Geo-polymer concrete are as below:

a) Fly Ash (to be collected from location within existing operating plant/from existing fly ash silos near plant boundary)
b) Ground Granulated Blast Furnace slag
c) Aggregates (Coarse and fine)
d) Sodium Silicate
e) Sodium Hydroxide
f) Chemical admixtures like super-plasticiser, retarder, shrink-reducing compound, evaporation reducer etc.

Fly ash produced by coal-based power stations of NTPC, if available, will be issued free of cost for the production of Geo-polymer concrete on 'as is where is' basis.

B) Batching & Mixing: Geopolymer concrete of minimum required grades of M10 and M35 shall be prepared for Dry Lean Concrete (DLC) and Pavement Quality Concrete (PQC), respectively. The solid constituents of geo-polymer concrete mix such as coarse aggregate, fine aggregate, fly ash and slag are to be mixed dry for 2-3 minutes, then Geo-activator solution, consisting of sodium silicate and sodium hydroxide pre-mixed in tanks at site, is added to the dry mix in batching plant mixer.The whole mixture is mixed until a homogeneous cohesive mix is obtained. Pumping devices shall be used for transferring activator solution from tank to the mixer. Proportion of different ingredients and mixing process are to be finalized/established during mix design finalization and trial mix at site. However, if any constraint is observed related to initial setting time of the geopolymer concrete and time required for transporting the geopolymer concrete mix from batching plant to the point of application then suitable alternative option such as mixing of geoactivator solution may have to be mixed in transit mixer instead of batching plant.
Bidder shall make available concrete batching plant suitably customized for handling/feeding/dosing/weighing etc of ingredients and capable of production of Geo-Polymer Concrete of suitable grade.

C) Geo-activator: This solution shall be prepared using Sodium Hydroxide & Sodium silicate with water in a certain ratio. The ratio of Sodium Silicate and Sodium Hydroxide in activator solution shall be decided during finalization of Design mix. Separate tanks having adequate capacity are to be constructed close to batching plant with fencing and a lockable gate for preparation of Sodium Hydroxide and Sodium Silicate solution. These tanks shall be provided with acid-alkali resistant lining and covered with GI sheet. Each tank shall be fitted with a chemical resistant pump of suitable capacity and dual valve in the discharge line for recirculation (to enable mixing) and also for transferring the Geo-Activator solution to mixer. This connection pipe from Pump discharge to batching plant mixer shall be HDPE of suitable Diameter.

Preparation of Geo-activator solution is a critical process and extra care needs to be taken during the preparation in respect of safety of personnel handling the chemicals. Worker handling the chemicals shall be provided with proper PPE's. A dedicated shower with water tank shall be available close to chemical handling area/tank on permanent basis for washing of affected person, in case of emergency. Bottles filled with distilled water in cupboard / Boxes near work place shall also be kept for emergency eye wash by worker exposed to such hazardous chemicals.

D) Placing: Laying /placing of Geopolymer concrete DLC and PQC manually with hand-guided means or by semi-mechanized methods may be permitted provided acceptance criteria as per MORT&H specification is achieved.

8.10.00 Controlled Low Strength Material (CLSM)

Bidder to refer Annexure-AC-3

a) Minimum 1000 mm high (from floor/ roof level) hand railing shall be provided around
all floor/roof openings, projections/balconies, walkways, platforms, steel stairs, etc.,
wherever the height of the building is more than 12m, railing height shall be 1.2m. All
handrails and ladder pipes (except at operating floors) shall be 32 mm nominal bore
MS pipes (medium class) conforming to IS: 1161 and **shall finished with suitable paint**. All rungs and ladders shall also be **finished with suitable paint**.
The spacing of vertical posts shall
be maximum 1500mm. Two number of horizontal rails shall be provided including the
top member. In addition, toe guard/ kick plate of min size 100x6th shall be provided
above the floor level.

D-1-9

9.01.0 …fer to 5.01.00 in this specification.

9.02.0

9.02.0 …oor/ roof level) hand railing shall be provided around …s/balconies, walkways, platforms, steel stairs, etc., …g is more than 12m, railing height shall be 1.2m. All …pt at operating floors) shall be 32 mm nominal bore …ming to IS: 1161 and shall be galvanised as per IS: …aint. All rungs and ladders shall also be galvanised. …all be 610 g/sqm. The spacing of vertical posts shall …ber of horizontal rails shall be provided including the …rd/ kick plate of min size 100x6th shall be provided

b) All stairs shall have a maximum riser height of 150mm and a minimum tread width of 300 mm. Minimum clear width of stair shall be 1500 mm unless specified otherwise. The width of staircase shall meet the National Building Code require-ments.

…s of … …floor …shall …all be …ber …e gu…

…ection VI)

For handrailing at operating floors of Main Power House including RCC stairs (for one
flight above and below operating floor level), passages, around all floor openings shall
be Stainless Steel (SS) pipes shall be used. For SS handrail 32NB/50NB/60NB
(polished) stainless steel **pipe with wall thickness 1.65 mm (minimum)** shall be provided. The spacing of vertical posts shall not
be more than 1500mm. Two number of horizontal rails shall be provided including the
top member. SS Toe guard, and knee guard **(100 mm wide and 6 mm thick)** shall be provided above the
floor level.

b) All stairs shall have a maximum riser height of 150mm and a minimum tread width of 300 mm. Minimum clear width of stair shall be 1500 mm unless specified otherwise. The width of staircase shall meet the National Building Code requirements.

…iser height of 175mm and a minimum tread width of …stair shall be 1200 mm unless specified otherwise.

…ng shall be provided with 1 meter high brick wall at …aving metal cladding shall be provided with a 150 mm …or) at the edge of the floor along the metal cladding. …ailing shall be provided on this RCC kerb, wherever …view.

…le arrangement for draining out water collected from …, floor washings, fire fighting, etc., shall be provided …all be suitably covered with grating or precast RCC

…rovided for main entrance of all RCC construction

…indow and 600mm door heads, 900mm over rolling shutters, architectural facia, projections, etc., shall be provided with drip course in cement sand mortar 1:3.

g) All fire exits shall be painted with fire resistant paint P.O red/signal red colour shade which shall not be used anywhere except to indicate emergency or safety measure. Fire safety norms shall be followed as per National Building Codes and fire safety requirements for providing fire exits, escape stairs and fire fighting equipment. In detailing of all buildings, fire safety requirements conforming to IS: 1641 and IS:1642 shall be followed.

9.03.00 **Water Supply and Sanitation**

9.03.01

Roof water tanks of adequate capacities depending on the number of users and 8 hours requirement sha… e. Polyethylene water storage tanks conformir… be complete with all fittings including lid, floa…

Chlorinated Po… 15778, having thermal stability for hot & cold wa… eaded fittings shall be used for internal piping w… For installation of CPVC pipes guidelins as stip… s shall be followed.

UPVC (conform… s above ground level.

All Buildings sh… ms.

All buildings sh… … facilities provided in the toilet block shall depe… n facilities to be provided shall be as stipulated… ved for working out the basic requirements fo…

In addition, IS:2… ection VI)

9.03.02

Each Toilet bloc… Unless specified all the fittings shall be of Chro… uar / Hindware/ equivalent) .

a) One nu… ina European water closet and dual flu… aucet (Jaquar / Hindware/ equivale…

b) One nu… basin 450x 550 mm (approx.) mounte… te beveled edge counter fitted with ph… ottle trap as per IS:2556. For commo… er requirement. However, for Pump H… oto voltaic control system for water c…

c) For Mal… tings with photovoltaic control flushing…

d) One nu… ar / Hindware / Asahi) , edge mounte… .2 mm thick plywood backing, one nur… ber liquid soap dispenser per wash ba…

e) One toi… physically challenged persons as per N…

f) Janitor…

g) Electric…

h) The par… pantry sink, as per IS : 13983, of size … oard of at least 450 mm length with cou… one number geyser of 25 liters capacity… over head water storage tank, as per … ty, complete with float valve, overflov… er supply pipe of minimum 12 mm dia… with lead joints) of minimum 75 mm dia…

Steel gr… drainage, with all bends, tees, junction… commissioning and efficient

ection VI)

Each Toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of Chromium plated brass (decorativetype).(Jaquar / Hindware/ equivalent)
a) One number wall mounted coloured glazed vitreous China European water closet and flushing valve system, water faucet, toilet paper holder as per IS:2556. (Jaquar / Hindware/ equivalent)
b) One number colour glazed ceramic oval shaped wash basin 450x 550 mm (pprox..) mounted under the counter with18mm thick granite beveled edge counter fitted with photo-voltaic control system for water controls, bottle trap as per IS:2556. For common toilets, number of washbasins shall be as per requirement. However, for Pump Houses the same shall be provided without photo voltaic control system for water control.
c) For Male Toilets Urinal as per requirements, with all fittings with photovoltaic control flushing system as per IS: 2556.
d) One number looking mirror 600 x 900 x 6 mm, edge mounted with teak beading and minimum 12 mm thick plywood backing or mounted with SS Studs, one number stainless towel rail 600 x 20 mm, one number liquid soap dispenser. (Jaquar / Hindware/ Asahi/ Saingobain /equivalent)
e) One toilet with required facilities shall be provided for physically challenged persons on Ground floor of Main Power House Building.
f) Janitor Space & space for drinking water cooler.
g) Electric operated hand dryer with photo voltaic control.
h) The pantry shall consist of one number stainless steel pantry sink, as per IS : 13983, of size 610 x 510 mm, bowl depth 200 mm with drain board of at least 450 mm length withcoupling , CP bottle trap, hot and cold water mixer, one number geyser of 25 liters capacity, with inlet and outlet connections, one number over head water storage tank, as per IS : 12701 and of minimum 500 liters capacity, complete with float valve, overflow drainage pipe arrangement, CPVC concealed water supply pipe of minimum 12 mm diameter, CPVC sanitary pipe (with lead joints) of minimum 75 mm diameter, floor trap with Stainless Steel grating, inlet and outlet connections for supply and drainage, with all bends, tees, junctions, sockets, etc., as are necessary for the commissioning and efficient functioning of the pantry (all sanitary fittings shall be heavy duty chrome plated brass, unless noted otherwise)

One number of pantry shall be provided on Control Room floor of ESP control room building and One number of pantry shall be provided in Buildings having Control Room ..
i) Laboratory sink shall be of white vitreous china of size 600x400x200 mm conforming to IS: 2556 (Part-5)with single 15 mm C.P. brass pillar taps with elbow operated levers ISI Marked.
j) In addition, adequate number of portable toilet units with adequate plumbing and sanitary arrangement, shall be provided during construction stage for workers.
k) Adequate number of toilet units with adequate plumbing and sanitary arrangement, shall be provided for workers (O&M workers).

functioning of the pantry (all sanitary fittings shall be heavy duty chrome plated brass, unless noted otherwise)

One number of pantry shall be provided on Control Room floor of ESP control room building and One number of pantry shall be provided in Buildings having Control Room .

i) Laboratory sink shall be of white vitreous china of size 600x400x200 mm conforming to IS: 2556 (Part-5) with single 15 mm C.P. brass pillar taps with elbow operated levers ISI Marked.

j) In addition, adequate number of portable toilet units with adequate plumbing and sanitary arrangement, shall be provided during construction stage for workers.

k) Adequate number of toilet units with necessary plumbing and sanitary arrangement, shall be provided for workers (O&M workers).

9.04.00 **Flooring**

Floor finishes of approved shade and colour over under bed of cement mortar / concrete, at all levels and for all kind of works, elevations, on horizontal and vertical surfaces for all types of work (like flooring, skirting, dado, wall lining & facing, tread and risers etc.), including topping, spreading white cement slurry at an average rate of 2.5 kg/Sq. M., (unless noted otherwise), jointing and joint filling with white cement (unless noted otherwise) slurry mixed with colour pigment, to match the shade of the finishing material, laying to plumb and water level in desired pattern, line and flush butt square jointing, curing, rubbing, grinding, polishing, edge moulding, finishing and cleaning, testing, providing opening of required size and shape, casting in panels wherever specified.

9.04.01 The nominal total thickness of floor finish shall be 50/70 mm i.e. underbed and topping. The floor shall be laid on an already laid and matured concrete base. The underbed for floors and similar horizontal surfaces shall consist of cement concrete M20 grade. Stone chips shall be 12.5 mm down well graded & proper filling shall be done with brick bats/cinders. Flooring like Tiles/ Stones shall be laid with 1:4 cement sand mortar and Tile/ Stone Cladding on wall shall be laid with 1:3 cement sand mortar.

9.04.02 All toilets shall have sunken slab to accommodate sanitary pipes and the finish level of floor shall match with general floor finish level. Sunken slabs shall be made watertight by suitable water proofing treatment.

Water proofing treatment in sunken portion of WCs, bathroom, kitchen, pantry etc., shall be done in two (2) coats by applying cement slurry mixed with water proofing cement compound (confirming to IS 2645).

The First layer shall be of slurry of cement @ 0.488 kg/sqm mixed with water proofing cement compound @ 0.253 kg/ sqm. This layer shall be allowed to air cure for 4 hours.

The Second layer shall be of slurry of cement @ 0.242 kg/sqm mixed with water proofing cement compound @ 0.126 kg/sqm. This layer will be allowed to air cure for 4 hours followed with water curing. The water proofing shall be done for the entire sunken area.

Metallic Hardener Topping shall be 12 mm thick. Metallic Hardening Compound shall be of approved quality consisting of uniformly graded iron particles, free from non-ferrous metal particles, oil, grease sand, soluble alkaline compounds. The ratio of Metallic hardener and Cement shall be 1:4. This mix

9.04.03 Metallic hardene ~~k (insitu) or finishing~~ the concrete / m slurry (with ordinary grey cement)

9.04.04 Heavy duty cem using white cement with pigment, wi s for wearing course as per IS:1237.

9.04.05 Digitally glazed glazed ceramic floor and wall tiles sh**ction VI)**

a) Floor - 300x3(Somany/ Johnson or equivalent

shall be mixed with 6mm nominal stone in Ratio of 1mix : 2 stone. The mixture so obtained shall be laid in 12 mm thickness, on cement concrete floor within 2 to 4 hours of its laying. For laying, The top surface pf underbed shall be roughened with brushes while the concrete is still green and the forms/strips shall be kept projecting up 12 mm over the concrete surface, to receive the metallic hardening compound topping. The topping shall be laid true to provide a uniform and even surface. It shall be firmly pressed into the bottom concrete so as to have good bond with it. After the initial set has started, the surface shall be finished smooth and true to slope with steel floats.

b) Walls - 300x omany/ Johnson or equivalent

c) Walls - 300x omany/ Johnson or equivalent

9.04.06 12mm / 20mm / rizontal and vertical surfaces, at all le n primer followed by 12 mm thick biti R. tiles, 6 mm thick under-bed by po nting of joints of tiles with acid/alkali r t-I), up to a depth of 20 mm and bitumastic end sealing.

Battery Room in all buildings shall be provided with acid/ alkali resistant tiles on flooring & dado 1200mm high.

9.04.07 (i) Mirror polished Digitally glazed vitrified & Matt Finish Digitally glazed Vitrified ceramic tiles with 3mm groove joints as per approved pattern pointed neatly with 3x4mm stainless epoxy grout mix of 0.70kg of organic coated filter of desired shade (0.10kg of hardener and 0.20kg of resin per kg) with sizes of the tiles shall be as under:

a) Double charged , Size of tile 600x600/605x605 of Kajaria/ Somany/ Series Johnson / NITCO / JHONSON / RAK or equivalent

b) Double Charged, Size of tile 800x800 of Kajaria/ Somany/ NITCO / Johnson /RAK or equivalent

ii) Anti-Skid Full Body Vitrified Tiles

Antiskid, full body Vitrified Tiles (KAJARIA/ RAK/NITCO / JOHNSON)of size 600X600X20 mm thick as specified below of approved make, shade, colour and pattern, over under bed of cement mortar / PCC shall be provided in TG Hall flooring at operating level. Full body Vitrified Tiles shall be laid on properly laid leveled floor, with joints 3 to5 mm wide & 8 to10 mm deep & shall be filled with approved Epoxy Grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardner and 0.20 kg of resin per kg).

Full body Vitrified Tiles (KAJARIA/ RAK/NITCO / JOHNSON) shall have water absorption less than 0.5%, Modulus of Rupture more than 38N/mm2, Breaking strength more than 7500 N, Mohs scale more than 6, Abrasion resistance less than 144 mm3 and coefficient of friction more than 0.4. Vitrified Tiles shall generally conform to IS: 15622.

9.04.08 For pathway, chequered and designed concrete tiles minimum 22 mm thick, 200x200 mm size conforming to IS: 13801 of approved shade and colour shall be used. 1000 wide pathways shall be provided for maintenance on rooftops of all buildings.

9.04.09 **Epoxy Flooring**

Epoxy Flooring shall be provided with surface preparation of concrete substrate with Captive Shot Blasting Machine OR Light Grinding to form the required anchor profile on the floor substrate followed by application of epoxy resin based moisture barrier underlay of 2 mm thickness including filling of saw cut joints with epoxy cementitious resin based moisture barrier underlay as per manufacturer specification. Application of self smoothing epoxy floor topping of epoxy based resin of 2 mm thickness over epoxy resin based moisture barrier underlay inclu...r.

It sh...ectively including surfa...ant.

White glazed tile

Above the Over deck insulation, White glazed tile (min. 5mm thick) for roofing over under bed of cement mortar/ concrete, topped with spreading the white ce-ment slurry at an average rate of 2.5 kg/sq m (unless noted otherwise), jointing and joint filling with white cement slurry, laid to plumb and water level in desired pattern, casted in panels, wherever required, shall be provided on the roof of Service Building.

9.04.10

9.04.11 Mirr...m) / Flame finish/ (mal...) - 18 mm thick (min...

9.04.12 Dec...nce concrete tiles of 2...

9.04.13 Skirt...upto false ceiling level from finished floor level. Skirting and Dado shall match with the floor finish.

9.04.14 Interlocking concrete blocks shall be of various sizes and thickness having M35 grade of concrete and pigmented to specified colours, in different pattern (in different textures chequered or other patterns in indentation for guiding band/s for visually impaired persons) including the preparation of sub base with 20mm thick sand and filling of joints with sand.

9.04.15 24 mm x 24 mm x 3.8 mm thick (minimum) glass mosaic tiles in decorative murals and pattern.

Engineered wooden flooring (15mm thick) of Mikasa/ Century/ Pergo / Equivalent shall be provided in VIP area, conference rooms.

9.04.16 **Ru...**

Ru... size of ...nts, res...nce an...tatic gra...

Matt finish (with grooves) Porcelain tiles (for guiding band/s for visually impaired persons in service building) shall be with 3mm groove joints as per approved pattern pointed neatly with 3x4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile. **Porcelain tiles shall be provided in Service Building.**

24 mm x 24 mm x 3.8 mm thick (minimum) glass mosaic tiles in decorative murals and pattern.

Engineered wooden flooring (15mm thick) of Mikasa/ Century/ Pergo / Equivalent shall be provided in VIP area, conference rooms of Service Building and MPH building.

9.05.00 **Ep...**

Se...tical su...ved col...

9.06.00 **Ro...**

9.06.01 Ex...ame wo...heet de...aint ha...shall be...d by the...ll be

CLAUSE NO.	TECHNICAL REQUIREMENTS
	provided over the metal decking. Water proofing cum plasticiser compound shall be added to concrete over the metal decking. Bidder shall demonstrate that the roof is leak proof by carrying out the w ter depth of 50mm over the roof surface f as given below for RCC roof slabs shall b
9.06.02	~~DELETED~~
9.06.03	For efficient dispo l not be less than 1:100 and the roof shall d. Gutter shall be made water tight using s ovided either in structure or subsequently p gregate) and/or cement mortar (1:4). Hov all be provided on top to achieve smooth s
9.06.04	Unplasticised PV with with joints with seal ring confirming to m the roof. These shall be suitably conce ting work to match with the exterior finish erned by IS 1742 and IS 2527. Roof drain situ RCC roof shall be provided with Rai g minimum thickness of 30 mm with 1:2:4 and finished with 12 mm thick cement sand able fittings and fixtures.
9.06.05	**Roof Water Proo**
	Roof water proofi
	a) For roofs having structural slope:
	Top surface of sloped R.C.C. slab shall be finished with 15mm thick cement plaster (1:4). Over the finished surface elastomeric membrane shall be laid. The elastomeric shall comprise of high solid content liquid applied urethane laid over reinforcing layer of polyscrim cloth or non woven geo-textile. The top of the elastomeric membrane shall be finished with 20 mm thick cement: sand (1:4) mortar with chicken wire mesh and pressed precast concrete tiles of 20 mm thickness where applicable shall be laid over mortar at green stage. Provision for thermal expansion of roofing tiles shall be kept by providing an expansion gap in both directions filled up with polysulphide joint sealant. The expansion gap shall be provided in the cement sand mortar underbed layer also.
	b) For roofs having no structural slope:

Over-Deck Insulation
Roof insulation with 40 mm thick impervious sprayed, closed cell free Rigid Polyurethane foam over deck insu-lation conforming to IS: 12432 Part-III (density of foam being 40-50 Kg/Cum), over a coat of Polyurethane primer applied @ 6-8 sqm per litre, laid over 400 G Polythene sheet over PUF spray and provided with a wearing course of 40 mm cement screed 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) in chequered rough finish, in panels of 2.5m X2.5m and em-bedded with 24G wire netting and sealing the joints with polymerized mastic, shall be provided on the roof of Ser-vice Building above the waterproofing.

The elastomeric membrane above mentioned for water-proofing shall be of two component, instant setting, 100% solids spray applied hybrid polyurea polyurethane liquid applied elastomeric seamless waterproofing membrane meeting the requirements of LAM as per ASTM C836 and having excellent tensile strength of 15MPa (As per ASTM D412), elongation more than 450% (as per ASTM D 412), tear strength of 60 Kn/m (As per ASTM D1004/ASTM D624), adhesion to concrete of 2MPa (as per ASTM D 4541), abrasion resistance of 60mg loss (1 Kg,CS 10 Wheels,1000 cycles - As per ASTM D4060), Shore A Hard-ness of 85 (As per ASTM D2240), resistance to hydrostatic pressure head of 7 Bar (As per ASTM D 5385/ DIN 16726), puncture resistance of 1000N (As per ASTM E154), water vapour permeability of 25 mg/m2/day (As per ASTM E96), Impact resistance of 17 N.m (As per ASTM D2794), Low temperature crack bridging ability up to 3.2mm (As per ASTM C 1305), dynamic crack bridging ability class B 3.2 (as per EN 1062-7 Method B- B3.2) with no crack observed in the coating after 20000 sinusoidal cycles, resistance to root (As per CEN TS/14416) and fire resistance of class B (As per EN 13501-1).The coating shall be applied with a total consumption of 1.6 Kg/Sqm to achieve a total system DFT of 1.5mm, thereby satisfy the requirements of LAM as per ASTM C898 and shall be applied on the entire horizon-tal surface extending upto 300mm above the FFL on the vertical surface as per the methodology.
The application system includes base preparation of cleaning, brushing and removal of flacky materials, grout-ing the porous area with cementitious grout, proper cov-ing between slab and wall junctions and priming the sur-face with two component solvent free epoxy primer which is applied with a consumption of 200 grams per Sqm, fol-lowed by spray application of hybrid polyurea waterproof-ing coating.
Protective geo textile fabric of minimum 150GSM over the entire membrane with proper overlaps shall be applied.

wall comprising structural steel post, runner and sheeting may be provided for buildings with metal sheet cladding.

9.06.08 Fillets at junction of roof and vertical walls shall be provided with cast-in-situ cement concrete (1:1.5:3) nominal mix followed by 12mm thick 1:4 cement sand plaster.

9.06.09 Pathways for handling of materials and movement of personals shall be provided with 22mm thick chequered cement concrete tiles as per IS:13801 for a width of 1000mm.

9.07.00 **Walls**

9.07.01 All walls shall be non-load bearing infill panel walls.

9.07.02 For initial height up to 1 metre in buildings one brick thick masonry wall shall be provided wherever metal cladding is specified.

9.07.03 All internal walls shall be with one brick thick in cement mortar (1:6). However, internal partition walls for toilets shall be with half brick masonry thick with cement mortar (1:4).

9.07.04 For ESP shall be of Autoclaved Aerated Concrete Block. Autoclav lock masonry shall be with blocks having dimensions of 625 mm from 100 mm to 300 mm conforming to I.S. :2185(part III).The the composition of 1: 6 (Cement: sand) shall be used with sui nd having modulus of fineness 1.1 shall be used. The horizont shall be approximately 10 mm. In case of partition walls (100 mm rcement i.e. 1 number of 6-8 mm diameter bars shall be place be anchored properly with the main structure. All other structura of masonry, joint reinforcement etc. in the AAC masonry work str structions laid down in IS 6041 – 1985, IS - 1905. For control om in MPH Building , walls shall be of factory made compos ted concrete panels,(minimum 2 hours of fire rating) consisti nt sheets (minimum 4 mm thick) on either side of light weight c n co nsity in the ra he th ovide external ll le

3.00 M ction oove jointing to t 1.25 mm thic 0 (minimum) as per IS : 277), fixing U profiled top and bottom c steel members which are placed at the maximum vertical spacing nised steel expansion fasteners, filling the joints

from bo aste and making the same water tight by covering with fibre gla de and minimum 0.5 mm thick) or by any other suitable material construction done with the light weight aerated concrete panels a urfaces are flush for painting, creating opening for doors / windov ans/AC etc. and finishing the opening face with the same U profile hich is used at the top and bottom.

For ESP Control Room Building, wall shall be of Autoclaved Aerated Concrete Block.

Autoclaved Aerated Concrete (AAC) block masonry shall be with blocks having dimensions of

625 mm x 250 mm. thickness ranging from 100 mm to 300 mm conforming to I.S. :2185(part III).The jointing cement sand mortar in the composition of 1: 6 (Cement: sand) shall be used with suitable plasticizer(optional). Sand having modulus of fineness 1.1 shall be used. The horizontal and vertical joint thickness shall be approximately 10 mm. In case of partition walls (100 mm /125 mm thk.) the joint reinforcement i.e. 1 number of 6-8 mm diameter bars shall be placed at every alternate course to be anchored properly with the main structure. All other structural requirements like stiffening of masonry, joint reinforcement etc. in the AAC masonry work strictly be carried out as per instructions laid down in IS 6041 – 1985, IS - 1905. For control room , control equipment room in MPH Building, **where dry wall construction is envisaged,** the walls shall be constructed of factory made composite modular light weight aerated concrete panels,(minimum 2 hours of fire rating) consisting of 2 fiber reinforced cement sheets (minimum 4 mm thick) on either side of light weight concrete core, having minimum compressive strength of 35 Kg / Cm2 and the density in the range of 700-900 Kg. / cu.m. of the thickness and fire rating as specified below, to provide external wall and internal partition at all levels, capable of sustaining wind pressure of 3.00 M height (H) within limiting deflection of span/250, fixed in position in tongue and groove jointing system by screwing the panels to top and bottom U channels, (channels minimum 1.25 mm thick and galvanised to grade 180 (minimum) as per IS : 277), fixing U profiled top and bottom channels to concrete / primary steel members which are placed at the maximum vertical spacing of 4.5m with the help of galvanised steel expansion fasteners, filling the joints from both faces with silicon acrylic paste and making the same water tight by covering with fibre glass tape (minimum 50 mm wide and minimum 0.5 mm thick) or by any other suitable material, so as to ensure that the entire construction done with the light weight aerated concrete panels are weather proof and panel surfaces are flush for painting, creating opening for doors / windows /ventilators / ducts / pipes/fans/AC etc. and finishing the opening face with the same U profiled galvanized steel channel which is used at the top and bottom.

The Outer wall of control room, control equipment room in MPH Building shall be made of aerated concrete panels over that 50 mm thick mineral wool insulation and metal sheeting on outside.

For ESP Control Room Building.....U profiled galvanized steel channel which is used at the top and bottom.

The Outer wall of control room, control equipment room in MPH Building shall be made of aerated concrete panels over that 50 mm thick mineral wool insulation and metal sheeting on outside

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9.07.05 Toilet Block in ESP Control Room Building shall be of Brick Masonry

9.07.06 50 mm thick DPC in Cement concrete (1:1.5:3) with water proofing compound followed by two layers of bitumen coating 85/25 grade as per IS: 702 @ 1.7 kg./sq.m. shall be provided at plinth level before starting the masonry work.

9.07.07 Enclosure of the elevator shall have 2 hours fire rating and it shall be sealed from outside to ensure dust free environment.

9.08.00 **COLOUR COATED AND OTHER SHEETING WORK**

9.08.01 **Material**

a) Wall Cladding & Roofing Material

Troughed permanently colour coated sheet of approved shade and colour shall be

i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y250 as per IS 15961 / grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150

ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y350 as per IS15961/ grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150.

iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y550 as per IS 15961/ grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150
Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS: 1254.

Bidder to ensure that same profile is to be used throughout the package for all facilities to maintain uniformity.

b) Metal Deck Roof Material

Troughed permanently colour coated metal decking sheets shall be

i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275.

ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275.

iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275.

Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking.

Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided.

Bidder to ensure that same profile is to be used throughout the package for all facilities to maintain uniformity. In addition, the depth of the profile shall be restricted to 60 mm (maximum) to reduce the overall thickness of floor slab and thus minimizing the dead load of the floor slab. If the bidder proposes to use two different metal deck sheets (same profile but different grades or thicknesses), the unexposed (concrete) side of the metal deck sheets shall be painted with clearly distinct colours to facilitate identification.

Bidder to ensure that both cladding sheet and decking sheet supplied at site to be provided with transparent organic film of thickness of 40 microns on each face. Also they should be stored in a covered place on wooden sleepers till erection.

9.08.02 Colour Coating

Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP) paint or Super Polyester paint or SDP paint (Super Durable Polyster with no TGIC Triglycidyl Isocynurate) . The silicon content in the SMP paint to be 30 to 50%. The paint to be , of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint/SDP systems shall be of industrial finish of product type 4 of AS/NZ2728.

Also the heavy metal content (Lead, Cadmium, Chromium etc) to be within environmental norms so that the sheet is also suitable for rainwater harvesting

9.08.03 Design Criteria

For wall cladding insulated / uninsulated and conveyor gallery sides and roof, permanently colour coated sheet of troughed profile shall be used. However alternative profile meeting the strength, deflection and other functional requirements such as section modulus and moment of inertia shall be provided.

Sheet shall be of profile, sectional properties, colour and shade as per specifications.

For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements.

For metal deck sheets used for roofing (with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition.

9.08.04 Fasteners

Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners confirming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.

Shear anchor studs shall also be provided through metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams as specified in Clause no. 8.03.00.

Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.

9.08.05 **Miscellaneous Details**

To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing.

Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners.

Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277

Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets

. Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer.

For insulation of cladding and other areas, mineral wool conforming to IS 8183 shall be used. The density shall be 32 or 48 kg. /cu.m for glass or rock wool respectively. The nominal thickness of insulation shall be 50mm.

All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer.

The contractor shall prepare working drawings of sheeting system including end and side laps, flashing, fixing details etc. before starting sheeting work at site.

9.08.06 **Pre-Fabricated Insulated Metal Sandwich Panels**

For buildings where Pre-Fabricated (Factory made) Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet & bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be

i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y250 as per IS15961/ grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150

ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y350 as per IS15961/ grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150

iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y550 as per IS15961/ grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150.

Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.

Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron

	(nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade. Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below. The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site. The insulation shall be of Polyurethane type. The polyurethane shall be Chlorofluorocarbon (CFC) free and self-extinguishing and shall conform to IS 12436: 1988. It shall have Modular Density 40 +/- 2 Kg/m3 and Thermal Conductivity @ 10 Deg.C 0.017 - 0.020 W/M 0k, Water absorption (% by vol) 3.1, Critical Oxygen Index 23 and Compressive Strength 1.2 Kg/sq.cm.
9.08.07	**Polycarbonate Sheets** The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points & pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details.
9.09.00	**Plastering**
9.09.01	Outer face (i.e. rough side) of all brick walls shall have 18 mm thick and inner face (i.e. smooth side) of all walls shall have 12 mm thick cement sand plaster 1:6.
9.09.02	Acrylic wall putty in two coats shall be applied over cement plastered surfaces in interior of building. The finish surface shall be smooth and shall be of 2 mm nominal thickness.
9.09.03	All R.C.C. walls shall have minimum 12mm thick cement sand plaster 1:6.
9.09.04	All RCC ceilings (except areas provided with false ceiling, cable vault ceiling and metal decking) shall be provided with 6mm thick cement sand plaster 1:4.
9.09.05	Groove of uniform size 12 x 12 mm up to 20 x 15 mm in plastered surface as per approved pattern, shall be provided as per approved drawing.
9.09.06	All plastering work shall conform to IS: 1661.
9.10.00	**Painting, Aluminium Composite Panel,**
9.10.01	All painting on masonry or concrete surface shall preferably be applied by roller. If applied by brush then same shall be finished off with roller.
9.10.02	All paints shall be of approved make including chemical resistant paint.
9.10.03	Minimum 2 finishing coats of paint shall be applied over a coat of primer.
	Stone work for wall lining etc. (Veneer work) over 20 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry @3.3kg/sq.m, including rubbing and polishing in complete. (Black polished granite stone slab, 18 mm thick / polished Sadarhally grey granite slab 18 mm thick / other equivalent approved sahde). The final, finished coating shall be fungus resistant, UV resistant, water repellent, alkali resistant, and extremely durable with colour fastness.
9.10.04	Acrylic emulsion paint shall be as per IS: 15489. Acrylic distemper shall be as per IS: 428. Cement paint shall conform to IS: 5410, white wash/colour wash shall conform to IS: 627.

9.10.05 All fire exits shall be painted in post office red/signal red colour shade, which shall not be used anywhere else except to indicate emergency or safety measure.

9.10.06 For painting on concrete, masonry and plastered surface IS: 2395 shall be followed. For painting on wood work IS: 2338 shall be followed.

9.10.07 For painting on steel work and ferrous metals, BS: 5493 and IS: 1477 shall be followed. The type of surface preparation, thickness and type of primer, intermediate and finishing paint shall be according to the painting system adopted.

9.10.08 Bitumen primer used in acid/alkali resistant treatment shall conform to IS: 158.

9.10.09 ~~All internal paints shall be of low VOC (Less than 50 g /L) content conforming to GRIHA rating for reduction of VOC content.~~

All internal paints shall be of low VOC (Less than 50 g /L) content.

9.10.10 Aluminium Composite Panel

Aluminum Composite Panel cladding with open grooves shall be designed, fabricated, tested installed and fixed for linear as well as curvilinear portions of the building for all heights and levels including:

a) Structural analysis & design and preparation of shop drawings for pressure equalization or rain screen principle as required, proper drainage of water to make it watertight including checking of all the structural and functional design.

b) Aluminium Composite Panel cladding (Alucobond/ Alpolic / Aludecor /Equivalent) in pan shape in metallic/ solid colour of approved shades made out of 4mm thick aluminium composite panel. ACP consisting of 3mm thick Fire Retardant mineral filled Core comprising of around 70% Inorganic compound which is 100% non-combustible mineral and balance 30% is food grade virgin polymer sandwiched between two Aluminium sheets (each 0.5mm thick). The aluminium composite panel top and bottom skin should confirm to Aluminium Alloy 5005 (AlMg 1) marine grade series and H 22/24 temper.

The ACP sheet shall be coil coated with Kynar 500 based (70:30 ratio) PVDF / Lumiflon based fluoropolymer resin coating of approved colour and shade on face # 1 and polymer (Service) coating on face # 2 as specified using stainless steel screws, nuts, bolts, washers, cleats, weather silicone sealant, backer rods etc.

c) The fastening brackets of Aluminium alloy 6005 T5 / MS with Hot Dip Galvanised with serrations and serrated washers to arrest the wind load movement, fasteners, SS 316 Pins and anchor bolts of approved make in SS 316, Nylon separators to prevent bi-metallic contacts all complete required to perform as per specification and drawing.

9.10.11 DELETED.

9.10.11 DELETED

9.10.13 **Exterior Painting on Wall (Premium Acrylic Smooth Exterior Paint with Silicone Additives)**

~~The paint shall be (premium acrylic smooth exterior paint with silicone additives) of approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.~~

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Exterior Painting on Wall (Premium Acrylic SmoothExterior Paint with Silicone Additives)

The paint shall be (premium acrylic smooth exterior paint with silicone additives) of approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer in charge after inspection before painting is commenced.

Textured base coat

Exterior wall Texture-New work (Two or more coats applied @ 6.5kg/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm). High Quality Exterior Acrylic Modified resin and special quality Silica Quartz with Trowel Texture (Asian / Dulux/ Nerolac/ Berger/ Equivalent) as per selection.....

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Application of exterior paint

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-incharge shall be followed meticulously.

The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust. Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

9.11.00 Doors & Windows

9.11.01 Doors, windows and ventilators of air-conditioned areas, entrance lobby of all buildings (where ever provided), and all windows and ventilators of all buildings (unless otherwise mentioned) shall have aluminium framework with glazing. The aluminium section shall have minimum 2 mm thickness. The aluminium frame shall be electro colour dyed (anodised with 15 micron coating thickness) when used on outer side of the building and it shall be powder coated(50 microns coating thickness) when used in interior of the building. All doors of toilet areas shall be of steel framed solid core flush shutter. For Mill Bunker Building, transfer points, crusher house, conveyor gallery, steel louvered windows shall be provided.

9.11.02 Control Rooms of all buildings shall be provided with Aluminium Glazed door.

9.11.03 Single glazed panels with aluminium framework shall be provided as partition between two airconditioned areas wherever clear view is necessary.

9.11.04 a) The doors frames shall be fabricated from 1.6 mm thick MS sheets and shall meet the general requirements of IS: 4351.

b) All steel doors shall consist of double plate flush door shutters. The door shutter shall be 35 mm (min.) thick with two outer sheets of 1.2 mm rigidly connected with continuous vertical 1.0 mm stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 1.2 mm. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, locks etc.

9.11.05 Steel windows and ventilators shall be as per IS: 1361 and IS: 1038.

9.11.06 Wherever functionally required Rolling shutter (fully closed/partly grilled) with suitable operating arrangement (manual/Electric) shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248. M.S sliding doors with suitable mechanical and electrical operations fixtures as per requirement for bigger openings shall be used.

9.11.07 All windows and ventilators on ground floor of all buildings shall be provided with suitable Aluminium grill.

9.11.08 Fire-Proof doors with panic devices shall be provided at all fire exit points as per requirements. These doors shall generally be as per IS 3614 (Part 2). Fire rating of the doors shall be of minimum 2 hours. These doors shall be double cover plated type with mineral wool insulation.

9.11.09 Hollow extruded section of minimum 2 mm wall thickness as per IS: 1285 (Grade of Alluminum shall be Alloy 63400) shall be used for all aluminium doors, windows and ventilators.

9.11.10 Minimum size of door provided shall be 2.1 m high and 1.2 m wide. However for toilets minimum width shall be 0.75 m and office areas minimum width shall be 1.20m.

9.11.11 Electrically operated, self operable/closing, aluminium framed with tinted glass, sliding doors shall be provided at the entrance of all common control rooms, entrance lobby of facility building. At the entrance of all common control rooms in MPH G.I. framed with fire resistant glass, sliding doors shall be provided.

The other doors in common control rooms in MPH shall be G.I. framed with fire resistant glass as per fire zoning.
Fire Resistant Glazed Door System (Swing / Sliding) shall be of uniform GI profile 50X50 mm with 14mm(Minimum) EI 20 GLASS for Interior Application.
Fire Resistant Glazed Door System shall have 120 minutes of integrity and radiation control (EW 120) with symmetrical (Bi-Directional) fire protection. The frames shall be cold rolled profiles as per EN standard EN 10327/ Indian Standard IS 513 . The door frames are cold rolled from 1.5 mm steel sheet to form a profile of 50 mm x 50 mm on all sides. The door shutter shall have the top rail, side rail and bottom rail dimensions of 50 mm x 50 mm. The overall door opening shall be as per tested evidence and tested as per EN 1634-1/ ISO 834- 1 / ISO 3009 /(Indian Standard) IS 16947:2018 in an accredited laboratory.

The glass must be minimum 14mm thick , clear (MADE IN INDIA)120 min fire rated for Integrity, Radiation control (EW 120) and partially insulation (EI 20) Non Wired Toughened Interlayered glass with a light transmission of 86% and a sound reduction of 37 dB and manufactured in UL & TUV audited Facility and including UL-EU Certification and compliant to class 1(B)1 category of Impact Resistance as per EN 12600. The glass shall be tested and certified for no formation of bubbles or yellowing after 5000 hours of exposure to UV radiation by TUV Rheinland as per EN 12543-4. The base glass and finished glass shall be made in India.
The shutters shall be fixed to the frame using Weld-on hinges of dimensions 179mm X 20mm. The profiles shall have groves to incorporate Fire Resistant gaskets. The glass shall be held in its place with the help of 1.5 mm cold rolled steel beading and Kerafix 2000 ceramic tape with cross section of 4 x 15 mm as per the test evidence. Beading shall be clipped on using Stainless Steel self-tapping screws fixed at a distance of 70 mm from the edges and 150 mm c/c henceforth. The glass panes are to be supported on non-combustible 6 mm Calcium Silicate setting blocks. The door shall be fitted with offset pull handle and door closer of Dorma (TS 73V, TS 83V, TS93V), Geze (TS 2000NV) or equivalent. The inactive leaf (in case of double leaf only)shall be fixed to the frame using a tower bolt at meeting edge at top or as per the tested evidence. The doors shall be manufactured in a TUV audited facility. The maximum glazing size shall be as per the test certification. The profile shall be fixed to the supporting construction by means of M10 or bigger steel bolts at every 150 mm from the edges and every 500 mm (approx.) c/c. The doors shall offer C4 level of wind resistance when tested as per EN12211 and shall provide class 4 level of air permeability as per EN 1026. The door shall also be subjected to durability tests as per EN 12400 for C5 classification (200,000 cycles). The doors shall also be tested for class 5 of impact resistance when tested as per EN 13049. The doors & partition shall also be tested for class 4 level of Mechanical strength when tested as per EN13115. The door shall have water tightness level of 8A when tested as per EN 1027.
The sliding door system shall be connected to the surrounding construction by means of interlocking labyrinths lined with intumescent tapes as per the test evidence and connected to the sliding mechanism at the top. The sliding mechanism shall be as mentioned in the tested evidence or Assessment and shall have steel rollers. The glass should be held in its place with the help of 1.5 mm cold rolled steel beading and Kerafix 2000 ceramic tape with cross section of 4 x 15 mm as per the test evidence. Beading shall be clipped on using Stainless Steel self-tapping screws fixed at a distance of 70 mm from the edges and 150 mm c/c henceforth. The glass panes are to be supported on non-combustible 6 mm Calcium Silicate setting blocks.
The sliding mechanism shall be fixed to adequate supporting construction (MS channel / Reinforced concrete) to ensure proper support for the door.

Fire Rated Door (swing / sliding) shall be of Makes- Saint Gobain, Acodor, IGI, Matrix. At the entrance of all common control rooms in MPH G.I. framed with fire resistant glass, sliding doors shall be provided. The other doors in common control rooms in MPH shall be G.I. framed with fire resistant glass as per fire zoning .Fire Resistant Glazed Door System shall be of Uniform Profile 50X50 mm with 14mm EI 20 GLASS For Interior Application.

FIRE RESISTANT GLAZED DOOR SYSTEM shall have 120 minutes of integrity and radiation control (EW 120) with symmetrical (Bi-Directional) fire protection. The frames shall be cold rolled profiles as per EN standard EN 10327/ Indian Standard IS 513 . The door frames are cold rolled from 1.5 mm steel sheet to form a profile of 50 mm x 50 mm on all sides. The door shutter shall

	have the top rail, side rail and bottom rail dimensions of 50 mm x 50 mm. The overall door opening shall be as per tested evidence and tested as per EN 1634-1/ ISO 834- 1 / ISO 3009 /(Indian Standard) IS 16947:2018 in an accredited laboratory. The glass must be minimum 14mm clear (MADE IN INDIA)120 min fire rated for Integrity, Radiation control (EW 120) and partially insulation (EI 20) Non Wired Toughened Interlayered glass with a light transmission of 86% and a sound reduction of 38 dB and manufactured in UL & TUV audited Facility and including UL-EU Certification and compliant to class 1(B)1 category of Impact Resistance as per EN 12600. The glass shall be tested and certified for no formation of bubbles or yellowing after 5000 hours of exposure to UV radiation by TUV Rheinland as per EN 12543-4.The base glass and finished glass must made in India . The shutters shall be fixed to the frame using Weld-on hinges of dimensions 179mm X 20mm. The profiles shall have groves to incorporate Fire Resistant gaskets. The glass shall be held in its place with the help of 1.5 mm cold rolled steel beading and Kerafix 2000 ceramic tape with cross section of 4 x 15 mm as per the test evidence. Beading shall be clipped on using Stainless Steel self-tapping screws fixed at a distance of 70 mm from the edges and 150 mm c/c henceforth. The glass panes are to be supported on non-combustible 6 mm Calcium Silicate setting blocks. The door shall be fitted with offset pull handle and door closer of Dorma (TS 73V, TS 83V, TS93V), Geze (TS 2000NV) or equivalent. The inactive leaf (in case of double leaf only)shall be fixed to the frame using a tower bolt at meeting edge at top or as per the tested evidence. The doors shall be manufactured in a TUV audited facility. The maximum glazing size shall be as per the test certification. The profile has to be fixed to the supporting construction by means of M10 or bigger steel bolts at every 150 mm from the edges and every 500 mm (approx.) c/c. The doors shall offer C4 level of wind resistance when tested as per EN12211 and shall provide class 4 level of air permeability as per EN 1026. The door shall also be subjected to durability tests as per EN 12400 for C5 classification (200,000 cycles). The doors shall also be tested for class 5 of impact resistance when tested as per EN 13049. The doors & partition shall also be tested for class 4 level of Mechanical strength when tested as per EN13115. The door shall have water tightness level of 8A when tested as per EN 1027. Fire Rated Door shall be of Makes- Saint Gobain, Acodor , IGI, Matrix.
9.11.12	Minimum area of windows in building on each floor level shall be 10% of floor area.
9.12.00	**Glazing**
9.12.01	All windows and ventilators (not specified elsewhere) shall be provided with minimum 6 mm thick toughened glass conforming to IS: 5437.
9.12.02	For single glazed aluminium partitions and doors, 8mm thick clear toughened glass shall be used.
9.12.03	Toughened tinted glass of 6 mm thickness shall be used for all windows and ventilators in toilets.
9.12.04	All glazing work shall conform to IS: 1083 and IS: 3548.
9.12.05	For glazings of Air Conditioned Buildings Composite double glazing shall be 24mm thick consisting of 6mm thick clear float glass on inner side and 6mm thick reflective toughened glass on outer side. The two glasses shall be separated by 12mm air-gap and hermetically sealed by beading of anodized aluminium with outer edge sealed with silicon sealant. Outer glass of 6mm thickness shall have following technical characteristics: Solar factor 25% or less, Maximum U-value 3.3 W/ SQMK, VLT min 30%: Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28). The glass to be used should be from the manufacturers of glass like Saint Gobain (India) or Asahi (India) or equivalent. The glass should be free from distortion and thermal stress.
9.12.06	For internal glazed partition, 8mm thick clear toughened glass shall be provided. Internal Glazed partition in in MPH shall be fully glazed fire rated fixed partition with 120 minutes of integrity and radiation control (EW 120) with symmetrical (Bi-Directional) fire protection. The frames shall be cold rolled profiles As per EN standard EN 10327/Indian Standard (IS 513) . The frames are cold rolled from 1.5 mm steel sheet to form a profile of 50 mm x 50 mm on all sides. he system shall be tested as per EN 1364-1/(Indian Standars) IS 16945:2018 in an accredited laboratory.

	The glass shall be 14mm(minimum) (MADE IN INDIA)clear 120 min fire rated for Integrity, Radiation control (EW 120) and partially insulation (EI 20) Non Wired Toughened Interlayered glass with a light transmission of 86% and a sound reduction of 37 dB and manufactured in UL & TUV audited Facility and including UL-EU Certification and compliant to class 1(B)1 category of Impact Resistance as per EN 12600. The glass shall be tested and certified for no formation of bubbles or yellowing after 5000 hours of exposure to UV radiation by TUV Rheinland as per EN 12543-4 The glass shall provide bi-directional (Symmetrical) fire protection. The base glass and processed glass must be made in INDIA. The glass shall be held in its place with the help of 1.5 mm cold rolled steel beading and Kerafix 2000 ceramic tape with cross section of 4 x 15 mm as per the test evidence. Beading shall be clipped on using Stainless Steel self-tapping screws fixed at a distance of 70 mm from the edges and 150 mm c/c henceforth. The glass panes are to be supported on noncombustible 5 mm Calcium Silicate setting blocks. The maximum glazing size shall be as per the test certification. The profile has to be fixed to the supporting construction by means of M10 or bigger steel bolts at every 150 mm from the edges and every 500 mm (approx.) c/c. The Partitions shall offer C4 level of wind resistance when tested as per EN12211 and shall provide class 4 level of air permeability as per EN 1026. The Partitions shall also be tested for class 5 of impact resistance when tested as per EN 13049. The Partitions shall also be tested for class 4 level of Mechanical strength when tested as per EN13115. The Partitions shall have water tightness level of 8A when tested as per EN 1027. Partitionr shall be of Makes - Saint Gobain,Acodor , IGI , Matrix ,Tata Pravesh.
9.13.00	**False ceiling**
9.13.01	False ceiling of 12.5 mm thick tapered/square edge glass fibre reinforced gypsum board conforming to IS : 2095 having fine texture finish, including providing and fixing of frame work at all levels, for all kind of work, consisting of light weight galvanised steel member (minimum 0.8 mm thick and galvanised as per IS: 277) having maximum grid size of 1200 mm x 600 mm for supporting panels of specified size, suspended from RCC structural steel or catwalkway grid above, with 4 mm (minimum) galvanised wires (rods), with special height adjustment clips, providing angle section of minimum 25 mm width along the perimeter of ceiling, supporting grid system (minimum 0.8 mm thick and galvanised as per IS: 277), expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts, return air grills, light fixtures, etc., all complete. (concealed grid and finished flat seamless and curve shape (dome etc.), finished smooth(seamless) along with the galvanised light gauge steel supporting system laid in profile to suit the profile of dome).
9.13.03	False ceiling of 12 mm thk calcium silicate board of 'HILUX' or equivalent with suspension system as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts, return air grills, light fixtures, etc., all complete. (With concealed grid and finished flat seamless).
9.13.05	ALUMINIUM FALSE CEILING : Aluminium false ceiling shall be in 600 mm x 600 mm tile or plank type of 0.6 mm thickness (minimum) with perforation of 2.5 mm dia in combination with built in nonwoven tissue for providing good acoustic properties. False ceiling shall have coil coating of thickness 25micron (minimum)and it shall be installed with T-Grid (of profile 24 mm) in same or contrasting colours or with 6 mm recess joints. The whole system shall be level adjusting arrangement and shall be suspended as per manufacturer guidelines.
9.13.08	Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, A.C. ducts etc.
9.13.09	Suitable M.S. channel (Minimum MC75 with maximum spacing of 1.2 m C/C both ways) grid shall be provided above the false ceiling level for movement of personnel and to facilitate maintenance of lighting fixtures, AC ducts etc.
9.13.10	Underdeck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air-conditioned area depending upon the functional requirements. This underdeck insulation

shall consist of 50mm thick mineral wool insulation with 0.05 mm thick aluminium foil & 0.6 mm x 25mm mesh wire netting and shall be fixed to the ceiling with 2 mm wire ties.

9.13.11 ~~Suitable cut-outs shall be provided in false ceiling to facilitate fixing of lighting fixtures, AC grills, smoke detectors, etc.~~

9.14.00 **Elevator Machine Room**

Suitable cut-outs shall be provided in false ceiling to facilitate fixing of lighting fixtures, AC grills, smoke detectors, etc. Batten ceiling: Batten ceiling made up of extruded aluminum / metal of minimum 0.6mm thickness with powder coated finish (min. 40 microns) / wooden finish (minimum 0.11mm). The ceiling must have superior acoustics and must ad-here to the highest health and safety standards. The bat-tens shall have possibility of curvilinear arrangement. The batten ceiling shall be Greenguard, tested/certified from UL/ Intertek. The product shall meet technical re-quirements of ASTM E84. Batten ceiling of 1”x1” made up of extruded aluminum with “click-on system”. Subli-mation/Heat transfer method should not be used for bet-ter scratch resistance. Die-casted click on joinery shall not be used. Designer membrane ceiling: The ceiling shall be have demountable translucent stretch ceiling membrane with harpoon, corners ready to install. It shall not get discolored & sag. All joints shall be provided with appropriate interface trims to be able to demount the ceiling to access the lights. The ceiling shall be installed using ceiling aluminum suspension system, complete as per manufacturer’s installation guidelines and as per approved shop drawings in line with the design intent and approval by Engineer In-charge. LED strips shall be installed using custom alumi-num extrusions to ensure longevity of the installation. The ceiling shall have following features and properties: - Durable: The systems shall resist shocks and shall not crack with movement or under stretch conditions. Safe: The membranes and profiles shall have passed the stringent fire and safety tests. The membrane shall have been classified as non-toxic upon burning. The Flexible membrane shall be b-s1-d0 / ASTM E-84 class A tested/certified. Green: Membranes shall be 100% recyclable. There shall not be any welding defect on Membranes.

equirements in either way.

ll be of RCC and wall shall be of one brick thick
e door and other requirements as per NBC and

with profiled metal decking sheet. Trough shall be
rock wool) and thereafter finished with Minimum
7 mm thick hardwood planks, finished with 11mm
o’ or equivalent) with plank size 193x1195mm
9), over 2 mm expanded polystyrene foam and

shall be provided with Prefabricated Insulated

Insulated Metal Sandwich Panels shall be as
of Technical Specification.

te Steel flush doors of thickness 45 mm with steel
s. Space between two sheets shall be filled with
shall be pressed steel sheets of 16 gauge. All
ded by the Bidder. Rubber sealing, for making the

truded anodised Aluminium Sections of minimum
aled double glazing consisting of two 6 mm thick

ulated metal sandwich panels/decking sheets

ecification.

9.1

all be conceived with the intention of projecting a

o inside working environment. It shall take into
activities involving power plant technology, and
control hierarchy and man machine interface. All
eiling, furniture, colour scheme equipment design
s and ergonomics requirements shall be detailed
etic spatial appearance.

r design process shall be control room complex
room, conference rooms and office areas in the
reviewed and evaluated for design. Furniture to
n complex and other control rooms shall be as

interface and suitable ergonomic practices.

ecture and interior design.

agnetic interference levels, taking into account the

air conditioning, fire fighting, fire escapes, etc.

e) Microprocessors based control system to control the functional requirements.

The above design philosophy put into practice shall be detailed out through presentation drawings, perspective views, scale models, detail drawings, etc.

9.16.00 **Stainless Steel Hand railing**

Providing and fixing knockdown railing system comprising of SS 304 Grade Stainless Railing of 50mm diameter handrail fixed on 50 mm SS round baluster placed at maximum 1000 c/c along with five numbers 19 mm diameter midrail connected at side of baluster by special brackets, both the end of mid rail should be bush inserted for jointing and to give extra strength (joints should not be welded and invisible). The balustrade should be fixed onto floor with casted plate of minimum 6mm thickness. Base plate shall be concealed with suitable SS 304 cover cap so that the mounting height fasteners are not visible after installation. Only high strength anchor fasteners would be used for fixing of baluster, as giving extra strength, rust proof and more durable. Onsite welding is strictly not allowed. Wherever welding is required, it should be Tig welding process with same grade 304/316 at factory only so that floor stone and other things would not be damaged and for safety purpose also. Baluster and handrail connector should be screwed tightened and not to be welded on site. Wall thickness of all pipes shall be taken as 2 mm. Along with all visible components developed in high grade SS and whenever required, joints to be filled with bushings for extra strength. Railing Height to be taken @ 1000/ 1200 mm from floor level.

9.17.00 **Finishing Schedule**

~~Interior and Exterior Finishes shall be as given in Tables-A & B respectively attached at the end of these specification.~~

Revised Table A B attached as annexure sl no AC-2 'D-1-9 - Table A and Table B'

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
1.	Main power house Building.			
	a) Unloading Bay	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	b) Cable vault	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	c) Balance area including passage	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	d) SWAS Room	Matt Finished Vitrified ceramic tiles.	Aluminium composite panel cladding on walls and columns upto false ceiling level	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	e) Equipment Area, ESP SWGR/ ACP Room/ UAF Room	Cement concrete with Metallic hardener topping	Acrylic distemper.	Acrylic distemper (except metal deck area
	f) UPS Battery charger room	Matt finished Vitrified ceramic tiles.	Aluminium composite panel cladding on walls and columns upto false ceiling level	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
	g) Deaerator floor	Cement concrete with Metallic hardener topping.		-
	h) Operating Floor	20 mm thick heavy duty anti skid full body vitrified tile in TG Hall. Rubber flooring at TG deck.	Colour coated Metal cladding on A-Row& Gable end, up to crane girder level.	Metal deck roofing (bottom of sheeting with RAL 9002 finish)
	i) General circulation and movement areas	20 mm thick heavy duty anti skid full body vitrified tile		Acrylic distemper (except metal deck area).
	j) Switchgear room	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	k) MCC Room	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	l) Control room area including control room	Matt Finish Vitrified ceramic tiles flooring of size 1000 x1000 mm	Partition in fire rated glass with fire rated frames with 2 hr fire rating & Metal Batten panel cladding for columns and walls	Metal Batten panel ceiling in combination with demountable translucent stretch ceiling membrane or as per approved design

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
	m) control equipment room,	Matt finish Vitrified ceramic tiles.	Partition in fire rated glass with fire rated frames with 2 hr fire rating & Aluminium composite panel cladding for columns and walls	Allluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	n) Conference room, senior executive room., Computer Room	Matt finish Vitrified ceramic tiles	Partition in fire rated glass with fire rated frames with 2 hr fire rating & Aluminium composite panel cladding for columns and walls	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	o) Record room	ceramic tiles	Acrylic distemper.	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	p) Locker room	Ceramic Tiles	Acrylic Emulsion Paint	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
	q)Toilet area	ceramic tiles	Digitally glazed ceramic wall tiles up to False Ceiling Height	Alluminium False ceiling in size 600x 600
	r) Office Room, Staff Room	Matt Finished Vitrified ceramic tiles.	Partition in fire rated glass with fire rated frames with 2 hr fire rating & Aluminium composite panel cladding for columns and walls	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	s)Laboratory area	Vitrified Ceramic / Acid/alkali resistant tiles.	Designer ceramic wall tiles up to False Ceiling Height/ Aluminium composite panel cladding for columns and walls in case of A.C Panel	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	t) RCC Stair case	18mm thick Granite (Polished and honed Finished) stone	Polished Granite Stone up to 1.2m. ht. & Acrylic Distemper Paint over wall putty finish for balance height.	Acrylic Distemper

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
	u) Lift and Staircase Lobby	18mm thick polished granite stone as pattern.	18mm thick polished granite & glass mosaic tile cladding up to False Ceiling Height	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	v) Passages and general circulation areas.	Deleted	Deleted	Deleted
	w) Battery Room	Acid and alkali resistant tile.	Acid and alkali resistant tile up to 1.2m height and chemical resistant paint for balance height	Chemical Resistant paint except in locations where Metal deck has been provided
	x) Oil canal, oil room, oil purification Tank and other areas where oil spillage is likely to occur.	Oil resistant paint (epoxy based) 150 micron over primer.	As above except oil canal Oil resistant Paint	As above except oil canal.
	y)Pathways including roof area.	22mm thick concrete chequered tiles.	-	-

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
2.	DELETED			
3	ESP control building/Air compressor house/ Safety Control Room			
	a) Operating/Maintenance areas	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	b) Office Room, Staff Room	Digitally glazed Vitrified ceramic tiles.	Aluminium composite panel cladding on walls and columns	Mineral fiber Board False Ceiling
	c) Control Room	Digitally glazed Vitrified ceramic tiles.	Aluminium composite panel cladding on walls and columns in ESP Control Room Building	Alluminium false ceiling in combination with GRG plaster board border in column depth or as per approved design
	d) MCC Room	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	e) RCC Stair case	Cement concrete with Metallic hardener topping	Polished Granite stone up to 1.2m.ht. & Acrylic Distemper	Acrylic Distemper (except metal deck area)

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
	f) Battery Room	Acid, Alkali resistant tile	Acid, Alkali resistant tile 1.2m height / chemical resistant paint above dado	Chemical resistant paint (except metal deck area)
	g) AHU/ AC Plant room/ Cable vault	Cement concrete with Metallic hardener topping	Acrylic Distemper	Acrylic Distemper (except metal deck area)
	h) Toilets	ceramic tiles.	Designer ceramic wall tiles dado up to false ceiling level.	Calcium silicate false ceiling.
4.	Mill & Bunker building/ T.P.s / Conveyor Galleries	Cement concrete with Metallic hardener topping	Acrylic distemper on masonry walls/ color coated Metal panel cladding	color coated Metal panel cladding
5.	Fire water booster water pump house/ CW PH/RWPH/ Switchgear Building			
	a) Maintenance /Pump floor/PLC	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	b) Control room /PLC.	Matt Finished Vitrified Ceramic Tiles	Acrylic emulsion paint.	Mineral fiber board false ceiling.

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
	Toilet area	ceramic tiles.	Digitally glazed ceramic wall tiles dado up to false ceiling level.	Acrylic distemper
6.	Ash slurry pump house/ Ash water pump house / Silo Area Utility Building / Transport air compressor house/ Fuel Oil pressurizing Pump House with switchgear building& control room / Miscellaneous Switchgear room CW Pump house, Switchgear room, control room/ RW Switchgear room, control room/Any other Building..			
	a) Operating/Maintenance areas/ MCC room	Cement concrete with Metallic hardener topping	Acrylic distemper	Acrylic distemper (except metal deck area)
	b) Office Room, / Control Room	Matt Finished Vitrified ceramic tiles.	Acrylic emulsion paint.	Mineral Fibre Board False Ceiling in A.C area

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
	c) Toilet area	ceramic tiles.	Digitally glazed ceramic wall tiles dado up to false ceiling level.	Acrylic distemper
7.	DELETED			
8.	Rest Room for O&M Workers			
	Rest room	Cement concrete with Metallic hardener topping.	Acrylic distemper	Metal roof
	Toilets	ceramic tiles.	Digitally glazed ceramic wall tiles dado up to 2100 high, Acrylic Distemper paint above	Metal roof
9.	First Aid Centre with Creche Facilities.			

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
	Waiting Lobby cum Reception/ Doctor's Chamber / First Aid Room/ Driver's Room	Matt Finished Vitrified ceramic tiles.	Acrylic emulsion paint.	Acrylic Emulsion Paint. / Mineral Fibre Board False Ceiling in A.C area
	Toilets/ Bath room	ceramic tiles.	Digitally glazed ceramic wall tiles dado up to 2100 high, Acrylic Distemper paint above	Metal roof/ Acrylic Distemper
	Crèche Facilities	5 mm thick vinyl flooring	Glass mosaic tiles in murals & patterns and Acrylic Emulsion Paint	Acrylic Emulsion paint
	Porch		Acrylic distemper	Acrylic distemper
	Covered Parking	Concrete Blocks	Acrylic distemper	Acrylic distemper
10.	Vehicle parking sheds			
		Concrete Blocks		

TABLE –A

INTERIOR FINISHING SCHEDULE

S.NO.	DESCRIPTION OF AREA	FLOOR FINISH	WALL FINISH	CEILING FINISH
9.	FQA Building			
	RT Film Processing and Viewing Room, DGM Room, Staff room , Passage	Matt Finished Vitrified ceramic tiles.	Acrylic emulsion paint.	Acrylic Emulsion Paint. / Mineral Fibre Board False Ceiling in A.C area
	Toilets/ Pantry / Bath room	ceramic tiles.	Digitally glazed ceramic wall tiles dado up to 2100 high, Acrylic Distemper paint above	Metal roof/ Acrylic Distemper
	Store, Civil Equipment room, Concrete mixture and Cube casting area , Cement Testing Room, Mechanical Equipment room, Record Room.	Cement concrete with Metallic hardener topping.	Acrylic distemper	Acrylic distemper
	Porch		Acrylic distemper	Acrylic distemper
	Covered Parking	Concrete Blocks	Acrylic distemper	Acrylic distemper

Note :

1. All wall above false ceiling shall be plastered.
2. The colour and pattern of finish shall be as per approved details.
3. All materials shall be of reputed and established brand approved by Engineer-in-charge.
4. Wherever alternative materials are specified, the final selection rests with Engineer-in-charge.
5. This finishing schedule shall also be applicable to similar functional areas for all other buildings and facilities.
6. All the finishing materials shall be applied/provided as per manufacturer specification and guidelines under the supervision & guidelines of manufacturer.
7. Requirement given above are suggestive and minimum. Bidder is welcome to suggest alternative scheme conforming to design functional requirement subject to approval of the Engineer-in-charge.

TABLE –B

EXTERIOR FINISHES SCHEDULE

TABLE –B

EXTERIOR FINISHES SCHEDULE

Sl.No.	DESCRIPTION OF AREA	WALL AND PROJECTIONS	SOFFIT OF PROJECTIONS
1.	Auxiliary building in steel framed structure.	Premium Acrylic Smooth exterior paint with silicon additives over suitable primer of Water Proof Cement Paint over plastered surface/ Aluminium Composite Panel Approved colour/ colour combination of colour coated metal cladding	Premium Acrylic Smooth exterior paint with silicon additives over suitable primer of Water Proof Cement Paint over plastered surface Approved colour/ colour combination of colour coated metal cladding
2.	Building with concrete frame work, etc.	Premium Acrylic Smooth exterior paint with silicon additives over suitable primer of Water Proof Cement Paint over plastered surface	Premium Acrylic Smooth exterior paint with silicon additives over suitable primer of Water Proof Cement Paint over plastered surface
3.	Steel Structure, trestles, etc.	High performance Paint of approved specification and shade.	
4.	DELETED		

NOTE : 1. The colour and pattern of finish shall be as finalized by Engineer.

2. All materials shall be of reputed and established brand approved by Engineer.

D-1-10 **MATERIAL SPECIFICATION**

10.01.00 **Cement**

Fly ash based portland pozzolana cement conforming to IS: 1489 (Part-1) shall be used for all areas other than for the critical structures identified below. Other properties shall be as per IS code.

Ordinary Portland Cement (OPC) shall necessarily be used for the following structures.

a) Ordinary Portland Cement (OPC) shall necessarily be used for RCC for Chimney shell.
b) TG foundation top deck/ Substructure
c) Spring supported decks of all machine foundations such as TDBFP/MDBFP

The grade of cement shall be Grade 43 for OPC conforming to IS: 269.

In place of fly ash based portland pozzolana cement, OPC mixed with Fly Ash can be used. Batching plant shall have facility for mixing fly ash. Fly ash shall conform to IS: 3812(Part I). Percentage of fly ash to be mixed in concrete shall be based on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement

10.02.00 **Aggregates**

a) **Coarse Aggregate**

Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383.

However, use of aggregate manufactured from other than natural sources (Listed in Annexure-A of IS 383) and Bottom Ash from Thermal Power Plants shall be permitted only in Lean Concrete of Grade M7.5 and M10 (for % of utilization refer Table-1 of IS 383).

b) **Fine Aggregate**

Fine aggregate shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Fine aggregate in concrete shall conform to IS: 383. Bidder can use either natural sand or crushed sand, confirming to IS:383, based on availability.

For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116.

However, use of aggregate manufactured from other than natural sources (as Listed in Annexure-A of IS 383) and Bottom Ash from Thermal Power Plants conforming to IS:383 shall be permitted only in Lean Concrete of Grade M7.5 and M10 (for % of utilization refer Table-1 of IS 383).

c) Petrographic examination of aggregate shall be carried out by the contractor at National Council for Cement and Building Materials (NCB), Ballabgarh, or any other approved laboratory to ascertain the structure and rock type including presence of strained quartz and other reactive minerals for machine foundations, etc. In case, the coarse aggregate sample is of composite nature, the proportions (by weight) of different rock types in the composite sample and petrographic evaluation of each rock should also be ascertained. While determining the rock type, special emphasis should be given on identification of known reactive rocks like chalcedony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed.

The laboratory shall determine potential reactivity of the aggregate, which may lead to reaction of silica in aggregate with the alkalis of cement and / or potential of some aggregates like limestone to cause residual expansion due to repeated temperature cycle. If the same is established, the contractor shall further carry out alkali aggregates

reactivity test as per IS 2386 (Pt.VII) and / or repeated temperature cycle test to establish the suitability of the aggregates for the concrete work. The test results, with the final recommendations of the laboratory, as to a suitability of the aggregate, for use in the concrete work for various structures and suggested measures, in case of results are not satisfactory, shall be submitted to the Engineer for his review, in a report form.

In case in the report, it is established, that the aggregates contain reactive silica, which would react with alkalis of the cement, the contractor shall change the source of supply of the aggregate or use low alkali cement as per recommendation or take measures as recommended in the report as instructed by Engineer. In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10 degree Celsius to 65 degree Celsius and for 60 temperature cycles) the material shall not be used for concreting of TGs', BFPs' and other equipment foundations which are likely to be subjected to repeated temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test.

10.03.00 **Reinforcement Steel**

Reinforcement steel shall be of high strength deformed TMT steel bars of grade Fe-415/Fe-500/Fe 500D/Fe550D and shall conform to IS 1786 and IS 13920. However, minimum elongation shall be 14.5%.

Relevant clause of IS 13920 are quoted below for clarity:

Quote

5.3.1 Steel reinforcement shall comply with all of the following:
a) Elongation shall be at least 14.5 percent,
b) Ratio of ultimate stress to 0.2 percent proof stress shall not exceed 1.25,
c) Ratio of ultimate stress to 0.2 percent proof stress shall be at least 1.15, and
d) Steel shall be only of strength grades with minimum 0.2 percent proof stress of 415 MPa, 500 MPa or 550 MPa, in addition to other requirements of IS 1786.'

5.3.2 The actual 0.2 percent proof stress of steel bars based on tensile test must not exceed their characteristic 0.2 percent proof stress by more than 20 percent

Unquote

Mild steel and medium tensile steel bars shall conform to Grade A of IS:432-Part 1 and hard drawn steel wire shall confirm to IS:432-Part II. Welded wire fabric shall conform to IS 1566.

10.04.00 **Structural Steel**

Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.

10.04.01 **Mild Steel**

a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.

b) Pipes shall conform to IS: 1161.

c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240 and minimum thickness shall be 4 mm..

d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.

10.04.02 **Medium and High Tensile Steel**

Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS: 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.

10.05.00 **Bricks**

Only fly ash bricks shall be used in all construction, except for elevator shafts, which can be either of burnt clay bricks or RCC construction as per functional / codal provisions. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm2. Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS: 13757 and IS: 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%.

10.06.00 **Foundation Bolts**

Material and details of foundation bolts shall conform to IS: 5624. Mild steel bars used for the fabrication of bolt assembly shall conform to grade 1of IS: 432 and/ or grade A of IS: 2062. Hexagonal nuts and lock nuts shall conform to IS: 1363 & IS: 1364 upto M36 diameter and IS: 5624 for M42 to M150 diameter.

10.07.00 **Stainless steel**

The material specification for stainless steel plates are mentioned in the design concept area of Mill Bunker building.

10.08.00 **Water**

Water used for cement concrete, mortar, plaster, grout, curing, washing of coarse aggregate, soaking of bricks, etc. shall be clean and free from oil, acids, alkalis, organic matters or other harmful substances in such amounts that may impair the strength or durability of the structure. Potable water shall generally be considered satisfactory for all masonry and concrete works, including curing. When water from the proposed source is used for making the concrete, the maximum permissible impurities, development of strength and initial setting time of concrete shall meet the requirements of IS: 456.

All materials brought for incorporation in works shall be of best quality as per IS unless specified otherwise.

10.09.00 PTFE (Poly Tetra Fluoroethylene) Bearing

The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm.

10.10.00 **Statutory Requirements**

Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc.

Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both

sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc.

Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tarrif Advisory Committee.

Statutory clearances and norms of State Pollution Control Board shall be followed.

Bidder shall obtain approval of Civil/Architectural drawings from concerned authorities before taking up the construction work.

10.11.00 **Autoclave Aerated Concrete (AAC) Block**

Providing and laying of **Autoclave Aerated Concrete (AAC) block masonry** using blocks having dimensions of 625mm x 250mm. thickness ranging from 100 mm to 300 mm conforming to IS:2185 (Part-III), for dimension and tolerance, with minimum compressive strength of 30 kg/ sq.cm. The jointing cement sand mortar in the composition of 1:6 (Cement: Sand) shall be used with suitable plasticizer (optional). Sand having modulus of fineness 1.1 shall be used. The horizontal and vertical joint thickness shall be approximately 10 mm. In case of partition walls (1000 mm/ 125 mm thk.) the jointing reinforcement i.e 1 number of 8 mm diameter bars shall be placed at every alternate course to be anchored properly with the main structure. All other structural requirements like stiffening of masonry, joint reinforcement etc. in the AAC masonry work strictly be carried out as per instruction laid down in IS:6041-1985, IS-1905) (Reinforcement bars shall be measured & paid separately under relevant items).

AAC blocks shall have the following physical properties:

Density (oven dry) - 550-650kg/ cum.
Compressive Strength - Min. 30 kg/ sq. cm.
Thermal Conductivity - 0.162W/mk (avg)
Resistant to fire - 2-6 hrs depending upon thickness
Dry shrinkage - 0.02% (avg)
Design gross density - 800 kg/cum (approx)

D-1-11 **Inspection, Testing and Quality Control**

11.01.00 Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used.

The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction.

11.02.00 Workmanship and dimensional tolerances shall be checked as stipulated else where in the specification.

D-1-12 **ANNEXURES**

D-1-12(A) **ANNEXURE (A)**

(a) List of Codes and Standards

All applicable standards, references, specifications, codes of practice, etc., shall be the latest edition including all applicable official amendments and revisions. A complete set of all these documents shall be available at site with Bidder. List of some of the applicable Standards, in original Codes and references is as following:

Where provisions are not covered in Indian Standards, reference shall be made to ACI, AISC, EN, CICIND and other International Standards.

LIST OF CODES AND STANDARDS

Excavation and Filling

IS :2720	Methods of test for soils(relevant parts)
IS:4701	Code of practice for earth work on canals.
IS:9759	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	33 grade for ordinary Portland cement.
IS:383	Coarse and fine aggregates from natural sources for concrete.
IS:432	Specification for mild steel and medium tensile steel bars and
(Part 1&2)	hard drawn steel wires for concrete reinforcement.
IS:455	Portland slag cement.
IS:702	Industrial bitumen.
IS:712	Specification for building limes.
IS:1077	Common burnt clay building bricks.
IS:1161	Steel tubes for structural purposes.
IS:1239	Mild steel tubes, tubulars and other wrought steel fitting - MS tubes.
IS:1363	Hexagon head bolts, screws and nuts of productions
(Part 1-3)	grade - C.
IS:1364	Hexagon head bolts, screws and nuts of productions
(Part 1-5)	grade-A & B.
IS:1367 (Part 1-18)	Technical supply condition for threaded fasteners.
IS:1489 (Part-I)	Portland-pozzolana cement. Fly ash based
IS:1542	Sand for Plaster.

IS:1566	Hard drawn steel wire fabric for concrete reinforcement.
IS:1786	High strength deformed steel bars & wires for concrete reinforcement.
IS:2062	Hot Rolled Low, Medium and High Tensile Structural Steel
IS:2116	Sand for masonry mortars.
IS : 2185 (Part 1) (Part 2)	Hollow & solid concrete blocks. Hollow & solid light weight concrete blocks.
IS:2386 (Part I-VIII)	Testing of aggregates for concrete.
IS:3812	Specification for fly ash for use as pozzolona and admixture.
IS:4082	Recommendation on stacking and storage of construction materiel and components at site
IS:8112	43 grade ordinary portland cement.
IS:8500	Structural steel-Microalloyed (Medium and high strength qualities).
IS:12269	53 grade ordinary portland cement.
IS:12894	Specification for fly ash lime bricks.
IS:13757	Burnt clay fly ash building bricks.

Cast in-situ Concrete and Allied Works

IS:280	Mild steel wire for general engineering purpose.
IS:456	Code of practice for plain and reinforcement concrete.
IS:457	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
IS:516 IS:1199	Method of test for strength of concrete. Methods of sampling and analysis of concrete.
IS:1791	General requirement for batch type concrete mixers.
IS:1834 IS:1838	Hot applied sealing compound for joints in concrete. Preformed fillers for expansion joints in concrete pavement and structures.
IS:2438	Specification for roller pan mixers.
IS:2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS:2505	Concrete vibrators - immersion type.

	IS:2506	General requirements for screed board concrete vibrators.
	IS:2722	Specification for Portable Swing weigh batchers for concrete (single and double bucket type).
	IS:2750	Steel scaffoldings
	IS:2751	Recommended practice for welding of mild steel plain and deformed bars for reinforced construction.
	IS:3150	Hexagonal wire netting for general purposes.
	IS:3366	Specification for pan vibrators.
	IS:3370 (Part 1-4)	Code of practice for concrete structures for the storage of liquids.
	IS:3558	Code of practice for use of immersion vibrators for consolidating concrete.
	IS:4014 (Part-1&2)	Code of practice for steel tubular scaffolding.
	IS:4326	Code of practice for earth quake resistant design and construction of buildings.
	IS:4656	Form vibrators for concrete.
	IS:4925	Concrete batching and mixing plant.
	IS:4990	Plywood for concrete shuttering work.
	IS:4995	Criteria for design of reinforced concrete bins for storage of granular and powdery materials
	IS:5256	Code of practice for sealing expansion joints in concrete lining on canals.
	IS:5525	Recommendations for detailing of reinforcement in reinforced concrete works.
	IS:6461	Glossary of terms relating to cement concrete.
	IS:6494	Code of practice for water proofing of underground reservoir and swimming pools.
	IS:6509	Code of practice for installation of joints in concrete pavements.
	IS:7861 (Part -1&2)	Code of practice for extreme weather concreting.
	IS:9012	Recommended practice for shotcreting.
	IS:9103	Admixtures for concrete.
	IS:9417	Recommendations for welding cold worked 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:12118	Two parts polysulphide based sealants.
IS:12200	Code of practice for provision of water stops at transverse construction joints in masonry and concrete dams.
IS:13311	Non destructive testing of concrete - methods of test.
(Part 1)	Ultrasonic pulse velocity.
(Part 2)	Rebound hammer.
IS:17452	Use of Alkali Activated Concrete for Precast Products-Guidelines
SP-16	Design codes for reinforced concrete to IS:456-1978.
SP-23	Hand book of concrete mixes.
SP-24	Explanatory handbook on Indian standards code for plain and reinforced concrete. (IS : 456)
SP-34	Hand book on concrete reinforcement and detailing.
ACI-318	American Concrete Institute code for structural concrete.

Precast Concrete Works

SP:7 (Part 6/Sec.7)	National Building Code - Structural Design Prefabrication and system building and mixed / composite construction.
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 waffle units.
IS:15658	Pre-cast concrete block for paving.
IS 15916	Building Design and Erection using Pre fabricated concrete

Masonry & Allied Works

IS:1905	Code of practice for structural use of unreinforced masonry.
IS: 2185	Part-1 Concrete Masonry Units - Specification Part 1 Hollow and Solid Concrete Blocks Part-3 Specification for concrete masonry units: Part 2 Hollow and solid light weight concrete blocks
IS:2212	Code of practice for brick work.
IS:2250	Code of practice for preparation and use of masonry mortars.
IS:2572	Code of practice for construction of hollow concrete block masonry.
SP:20	Hand book on masonry design and construction.

Sheeting Works

IS:277	Galvanised steel sheets (Plan & corrugated).
IS:513	Cold-rolled low carbon steel sheets & strips.
IS:730	Hook bolts for corrugated sheet roofing.
IS:801	Code of practice for use of cold formed light gauge steel structural members in general building construction.
IS:2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.
IS:7178	Technical supply condition 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:12436	Preformed rigid Polyurethane (PUR) and isocyanurate (PIR) foams for thermal insulation.
IS:12866	Plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced).
IS:14246	Continuously pre-painted galvanised steel sheets and coils.
BS:5950	Code of practice for design of light gauge profiled
(Part-6)	steel sheeting

Fabrication and Erection of Structural Steel Works

IS:800	Code of practice for General Construction of steel.
IS:813	Scheme for symbols for welding.
IS:814	Covered electrodes for manual metal arc welding of carbon & carbon manganese steel.
IS:816	Code of practice for use of metal arc welding for general construction in mild steel.
IS:817	Code of practice for training and testing of metal arc welders.
IS:1024	Welding in bridges and substructured subject to dynamic.
IS:1181	Qualifying tests for Metal Arc welders (engaged in welding structures other than pipes).
IS:1182	Recommended practice for Radiographic examination of fusion welded butt joints in steel plates

IS:1608	Mechanical testing of metals - tensile testing
IS:1852	Rolling and Cutting Tolerances for Hot rolled steel products.
IS:2016	Specification for Plain washers.
IS:2595	Code of practice for Radiographic testing
IS:2629	Hot dip galvanising of iron and steel
IS:3502	Steel chequred plate.
IS:3613	Acceptance tests for wire flux combination for submerged arc welding.
IS:3658	Code of practice for liquid penetrant flaw detection.
IS:3664	Code of practice for ultra sonic pulse echo testing contact and immersion method
IS:3757	High strength structural bolts.
IS:4000	High strength bolts in steel structure - code of practice.
IS:4353	Sub merged arc welding of mild steel and low alloy steel Recommendation
IS:4759	Hot dip zinc coating on structural steel and other allied products.
IS:5334	Code of practice for magnetic particle flaw detection of welds.
IS:5369	General requirements for plain washers and lock washer
IS : 6623	High strength structural nuts.
IS:6649	Hardened and tampered washers for high strength structural bolts & nuts.
IS:6911	Stainless steel plate, sheet and strip.
IS:7205	Safety code for erection of structural steel.
IS:7215	Tolerances for fabrication of structural steel.
IS:7307	Approved test for welding procedures
(Part - I)	Fusion welding of steel.
IS:7310 (Part-I)	Approval test for welders working to approval welding procedure. Fusion welding of steel
IS:9178 (Part-1to 3)	Criteria for design of steel bins for storage of bulk material.
IS:9595	Recommendations for metal arc welding of carbon & carbon manganese steel.

IS:12843	Tolerances for erection of steel structures.
SP:6 (Part 1 to 7)	ISI Hand book for structural Engineers.

Plastering and Allied Works

IS:1661	Code of practice for application of cement and cement lime plaster finishes.
IS:2402	Code of practice for external rendered finishes.
IS:2547 (Parts 1&2)	Gypsum building plaster.

Acid and Alkali Resistant Lining

IS:158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
IS:412	Expanded metal steel sheets for general purpose.
IS:4441	Code of practice for use of silica type chemical resistant mortars.
IS:4443	Code of practice for use of resin type chemical resistant mortars.
IS:4456 (Part I & II)	Method of Test for chemical resistant tiles.
IS:4457	Ceramic unglazed vitreous acid resisting tiles.
IS:4832	Specification for chemical resistant mortars.
(Part - 1)	Silicate type
(Part - 2)	Resin type
(Part - 3)	Sulfur type
IS:4860	Acid resistant bricks.
IS:9510	Bitumastic acid resisting grade.

Water Supply, Drainage and Sanitation

IS:458	Precast concrete pipes (with & without reinforcement).
IS:554	Pipe threads where pressure tight joints are made on the threads – dimensions, tolerances and designation.
IS:651	Salt glazed stoneware pipes and fittings.
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 & stop valves for water services.
IS:782	Caulking lead.
IS:783	Code of practice for laying of concrete pipes.
IS:1172	Code of basic requirements of water supply, drainage and sanitation.
IS:1230	Cast iron rain water pipes and fittings.
IS:1239 (Part 1&2)	Mild Steel tubes, tubulars and other wrought steel fittings
IS:1536	Centrifugally cast (Spun) iron pressure pipes for water.
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	Copper alloy float valve for water supply fitting.
IS:1726	Cast iron manhole covers and frames.
IS:1729	Cast iron / Ductile iron drainage pipes and pipe/fittings for over ground non pressure pipeline socket and spigot series.
IS:1742	Code of practice for building drainage.
IS:2064	Selection, installation and maintenance of sanitary appliances.
IS:2065	Code of practice for water supply in buildings.
IS:2326	Automatic flushing cisterns for urinals.
IS:2548	Plastic seats and covers for water closets.
IS:2556	Vitreous sanitary appliances (vitreous china).
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	steel pipe for water and sewage (168.3 to 2540mm outside diameter)
IS:3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS:4111 (Part 1 to 5)	Code of practice for ancillary structure in sewerage system.

	IS:4127	Code of practice for laying of glazed stone ware pipes.
	IS : 4733	Methods of sampling and testing sewage effluents.
	IS:4764	Tolerance limits for sewage effluents discharged into inland surface waters.
	IS:1068	Electroplated coating of nickel plus chromium and copper plus nickel plus chromium.
	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 electrically welded steel pipes for water supply.
	IS:5961	Specification for cast iron grating for drainage purpose.
	IS:7740	Code of practice for construction and maintenance of road gullies.
	IS:8931	Copper alloy fancy single taps combination tap assembly and stop valves for water services.
	IS:9762	Polyethylene floats for float valves.
	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.
	IS:13983	Stainless steel sinks for domestic purposes.
	SP:35	Hand book on water supply and drainage with special emphasis on plumbing.
	CPH&EEO	Manual on sewage and sewage treatment
	Publication	- as updated.
	Doors Windows and Allied Works	
	IS:204	Tower Bolts.
	(Part 1)	Ferrous metals
	(Part 2)	Non - ferrous metals
	IS:208	Door Handles.
	IS:281	Mild steel sliding door bolts for use with padlocks.
	IS:362	Parliament Hinges.
	IS:419	Putty, for use on window frames.
	IS:451	Technical supply conditions for wood screws

IS:733	Wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes.
IS:1003 (Part I)	Timber panelled and glazed shutters (doors shutters).
IS:1003	Timber panelled and glazed shutters
(Part-1)	door 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:1285	Wrought aluminium and aluminium alloy extruded round tube & hollow section (for general engineering purposes).
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	Wooden flush door shutters (solid core type) particle
(Part-2)	board face panels and hard board face panels.
IS:2209	Mortice locks (vertical type)
IS:2553	Safety glass.
(Part-1)	General purposes
IS:2835	Flat transparent sheet glass.
IS:3548	Code of practice for glazing in buildings.
IS:3564	Door closers (Hydraulically regulated)
IS:3614	Specification for fire check doors :
(Part-1)	plate, metal covered and rolling type.
(Part-2)	Resistance test and performance criteria.
IS:4351	Specification for steel door frames.
IS:5187	Flush bolts.
IS:5437	Figured, rolled and wired glass.
IS:6248	Specification for metal rolling shutters and rolling grills.

IS:6315	Specification for floor springs (Hydraulically regulated) for heavy doors.
IS:7196	Hold fast.
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:12823	Prelaminated particle boards.

Roof Water Proofing and Allied Works

IS:3067	code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
ASTM	Standard specification for high solid content cold
C836-89a	liquid applied elastomeric water proofing membrane for use with separate wearing course.
ASTM	Standard guide for high solid content cold
C898-89	liquid applied elastomeric water proofing membrane for use with separate wearing course.

Floor Finishes and Allied Works

IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.
IS:8042	White portland cement.
IS:13755	Dust pressed ceramic tiles with water absorption of 3%, E 6% (Group B11a).
IS:13801	Chequered cement concrete tiles.

Painting and Allied Works

IS:162	Ready mixed paint, brushing fire resisting, silicate type for use on wood, colour as required.
IS:428	Distemper, oil, emulsion, colour as required.
IS:1477	Code of practice for painting of terrous metals in buildings.
(Part -1) (Part -2)	Pretreatment. Painting.
IS:1650	Specification for colours for building and decorative materials.
IS:2074	Ready mixed paint, air drying, red oxide-zinc chrome, priming.

	IS:2338	Code of practice for finishing of wood and wood based materials.
	(Part -1)	Operations and Workmanship.
	(Part -2)	Schedule.
	IS:2395	Code of pratice for painting concrete, masonry and plaster surfaces.
	(Part-1)	Operations and Workmanship.
	(Part -2)	Schedule.
	IS:2524	Code of practice for painting of nonferrous metals in buildings.
	(Part -1)	Pretreatment
	(Part -2)	Painting.
	IS:2932	Enamel, synthetic, exterior, (a) under coating and (b) finishing.
	IS:2933	Enamel exterior, (a) under coating, (b) finishing.
	IS:4759	Hot dip zinc coatings on structural steel and other allied products.
	IS:5410	Specification for cement paint.
	IS:15489	Plastic emulsion paint.
	IS:6278	Code of practice for white washing and Colour washing.
	IS:10403	Glossary of term related to building finish.
	IS:12027	Silicone based water repellent
	IS:13238	Epoxy based zinc phosphate primer (2 pack)
	IS:13239	Epoxy surfacer (2 pack)
	IS:13467	Chlorinated rubber for paints
	IS:14209	Epoxy enamel, two component glossy.
	BS:5493	Code of practice for protective coating of iron and steel structures against corrosion.
	Piling and Foundation	
	IS:1080	Code of practice for design and construction of shallow foundations on soils.
	IS:1904	Code of practice for design and construction of foundation in Soils : General Requirements.
	IS:2314	Steel sheet piling sections.
	IS:2911	Code of practice for design and construction of pile foundations.

	(Relevant Parts)
IS:2950	Code of practice for designs and construction of Raft foundation.
(Part-1)	Design
IS:2974 (Part-1 to 5)	Code of practice for design and construction of machine foundation.
IS:4091	Code of practice for design and construction foundations for transmission line towers and poles.
IS:6403	Code of practice for determination of Bearing capacity of Shallow foundations.
IS:8009	Code of practice for calculation of settlement of foundation.
(Part -1)	Shallow foundations.
(Part -2)	Deep foundations.
IS:12070	Code of practice for design and construction of shallow foundations on rocks.
ISO 10816	Criteria for assessing mechanical vibrations of machines.
ISO 1940	Criteria for assessing the st of balance of rotating rigid bodies.
DIN : EN 13906-1	Helical compression spring made of round wire and rod : calculation and design of compression .
DIN:2096	Helical compression spring out of round wire and rod : Quality requirements for hot formed compression spring.
DIN:4024	Flexible supporting structures for machine with rotating machines.
Roads	
IRC:5 (Section-1)	Standard specifications and Code of practice for road bridges, General Features of Design.
IRC:14	Recommended practice for 2cm thick bitumen and tar carpets.
IRC:15	Standard specifications and code of practice for construction of concrete roads.
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 (Section-III)	Standard specifications and Code of practice for road bridges. Cement concrete (plain and reinforced).
IRC:34	Recommendations for road construction in water logged 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:58	Guidelines for the design of rigid pavements for highways.
	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 (Road wing), specifications for road and bridge works.
	IS:73	Paving bitumen.
	Loading	
	IS:875	Code of practice for design loads (other than earthquake) for (Relevant parts) 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 and poles.
	IRC:6 (Section-II)	Standard specifications & Code of practice for road bridges. loads and stresses
	Safety	
	IS:1641	Code of practice for fire safety of buildings - General principles of fire grading and classification.
	IS:1642	Code of practice for fire safety of buildings - Details of construction.
	IS:3696 (Part-1&2)	Safety code for scaffolds and ladders.
	IS:3764	Excavation work - code of safety.
	IS:4081 IS:4130	Safety code for blasting and related drilling operations. Demolition of buildings - code of safety.
	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 of structural steel work.

IS:7293 Safety code for working with construction machinery.

IS:7969 Safety code for handling and storage of building materials.
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)

ECBC Energy Conservation Building Code

GRIHA Green Rating For Integrated Habitat Assessment.

Tall Structures, Chimneys

IS:4998 Criteria for design of reinforced chimneys
IS:6533 Code of practice for design and construction of steel chimneys

ICAO International Civil Aviation Organisation (ICAO)

DGCA Instruction of Director General of Civil Aviation , India

ACI:307 Specification for the design and construction of reinforced concrete chimneys

BS:4076 Specification for steel chimneys

CICIND Model Code for concrete chimneys
Model code for steel chimneys

ASCE Code Design and construction of steel chimney liners prepared by Task committee on steel chimney liners. Fossil power committee, Power division published by ASCE - 1975.

IS:1554 PVC insulated (heavy duty) electric cables

IS:2606 Alloy lead anodes for chromium plating

IS:3043 Code of Practice for Earthing

IS:9537 Conduits for electrical installations.
The Indian Electricity Rules
The Indian Electricity Act
The Indian Electricity (Supply) Act
The Indian Factories Act

IS:2309 Practice for protection of buildings and allied structures against lightning

Miscellaneous

IS:802 (Relevant parts)	Code of practice for use of structural steel in 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	Criteria for design of lined canals and guidance for selection of type of lining.
IS:11592	Code of practice for selection and design of belt conveyors.
IS:12867	PVC handrails covers.
IS 11504	Criteria for structural design of reinforced concrete natural draught cooling towers
BS:4485 (IV)	British Standard : Code of design for water cooling towers
CIRIA Publication	Design and construction of buried thin-wall pipes.
IS 4671	Expanded polystyrene for thermal insulation purposes.

D-1-12(B)

ANNEXURE (B)

CONSTRUCTION METHODOLOGY

Construction and erection activities shall be fully mechanized from the start of the work.

All excavation and backfilling work shall be done using excavators, loaders, dumpers, dozers, poclains, excavator mounted rock breakers, rollers, sprinklers, water tankers, etc. Manual excavation can be done only on isolated places with specific approval of engineer.

For controlled rock blasting specialized agency, equipped with sensors to assess the impact of the blast on the adjoining existing structures, shall be employed.

Dewatering shall be done using the combination of electrical and standby diesel pumps.

Pile installation equipment suitable for flushing with air lift technique shall be used for construction of bored piles.

For concreting, weigh batching plants, transit mixers, concrete pumps, hoists, etc. shall be used.

All fabrication and erection activities of structural steel shall be carried out using automatic submerged arc welding machines, cutting machines, gantry cranes, crawler mounted heavy cranes and other equipment like heavy plate bending machines, shearing machines, lathe, milling machines, etc. Use of derricks shall not be permitted. Special enclosures, for blast cleaning of steel structure surface preparation, shall be used.

All handling of materials shall be with cranes. Heavy trailers shall be used for transportation.

Mechanized modular units of scaffolding and shuttering shall be used.

Grouting shall be carried out using hydraulically controlled grouting equipment.

Roadwork shall be done using pavers, rollers and premix plant.

All finishing items shall be installed using appropriate modern mechanical tools. Manual punching etc. shall not be permitted.

Heavy duty hoists for lifting of construction materials shall be deployed. Compressors for cleaning of foundations and other surfaces shall be used.

Field laboratory shall be provided with all modern equipment for survey, testing of soil, aggregates, concrete, welding, etc. For testing of steel works, ultrasonic testing machines, radiographic testing machines, dye penetration test equipment, destruction testing equipment, etc. shall be deployed.

All persons working at site shall be provided with necessary safety equipment and all safety aspects shall be duly considered for each construction/ erection activity. Moreover, only the persons who are trained in the respective trade shall be employed for executing that particular work.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 07/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.1

Co-ordinates E=(-)600.000 N=870.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 31/07/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.160 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of brownish grey, silty clay / clayey silt with decomposed rock.		Refusal	DS-1	0.50
		100 5.0 cm Pentn.	*SPT-1	1.00-1.05
1.40m.		100 Refusal 4.0 cm Pentn.	*SPT-2	1.40-1.44
Highly wearthered, reddish brown, fine grained, highly fractured shale.		NX. drilling from 1.40m to 20.00m	R1	CR=24% RQD=NIL
			R2	CR=25% RQD=NIL
2.75m.			R3	CR=28% RQD=NIL
			R4	CR=30% RQD=NIL
			R5	CR=32% RQD=16%
			R6	CR=36% RQD=13%
			R7	CR=40% RQD=20%
Highly wearthered, reddish brown, fine grained, highly fractured shale.			R8	CR=40% RQD=24%
			R9	CR=36% RQD=16%
			R10	CR=26% RQD=20%
			R11	CR=38% RQD=20%
			R12	CR=38% RQD=NIL
10.50m.				

1.40 → 2.00 → 2.75 → 3.50 → 4.25 → 5.00 → 5.75 → 6.50 → 7.25 → 8.00 → 8.75 → 9.50 → 10.25

BH-1/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.1

Co-ordinates E=(-)600.000 N=870.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 31/07/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.160 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m Highly wearthered, reddish brown, fine grained, fractured shale.			R13	CR=35% RQD=24% 11.00
11.00m			R14	CR=44% RQD=26% 11.75
			R15	CR=45% RQD=30% 12.50
			R16	CR=45% RQD=32% 13.25
Moderately weathered, reddish brown, fine grained, highly to modeartely fractured shale.			R17	CR=50% RQD=40% 14.00
			R18	CR=54% RQD=26% 14.75
			R19	CR=44% RQD=29% 15.50
			R20	CR=48% RQD=13% 16.25
16.25m			R21	CR=52% RQD=26% 17.00
			R22	CR=55% RQD=30% 17.75
Moderately weathered, reddish brown, fine grained, highly to modeartely fractured shale.			R23	CR=40% RQD=16% 18.50
			R24	CR=58% RQD=42% 19.25
			R25	CR=55% RQD=36% 20.00
20.00m				

N.B. – '*' means sample could not be recovered.

BH-1/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.2

Co-ordinates E=(-)585.000 N=920.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 03/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.230 M.
Water Struck At :
Standing Water Level : 3.50 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consist of brownish grey, clayey silt / silty clay with decomposed rock.			DS-1	0.50
		Refusal 100 5.0 cm Pentn.	*SPT-1	1.00-1.05
1.50m.		Refusal 100 4.0 cm Pentn.	*SPT-2	1.50-1.54
		NX. drilling from 1.50m to 20.00m	R1	CR=30% RQD=26%
			R2	CR=30% RQD=20%
			R3	CR=29% RQD=NIL
			R4	CR=32% RQD=NIL
			R5	CR=34% RQD=NIL
Highly to moderately weathered, reddish brown, fine grained, highly to moderately fractured shale.			R6	CR=38% RQD=NIL
			R7	CR=40% RQD=NIL
			R8	CR=38% RQD=NIL
			R9	CR=36% RQD=NIL
			R10	CR=40% RQD=24%
			R11	CR=42% RQD=16%
			R12	CR=40% RQD=20%
10.50m.				

1.50 2.25 3.00 3.75 4.50 5.25 6.00 6.75 7.50 8.25 9.00 9.75 10.50

BH-2/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 13/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.2

Co-ordinates E=(-)585.000 N=920.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 03/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.230 M.
Water Struck At :
Standing Water Level : 3.50 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m.				
			R13	CR=38% RQD=26% 11.25
			R14	CR=36% RQD=NIL 12.00
			R15	CR=38% RQD=NIL 12.75
			R16	CR=40% RQD=20% 13.50
			R17	CR=41% RQD=30% 14.25
			R18	CR=46% RQD=30% 15.00
Highly to moderately weathered, reddish brown, fine grained, highly to moderately fractured shale.			R19	CR=44% RQD=30% 15.75
			R20	CR=43% RQD=32% 16.50
			R21	CR=48% RQD=24% 17.25
			R22	CR=49% RQD=30% 18.00
			R23	CR=46% RQD=20% 18.75
18.75m.				
			R24	CR=58% RQD=40% 19.50
Moderately weathered, reddish brown, fine grained, highly to moderately fractured shale.			R25	CR=60% RQD=20% 20.00
20.00m.				

N.B. – '*' means sample could not be recovered.

BH-2/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.3

Co-ordinates E=(-)700.000 N=900.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 10/06/2018
Completion Date : 11/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.620 M.
Water Struck At :
Standing Water Level : 4.08 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Filled up soil consists of brown, clayey silt with decomposed rock fragments. 0.30m		Refusal 100 2.0 cm Pentr.	DS-1 *SPT-1	0.20 0.30-0.32
Moderately weathered, reddish brown, fine grained, highly fractured shale. 1.05m		NX. drilling from 0.30m to 15.00m	R1	CR=41% RQD=NIL
			R2	CR=58% RQD=NIL
			R3	CR=61% RQD=NIL
			R4	CR=60% RQD=NIL
			R5	CR=61% RQD=NIL
Moderately to slightly weathered, reddish brown, fine grained, highly to moderately fractured shale.			R6	CR=57% RQD=NIL
			R7	CR=68% RQD=NIL
			R8	CR=57% RQD=NIL
			R9	CR=65% RQD=NIL
			R10	CR=64% RQD=20%
7.80m Moderately weathered, reddish brown, fine grained, highly fractured shale. 8.50m			R11	CR=48% RQD=NIL

0.30 1.05 1.80 2.55 3.30 4.05 4.80 5.55 6.30 7.05 7.80 8.55

BH-3/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.3

Co-ordinates E=(-)700.000 N=900.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 10/06/2018
Completion Date : 11/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.620 M.
Water Struck At :
Standing Water Level : 4.08 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m Moderately weathered, reddish brown, fine grained, highly fractured shale.			R12	CR=45% RQD=NIL
9.30m				9.30
Moderately to slightly weathered, reddish brown to light grey, fine grained, highly to modeartely fractured shale.			R13	CR=56% RQD=NIL
				10.05
			R14	CR=62% RQD=37%
10.80m				10.80
Moderately to slightly weathered, light grey, fine grained, moderately fractured shale.			R15	CR=41% RQD=NIL
				11.55
			R16	CR=44% RQD=NIL
				12.30
			R17	CR=54% RQD=NIL
				13.05
			R18	CR=53% RQD=NIL
				13.80
			R19	CR=49% RQD=NIL
				14.50
			R20	CR=46% RQD=NIL
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-3/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.4

Co-ordinates E=(-)775.000 N=920.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 13/06/2018
Completion Date : 15/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.010 M.
Water Struck At :
Standing Water Level : 4.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	Depth (m)
0.00m				
Filled up soil consists of reddish brown, clayey silt with decomposed rock.			DS-1	0.50
1.00m		Refusal 100 3.0 cm Pentn. NX. drilling from 1.00m to 15.00m	*SPT-1	1.00-1.03
Moderately weathered, reddish brown, fine grained, highly fractured shale.			R1	CR=56% RQD=NIL
			R2	CR=60% RQD=NIL
			R3	CR=50% RQD=NIL
			R4	CR=53% RQD=NIL
			R5	CR=58% RQD=NIL
4.75m			R6	CR=48% RQD=NIL
Highly weathered, reddish brown, fine grained, highly fractured shale.			R7	CR=49% RQD=NIL
			R8	CR=36% RQD=NIL
7.00m			R9	CR=41% RQD=NIL
Moderately weathered, light grey to brownish grey, fine grained, highly fractured shale.			R10	CR=49% RQD=NIL
8.50m				

1.00 1.75 2.50 3.25 4.00 4.75 5.50 6.25 7.00 7.75 8.50

BH-4/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.4

Co-ordinates E=(-)775.000 N=920.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 13/06/2018
Completion Date : 15/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.010 M.
Water Struck At :
Standing Water Level : 4.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m				
Slightly weathered, light grey to brownish grey, fine grained, highly fractured shale.			R11	CR=65% RQD=NIL
9.25m				9.25
			R12	CR=35% RQD=NIL
				10.00
			R13	CR=40% RQD=NIL
				10.75
			R14	CR=44% RQD=NIL
				11.50
			R15	CR=31% RQD=NIL
				12.25
Highly weathered, light grey to brownish grey, fine grained, highly fractured shale.			R16	CR=39% RQD=NIL
				13.00
			R17	CR=26% RQD=NIL
				13.75
			R18	CR=26% RQD=NIL
				14.50
			R19	CR=24% RQD=NIL
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-4/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.5

Co-ordinates E=(-)780.000 N=875.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 25/06/2018
Completion Date : 26/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.950 M.
Water Struck At :
Standing Water Level : 3.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	Depth (m)
0.00m Filled up soil consists of reddish brown, clayey silt to silty clay with decomposed rock fragments.			DS-1	0.50
0.60m		Refusal 100 2.0 cm Pentn.	*SPT-1	0.60-0.62
		NX. drilling from 0.60m to 15.00m	R1	CR=29% RQD=NIL
			R2	CR=34% RQD=NIL
			R3	CR=38% RQD=NIL
			R4	CR=37% RQD=NIL
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R5	CR=39% RQD=10%
			R6	CR=40% RQD=NIL
			R7	CR=50% RQD=NIL
			R8	CR=42% RQD=40%
			R9	CR=44% RQD=NIL
7.25m Highly to moderately weathered, reddish brown to light grey, fine grained, fractured shale.			R10	CR=53% RQD=NIL
8.50m			R11	CR=56% RQD=NIL

0.60 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00

BH-5/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.5

Co-ordinates E=(-)780.000 N=875.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 25/06/2018
Completion Date : 26/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.950 M.
Water Struck At :
Standing Water Level : 3.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m Highly to moderately weathered, reddish brown to light grey, fine grained, fractured shale.				8.75
			R12	CR=54% RQD=NIL
9.50m				9.50
			R13	CR=49% RQD=17%
				10.25
			R14	CR=51% RQD=NIL
				11.00
			R15	CR=44% RQD=NIL
Highly weathered, light grey, fine grained, fractured shale.				11.75
			R16	CR=32% RQD=NIL
				12.50
			R17	CR=39% RQD=NIL
				13.25
			R18	CR=37% RQD=NIL
				14.00
			R19	CR=38% RQD=NIL
				14.50
			R20	CR=36% RQD=NIL
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-5/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.6

Co-ordinates E=(-)660.520 N=899.260

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 19/06/2018
Completion Date : 20/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.880 M.
Water Struck At :
Standing Water Level : 3.02 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m			DS-1	0.30
Filled up with reddish brown, clayey silt with decomposed rock fragments. 0.40m		Refusal 100	*SPT-1	0.40-0.42
Highly weathered, reddish brown, fine grained, fractured shale. 1.15m		2.0 cm Pentn. NX. drilling from 0.40m to 20.00m	R1	CR=40% RQD=14% 1.15
			R2	CR=65% RQD=26% 1.90
			R3	CR=76% RQD=NIL 2.65
			R4	CR=66% RQD=16% 3.40
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.			R5	CR=69% RQD=NIL 4.15
			R6	CR=74% RQD=NIL 4.90
			R7	CR=56% RQD=NIL 5.65
			R8	CR=56% RQD=NIL 6.40
6.90m			R9	CR=68% RQD=NIL 7.15
			R10	CR=69% RQD=NIL 7.90
			R11	CR=66% RQD=36% 8.65
Moderately / slightly weathered, reddish brown / light grey to dark grey, fine grained, fractured shale.			R12	CR=69% RQD=24% 9.40
			R13	CR=72% RQD=20% 10.15
10.50m			R14	CR=70% RQD=NIL

BH-6/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.6

Co-ordinates E=(-)660.520 N=899.260

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 19/06/2018
Completion Date : 20/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.880 M.
Water Struck At :
Standing Water Level : 3.02 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m				10.90
Moderately / slightly weathered, reddish brown / light grey to dark grey, fine grained, fractured shale.			R15	CR=53% RQD=NIL
				11.65
			R16	CR=61% RQD=NIL
12.40m				12.40
Highly to moderately weathered, light grey to dark grey, fine grained, fractured shale.			R17	CR=37% RQD=21%
				13.15
			R18	CR=48% RQD=40%
13.90m				13.90
Moderately weathered, light grey to dark grey, fine grained, fractured shale.			R19	CR=60% RQD=18%
				14.65
			R20	CR=56% RQD=13%
				15.40
			R21	CR=56% RQD=29%
				16.15
			R22	CR=57% RQD=NIL
16.90m				16.90
Highly weathered, light grey to dark grey, fine grained, fractured shale.			R23	CR=37% RQD=NIL
				17.65
			R24	CR=40% RQD=NIL
18.40m				18.40
Moderately / slightly weathered, light grey to dark grey, fine grained fractured shale.			R25	CR=63% RQD=33%
				19.15
			R26	CR=52% RQD=NIL
				19.60
			R27	CR=72% RQD=NIL
20.00m				20.00

N.B. – '*' means sample could not be recovered.

BH-6/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.7

Co-ordinates E=(-)676.000 N=846.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	1

Commencement Date : 12/06/2018
Completion Date : 14/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.840 M.
Water Struck At :
Standing Water Level : 3.27 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil with reddish brown, clayey silt with decomposed rock fragment. 0.40m.		Refusal 100 2.0 cm Pentr. NX. drilling from 0.40m to 20.00m	DS-1	0.20
			*SPT-1	0.40-0.42
			R1	CR=32% RQD=NIL
Highly weathered, reddish brown, fine grained, highly fractured shale.			R2	CR=36% RQD=NIL
			R3	CR=37% RQD=NIL
			R4	CR=33% RQD=NIL
03.40m.			WS-1	3.27
			R5	CR=61% RQD=NIL
			R6	CR=58% RQD=NIL
			R7	CR=65% RQD=NIL
			R8	CR=62% RQD=29%
Moderately / slightly weathered, reddish brown, fine grained, highly to moderately fractured shale.			R9	CR=63% RQD=NIL
			R10	CR=66% RQD=NIL
			R11	CR=60% RQD=NIL
			R12	CR=62% RQD=NIL
			R13	CR=54% RQD=NIL
10.50m.			R14	CR=60% RQD=NIL

0.40 1.15 1.90 2.65 3.40 4.15 4.90 5.65 6.40 7.15 7.90 8.65 9.40 10.15

BH-7/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.7

Co-ordinates E=(-)676.000 N=846.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	1

Commencement Date : 12/06/2018
Completion Date : 14/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.840 M.
Water Struck At :
Standing Water Level : 3.27 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				10.90
Moderately / slightly weathered, reddish brown, fine grained, highly to moderately fractured shale.			R15	CR=53% RQD=NIL
				11.65
			R16	CR=56% RQD=NIL
10.50m.				12.40
			R17	CR=48% RQD=17%
				13.15
Moderately weathered, reddish brown, fine grained, moderately fractured shale.			R18	CR=46% RQD=22%
				13.90
			R19	CR=48% RQD=NIL
12.40m.				14.65
			R20	CR=53% RQD=13%
				15.40
			R21	CR=56% RQD=NIL
				16.15
			R22	CR=61% RQD=16%
				16.90
Moderately to slightly weathered, light grey to brownish grey, fine grained, moderately fractured shale.			R23	CR=64% RQD=49%
				17.65
			R24	CR=58% RQD=NIL
				18.40
			R25	CR=65% RQD=36%
				19.15
			R26	CR=62% RQD=NIL
				19.65
			R27	CR=80% RQD=NIL
14.65m.				20.00
20.00m.				

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.8

Co-ordinates E=(-)649.000 N=849.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 17/06/2018
Completion Date : 18/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.060 M.
Water Struck At :
Standing Water Level : 4.14 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN=15CM)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Filled up with reddish brown, clayey silt with decomposed rock fragments.			DS-1	0.50
0.80m		Refusal 100 3.0 cm Pentn.	*SPT-1	0.80-0.83
Highly to moderately weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 0.80m to 20.00m	R1	CR=33% RQD=NIL 1.25
			R2	CR=28% RQD=NIL 2.00
			R3	CR=38% RQD=NIL 2.75
			R4	CR=44% RQD=NIL 3.50
3.50m Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R5	CR=56% RQD=NIL 4.25
			R6	CR=65% RQD=20% 5.00
			R7	CR=66% RQD=17% 5.75
			R8	CR=66% RQD=NIL 6.50
			R9	CR=65% RQD=NIL 7.25
			R10	CR=65% RQD=NIL 8.00
			R11	CR=64% RQD=13% 8.75
			R12	CR=62% RQD=NIL 9.50
			R13	CR=66% RQD=NIL 10.25
10.50m				

BH-8/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.8

Co-ordinates E=(-)649.000 N=849.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 17/06/2018
Completion Date : 18/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.060 M.
Water Struck At :
Standing Water Level : 4.14 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m Moderately to slightly weathered, reddish brown, fine grained, fractured shale. 11.00m			R14	CR=61% RQD=NIL 11.00
			R15	CR=57% RQD=NIL 11.75
			R16	CR=54% RQD=NIL 12.50
			R17	CR=62% RQD=24% 13.25
			R18	CR=60% RQD=46% 14.00
Moderately / slightly weathered, light grey to dark grey, fractured shale.			R19	CR=66% RQD=46% 14.75
			R20	CR=65% RQD=38% 15.50
			R21	CR=61% RQD=17% 16.25
			R22	CR=57% RQD=NIL 17.00
17.00m Moderately / slightly weathered, light grey to dark grey, fractured shale.			R23	CR=65% RQD=NIL 17.75
			R24	CR=54% RQD=NIL 18.50
			R25	CR=53% RQD=NIL 19.25
			R26	CR=66% RQD=NIL 20.00
20.00m				

N.B. – '*' means sample could not be recovered.

BH-8/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.9

Co-ordinates E=(-)665.000 N=820.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 14/06/2018
Completion Date : 16/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.092 M.
Water Struck At :
Standing Water Level : 4.34 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Filled up with reddish brown clayey silt with decomposed rock fragments			DS-1	0.40
0.50m		Refusal 100 2.0 cm Pentn.	*SPT-1	0.50-0.52
		NX. drilling from 0.50m to 20.00m	R1	CR=44% RQD=NIL
			R2	CR=45% RQD=NIL
			R3	CR=46% RQD=NIL
			R4	CR=41% RQD=NIL
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R5	CR=36% RQD=NIL
			R6	CR=37% RQD=NIL
			R7	CR=56% RQD=NIL
			R8	CR=44% RQD=NIL
6.50m			R9	CR=74% RQD=14%
			R10	CR=65% RQD=16%
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R11	CR=49% RQD=NIL
			R12	CR=57% RQD=36%
			R13	CR=57% RQD=NIL
10.50m			R14	CR=64% RQD=NIL

0.50 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00 8.75 9.50 10.25

BH-9/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.9

Co-ordinates E=(-)665.000 N=820.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 14/06/2018
Completion Date : 16/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.092 M.
Water Struck At :
Standing Water Level : 4.34 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN=15CM)	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m Moderately to slightly weathered, reddish brown, fine grained, fractured shale.				11.00
11.00m			R15	CR=34% RQD=NIL
				11.75
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R16	CR=45% RQD=NIL
				12.50
			R17	CR=50% RQD=NIL
13.25m				13.25
			R18	CR=62% RQD=37%
				14.00
			R19	CR=57% RQD=NIL
				14.75
			R20	CR=49% RQD=NIL
				15.50
Moderately to slightly weathered, light grey to dark grey, fine grained fractured shale.			R21	CR=69% RQD=18%
				16.25
			R22	CR=62% RQD=NIL
				17.00
			R23	CR=60% RQD=NIL
				17.75
			R24	CR=64% RQD=NIL
				18.50
			R25	CR=56% RQD=NIL
				19.25
			R26	CR=64% RQD=NIL
20.00m				20.00

N.B. – '*' means sample could not be recovered.

BH-9/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.10

Co-ordinates E=(-)769.000 N=1318.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	5
		Water Sample (WS)	0

Commencement Date : 17/07/2018
Completion Date : 19/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.712 M.
Water Struck At :
Standing Water Level : 4.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
			DS-1	0.50
			DS-2	1.00
Filled up with ash, coal, brick bats, concrete etc.			DS-3	2.00
			DS-4	3.00
		7 19 21 40	SPT-1	3.20-3.65
			DS-5	4.00
4.00m.		100 Refusal 2.0 cm Pentr.	*SPT-2	4.10-4.12
Hard, brownish grey, silty clay with decomposed rock fragments. 4.20m.		100 Refusal 2.0 cm Pentr.	*SPT-3	4.20-4.22
		NX. drilling from 4.20m to 15.00m	R1	CR=30% RQD=NIL 4.20
			R2	CR=25% RQD=NIL 4.75
			R3	CR=28% RQD=NIL 5.50
			R4	CR=29% RQD=NIL 6.25
Highly to modeartely weathered, reddish brown, fine grained, fractured shale.			R5	CR=29% RQD=NIL 7.00
			R6	CR=31% RQD=NIL 7.75
8.50m.				8.50

BH-10/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.10

Co-ordinates E=(-)769.000 N=1318.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	5
		Water Sample (WS)	0

Commencement Date : 17/07/2018
Completion Date : 19/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.712 M.
Water Struck At :
Standing Water Level : 4.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m				
Highly to modeartely weathered, reddish brown, fine grained, fractured shale.			R7	CR=46% RQD=13%
				9.25
			R8	CR=34% RQD=NIL
10.00m				10.00
			R9	CR=66% RQD=62%
				10.75
			R10	CR=68% RQD=64%
				11.50
Slightly weathered, reddish brown, fine grained, fractured shale.			R11	CR=67% RQD=53%
				12.25
			R12	CR=65% RQD=62%
				13.00
			R13	CR=69% RQD=64%
				13.75
			R14	CR=62% RQD=60%
				14.50
			R15	CR=62% RQD=58%
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-10/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.11

Co-ordinates E=(-)670.000 N=1371.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 30/06/2018
Completion Date : 05/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.590 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Filled up with road materials, brick bats, decomposed rock fragments.			DS-1	0.50
		Refusal		
1.00m		100	*SPT-1	1.00-1.03
Highly weathered, reddish brown, fine grained, fractured shale.		3.0 cm Pentn. NX. drilling from 1.00m to 17.25m	R1	CR=28% RQD=NIL
1.75m				1.00 / 1.75
			R2	CR=60% RQD=45%
				2.50
			R3	CR=59% RQD=49%
				3.25
			R4	CR=53% RQD=47%
				4.00
			R5	CR=51% RQD=47%
Moderately weathered, reddish brown, fine grained, fractured shale.				4.75
			R6	CR=54% RQD=28%
				5.50
			R7	CR=60% RQD=47%
				6.25
			R8	CR=50% RQD=45%
				7.00
			R9	CR=55% RQD=39%
				7.75
			R10	CR=60% RQD=32%
8.50m				8.50
			R11	CR=41% RQD=28%
				9.25
Moderately weathered, reddish brown, fine grained, fractured shale.			R12	CR=43% RQD=14%
				10.00
			R13	CR=43% RQD=NIL
10.50m				

BH-11/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.11

Co-ordinates E=(-)670.000 N=1371.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 30/06/2018
Completion Date : 05/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.590 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m				
10.75m				10.75
Moderately weathered, reddish brown, fine grained, fractured shale.			R14	CR=53% RQD=29%
				11.50
			R15	CR=52% RQD=45%
12.25m				12.25
			R16	CR=69% RQD=65%
				13.00
			R17	CR=78% RQD=66%
				13.75
			R18	CR=80% RQD=76%
				14.50
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R19	CR=89% RQD=82%
				15.25
			R20	CR=82% RQD=77%
				16.00
			R21	CR=90% RQD=82%
				16.75
			R22	CR=86% RQD=80%
17.25m				17.25

N.B. – '*' means sample could not be recovered.

BH-11/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.12

Co-ordinates E=(-)611.000 N=1334.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 25/07/2018
Completion Date : 27/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.330 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN=15CM)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Hard(N>50), reddish brown, clayey silt with decomposed rock fragments.(Cl)		Refusal 100 3.0 cm Pentn.	DS-1	0.50
			*SPT-1	1.00-1.03
1.50m		Refusal 100 2.0 cm Pentn.	*SPT-2	1.50-1.52
		NX. drilling from 1.50m to 20.00m	R1	CR=51% RQD=NIL
				2.25
			R2	CR=51% RQD=NIL
				3.00
			R3	CR=49% RQD=NIL
				3.75
			R4	CR=58% RQD=NIL
				4.50
			R5	CR=56% RQD=NIL
				5.25
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.			R6	CR=44% RQD=NIL
				6.00
			R7	CR=53% RQD=NIL
				6.75
			R8	CR=49% RQD=NIL
				7.50
			R9	CR=62% RQD=54%
				8.25
			R10	CR=60% RQD=40%
				9.00
			R11	CR=60% RQD=20%
				9.75
			R12	CR=60% RQD=15%
10.50m				10.50

BH-12/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.12

Co-ordinates E=(-)611.000 N=1334.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 25/07/2018
Completion Date : 27/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.330 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m				
			R13	CR=60% RQD=NIL
				11.25
			R14	CR=66% RQD=23%
				12.00
			R15	CR=63% RQD=13%
				12.75
			R16	CR=60% RQD=NIL
				13.50
			R17	CR=62% RQD=13%
				14.25
			R18	CR=62% RQD=45%
				15.00
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R19	CR=61% RQD=24%
				15.75
			R20	CR=60% RQD=NIL
				16.50
			R21	CR=64% RQD=32%
				17.25
			R22	CR=61% RQD=NIL
				18.00
			R23	CR=60% RQD=21%
				18.75
			R24	CR=64% RQD=21%
				19.50
			R25	CR=50% RQD=NIL
20.00m				20.00

N.B. – '*' means sample could not be recovered.

BH-12/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.13

Co-ordinates E=(-)711.000 N=1261.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 05/07/2018
Completion Date : 07/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.160 M.
Water Struck At :
Standing Water Level : 1.70 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consist of reddish brown, silty clay to clayey silt with rock fragments.		Refusal	DS-1	0.40
0.50m. Highly weathered, reddish brown, fine grained, fractured rock.		100 2.0 cm Pentrn. NX. drilling from 0.50m to 18.25m	*SPT-1	0.50-0.52
1.25m. Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R1	CR=27% RQD=21%
			R2	CR=70% RQD=50%
			R3	CR=61% RQD=NIL
			R4	CR=74% RQD=21%
			R5	CR=65% RQD=62%
			R6	CR=61% RQD=36%
			R7	CR=69% RQD=52%
			R8	CR=62% RQD=57%
			R9	CR=66% RQD=46%
			R10	CR=65% RQD=20%
			R11	CR=69% RQD=66%
			R12	CR=67% RQD=61%
			R13	CR=72% RQD=13%
10.50m.				

0.50 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00 8.75 9.50 10.25

BH-13/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.13

Co-ordinates E=(-)711.000 N=1261.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 05/07/2018
Completion Date : 07/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.160 M.
Water Struck At :
Standing Water Level : 1.70 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m			R14	CR=67% RQD=42% 11.00
			R15	CR=66% RQD=34% 11.75
			R16	CR=61% RQD=NIL 12.50
			R17	CR=62% RQD=NIL 13.25
			R18	CR=69% RQD=65% 14.00
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R19	CR=78% RQD=66% 14.75
			R20	CR=80% RQD=76% 15.50
			R21	CR=89% RQD=82% 16.25
			R22	CR=82% RQD=77% 17.00
			R23	CR=90% RQD=82% 17.75
			R24	CR=86% RQD=80% 18.25
18.25m				

N.B. – '*' means sample could not be recovered.

BH-13/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 20/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.14

Co-ordinates E=(-)668.000 N=1283.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 14/07/2018
Completion Date : 16/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.380 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN=15CM)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Filled up with reddish brown, clayey silt to silty clay with road material.			DS-1	0.40
0.50m		Refusal 100 2.0 cm Pentr.	*SPT-1	0.50-0.52
Moderately weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 0.50m to 16.00m	R1	CR=44% RQD=19%
			R2	CR=45% RQD=24%
			R3	CR=40% RQD=36%
2.75m			R4	CR=61% RQD=55%
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R5	CR=71% RQD=41%
			R6	CR=75% RQD=69%
5.00m			R7	CR=50% RQD=40%
			R8	CR=56% RQD=52%
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R9	CR=41% RQD=NIL
			R10	CR=56% RQD=33%
8.50m			R11	CR=49% RQD=NIL

0.50 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00

BH-14/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 20/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.14

Co-ordinates E=(-)668.000 N=1283.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 14/07/2018
Completion Date : 16/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.380 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m				8.75
			R12	CR=54% RQD=50%
				9.50
			R13	CR=52% RQD=48%
				10.25
			R14	CR=49% RQD=46%
				11.00
			R15	CR=61% RQD=58%
				11.75
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R16	CR=61% RQD=52%
				12.50
			R17	CR=68% RQD=64%
				13.25
			R18	CR=73% RQD=69%
				14.00
			R19	CR=61% RQD=53%
				14.75
			R20	CR=66% RQD=64%
				15.50
			R21	CR=68% RQD=64%
16.00m				16.00

N.B. – '*' means sample could not be recovered.

BH-14/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.15

Co-ordinates E=(-)627.000 N=1259.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 14/07/2018
Completion Date : 15/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.720 M.
Water Struck At :
Standing Water Level : 1.26 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Filled up with reddish brown, clayey silt with decomposed rock fragments. 0.50m		Refusal 100 2.0 cm Pentr.	DS-1 *SPT-1	0.30 0.50-0.52
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 0.50m to 20.00m	R1 R2 R3	CR=51% RQD=24% CR=67% RQD=NIL CR=60% RQD=NIL
2.75m Highly weathered, reddish brown to greyish brown, fine grained, fractured shale.			R4 R5	CR=24% RQD=NIL CR=40% RQD=NIL
4.25m Moderately / slighly weathered, reddish brown to greyish brown, fine grained, fractured shale.			R6 R7 R8 R9 R10 R11 R12 R13	CR=67% RQD=47% CR=72% RQD=65% CR=69% RQD=17% CR=76% RQD=18% CR=68% RQD=NIL CR=64% RQD=NIL CR=72% RQD=56% CR=69% RQD=61%
10.50m				0.50 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00 8.75 9.50 10.25

BH-15/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.15

Co-ordinates E=(-)627.000 N=1259.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 14/07/2018
Completion Date : 15/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.720 M.
Water Struck At :
Standing Water Level : 1.26 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m			R14	CR=78% RQD=NIL
				11.00
			R15	CR=76% RQD=29%
				11.75
			R16	CR=69% RQD=NIL
				12.50
			R17	CR=66% RQD=NIL
				13.25
			R18	CR=69% RQD=31%
				14.00
			R19	CR=66% RQD=NIL
				14.75
Moderately / slightly weathered, reddish brown to greyish brown, fine grained, fractured shale.			R20	CR=74% RQD=23%
				15.50
			R21	CR=72% RQD=69%
				16.25
			R22	CR=72% RQD=65%
				17.00
			R23	CR=76% RQD=66%
				17.75
			R24	CR=67% RQD=42%
				18.50
			R25	CR=71% RQD=60%
				19.25
			R26	CR=55% RQD=NIL
20.00m				20.00

N.B. – '*' means sample could not be recovered.

BH-15/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.16

Co-ordinates E=(-)588.000 N=1281.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 27/06/2018
Completion Date : 28/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.980 M.
Water Struck At :
Standing Water Level : 1.62 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up with reddish brown, clayey silt with decomposed rock fragments.			DS-1	0.40
0.50m.		Refusal 100 3.0 cm Pentr.	*SPT-1	0.50-0.53
Highly weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 0.50m to 15.25m	R1	CR=21% RQD=17%
1.25m. Highly weathered, reddish brown, fine grained, fractured shale.			R2	CR=38% RQD=NIL
2.00m.			R3	CR=53% RQD=38%
Moderately weathered, reddish brown, fine grained, fractured shale.			R4	CR=54% RQD=40%
			R5	CR=57% RQD=46%
4.25m.			R6	CR=64% RQD=46%
			R7	CR=56% RQD=NIL
			R8	CR=64% RQD=31%
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.			R9	CR=60% RQD=28%
			R10	CR=72% RQD=32%
8.50m.			R11	CR=65% RQD=NIL

0.50 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00

BH-16/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.16

Co-ordinates E=(-)588.000 N=1281.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 27/06/2018
Completion Date : 28/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.980 M.
Water Struck At :
Standing Water Level : 1.62 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m				8.75
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R12	CR=64% RQD=24%
9.50m				9.50
			R13	CR=54% RQD=NIL
				10.25
			R14	CR=73% RQD=64%
Moderately to slightly weathered / fresh, reddish brown, fine grained, fractured shale.				11.00
			R15	CR=82% RQD=66%
				11.75
			R16	CR=81% RQD=57%
12.50m				12.50
			R17	CR=77% RQD=61%
				13.25
			R18	CR=85% RQD=73%
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.				14.00
			R19	CR=85% RQD=74%
				14.75
			R20	CR=82% RQD=64%
15.25m				15.25

N.B. – '*' means sample could not be recovered.

BH-16/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.17

Co-ordinates E=(-)559.000 N=1253.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 29/06/2018
Completion Date : 30/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.380 M.
Water Struck At :
Standing Water Level : 2.02 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up with reddish brown, clayey silt with decomposed rock fragments.			DS-1	0.50
0.60m.		Refusal 100 / 2.0 cm Pentr.	*SPT-1	0.60-0.62
		NX. drilling from 0.60m to 15.00m	R1	CR=63% RQD=55%
Slightly weathered / fresh, yellowish to reddish brown, fine grained, fractured shale.			R2	CR=88% RQD=56%
			R3	CR=63% RQD=NIL
2.85m.			R4	CR=93% RQD=53%
			R5	CR=94% RQD=81%
			R6	CR=77% RQD=64%
			R7	CR=77% RQD=27%
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R8	CR=89% RQD=85%
			R9	CR=80% RQD=68%
			R10	CR=85% RQD=78%
8.50m.			R11	CR=88% RQD=73%

0.60 / 1.35 / 2.10 / 2.85 / 3.60 / 4.35 / 5.10 / 5.85 / 6.60 / 7.35 / 8.10

BH-17/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.17

Co-ordinates E=(-)559.000 N=1253.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 29/06/2018
Completion Date : 30/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.380 M.
Water Struck At :
Standing Water Level : 2.02 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				8.85
8.50m Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R12	CR=91% RQD=64%
				9.60
9.60m			R13	CR=73% RQD=NIL
				10.35
			R14	CR=92% RQD=41%
				11.10
			R15	CR=76% RQD=NIL
				11.85
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R16	CR=89% RQD=37%
				12.60
			R17	CR=77% RQD=40%
				13.35
			R18	CR=76% RQD=41%
				14.10
			R19	CR=84% RQD=66%
				14.60
			R20	CR=95% RQD=92%
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-17/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.18

Co-ordinates E=(-)706.000 N=1233.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 04/07/2018
Completion Date : 05/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.430 M.
Water Struck At :
Standing Water Level : 1.58 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Filled up soil consist of reddish brown, clayey silt / silty clay with decomposed rock fragments. 0.40m		Refusal 100 2.0 cm Pentr.	DS-1 *SPT-1	0.30 0.40-0.42
Moderately weathered, reddish brown, fine grained, fractured shale. 1.15m		NX. drilling from 0.40m to 15.00m	R1	CR=44% RQD=13%
			R2	CR=60% RQD=57%
			R3	CR=66% RQD=56%
			R4	CR=67% RQD=53%
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R5	CR=68% RQD=54%
			R6	CR=65% RQD=46%
			R7	CR=73% RQD=66%
			R8	CR=69% RQD=53%
			R9	CR=65% RQD=61%
			R10	CR=64% RQD=44%
8.00m				

0.40
1.15
1.90
2.65
3.40
4.15
4.90
5.65
6.40
7.15
7.90

BH-18/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 01/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.18

Co-ordinates E=(-)706.000 N=1233.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 04/07/2018
Completion Date : 05/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.430 M.
Water Struck At :
Standing Water Level : 1.58 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m			R11	CR=66% RQD=54%
				8.65
			R12	CR=69% RQD=58%
				9.40
			R13	CR=72% RQD=69%
				10.15
			R14	CR=73% RQD=71%
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.				10.90
			R15	CR=73% RQD=36%
				11.65
			R16	CR=74% RQD=72%
				12.40
			R17	CR=72% RQD=60%
				13.15
			R18	CR=66% RQD=34%
				13.90
			R19	CR=75% RQD=68%
				14.50
			R20	CR=62% RQD=40%
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-18/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.19

Co-ordinates E=(-)641.000 N=1222.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 16/07/2018
Completion Date : 17/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.990 M.
Water Struck At :
Standing Water Level : 0.82 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Hard(N>50), reddish brown, clayey silt with decomposed rock fragments.(Cl)		Refusal	DS-1	0.50
0.70m		100	*SPT-1	0.70-0.73
		3.0 cm Pentr.		0.70
		NX. drilling from 0.70m to 15.00m	R1	CR=54% RQD=13%
				1.45
			R2	CR=36% RQD=NIL
				2.20
			R3	CR=40% RQD=NIL
Highly / moderatey weathered, reddish brown, fine grained, fractured shale.				2.95
			R4	CR=47% RQD=NIL
				3.70
			R5	CR=43% RQD=NIL
				4.45
			R6	CR=48% RQD=NIL
5.20m				5.20
			R7	CR=60% RQD=23%
				5.95
			R8	CR=67% RQD=45%
Slightly weathered, reddish brown, fine grained, fractured shale.				6.70
			R9	CR=76% RQD=39%
				7.45
			R10	CR=76% RQD=NIL
8.00m				

BH-19/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 01/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.19

Co-ordinates E=(-)641.000 N=1222.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 16/07/2018
Completion Date : 17/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.990 M.
Water Struck At :
Standing Water Level : 0.82 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m				8.20
			R11	CR=80% RQD=19%
				8.95
			R12	CR=76% RQD=51%
				9.70
			R13	CR=75% RQD=NIL
				10.45
			R14	CR=76% RQD=13%
				11.20
Slightly weathered, reddish brown, fine grained, fractured shale.			R15	CR=78% RQD=44%
				11.95
			R16	CR=67% RQD=24%
				12.70
			R17	CR=73% RQD=20%
				13.45
			R18	CR=78% RQD=24%
				14.20
			R19	CR=75% RQD=NIL
				14.60
			R20	CR=70% RQD=NIL
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-19/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.20

Co-ordinates E=(-)679.310 N=1181.384

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 25/06/2018
Completion Date : 25/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.299 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consist of reddish brown, clayey silt with decomposed rock fragments.		Refusal	DS-1	0.30
0.40m. Moderately weathered, reddish brown, fine grained, fractured shale.		100 2.0 cm Pentn. NX. drilling from 0.40m to 15.00m	*SPT-1	0.40-0.42
			R1	CR=44% RQD=NIL
1.15m.			R2	CR=61% RQD=13%
			R3	CR=64% RQD=17%
			R4	CR=62% RQD=NIL
			R5	CR=66% RQD=30%
			R6	CR=73% RQD=NIL
Slightly weathered, reddish brown, fine grained, fractured shale.			R7	CR=73% RQD=26%
			R8	CR=70% RQD=17%
			R9	CR=74% RQD=24%
			R10	CR=73% RQD=NIL
			R11	CR=72% RQD=17%
8.50m.				

0.40 1.15 1.90 2.65 3.40 4.15 4.90 5.65 6.40 7.15 7.90

BH-20/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.20

Co-ordinates E=(-)679.310 N=1181.384

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 25/06/2018
Completion Date : 25/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.299 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				8.65
Slightly weathered, reddish brown, fine grained, fractured shale.			R12	CR=74% RQD=28%
8.50m				9.40
9.40m			R13	CR=84% RQD=54%
				10.15
			R14	CR=80% RQD=21%
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.				10.90
			R15	CR=70% RQD=13%
				11.65
			R16	CR=82% RQD=20%
12.40m				12.40
			R17	CR=74% RQD=25%
				13.15
Slightly weathered to fresh, reddish brown, fine grained, fracture shale.			R18	CR=77% RQD=58%
				13.90
			R19	CR=80% RQD=68%
				14.60
			R20	CR=87% RQD=32%
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-20/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.21

Co-ordinates E=(-)584.000 N=1229.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	1

Commencement Date : 01/07/2018
Completion Date : 02/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.420 M.
Water Struck At :
Standing Water Level : 1.25 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Hard (N>50), reddish brown, clayey silt with decomposed rock fragments.(Cl)		Refusal	DS-1	0.40
0.50m.		100	*SPT-1	0.50-0.53
		3.0 cm Pentn.		0.50
		NX. drilling from 0.50m to 20.00m	R1	CR=69% RQD=15%
			WS-1	1.25
				1.25
			R2	CR=76% RQD=NIL
				2.00
			R3	CR=75% RQD=27%
				2.75
			R4	CR=76% RQD=57%
				3.50
			R5	CR=83% RQD=57%
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.				4.25
			R6	CR=76% RQD=54%
				5.00
			R7	CR=76% RQD=19%
				5.75
			R8	CR=77% RQD=57%
				6.50
			R9	CR=77% RQD=31%
				7.25
			R10	CR=75% RQD=27%
8.00m.				8.00
			R11	CR=84% RQD=56%
				8.75
Fresh, reddish brown, fine grained, fractured shale.			R12	CR=84% RQD=61%
				9.50
			R13	CR=91% RQD=37%
				10.25
10.50m.				

BH-21/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.21

Co-ordinates E=(-)584.000 N=1229.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	1

Commencement Date : 01/07/2018
Completion Date : 02/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.420 M.
Water Struck At :
Standing Water Level : 1.25 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m.			R14	CR=83% RQD=43% 11.00
			R15	CR=87% RQD=53% 11.75
			R16	CR=88% RQD=51% 12.50
			R17	CR=83% RQD=56% 13.25
			R18	CR=88% RQD=77% 14.00
			R19	CR=84% RQD=72% 14.75
Fresh, reddish brown, fine grained, fractured shale.			R20	CR=93% RQD=33% 15.50
			R21	CR=95% RQD=61% 16.25
			R22	CR=89% RQD=80% 17.00
			R23	CR=91% RQD=68% 17.75
			R24	CR=91% RQD=69% 18.50
			R25	CR=78% RQD=73% 19.25
			R26	CR=84% RQD=67% 20.00
20.00m.				

N.B. – '*' means sample could not be recovered.

BH-21/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.22

Co-ordinates E=(-)763.000 N=1162.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/07/2018
Completion Date : 02/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.400 M.
Water Struck At :
Standing Water Level : 1.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	Depth (m)
0.00m. Filled up soil consist of reddish brown, clayey silt to silty clay with decomposed rock.			DS-1	0.50
0.60m.		Refusal 100 2.0 cm Pentr.	*SPT-1	0.60-0.62
		NX. drilling from 0.60m to 15.00m	R1	CR=26% RQD=NIL
			R2	CR=32% RQD=NIL
			R3	CR=36% RQD=NIL
			R4	CR=29% RQD=NIL
Highly to modeartely weathered, reddish brown, fine grained, fractured shale.			R5	CR=40% RQD=NIL
			R6	CR=34% RQD=NIL
			R7	CR=50% RQD=NIL
			R8	CR=45% RQD=NIL
			R9	CR=44% RQD=NIL
			R10	CR=41% RQD=NIL
8.50m.			R11	CR=50% RQD=NIL

0.60 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00

BH-22/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.22

Co-ordinates E=(-)763.000 N=1162.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/07/2018
Completion Date : 02/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.400 M.
Water Struck At :
Standing Water Level : 1.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m Highly to modeartely weathered, reddish brown, fine grained, fractured shale. 8.75m				8.75
			R12	CR=53% RQD=16%
				9.50
Modeartely weathered, reddish brown, fine grained, fractured shale.			R13	CR=52% RQD=15%
				10.25
			R14	CR=54% RQD=19%
11.00m				11.00
			R15	CR=48% RQD=20%
				11.75
Modeartely weathered, reddish brown, fine grained, fractured shale.			R16	CR=40% RQD=15%
				12.50
			R17	CR=45% RQD=16%
				13.25
			R18	CR=47% RQD=21%
14.00m				14.00
			R19	CR=54% RQD=NIL
Moderately weathered, reddish brown, fine grained, fractured shale.				14.50
			R20	CR=56% RQD=52%
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-22/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.23

Co-ordinates E=(-)678.000 N=1136.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 23/06/2018
Completion Date : 24/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.340 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Hard (N>50), reddish brown, clayey silt with decomposed rock fragments.(Cl) 0.40m		Refusal 100 3.0 cm Pentn.	DS-1 *SPT-1	0.30 0.40-0.43
		NX, drilling from 0.40m to 20.00m	R1	CR=52% RQD=16%
			R2	CR=61% RQD=16%
			R3	CR=60% RQD=25%
			R4	CR=64% RQD=45%
			R5	CR=73% RQD=NIL
			R6	CR=76% RQD=44%
			R7	CR=73% RQD=52%
Moderately to slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R8	CR=72% RQD=48%
			R9	CR=73% RQD=28%
			R10	CR=76% RQD=60%
			R11	CR=74% RQD=28%
			R12	CR=72% RQD=46%
			R13	CR=74% RQD=41%
10.50m			R14	CR=82% RQD=70%

0.40 1.15 1.90 2.65 3.40 4.15 4.90 5.65 6.40 7.15 7.90 8.65 9.40 10.15

BH-23/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.23

Co-ordinates E=(-)678.000 N=1136.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 23/06/2018
Completion Date : 24/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.340 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				10.90
Moderately to slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R15	CR=78% RQD=14%
				11.65
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R16	CR=82% RQD=NIL
				12.40
			R17	CR=76% RQD=NIL
13.15m				13.15
			R18	CR=88% RQD=84%
				13.90
			R19	CR=81% RQD=73%
				14.65
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R20	CR=81% RQD=62%
				15.40
			R21	CR=84% RQD=24%
				16.15
			R22	CR=78% RQD=53%
16.90m				16.90
			R23	CR=53% RQD=16%
				17.65
			R24	CR=50% RQD=NIL
Moderately weathered, light grey, fine grained, fractured shale.				18.40
			R25	CR=52% RQD=NIL
				19.15
			R26	CR=40% RQD=NIL
				19.60
			R27	CR=60% RQD=27%
20.00m				20.00

N.B. – '*' means sample could not be recovered.

BH-23/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.24

Co-ordinates E=(-)616.000 N=1139.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 18/07/2018
Completion Date : 19/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.210 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consist of brownish grey, concrete material.			DS-1	0.30
0.40m.		Refusal 100 3.0 cm Pentn.	*SPT-1	0.40-0.43
		NX. drilling from 0.40m to 15.00m	R1	CR=68% RQD=NIL
			R2	CR=73% RQD=NIL
			R3	CR=69% RQD=40%
			R4	CR=75% RQD=32%
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R5	CR=78% RQD=35%
			R6	CR=80% RQD=25%
			R7	CR=88% RQD=60%
			R8	CR=89% RQD=81%
			R9	CR=80% RQD=38%
			R10	CR=80% RQD=28%
			R11	CR=83% RQD=42%
8.50m.				

0.40 1.15 1.90 2.65 3.40 4.15 4.90 5.65 6.40 7.15 7.90

BH-24/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.24

Co-ordinates E=(-)616.000 N=1139.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 18/07/2018
Completion Date : 19/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.210 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m				8.65
			R12	CR=81% RQD=33%
				9.40
			R13	CR=81% RQD=NIL
				10.15
			R14	CR=80% RQD=24%
				10.90
			R15	CR=84% RQD=72%
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.				11.65
			R16	CR=83% RQD=39%
				12.40
			R17	CR=84% RQD=49%
				13.15
			R18	CR=86% RQD=57%
				13.90
			R19	CR=89% RQD=51%
				14.65
			R20	CR=85% RQD=49%
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-24/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.25

Co-ordinates E=(-)710.000 N=1112.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 03/07/2018
Completion Date : 04/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.030 M.
Water Struck At :
Standing Water Level : 2.50 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	Depth (m)
0.00m Filled up soil consist of reddish brown, clayey silt to silty clay with decomposed rock fragments.			DS-1	0.40
0.50m		Refusal 100 2.0 cm Pentr.	*SPT-1	0.50-0.52
		NX. drilling from 0.50m to 15.00m	R1	CR=34% RQD=NIL
			R2	CR=40% RQD=NIL
			R3	CR=60% RQD=NIL
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R4	CR=41% RQD=NIL
			R5	CR=48% RQD=NIL
			R6	CR=47% RQD=NIL
			R7	CR=44% RQD=NIL
			R8	CR=48% RQD=29%
6.50m			R9	CR=53% RQD=30%
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R10	CR=68% RQD=64%
8.50m			R11	CR=61% RQD=18%

0.50 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00

BH-25/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.25

Co-ordinates E=(-)710.000 N=1112.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 03/07/2018
Completion Date : 04/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.030 M.
Water Struck At :
Standing Water Level : 2.50 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				8.75
			R12	CR=64% RQD=44%
				9.50
			R13	CR=62% RQD=35%
				10.25
			R14	CR=61% RQD=50%
				11.00
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R15	CR=62% RQD=53%
				11.75
			R16	CR=63% RQD=52%
				12.50
			R17	CR=64% RQD=48%
				13.25
			R18	CR=62% RQD=57%
14.00m				14.00
Highly weathered, reddish brown, fine grained, fractured shale.			R19	CR=36% RQD=26%
				14.50
			R20	CR=38% RQD=36%
15.00m				15.00

N.B. – '*' means sample could not be recovered.

BH-25/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.26

Co-ordinates E=(-)563.000 N=1151.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 19/07/2018
Completion Date : 20/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.440 M.
Water Struck At :
Standing Water Level : 3.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Filled up with brownish grey, concrete material.				
		Refusal	DS-1	0.50
0.70m		100	*SPT-1	0.70-0.72
		2.0 cm Pentm.		0.70
		NX. drilling from 0.70m to 15.00m	R1	CR=65% RQD=NIL
				1.45
			R2	CR=69% RQD=36%
				2.20
			R3	CR=66% RQD=NIL
				2.95
			R4	CR=78% RQD=32%
				3.70
			R5	CR=82% RQD=17%
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.				4.45
			R6	CR=86% RQD=30%
				5.20
			R7	CR=75% RQD=56%
				5.95
			R8	CR=78% RQD=20%
				6.70
			R9	CR=80% RQD=NIL
				7.45
			R10	CR=76% RQD=NIL
				8.20
8.50m				

BH-26/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.26

Co-ordinates E=(-)563.000 N=1151.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 19/07/2018
Completion Date : 20/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.440 M.
Water Struck At :
Standing Water Level : 3.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m			R11	CR=77% RQD=22% 8.95
			R12	CR=80% RQD=64% 9.70
			R13	CR=80% RQD=NIL 10.45
			R14	CR=62% RQD=21% 11.20
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.			R15	CR=57% RQD=NIL 11.95
			R16	CR=52% RQD=NIL 12.70
			R17	CR=73% RQD=NIL 13.45
			R18	CR=76% RQD=13% 14.20
			R19	CR=77% RQD=NIL 14.60
			R20	CR=80% RQD=NIL 15.00
15.00m				

N.B. – '*' means sample could not be recovered.

BH-26/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.27

Co-ordinates E=(-)815.000 N=1104.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 29/06/2018
Completion Date : 30/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.440 M.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Filled up soil consist of reddish brown, fine grained, clayey silt to silty clay with decomposed rock fragments.			DS-1	0.50
0.90m		Refusal 100	*SPT-1	0.90-0.92
Highly weathered, reddish brown, fine grained, fractured shale.		2.0 cm Pentn. NX. drilling from 0.90m to 20.00m	R1	CR=21% RQD=NIL
			R2	CR=23% RQD=NIL
2.25m			R3	CR=41% RQD=NIL
Modeartely weathered, reddish brown, fine grained, fractured shale.			R4	CR=45% RQD=NIL
			R5	CR=48% RQD=NIL
			R6	CR=41% RQD=NIL
			R7	CR=47% RQD=NIL
6.00m			R8	CR=53% RQD=NIL
			R9	CR=58% RQD=NIL
Moderately / slightly weathered, reddish brown, fine grained fractured shale.			R10	CR=60% RQD=NIL
			R11	CR=61% RQD=16%
			R12	CR=62% RQD=NIL
			R13	CR=61% RQD=37%
10.50m				

0.90 1.50 2.25 3.00 3.75 4.50 5.25 6.00 6.75 7.50 8.25 9.00 9.75 10.50

BH-27/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.27

Co-ordinates E=(-)815.000 N=1104.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 29/06/2018
Completion Date : 30/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.440 M.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
	10.50m		R14	CR=65% RQD=53% 11.25
			R15	CR=58% RQD=54% 12.00
			R16	CR=60% RQD=49% 12.75
Moderately / slightly weathered, reddish brown, fine grained fractured shale.			R17	CR=65% RQD=54% 13.50
			R18	CR=53% RQD=NIL 14.25
			R19	CR=52% RQD=37% 15.00
			R20	CR=48% RQD=42% 15.75
	15.75m		R21	CR=61% RQD=30% 16.50
			R22	CR=56% RQD=53% 17.25
Moderately weathered, reddish brown, fine grained, fractured shale.			R23	CR=60% RQD=40% 18.00
			R24	CR=57% RQD=38% 18.75
			R25	CR=60% RQD=33% 19.50
	19.50m		R26	CR=42% RQD=NIL 20.00
Moderately weathered, reddish brown, fine grained, fractured shale.	20.00m			

N.B. – '*' means sample could not be recovered.

BH-27/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.28

Co-ordinates E=(-)879.000 N=1167.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 06/08/2018
Completion Date : 06/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.482 M.
Water Struck At :
Standing Water Level : 2.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Filled up soil consists of reddish brown, clayey silt to silty clay with decomposed rock fragments.			DS-1	0.50
			DS-2	1.00
		Refusal 100 4.0 cm Pentm.	*SPT-1	1.50-1.54
1.70m		Refusal 100 2.0 cm Pentm.	*SPT-2	1.70-1.72
Highly weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 1.70m to 14.20m	R1	CR=23% RQD=NIL 1.70 - 2.45
			R2	CR=21% RQD=NIL 2.45 - 3.20
			R3	CR=23% RQD=NIL 3.20 - 3.95
			R4	CR=25% RQD=NIL 3.95 - 4.70
			R5	CR=26% RQD=NIL 4.70 - 5.45
			R6	CR=24% RQD=NIL 5.45 - 6.20
6.20m				
Highly weathered, reddish brown, fine grained, fractured shale.			R7	CR=28% RQD=NIL 6.20 - 6.95
			R8	CR=35% RQD=NIL 6.95 - 7.70
8.00m				

BH-28/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.28

Co-ordinates E=(-)879.000 N=1167.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 06/08/2018
Completion Date : 06/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.482 M.
Water Struck At :
Standing Water Level : 2.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m			R9	CR=25% RQD=NIL
				8.45
Highly weathered, reddish brown, fine grained, fractured shale.			R10	CR=38% RQD=NIL
9.20m				9.20
			R11	CR=65% RQD=61%
				9.95
			R12	CR=62% RQD=58%
				10.70
			R13	CR=58% RQD=56%
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.				11.45
			R14	CR=56% RQD=51%
				12.20
			R15	CR=56% RQD=53%
				12.95
			R16	CR=67% RQD=64%
				13.70
			R17	CR=64% RQD=54%
14.20m				14.20

N.B. – '*' means sample could not be recovered.

BH-28/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.29

Co-ordinates E=(-)495.000 N=1141.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	0	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	0
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 18/07/2018
Completion Date : 19/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.244 M.
Water Struck At :
Standing Water Level : 3.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.		NX. drilling from 0.00m to 20.00m		0.00
			R1 CR=38% RQD=NIL	0.75
			R2 CR=40% RQD=NIL	1.50
			R3 CR=42% RQD=NIL	2.25
			R4 CR=45% RQD=NIL	3.00
Highly / moderately weathered, reddish brown, fine grained, highly fractured shale.			R5 CR=40% RQD=NIL	3.75
			R6 CR=39% RQD=NIL	4.50
			R7 CR=40% RQD=20%	5.25
			R8 CR=38% RQD=20%	6.00
6.00m.			R9 CR=42% RQD=14%	6.75
			R10 CR=40% RQD=NIL	7.50
			R11 CR=44% RQD=NIL	8.25
Highly / moderately weathered, reddish brown, fine grained, moderately fractured shale.			R12 CR=42% RQD=NIL	9.00
			R13 CR=40% RQD=NIL	9.75
			R14 CR=36% RQD=NIL	10.50
10.50m.				

BH-29/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.29

Co-ordinates E=(-)495.000 N=1141.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	0	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	0
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 18/07/2018
Completion Date : 19/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.244 M.
Water Struck At :
Standing Water Level : 3.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m				
			R15	CR=35% RQD=NIL
				11.25
			R16	CR=40% RQD=13%
				12.00
			R17	CR=40% RQD=30%
				12.75
			R18	CR=38% RQD=13%
				13.50
			R19	CR=42% RQD=20%
Highly / moderately weathered, reddish brown, fine grained, moderately fractured shale.				14.25
			R20	CR=40% RQD=24%
				15.00
			R21	CR=42% RQD=28%
				15.75
			R22	CR=39% RQD=36%
				16.50
			R23	CR=40% RQD=38%
				17.25
			R24	CR=44% RQD=18%
18.00m				18.00
			R25	CR=56% RQD=52%
				18.75
Moderately weathered, reddish brown, fine grained, moderately fractured shale.			R26	CR=60% RQD=54%
				19.50
			R27	CR=60% RQD=58%
20.00m				20.00

BH-29/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.30

Co-ordinates E=(-)501.000 N=1322.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 24/07/2018
Completion Date : 25/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.050 M.
Water Struck At :
Standing Water Level : 2.65 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Hard(N>50), redish brown, clayey silt with disintegrated rock fragments.(Cl) 0.60m		Refusal 100 3.0 cm Pentr.	DS-1 *SPT-1	0.50 0.60-0.63
		NX. drilling from 0.60m to 15.00m	R1	CR=51% RQD=26%
			R2	CR=64% RQD=25%
			R3	CR=62% RQD=33%
Moderately to slightly weathered / fresh, reddish to greyish brown, fine grained, fractured shale.			R4	CR=81% RQD=77%
			R5	CR=93% RQD=76%
			R6	CR=88% RQD=48%
			R7	CR=84% RQD=64%
			R8	CR=80% RQD=77%
			R9	CR=81% RQD=24%
			R10	CR=80% RQD=NIL
8.00m				

0.60 1.35 2.10 2.85 3.60 4.35 5.10 5.85 6.60 7.35

BH-30/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.30

Co-ordinates E=(-)501.000 N=1322.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 24/07/2018
Completion Date : 25/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.050 M.
Water Struck At :
Standing Water Level : 2.65 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				8.10
Moderately to slightly weathered / fresh, reddish to greyish brown, fine grained, fractured shale.	8.00m / 8.10m		R11	CR=80% RQD=48%
				8.85
			R12	CR=72% RQD=61%
				9.60
			R13	CR=65% RQD=37%
				10.35
			R14	CR=76% RQD=37%
				11.10
			R15	CR=80% RQD=69%
Slightly weathered, reddish brown, fine grained, fractured shale.				11.85
			R16	CR=70% RQD=49%
				12.60
			R17	CR=78% RQD=20%
				13.35
			R18	CR=73% RQD=42%
				14.10
			R19	CR=70% RQD=60%
				14.60
			R20	CR=65% RQD=42%
	15.00m			15.00

N.B. – '*' means sample could not be recovered.

BH-30/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.31

Co-ordinates E=(-)864.000 N=1342.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	4
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 10/07/2018
Completion Date : 12/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.474 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of reddish brown, silty clay to clayey silt with decomposed rock fragments.		9 13 14 (27)	DS-1	0.50
			SPT-1	1.00-1.45
1.50m.			DS-2	2.00
Hard(N>50), reddish brown, silty clay to clayey silt with disintegrated rock fragments.(Cl)		28 72 (>100) 8 cm Pentn.	SPT-2	2.50-2.73
		100 Refusal 3.0 cm Pentn.	*SPT-3	3.00-3.03
3.10m.		100 Refusal 2.0 cm Pentn.	*SPT-4	3.10-3.12
Moderately weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 3.10m to 15.00m	R1	CR=41% RQD=NIL
3.75m.			R2	CR=58% RQD=38%
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R3	CR=64% RQD=49%
			R4	CR=70% RQD=53%
			R5	CR=65% RQD=46%
			R6	CR=66% RQD=50%
			R7	CR=73% RQD=32%
8.50m.				

3.10
3.75
4.50
5.25
6.00
6.75
7.50
8.25

BH-31/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.31

Co-ordinates E=(-)864.000 N=1342.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	4
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 10/07/2018
Completion Date : 12/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.474 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.			R8	CR=68% RQD=62%
				9.00
			R9	CR=65% RQD=49%
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.				9.75
			R10	CR=75% RQD=62%
				10.50
			R11	CR=61% RQD=40%
11.25m.				11.25
			R12	CR=45% RQD=14%
Moderately weathered, reddish brown, fine grained, fractured shale.				12.00
			R13	CR=42% RQD=NIL
12.75m.				12.75
			R14	CR=66% RQD=64%
Slightly weathered, reddish brown, fine grained, fractured shale.				13.50
			R15	CR=70% RQD=39%
14.25m.				14.25
			R16	CR=48% RQD=46%
Moderately weathered, reddish brown, fine grained, fractured shale.				
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.32

Co-ordinates E=(-)1030.000 N=1287.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 14/07/2018
Completion Date : 15/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.300 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
			DS-1	0.50
Filled up soil consists of reddish brown, clayey silt to silty clay with road material.		10 16 21 (37)	SPT-1	1.00-1.45
			*UDS-1	2.00-2.45
2.50m.				
			DS-2	3.00
Hard, reddish brown, silty clay / clayey silt with decomposed rock fragments.(CI)		8 19 25 (44)	SPT-2	3.00-3.45
4.05m.		13 31 56 (81)	SPT-3	4.05-4.45
Hard(N>50), reddish brown, silty clay/clayey silt with decomposed rock fragments.(CI)		10 cm Pentn. 100 Refusal 3.0 cm Pentn.	*SPT-4	4.60-4.63
4.70m.		100 Refusal 2.0 cm Pentn.	*SPT-5	4.70-4.72
		NX. drilling from 4.70m to 15.00m	R1	CR=28% RQD=19% 4.70
				5.25
			R2	CR=51% RQD=NIL
				6.00
			R3	CR=44% RQD=NIL
Highly to moderatrely weathered, reddish brown, fine grained, fractured shale.				6.75
			R4	CR=57% RQD=26%
				7.50
			R5	CR=50% RQD=46%
				8.25
8.50m.				

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO. 32

Co-ordinates E=(-)1030.000 N=1287.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	5	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	5
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 14/07/2018
Completion Date : 15/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.300 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
Highly to moderatrely weathered, reddish brown, fine grained, fractured shale.			R6	CR=54% RQD=45%
				9.00
			R7	CR=48% RQD=36%
9.75m.				9.75
			R8	CR=60% RQD=26%
				10.50
			R9	CR=57% RQD=52%
				11.25
Moderatrely weathered, reddish brown, fine grained, fractured shale.			R10	CR=57% RQD=14%
				12.00
			R11	CR=60% RQD=26%
				12.75
			R12	CR=59% RQD=34%
				13.50
			R13	CR=59% RQD=49%
				14.25
			R14	CR=53% RQD=46%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 13/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.33

Co-ordinates E=(-)1106.000 N=1164.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 03/08/2018
Completion Date : 04/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.300 M.
Water Struck At :
Standing Water Level : 2.70 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Very dense, reddish brown, silty sand with decomposed rock fragments.(SM)			DS-1	0.50
			DS-2	1.00
		12 20 32 52	SPT-1	1.50-1.95
		100 Refusal 4.0 cm Pentn.	*SPT-2	2.20-2.24
2.50m.		100 Refusal 2.0 cm Pentn.	*SPT-3	2.50-2.52
Highly weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 2.50m to 15.00m	R1	CR=24% RQD=NIL
3.25m.				3.25
			R2	CR=28% RQD=NIL
				4.00
			R3	CR=28% RQD=NIL
				4.75
			R4	CR=26% RQD=NIL
Highly weathered, reddish brown, fine grained, fractured shale.				5.50
			R5	CR=30% RQD=NIL
				6.25
			R6	CR=36% RQD=NIL
				7.00
			R7	CR=32% RQD=NIL
				7.75
			R8	CR=35% RQD=NIL
8.50m.				8.50

BH-33/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.33

Co-ordinates E=(-)1106.000 N=1164.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 03/08/2018
Completion Date : 04/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.300 M.
Water Struck At :
Standing Water Level : 2.70 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
			R9	CR=40% RQD=NIL
				9.25
			R10	CR=32% RQD=NIL
Highly weathered, reddish brown, fine grained, fractured shale.				10.00
			R11	CR=36% RQD=NIL
				10.75
			R12	CR=29% RQD=NIL
11.50m.				11.50
			R13	CR=36% RQD=NIL
				12.25
			R14	CR=38% RQD=NIL
				13.00
Highly weathered, light grey, fine grained, fractured shale.			R15	CR=40% RQD=NIL
				13.75
			R16	CR=40% RQD=13%
				14.50
			R17	CR=40% RQD=26%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.34

Co-ordinates E=(-)1123.000 N=1123.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 05/08/2018
Completion Date : 05/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.478 M.
Water Struck At :
Standing Water Level : 3.50 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
			DS-1	0.50
			DS-2	1.00
Filled up soil consists of reddish brown, silty clay / clayey silt with decomposed rock fragments.		9 13 19 32	SPT-1	1.40-1.85
		Refusal 100 4.0 cm Pentn.	*SPT-2	2.40-2.44
2.80m.		Refusal 100 3.0 cm Pentn.	*SPT-3	2.80-2.83
		NX. drilling from 2.80m to 15.00m	R1	CR=27% RQD=NIL
			R2	CR=28% RQD=NIL
			R3	CR=29% RQD=NIL
			R4	CR=27% RQD=NIL
Highly weathered, reddish brown, fine grained, fractured shale.			R5	CR=31% RQD=NIL
			R6	CR=33% RQD=NIL
			R7	CR=29% RQD=NIL
			R8	CR=24% RQD=NIL
8.50m.				

2.80
3.50
4.25
5.00
5.75
6.50
7.25
8.00

BH-34/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 13/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.34

Co-ordinates E=(-)1123.000 N=1123.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 05/08/2018
Completion Date : 05/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 284.478 M.
Water Struck At :
Standing Water Level : 3.50 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				8.75
Highly weathered, reddish brown, fine grained, fractured shale.			R9	CR=38% RQD=NIL
				9.50
			R10	CR=28% RQD=NIL
10.25m.				10.25
			R11	CR=28% RQD=NIL
				11.00
			R12	CR=31% RQD=NIL
				11.75
			R13	CR=35% RQD=NIL
Highly weathered, light grey, fine grained, fractured shale.				12.50
			R14	CR=36% RQD=NIL
				13.25
			R15	CR=37% RQD=NIL
				14.00
			R16	CR=24% RQD=NIL
				14.50
			R17	CR=28% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.35

Co-ordinates E=(-)894.000 N=888.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 15/06/2018
Completion Date : 17/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.970 M.
Water Struck At :
Standing Water Level : 2.35 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Hard, reddish brown, clayey silt / silty clay with disintegrated rock fragments.(Cl)		7 15 16 — 31	DS-1	0.50
			SPT-1	1.00-1.45
		Refusal		
		100 — 3.0 cm Pentn.	*SPT-2	1.60-1.63
1.70m.		100 — Refusal 2.0 cm Pentn.	*SPT-3	1.70-1.72
		NX. drilling from 1.70m to 15.00m	R1	CR=36% RQD=NIL 1.70 - 2.00
			R2	CR=25% RQD=NIL 2.00 - 2.75
			R3	CR=36% RQD=NIL 2.75 - 3.50
			R4	CR=38% RQD=NIL 3.50 - 4.25
			R5	CR=49% RQD=NIL 4.25 - 5.00
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R6	CR=49% RQD=NIL 5.00 - 5.75
			R7	CR=28% RQD=NIL 5.75 - 6.50
			R8	CR=42% RQD=NIL 6.50 - 7.25
			R9	CR=49% RQD=NIL 7.25 - 8.00
			R10	CR=48% RQD=NIL 8.00 - 8.50
8.50m.				

BH-35/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.35

Co-ordinates E=(-)894.000 N=888.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 15/06/2018
Completion Date : 17/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.970 M.
Water Struck At :
Standing Water Level : 2.35 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				8.50m.
			R11	CR=38% RQD=NIL
				9.25
			R12	CR=37% RQD=NIL
				10.00
			R13	CR=46% RQD=NIL
				10.75
			R14	CR=41% RQD=17%
				11.50
Moderately weathered, light grey to dark grey, fine grained, fractured shale.			R15	CR=46% RQD=16%
				12.25
			R16	CR=48% RQD=NIL
				13.00
			R17	CR=49% RQD=NIL
				13.75
			R18	CR=41% RQD=NIL
				14.50
Slightly weathered, light grey to dark grey, fine grained, fractured shale.			R19	CR=68% RQD=NIL
				15.00m.

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.36

Co-ordinates E=(-)771.000 N=1053.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 27/06/2018
Completion Date : 28/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.710 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, clayey silt to silty clay with decomposed rock fragments.			DS-1	0.50
0.80m.		Refusal 100 2.0 cm Pentn. NX. drilling from 0.80m to 15.00m	*SPT-1	0.80-0.82
			R1	CR=40% RQD=NIL
			R2	CR=49% RQD=NIL
			R3	CR=48% RQD=NIL
Highly to modeartely weathered, reddish brown, fine grained fractured shale.			R4	CR=45% RQD=21%
			R5	CR=44% RQD=29%
			R6	CR=42% RQD=24%
5.25m.			R7	CR=34% RQD=NIL
			R8	CR=32% RQD=NIL
Highly to modeartely weathered, reddish brown, fine grained, fractured shale.			R9	CR=38% RQD=NIL
			R10	CR=32% RQD=NIL
8.50m.				

0.80 1.50 2.25 3.00 3.75 4.50 5.25 6.00 6.75 7.50 8.25

BH-36/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.36

Co-ordinates E=(-)771.000 N=1053.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 27/06/2018
Completion Date : 28/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.710 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.			R11	CR=36% RQD=NIL
				9.00
			R12	CR=34% RQD=NIL
				9.75
			R13	CR=36% RQD=NIL
				10.50
			R14	CR=37% RQD=NIL
				11.25
Highly to modeartely weathered, reddish brown, fine grained, fractured shale.			R15	CR=40% RQD=NIL
				12.00
			R16	CR=37% RQD=NIL
				12.75
			R17	CR=36% RQD=NIL
				13.50
			R18	CR=41% RQD=NIL
				14.25
			R19	CR=44% RQD=34%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.37

Co-ordinates E=(-)716.000 N=1016.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
		Disturbed (DS)	1
Vane (V)		Water Sample (WS)	1

Commencement Date : 22/06/2018
Completion Date : 24/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.590 M.
Water Struck At :
Standing Water Level : 2.58 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consist of reddish brown, clayey silt to silty clay with decomposed rock fragments.			DS-1	0.40
0.50m. Modeartely weathered, reddish brown, fine grained, fractured shale.		Refusal 100 2.0 cm Pentn. NX. drilling from 0.50m to 15.00m	*SPT-1	0.50-0.52
			R1	CR=44% RQD=NIL
1.25m.			R2	CR=51% RQD=NIL
			R3	CR=50% RQD=15%
			WS-1	2.58
			R4	CR=53% RQD=NIL
			R5	CR=52% RQD=NIL
Modeartely to slightly weathered, reddish brown, fine grained, fractured shale.			R6	CR=56% RQD=14%
			R7	CR=73% RQD=21%
			R8	CR=77% RQD=66%
			R9	CR=69% RQD=26%
			R10	CR=80% RQD=58%
8.50m.			R11	CR=72% RQD=NIL

0.50 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00

BH-37/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.37

Co-ordinates E=(-)716.000 N=1016.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	1

Commencement Date : 22/06/2018
Completion Date : 24/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.590 M.
Water Struck At :
Standing Water Level : 2.58 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				8.75
			R12	CR=74% RQD=NIL
				9.50
			R13	CR=73% RQD=42%
				10.25
			R14	CR=68% RQD=21%
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.				11.00
			R15	CR=68% RQD=NIL
				11.75
			R16	CR=69% RQD=NIL
				12.50
			R17	CR=54% RQD=13%
				13.25
			R18	CR=50% RQD=41%
				14.00
			R19	CR=60% RQD=NIL
14.50m.				14.50
Highly weathered, fine grained, reddish brown, fractured shale.			R20	CR=32% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.38

Co-ordinates E=(-)663.000 N=1061.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 21/06/2018
Completion Date : 22/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.770 M.
Water Struck At :
Standing Water Level : 1.98 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Reddish brown, clayey silt with decomposed rock fragments.(Cl) 0.30m		Refusal 100 2.0 cm Pentn.	DS-1	0.20
			*SPT-1	0.30-0.32
		NX. drilling from 0.30m to 15.80m	R1	CR=56% RQD=NIL
			R2	CR=50% RQD=NIL
			R3	CR=66% RQD=NIL
Moderately to slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R4	CR=64% RQD=NIL
			R5	CR=74% RQD=57%
			R6	CR=73% RQD=38%
			R7	CR=70% RQD=22%
			R8	CR=77% RQD=66%
			R9	CR=76% RQD=44%
			R10	CR=74% RQD=44%
			R11	CR=66% RQD=17%
8.50m				

0.30 1.05 1.80 2.55 3.30 4.05 4.80 5.55 6.30 7.05 7.80 8.55

BH-38/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.38

Co-ordinates E=(-)663.000 N=1061.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 21/06/2018
Completion Date : 22/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.770 M.
Water Struck At :
Standing Water Level : 1.98 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
			R12	CR=68% RQD=16%
				9.30
			R13	CR=69% RQD=NIL
				10.05
			R14	CR=76% RQD=40%
				10.80
Moderately to slightly weathered / fresh, reddish brown, fine grained, fracture shale.			R15	CR=70% RQD=53%
				11.55
			R16	CR=73% RQD=65%
				12.30
			R17	CR=74% RQD=62%
				13.05
			R18	CR=84% RQD=80%
13.80m.				13.80
			R19	CR=76% RQD=53%
				14.55
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R20	CR=70% RQD=68%
				15.30
			R21	CR=80% RQD=70%
15.80m.				15.80

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.39

Co-ordinates E=(-)625.000 N=1028.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 08/07/2018
Completion Date : 09/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.790 M.
Water Struck At :
Standing Water Level : 2.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Hard, reddish brown, clayey silt with decomposed rock fragment.(Cl)			DS-1	0.50
0.70m		100 Refusal 3.0 cm Pentn.	*SPT-1	0.70-0.73
Moderately werathered, reddish brown, fine grained, fractured shale.		NX. drilling from 0.70m to 14.95m	R1	CR=40% RQD=NIL
			R2	CR=47% RQD=NIL
2.20m			R3	CR=77% RQD=58%
			R4	CR=73% RQD=NIL
			R5	CR=72% RQD=51%
Slightly werathered, reddish brown, fine grained, fractured shale.			R6	CR=69% RQD=53%
			R7	CR=68% RQD=35%
			R8	CR=72% RQD=40%
			R9	CR=73% RQD=NIL
			R10	CR=75% RQD=15%
8.50m				

0.70 1.45 2.20 2.95 3.70 4.45 5.20 5.95 6.70 7.45 8.20

BH-39/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.39

Co-ordinates E=(-)625.000 N=1028.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 08/07/2018
Completion Date : 09/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.790 M.
Water Struck At :
Standing Water Level : 2.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
	8.50m.		R11	CR=76% RQD=20%
				8.95
			R12	CR=78% RQD=31%
Slightly werathered, reddish brown, fine grained, fractured shale.				9.70
			R13	CR=75% RQD=56%
				10.45
			R14	CR=79% RQD=74%
	11.20m.			11.20
			R15	CR=89% RQD=74%
				11.95
			R16	CR=86% RQD=60%
				12.70
Fresh, reddish brown, fine grained, fractured shale.			R17	CR=89% RQD=80%
				13.45
			R18	CR=89% RQD=52%
				14.20
			R19	CR=88% RQD=51%
	14.95m.			14.95

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.40

Co-ordinates E=(-)571.000 N=1049.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	0	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	0
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 28/07/2018
Completion Date : 29/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.589 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.		NX. drilling from 0.00m to 20.00m		0.00
			R1	CR=26% RQD=NIL
				0.75
			R2	CR=29% RQD=13%
				1.50
			R3	CR=26% RQD=16%
				2.25
			R4	CR=30% RQD=NIL
				3.00
			R5	CR=34% RQD=16%
				3.75
			R6	CR=40% RQD=20%
Highly to moderately weathered, reddish brown, fine grained, fractured shale.				4.50
			R7	CR=44% RQD=16%
				5.25
			R8	CR=56% RQD=30%
				6.00
			R9	CR=38% RQD=29%
				6.75
			R10	CR=42% RQD=24%
				7.50
			R11	CR=38% RQD=22%
				8.25
			R12	CR=40% RQD=20%
				9.00
			R13	CR=44% RQD=26%
				9.75
			R14	CR=48% RQD=30%
10.50m.				10.50
10.50m.				

BH-40/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.40

Co-ordinates E=(-)571.000 N=1049.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	0	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	0
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 28/07/2018
Completion Date : 29/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.589 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m.				
Moderately weathered, reddish brown, fine grained, fractured shale.			R15	CR=52% RQD=26%
				11.25
			R16	CR=54% RQD=36%
				12.00
			R17	CR=60% RQD=40%
				12.75
			R18	CR=56% RQD=32%
13.50m.				13.50
Highly / moderately weathered, reddish brown, fine grained, highly fractured shale.			R19	CR=48% RQD=38%
				14.25
			R20	CR=37% RQD=32%
15.00m.				15.00
Moderately weathered, reddish brown, fine grained, moderately fractured shale.			R21	CR=58% RQD=37%
				15.75
			R22	CR=55% RQD=40%
16.50m.				16.50
Highly to moderately weathered, reddish brown, fine grained, moderately fractured shale.			R23	CR=39% RQD=30%
				17.25
			R24	CR=45% RQD=42%
				18.00
			R25	CR=42% RQD=16%
18.75m.				18.75
Moderately weathered, reddish brown, fine grained, moderately fractured shale.			R26	CR=55% RQD=40%
				19.50
			R27	CR=60% RQD=40%
20.00m.				20.00

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.41

Co-ordinates E=(-)501.000 N=1039.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	0	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	0
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 20/07/2018
Completion Date : 21/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.511 M.
Water Struck At :
Standing Water Level : 2.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.		NX. drilling from 0.00m to 15.00m		0.00
			R1	CR=32% RQD=NIL
				0.75
			R2	CR=30% RQD=NIL
				1.50
			R3	CR=34% RQD=NIL
				2.25
			R4	CR=38% RQD=16%
				3.00
Highly to moderately weathered, reddish brown, fine grained, highly fractured shale.			R5	CR=40% RQD=36%
				3.75
			R6	CR=42% RQD=13%
				4.50
			R7	CR=37% RQD=34%
				5.25
			R8	CR=38% RQD=34%
				6.00
			R9	CR=36% RQD=18%
				6.75
			R10	CR=39% RQD=20%
				7.50
8.00m.			R11	CR=38% RQD=30%

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 01/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.41

Co-ordinates E=(-)501.000 N=1039.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	0	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	0
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 20/07/2018
Completion Date : 21/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.511 M.
Water Struck At :
Standing Water Level : 2.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.				8.25
Highly to moderately weathered, reddish brown, fine grained, highly fractured shale.			R12	CR=40% RQD=34%
				9.00
			R13	CR=44% RQD=38%
9.75m.				9.75
			R14	CR=38% RQD=20%
				10.50
			R15	CR=40% RQD=20%
				11.25
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R16	CR=42% RQD=26%
				12.00
			R17	CR=46% RQD=29%
				12.75
			R18	CR=46% RQD=38%
				13.50
			R19	CR=50% RQD=40%
14.25m.				14.25
Moderately weathered, reddish brown, fine grained, fractured shale.			R20	CR=55% RQD=36%
15.00m.				15.00

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.42

Co-ordinates E=(-)767.000 N=960.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 07/06/2018
Completion Date : 12/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.600 M.
Water Struck At :
Standing Water Level : 5.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Hard (N>50), reddish brown, clayey silt with decomposed rock fragment.(Cl)		100 Refusal 3.0 cm Pentn.	DS-1	0.50
			*SPT-1	0.60-0.63
0.70m. Highly weathered, reddish brown, fine grained, moderately strong fractured shale.		100 Refusal 2.0 cm Pentn. NX. drilling from 0.70m to 20.00m	*SPT-2	0.70-0.72
			R1	CR=23% RQD=NIL
1.25m.				1.25
			R2	CR=36% RQD=NIL
				2.00
			R3	CR=37% RQD=NIL
				2.75
			R4	CR=66% RQD=37%
				3.50
			R5	CR=42% RQD=NIL
				4.25
			R6	CR=44% RQD=13%
Highly to moderately weathered, reddish brown, fine grained, moderately fractured shale.				5.00
			R7	CR=48% RQD=NIL
				5.75
			R8	CR=49% RQD=NIL
				6.50
			R9	CR=53% RQD=NIL
				7.25
			R10	CR=54% RQD=36%
				8.00
			R11	CR=57% RQD=44%
				8.75
			R12	CR=44% RQD=NIL
				9.50
			R13	CR=38% RQD=NIL
10.25m.				10.25
10.50m.				

BH-42/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.42

Co-ordinates E=(-)767.000 N=960.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 07/06/2018
Completion Date : 12/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.600 M.
Water Struck At :
Standing Water Level : 5.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m.				
Moderately to slightly weathered, light grey to brownish grey, fine grained, highly fractured shale.			R14	CR=50% RQD=NIL 11.00
			R15	CR=52% RQD=NIL 11.75
			R16	CR=64% RQD=NIL 12.50
12.50m.			R17	CR=34% RQD=NIL 13.25
			R18	CR=36% RQD=NIL 14.00
			R19	CR=45% RQD=25% 14.75
			R20	CR=45% RQD=20% 15.50
Highly / moderately weathered, light grey to brownish grey, fine grained, highly to moderately fractured shale.			R21	CR=39% RQD=NIL 16.25
			R22	CR=30% RQD=NIL 17.00
			R23	CR=34% RQD=NIL 17.75
			R24	CR=36% RQD=NIL 18.50
			R25	CR=40% RQD=NIL 19.25
			R26	CR=49% RQD=NIL 20.00
20.00m.				

N.B. – '*' means sample could not be recovered.

BH-42/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.43

Co-ordinates E=(-)664.000 N=949.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 08/06/2018
Completion Date : 09/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.730 M.
Water Struck At :
Standing Water Level : 3.05 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, clayey silt with decomposed rock fragments. 0.40m.		Refusal 100 2.0 cm Pentr. NX. drilling from 0.40m to 15.00m	DS-1	0.20
			*SPT-1	0.40-0.42
			R1	CR=25% RQD=NIL
Highly weathered, reddish brown, fine grained, fractured shale. 1.75m.			R2	CR=24% RQD=NIL
			R3	CR=52% RQD=NIL
Moderately to slightly weathered, reddish brown, fine grained, fractured shale. 5.50m.			R4	CR=66% RQD=NIL
			R5	CR=52% RQD=NIL
			R6	CR=57% RQD=NIL
			R7	CR=66% RQD=13%
Highly weathered, reddish brown, fine grained, fractured shale. 7.00m.			R8	CR=33% RQD=NIL
			R9	CR=40% RQD=NIL
Slightly weathered, reddish brown, fine grained, fractured shale. 8.50m.			R10	CR=66% RQD=25%
			R11	CR=61% RQD=NIL

0.40 1.00 1.75 2.50 3.25 4.00 4.75 5.50 6.25 7.00 7.75 8.50

BH-43/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.43

Co-ordinates E=(-)664.000 N=949.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 08/06/2018
Completion Date : 09/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.730 M.
Water Struck At :
Standing Water Level : 3.05 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
			R12	CR=62% RQD=NIL
				9.25
			R13	CR=66% RQD=NIL
				10.00
Slightly weathered, reddish brown, fine grained, fractured shale.			R14	CR=65% RQD=13%
				10.75
			R15	CR=60% RQD=NIL
				11.50
			R16	CR=64% RQD=NIL
12.25m.				12.25
			R17	CR=48% RQD=NIL
				13.00
Moderately / slightly weathered, light grey, fine grained, fractured shale.			R18	CR=66% RQD=22%
				13.75
			R19	CR=56% RQD=41%
14.50m.				14.50
Highly weathered, light grey, fine grained, fractured shale.			R20	CR=36% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.44

Co-ordinates E=(-)582.000 N=962.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 30/07/2018
Completion Date : 01/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.500 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Hard (N>50), brownish grey, silty clay / clayey silt. Obs. decomposed rock.(Cl)		Refusal	DS-1	0.50
		100 5.0 cm Pentn.	*SPT-1	1.00-1.05
		Refusal		
1.50m		100 4.0 cm Pentn.	*SPT-2	1.50-1.54
		NX. drilling from 1.50m to 15.00m	R1	CR=28% RQD=NIL
			R2	CR=30% RQD=NIL
			R3	CR=32% RQD=13%
			R4	CR=36% RQD=16%
Highly weathered, reddish brown, fine grained, highly fractured shale.			R5	CR=40% RQD=30%
			R6	CR=29% RQD=NIL
			R7	CR=36% RQD=20%
			R8	CR=38% RQD=18%
			R9	CR=40% RQD=30%
8.50m				

1.50
2.25
3.00
3.75
4.50
5.25
6.00
6.75
7.50
8.25

BH-44/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.44

Co-ordinates E=(-)582.000 N=962.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 30/07/2018
Completion Date : 01/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.500 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m. Highly weathered, reddish brown, fine grained, highly fractured shale. 9.00m.			R10	CR=39% RQD=26% 9.00
			R11	CR=40% RQD=26% 9.75
			R12	CR=44% RQD=32% 10.50
			R13	CR=48% RQD=36% 11.25
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R14	CR=46% RQD=20% 12.00
			R15	CR=40% RQD=16% 12.75
			R16	CR=54% RQD=30% 13.50
			R17	CR=58% RQD=40% 14.25
			R18	CR=46% RQD=30% 15.00
15.00m.				

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.45

Co-ordinates E=(-)481.000 N=913.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.570 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of brownish grey, silty clay / clayey silt.			DS-1	0.50
			DS-2	1.00
1.40m.				
Hard(N>50), brownish grey, silty clay / clayey silt with decomposed rock.(Cl)		9 21 30 (51)	SPT-1	1.45-1.90
			DS-3	2.40
		Refusal 100 5.0 cm Pentn.	*SPT-2	2.70-2.75
2.90m.		Refusal 100 4.0 cm Pentn.	*SPT-3	2.90-2.94
		NX. drilling from 2.90m to 15.00m	R1	CR=28% RQD=NIL
				3.50
			R2	CR=30% RQD=NIL
				4.25
			R3	CR=28% RQD=NIL
				5.00
			R4	CR=33% RQD=NIL
Highly to moderately weathered, reddish brown, fine grained, highly fractured shale.				5.75
			R5	CR=40% RQD=NIL
				6.50
			R6	CR=38% RQD=NIL
				7.25
			R7	CR=36% RQD=NIL
				8.00
8.50m.			R8	CR=43% RQD=NIL

BH-45/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 07/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.45

Co-ordinates E=(-)481.000 N=913.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.570 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				8.75
			R9	CR=40% RQD=26%
				9.50
			R10	CR=45% RQD=26%
				10.25
			R11	CR=40% RQD=24%
				11.00
			R12	CR=38% RQD=30%
Highly to moderately weathered, reddish brown, fine grained, highly fractured shale.				11.75
			R13	CR=42% RQD=NIL
				12.50
			R14	CR=40% RQD=30%
				13.25
			R15	CR=40% RQD=36%
				14.00
			R16	CR=44% RQD=20%
				15.00

8.50m.

15.00m.

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.46

Co-ordinates E=(-)497.000 N=847.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 29/07/2018
Completion Date : 31/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.550 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of brownish grey, silty clay / clayey silt. Obs. kankars.			DS-1	0.50
			DS-2	1.00
1.50m. Hard(N>50), brownish grey, silty clay / clayey silt with decomposed rock.(Cl)		10 24 54 30	SPT-1	1.50-1.95
			DS-3	2.40
		Refusal 100 4.0 cm Pentn.	*SPT-2	2.60-2.64
2.80m.		Refusal 100 4.0 cm Pentn.	*SPT-3	2.80-2.84
		NX. drilling from 2.80m to 15.00m	R1	CR=24% RQD=NIL 2.80 - 3.50
			R2	CR=28% RQD=NIL 3.50 - 4.25
			R3	CR=26% RQD=NIL 4.25 - 5.00
Highly weathered, reddish brown, fine grained, highly fractured shale.			R4	CR=30% RQD=NIL 5.00 - 5.75
			R5	CR=32% RQD=NIL 5.75 - 6.50
			R6	CR=28% RQD=NIL 6.50 - 7.25
			R7	CR=38% RQD=NIL 7.25 - 8.00
8.50m.			R8	CR=39% RQD=NIL

BH-46/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.46

Co-ordinates E=(-)497.000 N=847.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 29/07/2018
Completion Date : 31/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.550 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				8.75
Highly weathered, reddish brown, fine grained, highly fractured shale.			R9	CR=40% RQD=NIL
9.50m.				9.50
			R10	CR=42% RQD=13%
				10.25
			R11	CR=44% RQD=16%
				11.00
			R12	CR=48% RQD=24%
				11.75
Moderately weathered, reddish brown, fine grained, highly to moderately fractured shale.			R13	CR=40% RQD=13%
				12.50
			R14	CR=38% RQD=NIL
				13.25
			R15	CR=52% RQD=38%
				14.00
			R16	CR=42% RQD=40%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

BH-46/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.47

Co-ordinates E=(-)753.000 N=765.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 27/07/2018
Completion Date : 30/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.854 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of reddish brown, clayey silt to silty clay with decomposed rock fragments.		Refusal	DS-1	0.50
		100 2.0 cm Pentn. Refusal	*SPT-1	1.40-1.42
1.50m.		100 2.0 cm Pentn.	*SPT-2	1.50-1.52
Highly weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 1.50m to 15.00m	R1	CR=25% RQD=NIL
2.25m.			R2	CR=31% RQD=NIL
			R3	CR=31% RQD=NIL
			R4	CR=28% RQD=NIL
			R5	CR=36% RQD=NIL
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R6	CR=32% RQD=16%
			R7	CR=29% RQD=NIL
			R8	CR=32% RQD=NIL
			R9	CR=45% RQD=20%
8.50m.				

1.50 2.25 3.00 3.75 4.50 5.25 6.00 6.75 7.50 8.25

BH-47/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 07/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.47

Co-ordinates E=(-)753.000 N=765.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 27/07/2018
Completion Date : 30/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.854 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.			R10	CR=41% RQD=20%
				9.00
			R11	CR=42% RQD=16%
				9.75
			R12	CR=47% RQD=13%
				10.50
			R13	CR=41% RQD=36%
				11.25
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R14	CR=49% RQD=37%
				12.00
			R15	CR=44% RQD=40%
				12.75
			R16	CR=50% RQD=29%
				13.50
			R17	CR=41% RQD=19%
				14.25
			R18	CR=49% RQD=33%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.48

Co-ordinates E=(-)571.000 N=759.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 21/07/2018
Completion Date : 22/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.211 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Medium, reddish brown, silty clay/clayey silt.(Cl)			DS-1	0.50
		2 3 3 6	SPT-1	1.50-1.95
2.40m		Refusal 100 3.0 cm Pentn.	*SPT-2	2.40-2.43
		NX. drilling from 2.40m to 15.00m	R1	CR=26% RQD=NIL
				3.15
			R2	CR=25% RQD=NIL
				3.90
Completely to highly weathered, reddish brown to greyish brown, fine grained, fractured shale.			R3	CR=20% RQD=NIL
				4.65
			R4	CR=23% RQD=NIL
				5.40
			R5	CR=25% RQD=NIL
6.15m				6.15
			R6	CR=28% RQD=NIL
				6.90
Highly to moderately weathered, reddish brown to greyish brown, fine grained, fractured shale.			R7	CR=38% RQD=NIL
				7.65
8.00m				

BH-48/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.48

Co-ordinates E=(-)571.000 N=759.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 21/07/2018
Completion Date : 22/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.211 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.			R8	CR=44% RQD=NIL 8.40
			R9	CR=44% RQD=NIL 9.15
			R10	CR=40% RQD=NIL 9.90
			R11	CR=50% RQD=18% 10.65
			R12	CR=49% RQD=15% 11.40
Highly to moderately weathered, reddish brown to greyish brown, fine grained, fractured shale.			R13	CR=49% RQD=NIL 12.15
			R14	CR=47% RQD=NIL 12.90
			R15	CR=48% RQD=13% 13.65
			R16	CR=52% RQD=NIL 14.40
			R17	CR=45% RQD=NIL 15.00
15.00m.				

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.49

Co-ordinates E=(-)1050.000 N=713.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 31/07/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.970 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of reddish brown, clayey silt to silty clay with decomposed rock fragments.		Refusal 100 3.0 cm Pentn.	DS-1	0.50
			*SPT-1	0.80-0.83
1.00m.		Refusal 100 2.0 cm Pentn.	*SPT-2	1.00-1.02
		NX. drilling from 1.00m to 15.00m	R1	CR=37% RQD=NIL
			R2	CR=33% RQD=NIL
			R3	CR=35% RQD=NIL
			R4	CR=40% RQD=14%
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R5	CR=36% RQD=NIL
			R6	CR=45% RQD=31%
			R7	CR=44% RQD=NIL
			R8	CR=48% RQD=16%
			R9	CR=44% RQD=24%
			R10	CR=47% RQD=15%
8.50m.				

1.00 1.75 2.50 3.25 4.00 4.75 5.50 6.25 7.00 7.75 8.50

BH-49/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 13/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.49

Co-ordinates E=(-)1050.000 N=713.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 31/07/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.970 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
			R11	CR=49% RQD=14%
				9.25
			R12	CR=47% RQD=NIL
				10.00
			R13	CR=45% RQD=14%
				10.75
			R14	CR=44% RQD=NIL
Highly to moderately weathered, reddish brown, fine grained, fractured shale.				11.50
			R15	CR=43% RQD=14%
				12.25
			R16	CR=45% RQD=NIL
				13.00
			R17	CR=33% RQD=NIL
				13.75
			R18	CR=47% RQD=14%
				14.50
			R19	CR=42% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.50

Co-ordinates E=(-)1050.000 N=650.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 29/07/2018
Completion Date : 31/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.070 M.
Water Struck At :
Standing Water Level : 4.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
			DS-1	0.50
			DS-2	1.00
Filled up soil consists of reddish brown, clayey silt to silty clay with disintegrated rock fragments.		7 9 11 20	SPT-1	1.50-1.95
			DS-3	2.50
		Refusal		
		100 4.0 cm Pentn.	*SPT-2	2.80-2.84
3.00m.		100 Refusal 3.0 cm Pentn.	*SPT-3	3.00-3.03
		NX. drilling from 3.00m to 15.00m	R1	CR=25% RQD=NIL
			R2	CR=26% RQD=NIL
			R3	CR=24% RQD=NIL
Highly weathered, light grey to dark grey, fine grained, fractured shale.			R4	CR=21% RQD=NIL
			R5	CR=22% RQD=NIL
			R6	CR=22% RQD=NIL
			R7	CR=25% RQD=NIL
8.50m.				

3.00 3.75 4.50 5.25 6.00 6.75 7.50 8.25

BH-50/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.50

Co-ordinates E=(-)1050.000 N=650.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 29/07/2018
Completion Date : 31/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.070 M.
Water Struck At :
Standing Water Level : 4.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m. Highly weathered, light grey to dark grey, fine grained, fractured shale.			R8	CR=24% RQD=NIL 9.00
9.00m.			R9	CR=29% RQD=NIL 9.75
			R10	CR=36% RQD=17% 10.50
Highly weathered, light grey to dark grey, fine grained, fractured shale.			R11	CR=32% RQD=NIL 11.25
			R12	CR=31% RQD=NIL 12.00
			R13	CR=37% RQD=NIL 12.75
12.75m.			R14	CR=28% RQD=NIL 13.50
Highly to modeartely weathered, light grey to dark grey, fine grained, fractured shale.			R15	CR=36% RQD=NIL 14.25
			R16	CR=31% RQD=NIL 15.00
15.00m.				

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.51

Co-ordinates E=(-)895.000 N=654.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
		Disturbed (DS)	3
Vane (V)		Water Sample (WS)	1

Commencement Date : 02/08/2018
Completion Date : 04/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.110 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
			DS-1	0.50
Hard, brownish grey to light grey, silty clay / clayey silt with decomposed rock fragments.(Cl)			DS-2	1.00
			DS-3	1.50
		11 9 24 33	SPT-1	2.00-2.45
		100 Refusal 3.0 cm Pentn.	*SPT-2	2.60-2.63
2.70m.		100 Refusal 2.0 cm Pentn.	*SPT-3	2.70-2.72
		NX. drilling from 2.70m to 15.00m	R1	CR=22% RQD=NIL
			WS-1	2.80
Highly weathered, light grey, fine grained, fractured shale.			R2	CR=24% RQD=NIL
			R3	CR=24% RQD=17%
			R4	CR=26% RQD=NIL
			R5	CR=23% RQD=NIL
			R6	CR=25% RQD=NIL
			R7	CR=27% RQD=NIL
8.50m.			R8	CR=23% RQD=NIL

2.70
3.45
4.25
5.00
5.75
6.50
7.25
8.00

BH-51/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.51

Co-ordinates E=(-)895.000 N=654.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	1

Commencement Date : 02/08/2018
Completion Date : 04/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.110 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m. Highly weathered, light grey, fine grained, fractured shale.				8.75
			R9	CR=25% RQD=NIL
9.50m.				9.50
			R10	CR=34% RQD=14%
				10.25
			R11	CR=31% RQD=NIL
				11.00
			R12	CR=28% RQD=NIL
Highly weathered, light grey, fine grained, fractured shale.				11.75
			R13	CR=26% RQD=NIL
				12.50
			R14	CR=29% RQD=NIL
				13.25
			R15	CR=31% RQD=NIL
				14.00
			R16	CR=30% RQD=NIL
				14.50
			R17	CR=32% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.52

Co-ordinates E=(-)938.000 N=620.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 31/07/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.182 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
			DS-1	0.50
			DS-2	1.00
Filled up soil consist of reddish brown, clayey silt to silty clay with decomposed rock fragments.		8 11 13 (24)	SPT-1	1.50-1.95
			DS-3	2.50
		Refusal	*SPT-2	2.90-2.93
		100 3.0 cm Pentr.		
3.00m.		100 Refusal	*SPT-3	3.00-3.03
		3.0 cm Pentr.		3.00
		NX. drilling from 3.00m to 15.00m	R1	CR=25% RQD=NIL
				3.75
			R2	CR=25% RQD=NIL
				4.50
			R3	CR=23% RQD=NIL
				5.25
Highly weathered, reddish brown, fine grained, fractured shale.			R4	CR=25% RQD=NIL
				6.00
			R5	CR=29% RQD=NIL
				6.75
			R6	CR=28% RQD=NIL
				7.50
			R7	CR=24% RQD=NIL
8.25m.				8.25
8.50m.				

BH-52/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.52

Co-ordinates E=(-)938.000 N=620.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 31/07/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.182 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
			R8	CR=38% RQD=20%
				9.00
			R9	CR=35% RQD=14%
				9.75
Highly weathered, reddish brown, fine grained, fractured shale.			R10	CR=33% RQD=NIL
				10.50
			R11	CR=39% RQD=NIL
8.50m.				11.25
			R12	CR=36% RQD=NIL
				12.00
			R13	CR=28% RQD=NIL
				12.75
Highly weathered, whitish grey, fine grained, fractured shale.			R14	CR=29% RQD=NIL
				13.50
			R15	CR=33% RQD=NIL
				14.25
			R16	CR=32% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.53

Co-ordinates E=(-)755.000 N=667.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 17/06/2018
Completion Date : 20/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.060 M.
Water Struck At :
Standing Water Level : 5.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consist of reddish brown, clayey silt with rock fragments.				
0.50m. Hard(N>50), reddish brown, clayey silt / silty clay with decomposed rock.(Cl)		>100 (32 68) 5.0 cm Pentn.	DS-1	0.50
			SPT-1	1.00-1.20
		100 Refusal 2.0 cm Pentn.	*SPT-2	1.40-1.42
1.50m. Highly weathered, yellowish grey, to light grey, fine grained, fractured shale.		100 Refusal 2.0 cm Pentn. NX. drilling from 1.50m to 15.00m	*SPT-3	1.50-1.52
			R1	CR=25% RQD=NIL
2.25m.			R2	CR=28% RQD=NIL
			R3	CR=29% RQD=NIL
			R4	CR=37% RQD=NIL
Highly to moderately weathered, yellowish grey to light grey, fine grained, fractured shale.			R5	CR=45% RQD=26%
			R6	CR=48% RQD=NIL
			R7	CR=44% RQD=NIL
			R8	CR=49% RQD=NIL
			R9	CR=44% RQD=NIL
8.50m.				

1.50 2.25 3.00 3.75 4.50 5.25 6.00 6.75 7.50 8.25

BH-53/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.53

Co-ordinates E=(-)755.000 N=667.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 17/06/2018
Completion Date : 20/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.060 M.
Water Struck At :
Standing Water Level : 5.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.			R10	CR=41% RQD=NIL 9.00
Highly to moderately weathered, yellowish grey to light grey, fine grained, fractured shale.			R11	CR=47% RQD=NIL 9.75
			R12	CR=46% RQD=NIL 10.25
10.25m.			R13	CR=37% RQD=31% 11.00
			R14	CR=21% RQD=NIL 11.75
			R15	CR=37% RQD=NIL 12.50
Highly to moderately weathered, light grey to dark grey, fine grained, fractured shale.			R16	CR=53% RQD=NIL 13.25
			R17	CR=40% RQD=NIL 14.00
			R18	CR=48% RQD=NIL 14.50
14.50m.			R19	CR=52% RQD=NIL 15.00
Moderately weathered, light grey, to dark grey, fine grained, fractured shale. 15.00m.				

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 24/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.54

Co-ordinates E=(-)621.000 N=625.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 20/06/2018
Completion Date : 22/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.360 M.
Water Struck At :
Standing Water Level : 2.08 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consist of reddish brown, clayey silt to silty clay with decomposed rock.		Refusal	DS-1	0.30
0.40m.		100 3.0 cm Pentn. NX. drilling from 0.40m to 15.00m	*SPT-1	0.40-0.43
			R1	CR=58% RQD=31%
			R2	CR=45% RQD=33%
			R3	CR=44% RQD=14%
Highly / moderately weathered, reddish brown, fine grained, fractured shale.			R4	CR=25% RQD=NIL
			R5	CR=29% RQD=13%
			R6	CR=50% RQD=48%
4.75m.			R7	CR=84% RQD=78%
Slightly weathered, reddish brown, fractured shale.			R8	CR=72% RQD=56%
			R9	CR=76% RQD=60%
7.00m.			R10	CR=44% RQD=NIL
Moderately to slightly weathered, reddish brown to light grey, fine grained, fractured shale.			R11	CR=50% RQD=22%
8.50m.				

0.40 1.00 1.75 2.50 3.25 4.00 4.75 5.50 6.25 7.00 7.75 8.50

BH-54/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 24/07/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.54

Co-ordinates E=(-)621.000 N=625.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 20/06/2018
Completion Date : 22/06/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.360 M.
Water Struck At :
Standing Water Level : 2.08 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
			R12	CR=65% RQD=NIL
				9.25
			R13	CR=80% RQD=76%
				10.00
			R14	CR=73% RQD=53%
				10.75
			R15	CR=80% RQD=50%
				11.50
Moderately / slightly weathered, reddish brown to light grey, fine grained, fractured shale.			R16	CR=80% RQD=65%
				12.25
			R17	CR=70% RQD=52%
				13.00
			R18	CR=65% RQD=42%
				13.75
			R19	CR=65% RQD=62%
				14.50
			R20	CR=54% RQD=44%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157	Created by : T.SAHA	Created on : 01/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.55

Co-ordinates E=(-)563.000 N=684.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 22/07/2018
Completion Date : 23/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.480 M.
Water Struck At :
Standing Water Level : 1.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Hard(N>50), brownish grey, clayey silt / silty clay with decomposed rock.(Cl)		Refusal 100 5.0 cm Pentn.	DS-1	0.50
			*SPT-1	1.00-1.05
1.50m		Refusal 100 3.0 cm Pentn. NX. drilling from 1.50m to 20.00m	*SPT-2	1.50-1.53
			R1	CR=38% RQD=NIL
			R2	CR=40% RQD=NIL
			R3	CR=36% RQD=NIL
Highly to moderately weathered, yellowish brown, fine grained, highly fractured shale.			R4	CR=35% RQD=NIL
			R5	CR=30% RQD=NIL
			R6	CR=30% RQD=NIL
			R7	CR=40% RQD=13%
			R8	CR=42% RQD=20%
7.50m			R9	CR=36% RQD=16%
Highly to moderately weathered, reddish brown, fine grained, moderately fractured shale.			R10	CR=44% RQD=NIL
			R11	CR=50% RQD=20%
9.75m			R12	CR=54% RQD=15%
Moderately to slightly weathered, reddish brown, fine grained, moderately fractured shale.				
10.50m				

1.50
2.25
3.00
3.75
4.50
5.25
6.00
6.75
7.50
8.25
9.00
9.75
10.50

BH-55/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.55

Co-ordinates E=(-)563.000 N=684.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 22/07/2018
Completion Date : 23/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.480 M.
Water Struck At :
Standing Water Level : 1.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m.				
			R13	CR=54% RQD=24% 11.25
			R14	CR=40% RQD=13% 12.00
			R15	CR=63% RQD=20% 12.75
			R16	CR=54% RQD=NIL 13.50
			R17	CR=60% RQD=30% 14.25
Moderately to slightly weathered, reddish brown, fine grained, moderately fractured shale.			R18	CR=48% RQD=32% 15.00
			R19	CR=55% RQD=39% 15.75
			R20	CR=63% RQD=40% 16.50
			R21	CR=65% RQD=36% 17.25
			R22	CR=72% RQD=44% 18.00
			R23	CR=70% RQD=29% 18.75
			R24	CR=68% RQD=48% 19.50
			R25	CR=70% RQD=20% 20.00
20.00m.				

N.B. – '*' means sample could not be recovered.

BH-55/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.56

Co-ordinates E=(-)459.000 N=717.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 03/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.100 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Very dense, brownish grey, silty sand with decomposed rock fragments.(SM) 0.70m.		100 Refusal 5.0 cm Pentn. 100 Refusal 4.0 cm Pentn. NX. drilling from 0.70m to 20.00m	DS-1 *SPT-1 *SPT-2	0.40 0.50-0.55 0.70-0.74
Highly weathered, reddish brown, fine grained, highly fractured shale.			R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13	0.70 CR=28% RQD=NIL 1.50 CR=30% RQD=NIL 2.25 CR=32% RQD=13% 3.00 CR=30% RQD=NIL 3.75 CR=34% RQD=NIL 4.50 CR=35% RQD=16% 5.25 CR=38% RQD=18% 6.00 CR=40% RQD=20% 6.75 CR=38% RQD=NIL 7.50 CR=26% RQD=13% 8.25 CR=35% RQD=16% 9.00 CR=38% RQD=20% 9.75 CR=39% RQD=26% 10.50
10.50m.				

BH-56/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.56

Co-ordinates E=(-)459.000 N=717.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 03/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.100 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m.				
			R14	CR=40% RQD=30% 11.25
			R15	CR=38% RQD=26% 12.00
			R16	CR=32% RQD=16% 12.75
Highly weathered, reddish brown, fine grained, highly fractured shale.			R17	CR=36% RQD=NIL 13.50
			R18	CR=38% RQD=16% 14.25
			R19	CR=37% RQD=13% 15.00
			R20	CR=39% RQD=16% 15.75
15.75m.				
			R21	CR=42% RQD=20% 16.50
Moderately weathered, reddish brown, fine grained, highly to moderately fractured shale.			R22	CR=44% RQD=24% 17.25
			R23	CR=48% RQD=30% 18.00
18.00m.				
			R24	CR=52% RQD=24% 18.75
Moderately weathered, reddish brown, fine grained, highly to moderately fractured shale.			R25	CR=55% RQD=29% 19.50
			R26	CR=60% RQD=20% 20.00
20.00m.				

N.B. – '*' means sample could not be recovered.

BH-56/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.57

Co-ordinates E=(-)458.000 N=649.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 05/08/2018
Completion Date : 07/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.050 M.
Water Struck At :
Standing Water Level : 2.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, clayey silt / silty clay with decomposed rock.		Refusal 100 3.0 cm Pentn.	DS-1	0.50
			*SPT-1	0.60-0.63
0.70m.		Refusal 100 2.0 cm Pentn.	*SPT-2	0.70-0.72
		NX. drilling from 0.70m to 15.00m	R1	CR=36% RQD=NIL
			R2	CR=35% RQD=NIL
			R3	CR=33% RQD=NIL
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R4	CR=56% RQD=39%
			R5	CR=45% RQD=NIL
			R6	CR=44% RQD=NIL
			R7	CR=44% RQD=42%
5.75m.			R8	CR=55% RQD=40%
			R9	CR=55% RQD=40%
Moderately weathered, reddish brown, fine grained, fractured shale.			R10	CR=57% RQD=52%
8.50m.			R11	CR=58% RQD=54%

0.70 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00

BH-57/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.57

Co-ordinates E=(-)458.000 N=649.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 05/08/2018
Completion Date : 07/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.050 M.
Water Struck At :
Standing Water Level : 2.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
8.75m.				8.75
			R12	CR=48% RQD=43%
				9.50
			R13	CR=52% RQD=48%
				10.25
			R14	CR=44% RQD=40%
				11.00
			R15	CR=57% RQD=51%
Moderately weathered, reddish brown, fine grained, fractured shale.				11.75
			R16	CR=43% RQD=39%
				12.50
			R17	CR=43% RQD=23%
				13.25
			R18	CR=48% RQD=45%
				14.00
			R19	CR=50% RQD=28%
				14.50
			R20	CR=46% RQD=24%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.58

Co-ordinates E=(-)1048.000 N=517.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 28/07/2018
Completion Date : 30/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.060 M.
Water Struck At :
Standing Water Level : 1.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
			DS-1	0.50
			DS-2	1.00
Filled up soil consists of reddish brown, silty sand with moorum. Obs. decomposed rock.		10 26 32 58	SPT-1	1.50-1.95
			DS-3	2.40
		Refusal		
		100	*SPT-2	2.60-2.65
		5.0 cm Pentn.		
2.80m.		100 Refusal	*SPT-3	2.80-2.84
		4.0 cm Pentn.		2.80
Highly weathered, reddish brown, fine grained, highly to modeartely fractured shale.		NX. drilling from 2.80m to 15.00m	R1	CR=24% RQD=NIL
3.50m.				3.50
			R2	CR=26% RQD=13%
				4.25
			R3	CR=30% RQD=16%
				5.00
			R4	CR=37% RQD=20%
Highly to moderately weathered, reddish brown, fine grained, highly to modeartely fractured shale.				5.75
			R5	CR=34% RQD=16%
				6.50
			R6	CR=40% RQD=18%
				7.25
			R7	CR=44% RQD=30%
				8.00
			R8	CR=46% RQD=40%
8.50m.				

BH-58/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.58

Co-ordinates E=(-)1048.000 N=517.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 28/07/2018
Completion Date : 30/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 283.060 M.
Water Struck At :
Standing Water Level : 1.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				8.75
			R9	CR=38% RQD=16%
				9.50
			R10	CR=39% RQD=26%
				10.25
			R11	CR=44% RQD=36%
				11.00
			R12	CR=52% RQD=30%
Highly to moderately weathered, reddish brown, fine grained, highly to modeartely fractured shale.				11.75
			R13	CR=54% RQD=40%
				12.50
			R14	CR=48% RQD=24%
				13.25
			R15	CR=58% RQD=40%
				14.00
			R16	CR=45% RQD=30%
				15.00

8.50m

15.00m

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 07/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.59

Co-ordinates E=(-)892.000 N=572.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 31/07/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.897 M.
Water Struck At :
Standing Water Level : 2.60 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of reddish brown, clayey silt to silty clay with decomposed rock fragments.		Refusal 100 3.0 cm Pentn.	DS-1	0.50
			*SPT-1	0.80-0.83
1.00m.		100 Refusal 2.0 cm Pentn.	*SPT-2	1.00-1.02
		NX. drilling from 1.00m to 15.00m	R1	CR=24% RQD=NIL
			R2	CR=25% RQD=NIL
			R3	CR=28% RQD=NIL
Highly weathered, reddish brown, fine grained, fractured shale.			R4	CR=23% RQD=NIL
			R5	CR=25% RQD=NIL
			R6	CR=24% RQD=NIL
			R7	CR=25% RQD=NIL
6.25m.			R8	CR=38% RQD=NIL
Highly weathered, reddish brown, fine grained, fractured shale.			R9	CR=32% RQD=20%
			R10	CR=31% RQD=17%
8.50m.				

1.00 1.75 2.50 3.25 4.00 4.75 5.50 6.25 7.00 7.75 8.50

BH-59/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.59

Co-ordinates E=(-)892.000 N=572.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 31/07/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.897 M.
Water Struck At :
Standing Water Level : 2.60 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
			R11	CR=33% RQD=NIL
				9.25
			R12	CR=28% RQD=21%
				10.00
			R13	CR=37% RQD=21%
				10.75
			R14	CR=36% RQD=20%
				11.50
Highly weathered, reddish brown, fine grained, fractured shale.			R15	CR=32% RQD=NIL
				12.25
			R16	CR=36% RQD=NIL
				13.00
			R17	CR=39% RQD=20%
				13.75
			R18	CR=40% RQD=NIL
				14.50
			R19	CR=24% RQD=14%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 14/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.60

Co-ordinates E=(-)1073.000 N=375.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 09/08/2018
Completion Date : 10/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.560 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Hard, brownish grey, silty clay / clayey silt with decomposed rock fragments.(Cl)		5 12 19 31	DS-1	0.50
			SPT-1	1.00-1.45
		Refusal	DS-2	2.00
		100 2.0 cm Pentn.	*SPT-2	2.10-2.12
2.30m		100 Refusal 2.0 cm Pentn.	*SPT-3	2.30-2.32
Highly weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 2.30m to 15.00m	R1	CR=24% RQD=NIL
3.05m				3.05
Highly weathered, reddish brown, fine grained, fractured shale.			R2	CR=29% RQD=NIL
				3.80
			R3	CR=23% RQD=NIL
4.55m				4.55
			R4	CR=56% RQD=39%
				5.30
			R5	CR=52% RQD=34%
				6.05
Highly / moderately weathered, reddish brown, fine grained, fractured shale.			R6	CR=41% RQD=25%
				6.80
			R7	CR=42% RQD=27%
				7.55
			R8	CR=35% RQD=21%
8.30m				8.30
8.50m				

BH-60/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 14/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.60

Co-ordinates E=(-)1073.000 N=375.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 09/08/2018
Completion Date : 10/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.560 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.			R9	CR=34% RQD=NIL
				9.05
			R10	CR=32% RQD=NIL
				9.80
			R11	CR=40% RQD=NIL
				10.55
			R12	CR=36% RQD=NIL
				11.30
Highly / moderately weathered, whitish grey to greenish grey, fine grained, fractured shale.			R13	CR=40% RQD=NIL
				12.05
			R14	CR=40% RQD=NIL
				12.80
			R15	CR=27% RQD=NIL
				13.55
			R16	CR=46% RQD=NIL
				14.30
			R17	CR=26% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 14/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.61

Co-ordinates E=(-)1051.000 N=352.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	4
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 07/08/2018
Completion Date : 09/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.687 M.
Water Struck At :
Standing Water Level : 3.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Hard, brownish grey, silty clay / clayey silt with decomposed rock fragments.(Cl)		6 14 18 32	DS-1	0.50
			SPT-1	1.00-1.45
		Refusal 100 2.0 cm Pentn.	*SPT-2	1.80-1.82
2.00m		Refusal 100 2.0 cm Pentn.	*SPT-3	2.00-2.02
				2.00
			R1	CR=18% RQD=NIL
Completely to highly weathered, reddish brown, fine grained, fractured shale.		Refusal 100 2.0 cm Pentn. NX. drilling from 2.00m to 15.00m	*SPT-4	2.75-2.77
				2.75
			R2	CR=21% RQD=NIL
3.50m				3.50
			R3	CR=32% RQD=NIL
				4.25
			R4	CR=27% RQD=NIL
				5.00
Highly / moderately weathered, reddish brown, fine grained, fractured shale.			R5	CR=42% RQD=NIL
				5.75
			R6	CR=27% RQD=NIL
				6.50
			R7	CR=40% RQD=NIL
				7.25
			R8	CR=65% RQD=27%
				8.00
8.50m			R9	CR=52% RQD=25%

BH-61/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 14/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.61

Co-ordinates E=(-)1051.000 N=352.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	4
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 07/08/2018
Completion Date : 09/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.687 M.
Water Struck At :
Standing Water Level : 3.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				8.75
Highly / moderately weathered, reddish brown, fine grained, fractured shale.			R10	CR=40% RQD=16%
9.50m.				9.50
			R11	CR=45% RQD=32%
				10.25
			R12	CR=35% RQD=20%
				11.00
			R13	CR=42% RQD=NIL
				11.75
Highly / moderately weathered, whitish grey to greenish grey, fine grained, fractured shale.			R14	CR=40% RQD=NIL
				12.50
			R15	CR=36% RQD=NIL
				13.25
			R16	CR=27% RQD=NIL
				14.00
			R17	CR=52% RQD=NIL
				14.50
			R18	CR=50% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 14/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.62

Co-ordinates E=(-)550.000 N=353.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 10/08/2018
Completion Date : 11/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.820 M.
Water Struck At :
Standing Water Level : 3.60 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Hard, brownish grey, silty clay with decomposed rock fragments.(Cl)		7 13 24 37	DS-1	0.50
			SPT-1	1.00-1.45
			DS-2	2.00
		Refusal 100 2.0 cm Pentr.	*SPT-2	2.10-2.12
2.20m.		Refusal 100 1.0 cm Pentr.	*SPT-3	2.20-2.21
		NX. drilling from 2.20m to 15.00m	R1	CR=28% RQD=NIL
			R2	CR=36% RQD=NIL
			R3	CR=36% RQD=NIL
			R4	CR=32% RQD=NIL
Highly / moderately weathered, reddish brown, fine grained, fractured shale.			R5	CR=31% RQD=NIL
			R6	CR=47% RQD=NIL
			R7	CR=33% RQD=NIL
			R8	CR=27% RQD=NIL
8.20m. Highly weathered, light greenish grey, fine grained, fractured shale.				
8.50m.				

2.20 2.95 3.70 4.45 5.20 5.95 6.70 7.45 8.20

BH-62/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 14/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.62

Co-ordinates E=(-)550.000 N=353.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 10/08/2018
Completion Date : 11/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.820 M.
Water Struck At :
Standing Water Level : 3.60 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.			R9	CR=31% RQD=NIL
				8.95
			R10	CR=32% RQD=NIL
				9.70
			R11	CR=30% RQD=NIL
				10.45
			R12	CR=27% RQD=NIL
				11.20
Highly weathered, light greenish grey, fine grained, fractured shale.			R13	CR=32% RQD=NIL
				11.95
			R14	CR=35% RQD=NIL
				12.70
			R15	CR=26% RQD=NIL
				13.45
			R16	CR=31% RQD=NIL
				14.20
			R17	CR=35% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.63

Co-ordinates E=(-)1631.000 N=858.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 07/08/2018
Completion Date : 08/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.986 M.
Water Struck At :
Standing Water Level : 4.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Very stiff, reddish brown, clayey silt with rock fragments.(Cl)			DS-1	0.50
		8 7 11 18	SPT-1	1.50-1.95
2.20m.		Refusal 100	*SPT-2	2.20-2.23
		3.0 cm Pentr.		2.20
		NX. drilling from 2.20m to 15.00m	R1	CR=60% RQD=26%
				2.95
			R2	CR=64% RQD=24%
				3.70
			R3	CR=60% RQD=53%
				4.45
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R4	CR=92% RQD=90%
				5.20
			R5	CR=85% RQD=80%
				5.95
			R6	CR=92% RQD=89%
				6.70
			R7	CR=81% RQD=78%
				7.45
			R8	CR=80% RQD=34%
				8.20
8.50m.				

BH-63/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 13/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.63

Co-ordinates E=(-)1631.000 N=858.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 07/08/2018
Completion Date : 08/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.986 M.
Water Struck At :
Standing Water Level : 4.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
	8.50m.		R9	CR=86% RQD=84% 8.95
			R10	CR=93% RQD=90% 9.70
			R11	CR=91% RQD=85% 10.45
			R12	CR=92% RQD=90% 11.20
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R13	CR=91% RQD=88% 11.95
			R14	CR=82% RQD=78% 12.70
			R15	CR=88% RQD=40% 13.45
			R16	CR=85% RQD=80% 14.20
			R17	CR=95% RQD=90% 14.60
			R18	CR=95% RQD=55% 15.00
	15.00m.			

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 14/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.64

Co-ordinates E=(-)1383.000 N=911.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	1

Commencement Date : 09/08/2018
Completion Date : 10/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.583 M.
Water Struck At :
Standing Water Level : 3.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	Depth (m)
0.00m.				
Very stiff, reddish brown, silty clay with moorum.(Cl)			DS-1	0.50
			DS-2	1.00
		7 10 12 22	SPT-1	1.30-1.75
2.00m.		100 Refusal 3.0 cm Pentn.	*SPT-2	2.00-2.03
		NX. drilling from 2.00m to 15.00m	R1	CR=41% RQD=NIL
Moderately weathered, reddish brown, fine grained, highly fractured shale.			R2	CR=49% RQD=16%
			WS-1	3.20
3.50m.			R3	CR=52% RQD=23%
			R4	CR=53% RQD=NIL
			R5	CR=60% RQD=NIL
Moderately to slightly weathered / fresh, redish brown, fine grained, highly fractured shale.			R6	CR=61% RQD=17%
			R7	CR=64% RQD=NIL
			R8	CR=61% RQD=33%
8.50m.			R9	CR=53% RQD=29%

2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00

BH-64/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 14/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.64

Co-ordinates E=(-)1383.000 N=911.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	1

Commencement Date : 09/08/2018
Completion Date : 10/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.583 M.
Water Struck At :
Standing Water Level : 3.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				8.75
			R10	CR=62% RQD=30%
				9.50
			R11	CR=64% RQD=23%
				10.25
			R12	CR=66% RQD=24%
				11.00
Moderately to slightly weathered / fresh, redish brown, fine grained, highly fractured shale.			R13	CR=72% RQD=27%
				11.75
			R14	CR=76% RQD=36%
				12.50
			R15	CR=78% RQD=32%
				13.25
			R16	CR=68% RQD=40%
				14.00
			R17	CR=62% RQD=38%
				14.50
			R18	CR=82% RQD=42%
				15.00

8.50m.

15.00m.

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 14/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.65

Co-ordinates E=(-)1509.000 N=1011.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 06/08/2018
Completion Date : 08/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 280.444 M.
Water Struck At :
Standing Water Level : 4.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Hard, brownish grey, silty clay with decomposed rock fragments.(Cl)		Refusal 100 4.0 cm Pentn.	DS-1	0.50
			*SPT-1	0.70-0.74
0.80m.		Refusal 100 3.0 cm Pentn.	*SPT-2	0.80-0.83
		NX. drilling from 0.80m to 15.00m	R1	CR=60% RQD=34%
			R2	CR=57% RQD=54%
			R3	CR=53% RQD=34%
			R4	CR=75% RQD=27%
Moderately to slightly weathered / fresh, reddish brown, fine grained, moderately to slightly fractured shale.			R5	CR=62% RQD=30%
			R6	CR=65% RQD=32%
			R7	CR=68% RQD=35%
			R8	CR=70% RQD=39%
			R9	CR=72% RQD=30%
			R10	CR=72% RQD=32%
8.50m.				

0.80 1.55 2.30 3.05 3.80 4.55 5.30 6.05 6.80 7.55 8.30

BH-65/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 14/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.65

Co-ordinates E=(-)1509.000 N=1011.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
		Disturbed (DS)	1
Vane (V)		Water Sample (WS)	0

Commencement Date : 06/08/2018
Completion Date : 08/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 280.444 M.
Water Struck At :
Standing Water Level : 4.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
			R11	CR=76% RQD=38%
				9.05
			R12	CR=81% RQD=35%
				9.80
			R13	CR=72% RQD=36%
				10.55
			R14	CR=75% RQD=40%
				11.30
Moderately to slightly weathered / fresh, reddish brown, fine grained, moderately to slightly fractured shale.			R15	CR=81% RQD=45%
				12.05
			R16	CR=80% RQD=48%
				12.80
			R17	CR=86% RQD=52%
				13.55
			R18	CR=90% RQD=63%
				14.30
			R19	CR=92% RQD=65%
				15.00

8.50m.

15.00m.

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 14/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.66

Co-ordinates E=(-)1369.000 N=1164.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 09/08/2018
Completion Date : 10/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 279.543 M.
Water Struck At :
Standing Water Level : 3.05 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Hard, reddish brown, silty clay with moorum & decomposed rock.(Cl)		11 14 21 35	DS-1	0.50
			SPT-1	1.00-1.45
1.80m.		Refusal 100	*SPT-2	1.80-1.82
		2.0 cm Pentn. NX. drilling from 1.80m to 15.00m	R1	CR=27% RQD=NIL
			R2	CR=30% RQD=NIL
			R3	CR=46% RQD=18%
			R4	CR=52% RQD=18%
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R5	CR=44% RQD=16%
			R6	CR=35% RQD=NIL
			R7	CR=46% RQD=NIL
			R8	CR=52% RQD=NIL
			R9	CR=54% RQD=NIL
8.50m.				

1.80
2.55
3.30
4.05
4.80
5.55
6.30
7.05
7.80

BH-66/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 14/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.66

Co-ordinates E=(-)1369.000 N=1164.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 09/08/2018
Completion Date : 10/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 279.543 M.
Water Struck At :
Standing Water Level : 3.05 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
				8.55
			R10	CR=46% RQD=20%
				9.30
			R11	CR=47% RQD=24%
8.50m. Highly to moderately weathered, reddish brown, fine grained, fractured shale.				10.05
10.05m.			R12	CR=56% RQD=27%
				10.80
			R13	CR=55% RQD=21%
				11.55
Moderately to slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R14	CR=56% RQD=27%
				12.30
			R15	CR=64% RQD=45%
				13.05
			R16	CR=80% RQD=61%
				13.80
			R17	CR=86% RQD=54%
				14.55
			R18	CR=93% RQD=85%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

BH-66/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.67

Co-ordinates E=(-)452.000 N=1437.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 28/07/2018
Completion Date : 28/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.540 M.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consist of reddish brown, clayey silt / silty clay with rock fragments.		Refusal 100 2.0 cm Pentn.	DS-1	0.50
		Refusal 100 2.0 cm Pentn.	*SPT-1	1.30-1.32
1.50m.		NX. drilling from 1.50m to 15.00m	*SPT-2	1.50-1.52
			R1	CR=56% RQD=NIL 1.50 - 2.25
Moderately to slightly weathered, reddish brown, fine grained, fracturted shale.			R2	CR=59% RQD=20% 2.25 - 3.00
			R3	CR=55% RQD=40% 3.00 - 3.75
			R4	CR=57% RQD=51% 3.75 - 4.50
4.50m.			R5	CR=47% RQD=NIL 4.50 - 5.25
			R6	CR=48% RQD=NIL 5.25 - 6.00
Moderately to slightly weathered, reddish brown, fine grained, fracturted shale.			R7	CR=45% RQD=24% 6.00 - 6.75
			R8	CR=50% RQD=20% 6.75 - 7.50
7.50m.			R9	CR=53% RQD=35%
Moderately to slightly weathered, reddish brown, fine grained, fracturted shale.				
8.00m.				

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.67

Co-ordinates E=(-)452.000 N=1437.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 28/07/2018
Completion Date : 28/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.540 M.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.				8.25
			R10	CR=54% RQD=29%
				9.00
			R11	CR=56% RQD=51%
				9.75
			R12	CR=58% RQD=56%
				10.50
			R13	CR=58% RQD=30%
				11.25
Moderately to slightly weathered, reddish brown, fine grained, fracturted shale.			R14	CR=57% RQD=41%
				12.00
			R15	CR=57% RQD=27%
				12.75
			R16	CR=63% RQD=27%
				13.50
			R17	CR=66% RQD=44%
				14.25
			R18	CR=61% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

BH-67/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.68

Co-ordinates E=(-)478.000 N=1492.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 20/07/2018
Completion Date : 21/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.214 M.
Water Struck At :
Standing Water Level : 2.85 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of reddish brown, clayey silt / silty clay with decomposed rock.			DS-1	0.50
1.00m.		Refusal 100 2.0 cm Pentn. NX. drilling from 1.00m to 15.00m	*SPT-1	1.00-1.02
			R1	CR=31% RQD=NIL
			R2	CR=32% RQD=NIL
			R3	CR=37% RQD=31%
			R4	CR=38% RQD=16%
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R5	CR=38% RQD=28%
			R6	CR=36% RQD=25%
			R7	CR=47% RQD=23%
			R8	CR=45% RQD=35%
			R9	CR=45% RQD=33%
8.00m.				

1.00 1.75 2.50 3.25 4.00 4.75 5.50 6.25 7.00 7.75

BH-68/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.68

Co-ordinates E=(-)478.000 N=1492.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 20/07/2018
Completion Date : 21/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.214 M.
Water Struck At :
Standing Water Level : 2.85 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.			R10	CR=44% RQD=NIL
				8.50
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R11	CR=45% RQD=NIL
9.25m.				9.25
			R12	CR=32% RQD=16%
				10.00
			R13	CR=47% RQD=33%
				10.75
			R14	CR=52% RQD=NIL
				11.50
Highly / moderately weathered, reddish brown, fine grained, fractured shale.			R15	CR=51% RQD=31%
				12.25
			R16	CR=47% RQD=NIL
				13.00
			R17	CR=44% RQD=20%
				13.75
			R18	CR=41% RQD=16%
				14.50
			R19	CR=38% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.69

Co-ordinates E=(-)664.000 N=1519.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 13/07/2018
Completion Date : 17/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.572 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, clayey silt to silty clay with decomposed rock fragments.			DS-1	0.50
0.80m. Highly weathered, reddish brown, fine grained, fractured shale.		100 Refusal 2.0 cm Pentn. NX. drilling from 0.80m to 15.00m	*SPT-1	0.80-0.82
			R1	CR=24% RQD=NIL
			R2	CR=23% RQD=NIL
2.25m.			R3	CR=27% RQD=NIL
			R4	CR=28% RQD=NIL
Highly to modeartely weathered, reddish brown, fine grained, fractured shale.			R5	CR=30% RQD=NIL
			R6	CR=37% RQD=33%
			R7	CR=22% RQD=NIL
			R8	CR=49% RQD=NIL
			R9	CR=41% RQD=NIL
7.50m. Moderately / slightly weathered, reddish brown, fine grained, fractured shale.			R10	CR=57% RQD=53%
8.00m.				

0.80 1.50 2.25 3.00 3.75 4.50 5.25 6.00 6.75 7.50

BH-69/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.69

Co-ordinates E=(-)664.000 N=1519.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 13/07/2018
Completion Date : 17/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.572 M.
Water Struck At :
Standing Water Level : 2.90 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.				8.25
			R11	CR=61% RQD=59%
				9.00
			R12	CR=62% RQD=60%
				9.75
			R13	CR=66% RQD=64%
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.				10.50
			R14	CR=66% RQD=62%
				11.25
			R15	CR=65% RQD=61%
				12.00
			R16	CR=54% RQD=52%
12.50m.				12.50

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.70

Co-ordinates E=(-)521.000 N=1608.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 22/07/2018
Completion Date : 25/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.678 M.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consist of reddish brown, clayey silt to silty clay with decomposed rock.			DS-1	0.50
1.00m.		Refusal 100 2.0 cm Pentn.	*SPT-1	1.00-1.02
		NX. drilling from 1.00m to 15.00m	R1	CR=25% RQD=NIL
			R2	CR=38% RQD=24%
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R3	CR=41% RQD=29%
			R4	CR=42% RQD=40%
			R5	CR=45% RQD=41%
4.75m.				
Moderately weathered, reddish brown, fine grained, fractured shale.			R6	CR=57% RQD=17%
			R7	CR=58% RQD=40%
6.25m.				
			R8	CR=65% RQD=19%
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R9	CR=61% RQD=58%
8.00m.				

1.00 1.75 2.50 3.25 4.00 4.75 5.50 6.25 7.00 7.75

BH-70/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.70

Co-ordinates E=(-)521.000 N=1608.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 22/07/2018
Completion Date : 25/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.678 M.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.			R10	CR=70% RQD=42%
				8.50
			R11	CR=61% RQD=56%
				9.25
			R12	CR=68% RQD=33%
				10.00
			R13	CR=61% RQD=53%
				10.75
			R14	CR=61% RQD=NIL
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.				11.50
			R15	CR=68% RQD=28%
				12.25
			R16	CR=84% RQD=80%
				13.00
			R17	CR=85% RQD=58%
				13.75
			R18	CR=81% RQD=64%
				14.50
			R19	CR=82% RQD=77%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

BH-70/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.71

Co-ordinates E=(-)460.000 N=1609.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 17/07/2018
Completion Date : 19/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.368 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Hard (N>50), reddish brown, clayey silt to silty clay with decomposed rock.(Cl)			DS-1	0.50
			DS-2	1.00
		12 22 30 52 Refusal	SPT-1	1.40-1.85
		100 4.0 cm Pentn.	*SPT-2	2.10-2.14
2.30m.		100 Refusal 4.0 cm Pentn.	*SPT-3	2.30-2.34
		NX. drilling from 2.30m to 20.00m	R1	CR=30% RQD=NIL
			R2	CR=28% RQD=NIL
			R3	CR=30% RQD=NIL
			R4	CR=30% RQD=28%
			R5	CR=28% RQD=26%
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R6	CR=30% RQD=20%
			R7	CR=32% RQD=30%
			R8	CR=40% RQD=38%
			R9	CR=34% RQD=22%
			R10	CR=29% RQD=20%
			R11	CR=27% RQD=NIL
10.50m.				

2.30 3.00 3.75 4.50 5.25 6.00 6.75 7.50 8.25 9.00 9.75 10.50

BH-71/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.71

Co-ordinates E=(-)460.000 N=1609.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	3
		Water Sample (WS)	0

Commencement Date : 17/07/2018
Completion Date : 19/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.368 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
10.50m.				
			R12	CR=24% RQD=NIL
				11.25
			R13	CR=32% RQD=29%
				12.00
			R14	CR=27% RQD=17%
				12.75
			R15	CR=24% RQD=23%
				13.50
			R16	CR=33% RQD=30%
				14.25
			R17	CR=40% RQD=37%
				15.00
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R18	CR=38% RQD=36%
				15.75
			R19	CR=29% RQD=19%
				16.50
			R20	CR=49% RQD=16%
				17.25
			R21	CR=44% RQD=16%
				18.00
			R22	CR=46% RQD=16%
				18.75
			R23	CR=52% RQD=NIL
				19.50
			R24	CR=48% RQD=NIL
20.00m.				20.00

N.B. – '*' means sample could not be recovered.

BH-71/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.72

Co-ordinates E=(-)404.000 N=1626.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 21/07/2018
Completion Date : 23/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.280 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consist of reddish brown, clayey silt to silty clay with decomposed rock.			DS-1	0.50
1.00m.		Refusal 100 2.0 cm Pentn. NX. drilling from 1.00m to 15.00m	*SPT-1	1.00-1.02
			R1	CR=27% RQD=NIL
			R2	CR=37% RQD=19%
			R3	CR=39% RQD=24%
			R4	CR=40% RQD=37%
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R5	CR=39% RQD=32%
			R6	CR=43% RQD=32%
			R7	CR=47% RQD=35%
			R8	CR=44% RQD=NIL
			R9	CR=51% RQD=28%
8.00m.				

1.00 1.75 2.50 3.25 4.00 4.75 5.50 6.25 7.00 7.75

BH-72/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.72

Co-ordinates E=(-)404.000 N=1626.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 21/07/2018
Completion Date : 23/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.280 M.
Water Struck At :
Standing Water Level : 2.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.			R10	CR=48% RQD=45%
				8.50
			R11	CR=51% RQD=28%
				9.25
			R12	CR=49% RQD=19%
				10.00
			R13	CR=52% RQD=19%
				10.75
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R14	CR=44% RQD=36%
				11.50
			R15	CR=44% RQD=41%
				12.25
			R16	CR=59% RQD=56%
				13.00
			R17	CR=55% RQD=49%
				13.75
			R18	CR=52% RQD=NIL
				14.50
			R19	CR=48% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.73

Co-ordinates E=(-)339.000 N=1602.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 24/07/2018
Completion Date : 27/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.420 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consist of reddish brown, clayey silt to silty clay with decomposed rock.			DS-1	0.50
1.00m.		Refusal 100 3.0 cm Pentn. NX. drilling from 1.00m to 15.00m	*SPT-1	1.00-1.03
			R1	CR=32% RQD=21%
			R2	CR=40% RQD=NIL
			R3	CR=27% RQD=15%
			R4	CR=31% RQD=24%
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R5	CR=43% RQD=40%
			R6	CR=53% RQD=47%
			R7	CR=43% RQD=40%
			R8	CR=45% RQD=21%
			R9	CR=41% RQD=25%
8.00m.				

1.00 1.75 2.50 3.25 4.00 4.75 5.50 6.25 7.00 7.75

BH-73/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.73

Co-ordinates E=(-)339.000 N=1602.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 24/07/2018
Completion Date : 27/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.420 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.			R10	CR=47% RQD=32% 8.50
			R11	CR=59% RQD=32% 9.25
			R12	CR=58% RQD=45% 10.00
			R13	CR=41% RQD=32% 10.75
			R14	CR=55% RQD=45% 11.50
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R15	CR=51% RQD=48% 12.25
			R16	CR=49% RQD=47% 13.00
			R17	CR=47% RQD=44% 13.75
			R18	CR=59% RQD=55% 14.50
			R19	CR=42% RQD=26% 15.00
15.00m.				

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.74

Co-ordinates E=(-)348.000 N=1658.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 25/07/2018
Completion Date : 28/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.270 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of reddish brown, clayey silt / silty clay with decomposed rock fragments.		Refusal 100 3.0 cm Pentn.	DS-1	0.50
			*SPT-1	0.90-0.93
1.00m.		Refusal 100 2.0 cm Pentn.	*SPT-2	1.00-1.02
		NX. drilling from 1.00m to 15.00m	R1	CR=31% RQD=NIL 1.00 - 1.75
Highly to modeartely weathered, reddish brown, fine grained, fractured shale.			R2	CR=36% RQD=NIL 1.75 - 2.50
			R3	CR=36% RQD=25% 2.50 - 3.25
			R4	CR=48% RQD=45% 3.25 - 4.00
4.00m.			R5	CR=56% RQD=53% 4.00 - 4.75
			R6	CR=59% RQD=57% 4.75 - 5.50
Modeartely weathered, reddish brown, fine grained, fractured shale.			R7	CR=53% RQD=52% 5.50 - 6.25
			R8	CR=50% RQD=40% 6.25 - 7.00
			R9	CR=53% RQD=45% 7.00 - 7.75
8.00m.				

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.74

Co-ordinates E=(-)348.000 N=1658.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 25/07/2018
Completion Date : 28/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.270 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.			R10	CR=54% RQD=40%
				8.50
			R11	CR=56% RQD=34%
				9.25
			R12	CR=53% RQD=46%
				10.00
			R13	CR=47% RQD=40%
				10.75
Modeartely weathered, reddish brown, fine grained, fractured shale.			R14	CR=57% RQD=53%
				11.50
			R15	CR=52% RQD=44%
				12.25
			R16	CR=51% RQD=36%
				13.00
			R17	CR=54% RQD=45%
				13.75
			R18	CR=57% RQD=49%
				14.50
			R19	CR=44% RQD=40%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

BH-74/Sheet-2

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.75

Co-ordinates E=(-)540.000 N=1850.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	4
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.640 M.
Water Struck At :
Standing Water Level : 4.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
			DS-1	0.50
		7 11 13 (24)	SPT-1	1.00-1.45
Very stiff, reddish brown to dark greyish brown, clayey silt / silty clay.(Cl)			UDS-1	2.00-2.45
		8 10 12 (22)	SPT-2	2.45-2.90
			DS-2	3.50
		16 18 34 (52)	SPT-3	4.00-4.45
4.00m				
Hard (N>50), reddish brown to dark greyish brown, clayey silt / silty clay.(Cl)		Refusal		
4.70m		100	*SPT-4	4.70-4.72
		2.0 cm Pentn.		4.70
		NX. drilling from 4.70m to 15.00m	R1	CR=40% RQD=NIL
				5.45
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.			R2	CR=64% RQD=NIL
				6.20
			R3	CR=52% RQD=NIL
6.95m				6.95
			R4	CR=71% RQD=NIL
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.				7.70
			R5	CR=60% RQD=NIL
				8.45
8.50m				

BH-75/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 07/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.75

Co-ordinates E=(-)540.000 N=1850.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	4
		Disturbed (DS)	2
Vane (V)		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 02/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.640 M.
Water Struck At :
Standing Water Level : 4.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
			R6	CR=71% RQD=NIL
				9.20
			R7	CR=68% RQD=35%
				9.95
			R8	CR=65% RQD=NIL
				10.70
			R9	CR=84% RQD=69%
				11.45
			R10	CR=92% RQD=75%
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.				12.20
			R11	CR=75% RQD=51%
				12.95
			R12	CR=91% RQD=86%
				13.70
			R13	CR=92% RQD=89%
				14.45
			R14	CR=88% RQD=73%
				15.20
			R15	CR=93% RQD=67%
15.95m.				15.95

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.76

Co-ordinates E=(-)308.000 N=1849.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 30/07/2018
Completion Date : 31/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.190 M.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
			DS-1	0.50
Hard, reddish brown, clayey silt with rock fragments.(Cl)		7 14 17 31	SPT-1	1.50-1.95
2.50m		Refusal 100	*SPT-2	2.50-2.54
		4.0 cm Pentn. NX. drilling from 2.50m to 15.00m	R1	CR=68% RQD=55% 2.50 - 3.25
			R2	CR=78% RQD=53% 3.25 - 4.00
			R3	CR=84% RQD=80% 4.00 - 4.75
			R4	CR=93% RQD=NIL 4.75 - 5.50
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R5	CR=81% RQD=19% 5.50 - 6.25
			R6	CR=80% RQD=31% 6.25 - 7.00
			R7	CR=90% RQD=88% 7.00 - 7.75
			R8	CR=90% RQD=72% 7.75 - 8.50
8.50m				

BH-76/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.76

Co-ordinates E=(-)308.000 N=1849.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 30/07/2018
Completion Date : 31/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.190 M.
Water Struck At :
Standing Water Level : 2.30 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
			R9	CR=61% RQD=40%
				9.25
			R10	CR=68% RQD=NIL
				10.00
			R11	CR=63% RQD=45%
				10.75
			R12	CR=61% RQD=32%
				11.50
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R13	CR=61% RQD=NIL
				12.25
			R14	CR=65% RQD=NIL
				13.00
			R15	CR=70% RQD=54%
				13.75
			R16	CR=72% RQD=40%
				14.50
			R17	CR=78% RQD=38%
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.77

Co-ordinates E=(-)165.000 N=1808.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 03/08/2018
Completion Date : 03/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.260 M.
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up with greyish brown, concrete material. 0.50m.		Refusal 100 3.0 cm Pentn. NX. drilling from 0.50m to 10.00m	*SPT-1	0.50-0.53 0.50
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R1	CR=80% RQD=53% 1.25
			R2	CR=78% RQD=61% 2.00
			R3	CR=89% RQD=71% 2.75
			R4	CR=84% RQD=64% 3.50
			R5	CR=81% RQD=33% 4.25
			R6	CR=90% RQD=72% 5.00
			R7	CR=84% RQD=55% 5.75
			R8	CR=91% RQD=69% 6.50
			R9	CR=88% RQD=60% 7.25
			R10	CR=88% RQD=83% 8.00
			R11	CR=85% RQD=60% 8.75
9.25m.			R12	CR=92% RQD=74% 9.25

N.B. - '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.78

Co-ordinates E=170.000 N=1814.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 04/08/2018
Completion Date : 05/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.278 M.
Water Struck At :
Standing Water Level : 3.28 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consist of concrete material & reddish brown, clayey silt with rock fragments.		Refusal 100 5.0 cm Pentn.	DS-1	0.40
			*SPT-1	0.60-0.65
0.70m.		Refusal 100 2.0 cm Pentn.	*SPT-2	0.70-0.72
		NX. drilling from 0.70m to 10.00m	R1	CR=70% RQD=27% 0.70 - 1.25
			R2	CR=64% RQD=NIL 1.25 - 2.00
			R3	CR=60% RQD=NIL 2.00 - 2.75
			R4	CR=75% RQD=NIL 2.75 - 3.50
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R5	CR=61% RQD=NIL 3.50 - 4.25
			R6	CR=61% RQD=NIL 4.25 - 5.00
			R7	CR=68% RQD=51% 5.00 - 5.75
			R8	CR=85% RQD=61% 5.75 - 6.50
6.50m.			R9	CR=76% RQD=70% 6.50 - 7.25
			R10	CR=79% RQD=52% 7.25 - 8.00
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R11	CR=86% RQD=67% 8.00 - 8.75
			R12	CR=96% RQD=85% 8.75 - 9.50
			R13	CR=92% RQD=90% 9.50 - 10.00
10.00m.				

N.B. - '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.79

Co-ordinates E=(-)131.000 N=1726.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 28/07/2018
Completion Date : 29/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.057 M.
Water Struck At :
Standing Water Level : 2.75 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of greyish brown, concrete material.			DS-1	0.50
0.90m.		Refusal 100 5.0 cm Pentn. NX. drilling from 0.90m to 15.00m	*SPT-1	0.90-0.95
			R1	CR=56% RQD=43%
			R2	CR=60% RQD=NIL
			R3	CR=60% RQD=23%
			R4	CR=60% RQD=NIL
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R5	CR=75% RQD=51%
			R6	CR=80% RQD=71%
			R7	CR=77% RQD=28%
			R8	CR=71% RQD=53%
			R9	CR=72% RQD=64%
7.65m. Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R10	CR=85% RQD=37%
8.50m.				

0.90 1.65 2.40 3.15 3.90 4.65 5.40 6.15 6.90 7.65 8.40

BH-79/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.79

Co-ordinates E=(-)131.000 N=1726.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 28/07/2018
Completion Date : 29/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.057 M.
Water Struck At :
Standing Water Level : 2.75 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				
			R11	CR=84% RQD=29%
				9.15
			R12	CR=88% RQD=82%
				9.90
			R13	CR=85% RQD=69%
				10.65
			R14	CR=80% RQD=38%
				11.40
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R15	CR=82% RQD=73%
				12.15
			R16	CR=81% RQD=77%
				12.90
			R17	CR=93% RQD=89%
				13.65
			R18	CR=93% RQD=72%
				14.40
			R19	CR=85% RQD=66%
				15.15
			R20	CR=81% RQD=65%
				15.90
			R21	CR=73% RQD=61%
16.50m.				16.50

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.80

Co-ordinates E=(-)142.000 N=1660.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 03/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.800 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up with dark brown / grey, bituminious material.			DS-1	0.40
0.60m.		Refusal 100 4.0 cm Pentn. NX. drilling from 0.60m to 15.00m	*SPT-1	0.60-0.64
			R1	CR=55% RQD=NIL
			R2	CR=60% RQD=16%
			R3	CR=61% RQD=NIL
			R4	CR=68% RQD=NIL
Moderately / slightly weathered, reddish brown to greyish brown, fine grained, fractured shale.			R5	CR=68% RQD=NIL
			R6	CR=61% RQD=NIL
			R7	CR=71% RQD=43%
			R8	CR=63% RQD=15%
			R9	CR=68% RQD=29%
			R10	CR=68% RQD=37%
8.50m.			R11	CR=65% RQD=39%

0.60 1.35 2.10 2.85 3.60 4.35 5.10 5.85 6.60 7.35 8.10

BH-80/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 13/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.80

Co-ordinates E=(-)142.000 N=1660.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 01/08/2018
Completion Date : 03/08/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 281.800 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.				8.85
			R12	CR=64% RQD=NIL
				9.60
			R13	CR=60% RQD=35%
				10.35
			R14	CR=59% RQD=31%
				11.10
Moderately / slightly weathered, reddish brown to greyish brown, fine grained, fractured shale.			R15	CR=59% RQD=31%
				11.85
			R16	CR=51% RQD=NIL
				12.60
			R17	CR=47% RQD=NIL
				13.35
			R18	CR=52% RQD=NIL
				14.10
			R19	CR=60% RQD=NIL
				14.60
			R20	CR=60% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.81

Co-ordinates E=(-)48.000 N=1615.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 25/07/2018
Completion Date : 26/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.400 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Hard (N>50), reddish brown, clayey silt with rock fragments.(Cl)		Refusal	DS-1	0.20
0.40m.		100	*SPT-1	0.40-0.42
		2.0 cm Pentn.		0.40
		NX. drilling from 0.40m to 15.00m	R1	CR=51% RQD=NIL
				1.15
			R2	CR=55% RQD=NIL
				1.90
			R3	CR=66% RQD=45%
				2.65
			R4	CR=65% RQD=NIL
Moderately to slightly weathered, reddish to greyish brown, fine grained, fractured shale.				3.40
			R5	CR=73% RQD=27%
				4.15
			R6	CR=61% RQD=NIL
				4.90
			R7	CR=76% RQD=44%
				5.65
			R8	CR=77% RQD=36%
				6.40
			R9	CR=72% RQD=NIL
				7.15
			R10	CR=75% RQD=58%
				7.90
8.00m.				

BH-81/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.81

Co-ordinates E=(-)48.000 N=1615.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 25/07/2018
Completion Date : 26/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.400 M.
Water Struck At :
Standing Water Level : 2.40 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.00m.				
			R11	CR=66% RQD=30%
				8.65
			R12	CR=66% RQD=57%
				9.40
Moderately to slightly weathered, reddish to greyish brown, fine grained, fractured shale.			R13	CR=66% RQD=37%
				10.15
			R14	CR=69% RQD=66%
				10.90
			R15	CR=78% RQD=58%
				11.65
			R16	CR=72% RQD=48%
12.40m.				12.40
			R17	CR=46% RQD=NIL
				13.15
			R18	CR=48% RQD=NIL
Moderately to slightly weathered, greyish brown, fine grained, fractured shale.				13.90
			R19	CR=45% RQD=NIL
				14.45
			R20	CR=42% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.82

Co-ordinates E=40.000 N=1663.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 27/07/2018
Completion Date : 28/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.080 M.
Water Struck At :
Standing Water Level : 2.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Hard (N>50), reddish brown, clayey silt with decomposed rock fragments(Cl) 0.40m.		Refusal 100 3.0 cm Pentn. NX. drilling from 0.40m to 15.00m	DS-1	0.20
			*SPT-1	0.40-0.43
			R1	CR=56% RQD=20%
			R2	CR=60% RQD=NIL
			R3	CR=72% RQD=53%
Moderately to slightly weathered, reddish to greyish brown, fine grained, fractured shale.			R4	CR=69% RQD=13%
			R5	CR=73% RQD=49%
			R6	CR=72% RQD=58%
			R7	CR=60% RQD=26%
			R8	CR=72% RQD=32%
			R9	CR=73% RQD=48%
			R10	CR=72% RQD=61%
8.00m.				0.40 1.15 1.90 2.65 3.40 4.15 4.90 5.65 6.40 7.15 7.90

BH-82/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 01/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.82

Co-ordinates E=40.000 N=1663.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 27/07/2018
Completion Date : 28/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.080 M.
Water Struck At :
Standing Water Level : 2.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
			R11	CR=66% RQD=52%
				8.65
			R12	CR=69% RQD=35%
				9.40
			R13	CR=65% RQD=NIL
				10.15
Moderately to slightly weathered, reddish to greyish brown, fine grained, fractured shale.			R14	CR=60% RQD=28%
				10.90
			R15	CR=68% RQD=13%
				11.65
			R16	CR=55% RQD=NIL
				12.40
			R17	CR=56% RQD=NIL
				13.15
13.15m.			R18	CR=44% RQD=NIL
				13.90
Moderately weathered, reddish to greyish brown, fine grained, fractured shale.			R19	CR=53% RQD=NIL
				14.45
			R20	CR=49% RQD=NIL
15.00m.				15.00

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.83

Co-ordinates E=161.000 N=1621.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	0	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	0
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 30/07/2018
Completion Date : 31/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.130 M.
Water Struck At :
Standing Water Level : 2.25 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.		NX. drilling from 0.00m to 15.00m		0.00
			R1 CR=60% RQD=NIL	0.75
			R2 CR=61% RQD=46%	1.50
			R3 CR=61% RQD=15%	2.25
			R4 CR=63% RQD=51%	3.00
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R5 CR=64% RQD=23%	3.75
			R6 CR=60% RQD=37%	4.50
			R7 CR=65% RQD=NIL	5.25
			R8 CR=61% RQD=33%	6.00
			R9 CR=69% RQD=27%	6.75
			R10 CR=61% RQD=48%	7.50
			R11 CR=77% RQD=60%	8.25
8.50m.				

BH-83/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 07/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.83

Co-ordinates E=161.000 N=1621.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	0	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	0
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 30/07/2018
Completion Date : 31/07/2018
Bore Hole Diameter : 150 mm./ N.X
Level Of Ground : 282.130 M.
Water Struck At :
Standing Water Level : 2.25 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
8.50m.			R12	CR=67% RQD=25%
				9.00
			R13	CR=75% RQD=33%
				9.75
			R14	CR=61% RQD=NIL
				10.50
			R15	CR=64% RQD=13%
				11.25
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R16	CR=88% RQD=48%
				12.00
			R17	CR=92% RQD=61%
				12.75
			R18	CR=85% RQD=28%
				13.50
			R19	CR=89% RQD=21%
				14.25
			R20	CR=93% RQD=27%
15.00m.				15.00

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-1(Main) | Co-ordinates E=(-)594.000 N=1311.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 16/07/2018
Completion Date : 18/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 283.460 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m 0.10m. Filled up soil consist of reddish brown, decomposed rock fragments.		100 Refusal 2.0 cm Pentn. NX. drilling from 0.10m to 13.50m	*SPT-1	0.10-0.12 0.10
			R1	CR=50% RQD=46% 0.75
			R2	CR=64% RQD=40% 1.50
			R3	CR=79% RQD=73% 2.25
			R4	CR=78% RQD=72% 3.00
			R5	CR=77% RQD=72% 3.75
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R6	CR=61% RQD=NIL 4.50
			R7	CR=72% RQD=49% 5.25
			R8	CR=81% RQD=76% 6.00
			R9	CR=93% RQD=90% 6.75
			R10	CR=90% RQD=86% 7.50
			R11	CR=52% RQD=NIL 8.25
8.25m.			R12	CR=68% RQD=58% 9.00
			R13	CR=74% RQD=66% 9.75
			R14	CR=88% RQD=53% 10.50
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R15	CR=84% RQD=61% 11.25
			R16	CR=84% RQD=65% 12.00
			R17	CR=76% RQD=60% 12.75
			R18	CR=79% RQD=66% 13.50
13.50m.				

N.B. - '*' means sample could not be recovered.

BH-1/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 14/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-1 (Receiver-1)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 18/07/2018
Completion Date : 22/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 283.460 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Filled up soil consists of reddish brown, 0.10m. decomnposed rock fragments.		100 Refusal 3.0 cm Pentn.	*SPT-1	0.10-0.13 0.10
		NX. drilling from 0.10m to 13.50m	R1	CR=44% RQD=40% 0.75
			R2	CR=43% RQD=21% 1.50
			R3	CR=49% RQD=NIL 2.25
			R4	CR=44% RQD=42% 3.00
			R5	CR=50% RQD=42% 3.75
			R6	CR=47% RQD=32% 4.50
			R7	CR=43% RQD=15% 5.25
			R8	CR=56% RQD=42% 6.00
			R9	CR=48% RQD=45% 6.75
Moderately weathered, reddish brown, fine grained, fractured shale.			R10	CR=41% RQD=NIL 7.50
			R11	CR=44% RQD=24% 8.25
			R12	CR=42% RQD=20% 9.00
			R13	CR=41% RQD=NIL 9.75
			R14	CR=45% RQD=18% 10.50
			R15	CR=46% RQD=30% 11.25
			R16	CR=49% RQD=NIL 12.00
			R17	CR=45% RQD=NIL 12.75
			R18	CR=56% RQD=16% 13.50
13.50m.				

N.B. – '*' means sample could not be recovered.

BH-1001/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-1 (Receiver-2)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 22/07/2018
Completion Date : 25/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 283.460 M
Water Struck At :
Standing Water Level : 3.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up with brick bats, road materials.		Refusal 100 3.0 cm Pentn.	DS-1	0.50
			*SPT-1	1.30-1.33
1.50m.		Refusal 100 2.0 cm Pentn.	*SPT-2	1.50-1.52
		NX. drilling from 1.50m to 13.50m	R1	CR=44% RQD=NIL 2.25
			R2	CR=58% RQD=25% 3.00
Moderately weathered, reddish brown, fine grained, fractured shale.			R3	CR=51% RQD=39% 3.75
			R4	CR=53% RQD=20% 4.50
			R5	CR=54% RQD=52% 5.25
			R6	CR=53% RQD=43% 6.00
6.00m.			R7	CR=60% RQD=44% 6.75
			R8	CR=66% RQD=64% 7.50
			R9	CR=62% RQD=20% 8.25
			R10	CR=61% RQD=58% 9.00
Moderately to slightly weathered, whitish grey to reddish brown, fine grained, fractured shale.			R11	CR=66% RQD=53% 9.75
			R12	CR=63% RQD=52% 10.50
			R13	CR=70% RQD=67% 11.25
			R14	CR=69% RQD=20% 12.00
			R15	CR=73% RQD=69% 12.75
			R16	CR=70% RQD=68% 13.50
13.50m.				

N.B. – '*' means sample could not be recovered.

BH-1002/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 26/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST- 2(Main) | Co-ordinates E=(-)660.000 N=1253.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 18/07/2018
Completion Date : 19/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.482 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	Depth (m)
0.00m Reddish brown, clayey silt with decomposed rock fragments.(Cl) 0.50m		Refusal 100 3.0 cm Pentn.	DS-1 *SPT-1	0.30 0.50-0.53 0.50
Moderately weathered, reddish brown, fine grained, fractured shale. 2.75m		NX. drilling from 0.50m to 13.50m	R1 R2 R3 R4 R5 R6 R7	CR=45% RQD=NIL 1.25 CR=46% RQD=37% 2.00 CR=48% RQD=45% 2.75 CR=54% RQD=49% 3.50 CR=75% RQD=66% 4.25 CR=72% RQD=42% 5.00 CR=72% RQD=55% 5.75
Moderately to slightly weathered, reddish brown, fine grained, fractured shale. 5.75m			R8 R9 R10 R11 R12 R13 R14 R15 R16 R17 R18	CR=86% RQD=60% 6.50 CR=89% RQD=66% 7.25 CR=81% RQD=19% 8.00 CR=88% RQD=85% 8.75 CR=96% RQD=72% 9.50 CR=95% RQD=90% 10.25 CR=93% RQD=45% 11.00 CR=96% RQD=90% 11.75 CR=97% RQD=84% 12.50 CR=68% RQD=26% 13.00 CR=66% RQD=NIL 13.50
Slightly weathered / fresh, reddish brown, fine grained, fractured shale. 13.50m				

N.B. – '*' means sample could not be recovered.

BH-2/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 26/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-2 (Receiver-1)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 19/07/2018
Completion Date : 20/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.482 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Reddish brown, clayey silt with decomposed rock fragments.(Cl) 0.50m.		100 Refusal 3.0 cm Pentn. NX. drilling from 0.50m to 13.50m	DS-1 *SPT-1	0.30 0.50-0.53
			R1	CR=71% RQD=NIL 0.50 - 1.25
			R2	CR=69% RQD=43% 1.25 - 2.00
			R3	CR=76% RQD=46% 2.00 - 2.75
			R4	CR=61% RQD=36% 2.75 - 3.50
			R5	CR=70% RQD=36% 3.50 - 4.25
			R6	CR=78% RQD=20% 4.25 - 5.00
			R7	CR=90% RQD=48% 5.00 - 5.75
			R8	CR=90% RQD=66% 5.75 - 6.50
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R9	CR=80% RQD=33% 6.50 - 7.25
			R10	CR=88% RQD=26% 7.25 - 8.00
			R11	CR=88% RQD=48% 8.00 - 8.75
			R12	CR=89% RQD=16% 8.75 - 9.50
			R13	CR=90% RQD=26% 9.50 - 10.25
			R14	CR=88% RQD=20% 10.25 - 11.00
			R15	CR=86% RQD=38% 11.00 - 11.75
			R16	CR=88% RQD=40% 11.75 - 12.50
			R17	CR=81% RQD=NIL 12.50 - 13.00
			R18	CR=80% RQD=NIL 13.00 - 13.50
13.50m.				

N.B. – '*' means sample could not be recovered.

BH-2001/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-2 (Receiver-2)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 21/07/2018
Completion Date : 22/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.482 M.
Water Struck At :
Standing Water Level : 3.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Reddish brown, clayey silt with decomposed rock fragments.(Cl) 0.50m.		Refusal 100 2.0 cm Pentr.	DS-1 *SPT-1	0.30 0.50-0.52 0.50
		NX. drilling from 0.50m to 13.50m	R1	CR=73% RQD=29% 1.25
			R2	CR=74% RQD=58% 2.00
			R3	CR=73% RQD=65% 2.75
			R4	CR=72% RQD=46% 3.50
			R5	CR=89% RQD=19% 4.25
			R6	CR=84% RQD=19% 5.00
			R7	CR=82% RQD=NIL 5.75
			R8	CR=84% RQD=NIL 6.50
Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R9	CR=88% RQD=13% 7.25
			R10	CR=85% RQD=16% 8.00
			R11	CR=86% RQD=13% 8.75
			R12	CR=88% RQD=NIL 9.50
			R13	CR=84% RQD=NIL 10.25
			R14	CR=89% RQD=19% 11.00
			R15	CR=88% RQD=13% 11.75
			R16	CR=90% RQD=NIL 12.50
			R17	CR=76% RQD=NIL 13.00
			R18	CR=80% RQD=NIL 13.50
13.50m.				

N.B. – '*' means sample could not be recovered.

BH-2002/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST- 3(Main) | Co-ordinates E=(-)709.000 N=1150.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 24/07/2018
Completion Date : 25/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.480 M.
Water Struck At :
Standing Water Level : 5.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, silty clay with rock fragments. 0.50m.				
		100 Refusal 2.0 cm Pentn. NX. drilling from 0.50m to 13.50m	*SPT-1	0.50-0.52 0.50
			R1	CR=56% RQD=NIL 1.25
			R2	CR=60% RQD=NIL 2.00
			R3	CR=67% RQD=NIL 2.75
			R4	CR=69% RQD=NIL 3.50
			R5	CR=61% RQD=13% 4.25
			R6	CR=68% RQD=NIL 5.00
			R7	CR=61% RQD=NIL 5.75
			R8	CR=59% RQD=17% 6.50
Moderately to slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R9	CR=65% RQD=48% 7.25
			R10	CR=72% RQD=NIL 8.00
			R11	CR=57% RQD=NIL 8.75
			R12	CR=71% RQD=44% 9.50
			R13	CR=68% RQD=NIL 10.25
			R14	CR=72% RQD=19% 11.00
			R15	CR=74% RQD=20% 11.75
			R16	CR=69% RQD=41% 12.50
			R17	CR=84% RQD=40% 13.00
			R18	CR=70% RQD=68% 13.50
13.50m. N.B. - '*' means sample could not be recovered.				

BH-3/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-3 (Receiver-1)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 25/07/2018
Completion Date : 26/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.480 m.
Water Struck At :
Standing Water Level : 4.95 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, silty clay with rock fragments. 0.50m.		100 Refusal 3.0 cm Pentn. NX. drilling from 0.50m to 13.50m	*SPT-1	0.50-0.53 0.50
			R1	CR=57% RQD=NIL 1.25
			R2	CR=60% RQD=NIL 2.00
			R3	CR=56% RQD=NIL 2.75
			R4	CR=61% RQD=15% 3.50
			R5	CR=69% RQD=13% 4.25
			R6	CR=67% RQD=16% 5.00
			R7	CR=75% RQD=13% 5.75
			R8	CR=65% RQD=NIL 6.50
Moderately to slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R9	CR=63% RQD=NIL 7.25
			R10	CR=64% RQD=NIL 8.00
			R11	CR=67% RQD=19% 8.75
			R12	CR=72% RQD=16% 9.50
			R13	CR=77% RQD=36% 10.25
			R14	CR=64% RQD=15% 11.00
			R15	CR=84% RQD=13% 11.75
			R16	CR=80% RQD=NIL 12.50
			R17	CR=82% RQD=46% 13.00
			R18	CR=80% RQD=52% 13.50
13.50m. N.B. - '*' means sample could not be recovered.				

BH-3001/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-3 (Receiver-2)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 26/07/2018
Completion Date : 27/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.480 M.
Water Struck At :
Standing Water Level : 5.05 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, silty clay with rock fragments. 0.60m.		Refusal 100 3.0 cm Pentn. NX. drilling from 0.60m to 13.50m	*SPT-1	0.60-0.63 0.60
			R1 CR=75% RQD=NIL	1.25
			R2 CR=69% RQD=NIL	2.00
			R3 CR=63% RQD=NIL	2.75
			R4 CR=71% RQD=NIL	3.50
			R5 CR=67% RQD=NIL	4.25
			R6 CR=69% RQD=15%	5.00
			R7 CR=71% RQD=25%	5.75
			R8 CR=81% RQD=56%	6.50
Slightly weatherd to fresh, reddish brown, fine grained, fractured shale.			R9 CR=85% RQD=NIL	7.25
			R10 CR=73% RQD=24%	8.00
			R11 CR=71% RQD=59%	8.75
			R12 CR=65% RQD=33%	9.50
			R13 CR=64% RQD=37%	10.25
			R14 CR=73% RQD=13%	11.00
			R15 CR=76% RQD=49%	11.75
			R16 CR=64% RQD=33%	12.50
			R17 CR=60% RQD=24%	13.00
			R18 CR=62% RQD=NIL	13.50
13.50m. N.B. - '*' means sample could not be recovered.				

BH-3002/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 26/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST- 4(Main) | Co-ordinates E=(-)697.000 N=867.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 15/07/2018
Completion Date : 18/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 281.520 M.
Water Struck At :
Standing Water Level : 4.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of brownish grey, silty clay / clayey silt with rock fragments. 0.40m.		50 Refusal 4.0 cm Pentn. 50 Refusal 3.0 cm Pentn. NX. drilling from 0.40m to 13.50m	DS-1	0.20
			*SPT-1	0.30-0.34
			*SPT-2	0.40-0.43
			R1	CR=50% RQD=NIL 0.40-1.00
			R2	CR=68% RQD=19% 1.00-1.75
			R3	CR=67% RQD=NIL 1.75-2.50
			R4	CR=64% RQD=NIL 2.50-3.25
			R5	CR=61% RQD=NIL 3.25-4.00
			R6	CR=72% RQD=NIL 4.00-4.75
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R7	CR=67% RQD=NIL 4.75-5.50
			R8	CR=63% RQD=29% 5.50-6.25
			R9	CR=72% RQD=NIL 6.25-7.00
			R10	CR=80% RQD=24% 7.00-7.75
			R11	CR=73% RQD=NIL 7.75-8.50
9.00m.			R12	CR=67% RQD=20% 8.50-9.25
			R13	CR=41% RQD=NIL 9.25-10.00
			R14	CR=47% RQD=NIL 10.00-10.75
Moderately weathered, light greenish grey, fine grained, fractured shale.			R15	CR=56% RQD=36% 10.75-11.50
			R16	CR=51% RQD=25% 11.50-12.25
			R17	CR=55% RQD=NIL 12.25-13.00
13.50m.			R18	CR=60% RQD=NIL 13.00-13.50

N.B. – '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh.			CETEST
Job No : 4157	Created by : T.SAHA	Created on : 08/08/2018	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-4 (Receiver-1)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 19/07/2018
Completion Date : 22/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 281.520 M.
Water Struck At :
Standing Water Level : 4.15 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, silty clay with rock fragments.		Refusal 100 3.0 cm Pentn.	DS-1	0.50
			*SPT-1	0.90-0.93
1.00m.		Refusal 100 2.0 cm Pentn. NX. drilling from 1.00m to 13.50m	*SPT-2	1.00-1.02
			R1	CR=26% RQD=NIL 1.75
			R2	CR=40% RQD=NIL 2.50
			R3	CR=40% RQD=NIL 3.25
			R4	CR=33% RQD=NIL 4.00
			R5	CR=37% RQD=NIL 4.75
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R6	CR=37% RQD=NIL 5.50
			R7	CR=46% RQD=NIL 6.25
			R8	CR=40% RQD=NIL 7.00
			R9	CR=40% RQD=NIL 7.75
			R10	CR=42% RQD=NIL 8.50
			R11	CR=33% RQD=NIL 9.25
			R12	CR=40% RQD=NIL 10.00
10.50m.			R13	CR=44% RQD=NIL 10.75
			R14	CR=68% RQD=NIL 11.50
Moderately to slightly weathered, light greenish grey, fine grained, fractured shale.			R15	CR=64% RQD=NIL 12.25
			R16	CR=75% RQD=37% 13.00
13.50m.			R17	CR=80% RQD=42% 13.50

N.B. - '*' means sample could not be recovered.

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-4 (Receiver-2)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	0
		Water Sample (WS)	0

Commencement Date : 23/07/2018
Completion Date : 26/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 281.520 M.
Water Struck At :
Standing Water Level : 4.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, silty clay with rock fragments. 0.30m.		100 Refusal 2.0 cm Pentn. NX. drilling from 0.30m to 13.50m	*SPT-1	0.30-0.32 0.30
			R1	CR=50% RQD=NIL 1.00
			R2	CR=51% RQD=NIL 1.75
			R3	CR=64% RQD=NIL 2.50
			R4	CR=56% RQD=NIL 3.25
			R5	CR=51% RQD=NIL 4.00
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R6	CR=59% RQD=NIL 4.75
			R7	CR=51% RQD=NIL 5.50
			R8	CR=53% RQD=NIL 6.25
			R9	CR=76% RQD=NIL 7.00
			R10	CR=64% RQD=NIL 7.75
			R11	CR=67% RQD=NIL 8.50
9.00m.			R12	CR=69% RQD=NIL 9.25
			R13	CR=62% RQD=NIL 10.00
			R14	CR=73% RQD=39% 10.75
Slightly weathered to fresh, light greenish grey, fine grained, fractured shale.			R15	CR=77% RQD=NIL 11.50
			R16	CR=80% RQD=24% 12.25
			R17	CR=87% RQD=15% 13.00
			R18	CR=84% RQD=NIL 13.50
13.50m.				

N.B. - '*' means sample could not be recovered.

BH-4002/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST- 5(Main) | Co-ordinates E=(-)523.000 N=857.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 22/07/2018
Completion Date : 24/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.250 M.
Water Struck At :
Standing Water Level : 2.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of reddish brown, silty clay / clayey silt with decomposed rock.			DS-1	0.50
		100 Refusal 4.0 cm Pentn.	*SPT-1	1.00-1.04
1.30m.		100 Refusal 3.0 cm Pentn. NX. drilling from 1.30m to 13.50m	*SPT-2	1.30-1.33
			R1	CR=29% RQD=NIL 2.00
			R2	CR=38% RQD=NIL 2.75
			R3	CR=38% RQD=27% 3.50
			R4	CR=35% RQD=NIL 4.25
Highly to moderately weathered, reddish brown fine grained, highly fractured shale.			R5	CR=36% RQD=NIL 5.00
			R6	CR=40% RQD=36% 5.75
			R7	CR=42% RQD=36% 6.50
			R8	CR=42% RQD=24% 7.25
			R9	CR=39% RQD=20% 8.00
			R10	CR=42% RQD=16% 8.75
8.75m.			R11	CR=45% RQD=30% 9.50
			R12	CR=48% RQD=36% 10.25
Moderately weathered, reddish grey to light grey, fine grained, moderately fractured shale.			R13	CR=50% RQD=40% 11.00
			R14	CR=52% RQD=30% 11.75
			R15	CR=58% RQD=28% 12.50
			R16	CR=45% RQD=26% 13.00
			R17	CR=48% RQD=30% 13.50
13.50m. N.B. – '*' means sample could not be recovered.				

BH-5/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-5 (Receiver-1)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 25/07/2018
Completion Date : 27/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.250 M.
Water Struck At :
Standing Water Level : 2.60 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of yellowish brown, silty clay / clayey silt. Obs. decomposed rock.		>100 (11 35 66) Refusal	DS-1	0.50
			SPT-1	1.00-1.45
		100 5.0 cm Pentn.	*SPT-2	1.70-1.75
1.80m.		100 Refusal	*SPT-3	1.80-1.84
		4.0 cm Pentn.		1.80
		NX. drilling from 1.80m to 13.50m	R1	CR=32% RQD=NIL 2.50
			R2	CR=36% RQD=NIL 3.25
			R3	CR=42% RQD=NIL 4.00
			R4	CR=42% RQD=16% 4.75
			R5	CR=40% RQD=NIL 5.50
			R6	CR=46% RQD=NIL 6.25
			R7	CR=40% RQD=NIL 7.00
Highly / moderately weathered, reddish brown, fine grained, highly fractured shale.			R8	CR=38% RQD=NIL 7.75
			R9	CR=40% RQD=NIL 8.50
			R10	CR=46% RQD=30% 9.25
			R11	CR=45% RQD=40% 10.00
			R12	CR=42% RQD=38% 10.75
			R13	CR=48% RQD=36% 11.50
			R14	CR=50% RQD=40% 12.25
			R15	CR=48% RQD=32% 13.00
			R16	CR=56% RQD=30% 13.50
13.50m.				

N.B. - '*' means sample could not be recovered.

BH-5001/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 08/08/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.CHST-5 (Receiver-2)

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 27/07/2018
Completion Date : 28/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.250 M.
Water Struck At :
Standing Water Level : 2.00 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of reddish brown, silty clay / clayey silt with decomposed rock.		12 22 32 (54) Refusal	DS-1	0.50
			SPT-1	1.00-1.45
		100 5.0 cm Pentrn.	*SPT-2	1.80-1.85
2.00m.		100 Refusal 2.0 cm Pentrn.	*SPT-3	2.00-2.02
		NX. drilling from 2.00m to 13.50m	R1	CR=24% RQD=NIL 2.75
			R2	CR=30% RQD=NIL 3.50
			R3	CR=40% RQD=NIL 4.25
			R4	CR=38% RQD=NIL 5.00
			R5	CR=38% RQD=NIL 5.75
Highly to moderately weathered, reddish brown, fine grained, highly to moderately fractured shale.			R6	CR=42% RQD=13% 6.50
			R7	CR=36% RQD=NIL 7.25
			R8	CR=40% RQD=20% 8.00
			R9	CR=42% RQD=29% 8.75
			R10	CR=40% RQD=20% 9.50
			R11	CR=38% RQD=30% 10.25
			R12	CR=40% RQD=32% 11.00
			R13	CR=44% RQD=26% 11.75
11.75m.			R14	CR=52% RQD=26% 12.50
Moderately weathered, reddish brown, fine grained, highly to moderately fractured shale.			R15	CR=60% RQD=26% 13.00
13.50m.			R16	CR=55% RQD=29% 13.50

N.B. - '*' means sample could not be recovered.

BH-5002/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT1

Co-ordinates E=(-)663.000 N=835.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 10/07/2018
Completion Date : 11/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.110 M.
Water Struck At :
Standing Water Level : 1.80 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	Depth (m)
0.00m				
Medium, reddish brown, clayey silt.(Cl)		3 2 3 5	DS-1	0.50
			SPT-1	1.50-1.95
2.80m		Refusal 100	*SPT-2	2.80-2.83
Moderately weathered, reddish brown, fine grained, fractured shale.		3.0 cm Pentn. NX. drilling from 2.80m to 12.00m	R1	CR=43% RQD=NIL 2.80 - 3.55
3.55m			R2	CR=75% RQD=NIL 3.55 - 4.30
			R3	CR=75% RQD=NIL 4.30 - 5.05
			R4	CR=77% RQD=NIL 5.05 - 5.80
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R5	CR=72% RQD=NIL 5.80 - 6.55
			R6	CR=71% RQD=NIL 6.55 - 7.30
			R7	CR=76% RQD=NIL 7.30 - 8.05
			R8	CR=72% RQD=NIL 8.05 - 8.80
			R9	CR=66% RQD=NIL 8.80 - 9.55
9.55m			R10	CR=57% RQD=NIL 9.55 - 10.30
Modeartely to slightly weathered, reddish brown, fine grained, fractured shale.			R11	CR=60% RQD=NIL 10.30 - 11.05
			R12	CR=52% RQD=NIL 11.05 - 11.55
			R13	CR=75% RQD=NIL 11.55 - 12.00
12.00m				

N.B. - '*' means sample could not be recovered.

BH-1/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT2

Co-ordinates E=(-)682.000 N=1314.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 09/07/2018
Completion Date : 10/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.340 M.
Water Struck At :
Standing Water Level : 1.46 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Stiff, reddish brown, clayey silt with decomposed rock fragments.(Cl)		3 5 8 — 13	DS-1 SPT-1	0.50 1.50-1.95
2.60m Highly weathered, reddish brown, fine grained, fractured shale.		100 — Refusal 3.0 cm Pentn. NX. drilling from 2.60m to 12.00m	*SPT-2 R1	2.60-2.63 CR=40% RQD=NIL
3.55m Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R2 R3 R4 R5 R6 R7	CR=80% RQD=28% CR=88% RQD=72% CR=87% RQD=73% CR=87% RQD=72% CR=76% RQD=73% CR=69% RQD=57%
7.85m Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R8 R9 R10 R11 R12 R13	CR=85% RQD=NIL CR=81% RQD=66% CR=75% RQD=65% CR=69% RQD=17% CR=75% RQD=62% CR=68% RQD=NIL
12.00m				

2.60 → 3.35 → 4.10 → 4.85 → 5.60 → 6.35 → 7.10 → 7.85 → 8.60 → 9.35 → 10.10 → 10.85 → 11.60 → 12.00

N.B. – '*' means sample could not be recovered.

BH-2/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT3

Co-ordinates E=(-)686.000 N=1263.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	3	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	3
Vane (V)		Disturbed (DS)	2
		Water Sample (WS)	0

Commencement Date : 08/07/2018
Completion Date : 09/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.348 M.
Water Struck At :
Standing Water Level : 1.60 m.

DESCRIPTION	N-VALUE (EACH DIVN=15CM)	SAMPLES Ref. No	Depth (m)
0.00m.			
Filled up with silty clay / clayey silt with decomposed rock fragments.	7 11 19 (30)	DS-1	0.50
		SPT-1	1.00-1.45
1.50m.		DS-2	2.00
Hard(N>50), Reddish brown, clayey silt / silty clay with decomposed rock fragments.(Cl)	Refusal 100 2.0 cm Pentn.	*SPT-2	2.10-2.12
2.20m.	100 Refusal 3.0 cm Pentn.	*SPT-3	2.20-2.23
	NX. drilling from 2.20m to 12.00m	R1 CR=32% RQD=NIL	2.20 / 2.70
		R2 CR=46% RQD=20%	2.70 / 3.45
Highly to modeartely weathered, reddish brown, fine grained, fractured shale.		R3 CR=45% RQD=40%	3.45 / 4.20
		R4 CR=47% RQD=44%	4.20 / 4.95
		R5 CR=46% RQD=33%	4.95 / 5.70
5.70m.		R6 CR=57% RQD=32%	5.70 / 6.45
Modeartely weathered, reddish brown, fine grained, fractured shale.		R7 CR=54% RQD=38%	6.45 / 7.20
		R8 CR=53% RQD=50%	7.20 / 7.95
7.95m.		R9 CR=69% RQD=67%	7.95 / 8.70
		R10 CR=63% RQD=50%	8.70 / 9.45
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.		R11 CR=68% RQD=52%	9.45 / 10.20
		R12 CR=48% RQD=NIL	10.20 / 10.95
		R13 CR=47% RQD=NIL	10.95 / 11.50
		R14 CR=54% RQD=NIL	11.50 / 12.00
12.00m.			

N.B. - '*' means sample could not be recovered.

BH-3/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT4

Co-ordinates E=(-)595.000 N=1261.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 03/07/2018
Completion Date : 04/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.730 M.
Water Struck At :
Standing Water Level : 1.26 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Very stiff, reddish brown, clayey silt with decomposed rock fragments.(Cl)			DS-1	0.50
		4 6 16 — 22 Refusal	SPT-1	1.40-1.85
1.95m.		100 3.0 cm Pentn.	*SPT-2	1.95-1.98
Moderately weathered to fresh, reddish brown, fine grained, fractured shale.		NX. drilling from 1.95m to 12.00m	R1	CR=56% RQD=18% 1.95 - 2.50
			R2	CR=85% RQD=73% 2.50 - 3.25
			R3	CR=80% RQD=59% 3.25 - 4.00
			R4	CR=83% RQD=79% 4.00 - 4.75
			R5	CR=81% RQD=68% 4.75 - 5.50
			R6	CR=60% RQD=24% 5.50 - 6.00
			R7	CR=52% RQD=NIL 6.00 - 6.50
6.50m. Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R8	CR=84% RQD=72% 6.50 - 7.25
			R9	CR=91% RQD=88% 7.25 - 8.00
			R10	CR=77% RQD=57% 8.00 - 8.75
			R11	CR=89% RQD=72% 8.75 - 9.50
9.50m. Slightly weathered to fresh, reddish brown, fine grained, fractured shale.			R12	CR=72% RQD=68% 9.50 - 10.00
			R13	CR=76% RQD=58% 10.00 - 10.50
			R14	CR=83% RQD=80% 10.50 - 11.25
			R15	CR=89% RQD=86% 11.25 - 12.00
12.00m. N.B. — '*' means sample could not be recovered.				

BH-4/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT5

Co-ordinates E=(-)647.000 N=1191.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 04/07/2018
Completion Date : 05/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.560 M.
Water Struck At :
Standing Water Level : 1.22 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Reddish brown, clayey silt with decomposed rock fragments.(Cl) 0.50m.		Refusal 100 3.0 cm Pentn.	DS-1	0.40
			*SPT-1	0.50-0.53
		NX. drilling from 0.50m to 12.00m	R1	CR=56% RQD=NIL 1.25
			R2	CR=70% RQD=NIL 2.00
			R3	CR=68% RQD=13% 2.75
			R4	CR=68% RQD=32% 3.50
			R5	CR=75% RQD=24% 4.25
			R6	CR=69% RQD=20% 5.00
			R7	CR=78% RQD=51% 5.75
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R8	CR=77% RQD=36% 6.50
			R9	CR=79% RQD=13% 7.25
			R10	CR=75% RQD=36% 8.00
			R11	CR=80% RQD=47% 8.75
			R12	CR=77% RQD=NIL 9.50
			R13	CR=77% RQD=24% 10.25
			R14	CR=73% RQD=39% 11.00
			R15	CR=70% RQD=NIL 11.50
			R16	CR=80% RQD=NIL 12.00
12.00m.				

N.B. - '*' means sample could not be recovered.

BH-5/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT6 | Co-ordinates E=(-)655.000 N=1116.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 05/07/2018
Completion Date : 06/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.380 M.
Water Struck At :
Standing Water Level : 0.97 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Reddish brown, clayey silt with decomposed rock fragments.(Cl)			DS-1	0.40
0.50m.		Refusal 100	*SPT-1	0.50-0.52
		2.0 cm Pentn.	R1	CR=84% RQD=40%
		NX. drilling from 0.50m to 10.25m	R2	CR=75% RQD=73%
			R3	CR=80% RQD=47%
			R4	CR=77% RQD=39%
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R5	CR=80% RQD=39%
			R6	CR=76% RQD=NIL
			R7	CR=78% RQD=57%
			R8	CR=77% RQD=57%
			R9	CR=80% RQD=51%
7.25m.			R10	CR=89% RQD=86%
Slightly weathered / fresh, reddish brown, fine grained, fractured shale.			R11	CR=86% RQD=57%
			R12	CR=84% RQD=64%
			R13	CR=83% RQD=59%
			R14	CR=84% RQD=77%
			R15	CR=68% RQD=NIL
12.00m.			R16	CR=80% RQD=50%

0.50 1.25 2.00 2.75 3.50 4.25 5.00 5.75 6.50 7.25 8.00 8.75 9.50 10.25 11.00 11.50 12.00

N.B. – '*' means sample could not be recovered.

BH-6/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT7 | Co-ordinates E=(-)628.000 N=1050.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 06/07/2018
Completion Date : 07/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.920 M.
Water Struck At :
Standing Water Level : 2.50 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Reddish brown, clayey silt with decomposed rock fragments.(Cl)			DS-1	0.50
0.70m		Refusal 100 3.0 cm Pentr.	*SPT-1	0.70-0.73
Moderately weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 0.70m to 12.00m	R1	CR=47% RQD=NIL 0.70 - 1.45
			R2	CR=47% RQD=NIL 1.45 - 2.20
2.20m			R3	CR=77% RQD=NIL 2.20 - 2.95
			R4	CR=75% RQD=NIL 2.95 - 3.70
			R5	CR=75% RQD=NIL 3.70 - 4.45
			R6	CR=80% RQD=NIL 4.45 - 5.20
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R7	CR=72% RQD=NIL 5.20 - 5.95
			R8	CR=77% RQD=28% 5.95 - 6.70
			R9	CR=80% RQD=17% 6.70 - 7.45
			R10	CR=73% RQD=32% 7.45 - 8.20
			R11	CR=79% RQD=29% 8.20 - 8.95
			R12	CR=79% RQD=19% 8.95 - 9.70
			R13	CR=80% RQD=75% 9.70 - 10.45
10.45m			R14	CR=82% RQD=64% 10.45 - 11.20
Fresh, reddish brown, fine grained, fractured shale.			R15	CR=83% RQD=29% 11.20 - 11.60
12.00m			R16	CR=82% RQD=36% 11.60 - 12.00

N.B. - '*' means sample could not be recovered.

BH-7/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT8

Co-ordinates E=(-)514.000 N=904.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 12/07/2018
Completion Date : 13/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.300 M.
Water Struck At :
Standing Water Level : 3.50 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Hard(N>50), reddish brown, clayey silt.(CI)			DS-1	0.50
		37 100 >100 7.0 cm Pentn.	SPT-1	1.50-1.72
1.80m		100 Refusal 3.0 cm Pentn.	*SPT-2	1.80-1.83
		NX. drilling from 1.80m to 12.00m	R1	CR=40% RQD=NIL 1.80 - 2.55
			R2	CR=52% RQD=13% 2.55 - 3.30
			R3	CR=56% RQD=13% 3.30 - 4.05
			R4	CR=76% RQD=13% 4.05 - 4.80
			R5	CR=75% RQD=NIL 4.80 - 5.55
			R6	CR=75% RQD=13% 5.55 - 6.30
Moderately to slightly weathered, reddish to greyish brown, fine grained, fractured shale.			R7	CR=69% RQD=37% 6.30 - 7.05
			R8	CR=77% RQD=37% 7.05 - 7.80
			R9	CR=68% RQD=NIL 7.80 - 8.55
			R10	CR=72% RQD=NIL 8.55 - 9.30
			R11	CR=76% RQD=NIL 9.30 - 10.05
			R12	CR=61% RQD=NIL 10.05 - 10.80
			R13	CR=63% RQD=16% 10.80 - 11.55
			R14	CR=73% RQD=NIL 11.55 - 12.00
12.00m				

N.B. - '*' means sample could not be recovered.

BH-8/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT9

Co-ordinates E=(-)1443.000 N=1014.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	2	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	2
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 15/07/2018
Completion Date : 16/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.245 M.
Water Struck At :
Standing Water Level : 3.50 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	Depth (m)
0.00m.				
Filled up soil consists of reddish brown, silty clay / clayey silt with decomposed rock.		Refusal	DS-1	0.50
		100 4.0 cm Pentn.	*SPT-1	1.00-1.04
1.30m.		100 Refusal	*SPT-2	1.30-1.33
		3.0 cm Pentn.		1.30
		NX. drilling from 1.30m to 12.00m	R1	CR=22% RQD=NIL
Highly weathered, reddish brown, fine grained, fractured shale.				2.00
			R2	CR=24% RQD=13%
				2.75
			R3	CR=24% RQD=16%
3.50m.				3.50
			R4	CR=30% RQD=NIL
				4.25
			R5	CR=32% RQD=NIL
				5.00
			R6	CR=30% RQD=20%
				5.75
			R7	CR=32% RQD=NIL
				6.50
			R8	CR=29% RQD=NIL
				7.25
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R9	CR=30% RQD=NIL
				8.00
			R10	CR=33% RQD=NIL
				8.75
			R11	CR=40% RQD=40%
				9.50
			R12	CR=38% RQD=NIL
				10.25
			R13	CR=36% RQD=NIL
				11.00
			R14	CR=35% RQD=13%
12.00m.				12.00

N.B. – '*' means sample could not be recovered.

BH-9/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT10

Co-ordinates E=(-)878.000 N=1314.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	4	Undisturbed (UDS)	1
Cone (Pc)		Penetrometer (SPT)	4
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 12/07/2018
Completion Date : 13/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.476 M.
Water Struck At :
Standing Water Level : 3.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up with reddish brown, silty clay / clayey silt with road materials		8 9 17 (26)	DS-1	0.50
			SPT-1	1.00-1.45
			*UDS-1	2.00-2.45
2.50m.				
Very stiff to hard, reddish brown, silty clay / clayey silt with decomposed rock fragments.(Cl)		5 9 11 (20)	SPT-2	3.00-3.45
		Refusal 100 3.0 cm Pentn.	*SPT-3	4.10-4.13
4.20m.		Refusal 100 2.0 cm Pentn.	*SPT-4	4.20-4.22
		NX. drilling from 4.20m to 12.00m	R1	CR=40% RQD=24% 4.20-4.95
Highly to moderately weathered, reddish brown, fine grained, fractured shale.			R2	CR=38% RQD=26% 4.95-5.70
			R3	CR=33% RQD=30% 5.70-6.45
			R4	CR=50% RQD=37% 6.45-7.20
7.20m.			R5	CR=66% RQD=62% 7.20-7.95
			R6	CR=69% RQD=63% 7.95-8.70
			R7	CR=46% RQD=40% 8.70-9.45
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.			R8	CR=60% RQD=58% 9.45-10.20
			R9	CR=57% RQD=52% 10.20-10.95
			R10	CR=54% RQD=52% 10.95-11.50
			R11	CR=52% RQD=48% 11.50-12.00
12.00m.				

N.B. - '*' means sample could not be recovered.

BH-10/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT11

Co-ordinates E=(-)495.000 N=1652.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 15/07/2018
Completion Date : 16/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.287 M.
Water Struck At :
Standing Water Level : 1.10 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Reddish brown, clayey silt with decomposed rock fragments.(Cl)			DS-1	0.50
1.50m		Refusal 100 3.0 cm Pentn.	*SPT-1	1.50-1.53
Moderately / slightly weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 1.50m to 12.00m	R1	CR=53% RQD=26%
			R2	CR=49% RQD=19%
			R3	CR=72% RQD=57%
			R4	CR=74% RQD=NIL
			R5	CR=68% RQD=NIL
			R6	CR=70% RQD=NIL
			R7	CR=72% RQD=NIL
			R8	CR=72% RQD=NIL
			R9	CR=63% RQD=NIL
			R10	CR=55% RQD=NIL
			R11	CR=58% RQD=NIL
			R12	CR=51% RQD=NIL
			R13	CR=59% RQD=NIL
			R14	CR=57% RQD=NIL
12.00m				

1.50 2.25 3.00 3.75 4.50 5.25 6.00 6.75 7.50 8.25 9.00 9.75 10.50 11.25 12.00

N.B. – '*' means sample could not be recovered.

BH-11/Sheet-1

Project : Geotechnical Inv. Work for 1x800MW Sipat STPP at Sipat, Chhattisgarh. CETEST

Job No : 4157 | Created by : T.SAHA | Created on : 31/07/2018 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.PMT12

Co-ordinates E=(-)73.000 N=1656.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	1	Undisturbed (UDS)	0
Cone (Pc)		Penetrometer (SPT)	1
Vane (V)		Disturbed (DS)	1
		Water Sample (WS)	0

Commencement Date : 16/07/2018
Completion Date : 16/07/2018
Bore Hole Diameter : N.X
Level Of Ground : 282.580 M.
Water Struck At :
Standing Water Level : 1.20 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN=15CM	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m Reddish brown, clayey silt with decomposed rock fragments.(Cl)			DS-1	0.50
1.00m.		Refusal 100 2.0 cm Pentn.	*SPT-1	1.00-1.02
Moderately to slightly weathered, reddish brown, fine grained, fractured shale.		NX. drilling from 1.00m to 12.00m	R1	CR=41% RQD=NIL 1.00 - 1.75
			R2	CR=44% RQD=14% 1.75 - 2.50
			R3	CR=67% RQD=52% 2.50 - 3.25
			R4	CR=69% RQD=NIL 3.25 - 4.00
			R5	CR=63% RQD=NIL 4.00 - 4.75
			R6	CR=64% RQD=NIL 4.75 - 5.50
			R7	CR=67% RQD=NIL 5.50 - 6.25
			R8	CR=65% RQD=NIL 6.25 - 7.00
			R9	CR=63% RQD=NIL 7.00 - 7.75
			R10	CR=51% RQD=NIL 7.75 - 8.50
			R11	CR=53% RQD=NIL 8.50 - 9.25
			R12	CR=51% RQD=NIL 9.25 - 10.00
			R13	CR=55% RQD=NIL 10.00 - 10.75
			R14	CR=57% RQD=NIL 10.75 - 11.50
			R15	CR=52% RQD=NIL 11.50 - 12.00
12.00m.				

N.B. - '*' means sample could not be recovered.

BH-12/Sheet-1

BORE LOG OF DRILL HOLE DBH - 01

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -2860, W-434** | **GROUND LEVEL (m) : 281.890**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 2.10** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.70 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 13.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 14.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Brownish Soil & Boulder.																										
0.50	1.50																											
1.50	1.95	Hard, Yellowish, Clay With Medium Plasticity.				15	17	30	-	47				11.29	8.73	69.53	10.45	2.76	CI									
1.95	3.20																											
3.20	4.50	Moderately Weathered, Brown-White, Shale.		CORE	1-6						64	64	W_1							2.85	2.81	2.82	0.45	1.25	1330.1	-	-	-
4.50	6.00	Fresh, Brown-White, Shale.		CORE	7-13						94	92	W_1							-	2.74	-	-	-	656.36	-	-	-
6.00	7.50			CORE	14-20						91	89	W_2							-	-	-	-	-	-	51.4	-	-
7.50	9.00			CORE	21-24						100	100	W_2															
9.00	10.00	Fresh, Brownish, Argillaceous Shale.		CORE	25-27						100	100	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 02

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -2386, W-427** | **GROUND LEVEL (m) : 281.807**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 2.00** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 12.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 13.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.10	Filling with Brownish Soil, Clay & Boulder.																										
0.10	1.50																											
1.50	1.95	Very Stiff,Yellow Soil With Clay				7	8	11	-	19				15.74	50.64	25.42	8.2	2.6	-									
1.95	3.00	Moderately Weathered, Brown-White, Shale.		CORE	1-2						38	38	W_3							2.79	2.76	2.77	0.43	1.18	556.67	-	16726	0.03
3.00	4.50			CORE	3-8						43	15	W_3							-	-	-	-	-	-	34.89	-	-
4.50	6.00	Highly Weathered, Brown-White, Shale.		CORE	9-14						31	Nil	W_4							2.66	2.56	2.6	1.42	3.63	-	13.45	-	-
6.00	7.50			CORE	15-22						52	Nil	W_4							-	-	-	-	-	-	29	-	-
7.50	9.00			CORE	23-51						48	Nil	W_4															
9.00	10.00	Moderately Weathered, Brown-White, Shale.		CORE	52-41						41	15	W_3															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 03

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -2226, W-850** | **GROUND LEVEL (m) : 281.746**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 6.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 3.50 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 11.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 12.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS				SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %											
0.00	0.10	Filling, Concrete Cutting & RCC Material.		DS																								
0.10	0.50			DS																								
0.50	1.50			DS																-	-	-	-	-	-	27.55	-	-
1.50	3.00			DS																								
3.00	4.50			DS																								
4.50	4.95	Very Stiff, Yellowish Sandy Soil With Clay.		SPT	1	5	10	13	-	23				22.41	34.37	38.98	4.24	2.75	-									
4.95	6.00																											
6.00	6.55			SPT	2	7	11	14	-	25				33.25	33.69	24.46	8.6	2.79	-									
6.55	7.50	Moderately Weathered, Brown-White, Shale.		CORE	2-9						45	33	W_4							2.8	2.74	2.76	0.72	1.98	-	43.62	-	-
7.50	9.00			CORE	10-25						81	28	W_4							-	-	-	-	-	-	40.01	-	-
9.00	10.00	Completely Weathered, Brown-White, Shale.		CORE	26-29						34	7	W_3															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 04

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1820, W-833** | **GROUND LEVEL (m) : 281.833**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 3.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.80 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 13.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 14.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.10	Filling, Concrete Cutting & Rcc Material.																										
0.10	1.50	Brownish Clayey Soil & Boulder.																										
1.50	3.00																											
3.00	3.45	Stiff to Very Stiff, Yellowish, Clay with medium Plasticity.		SPT	1	3	5	6	-	11				1.17	6.67	79.75	12.41	2.62	Cl									
3.45	4.50																											
4.50	4.95			SPT	2	10	15	18	-	33				3.59	12.4	60.6	23.4	2.54	Cl									
4.95	6.00																											
6.00	6.50			SPT	3	16	19	22	-	41				21.4	13.7	54.5	10.4	2.52	-									
6.50	7.50	Moderately Weathered, Brown-White, Shale.		CORE	1-2						55	55	W_3							2.71	2.63	2.66	1.1	2.89	506.28	-	78399	0.15
7.50	9.00			CORE	3-4						65	25	W_3							-	-	-	-	-	769	-	-	-
9.00	10.00			CORE	5-23						55	34	W_3							-	-	-	-	-	-	31.51	-	-

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 05

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1423, W-845** | **GROUND LEVEL (m) : 281.912**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 3.00** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 2.40 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 18.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 18.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.75	Medium Stiff, Yellowish, Clay With Medium Plasticity.																										
0.75	1.05			UDS	1									17.75	9.64	54.97	17.64	2.31	CI									
1.05	1.50																											
1.50	1.95					2	3	5	-	8				10.97	7.49	58.39	23.15	2.73	CI									
1.95	2.25																											
2.25	2.70					3	5	8	-	13				4.76	4.23	75.48	15.53	2.67	CI									
2.70	3.00																											
3.00	4.65	Completely Weathered, Brownish, Disintegrated Argillaceous Shale.		SP							23	Nil	W_3															
4.65	6.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	1-11						96	56	W_4							2.68	2.57	2.61	1.56	4.01	193.56	-	-	-
6.00	7.50	Fresh, Brownish, Argillaceous Shale.		CORE	12-21						97	88	W_4							2.77	2.74	2.75	0.41	1.13	229.36	-	-	-
7.50	9.00			CORE	22-28						100	93	W_4							-	-	-	-	-	1083.72	-	-	-
9.00	10.00			CORE	29-31						91	91	W_3															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 06

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1426, W-522** | **GROUND LEVEL (m) : 282.510**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 3.00** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 12.00 | **GROUND W.L BGL (m) : 2.40 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 15.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 17.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS				SPECIFIC GRAVITY	IS CLASSIFICATION									
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %			SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Brownish Soil, Clay & Boulder.																										
0.50	1.50																											
1.50	1.95	Hard, Brownish, Clay with medium Plasticity.				8	15	25	-	40				24.93	5.88	60.23	8.96	2.46	Cl									
1.95	3.35																											
3.35	4.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	1-9						63	40	W_3							2.61	2.6	2.6	0.15	0.4	629.41	-	-	-
4.50	6.00	Fresh, Brownish, Argillaceous Shale.		CORE	10-17						93	87	W_3							-	-	-	-	-	288.67	-	-	-
6.00	7.50			CORE	18-26						97	89	W_4							-	-	-	-	-	654.3	-	-	-
7.50	9.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	27-34						95	91	W_4															
9.00	10.50	Fresh, Brownish, Argillaceous Shale.		CORE	35-47						97	61	W_4															
10.50	12.00			CORE	48-59						100	80	W_3															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SANDSTONE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 07

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1260, W-450** | **GROUND LEVEL (m) : 281.727**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 18.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 18.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Brownis Silty Sand & Boulder.																										
0.50	1.50	Fresh, Brownish, Argillaceous Shale.		CORE	1-8						93	87	W_2							-	-	-	-	-	1063.15	-	-	-
1.50	3.00			CORE	9-21						100	79	W_5							2.78	2.74	2.75	0.59	1.62	367.43	-	74379	0.07
3.00	4.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	22-33						95	72	W_1															
4.50	6.00			CORE	34-49						88	57	W_1															
6.00	7.50			CORE	50-63						97	65	W_2															-
7.50	9.00			CORE	64-74						93	67	W_2															-
9.00	10.00			CORE	75-84						100	75	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 08

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1300, W-825** | **GROUND LEVEL (m) : 282.630**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.80 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 19.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 22.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS				SPECIFIC GRAVITY	IS CLASSIFICATION									
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %			SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	1.50	Filling with Brownish Soil, Clay & Boulder.																									
1.50	1.95	Very Dense, Brownish, Silty Sand.				15	18	31	-	49				41.01	45.18	13.81		2.82	SM								
1.95	3.00	Moderately Weathered, White-Brown, Shale.		CORE	1-4						45	27	W_3							2.69	2.58	2.62	1.59	4.1	-	29.56	-	-
3.00	4.50	Fresh, White-Brown, Shale.		CORE	5-12						95	93	W_1							-	-	-	-	-	1671.23	-	34733	0.02
4.50	6.00			CORE	13-19						100	93	W_1															
6.00	7.50			CORE	20-27						100	98	W_1															
7.50	9.00	Slightly Weathered, White-Brown, Shale.		CORE	28-41						73	45	W_2															
9.00	10.50			CORE	42-47						100	100	W_2															
10.50	12.00			CORE	48-56						73	61	W_2															
12.00	13.50	Fresh, White-Brown, Shale.		CORE	57-67						97	74	W_1															
13.50	15.00			CORE	68-77						97	84	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 09

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1220, W-880** | **GROUND LEVEL (m) : 282.463**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 03.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 04.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.55	Filling with Clayey Silty Sand.																										
0.55	1.50	Slightly Weathered, Brownish, Sandstone.		CORE	1-4						80	80	W_2															
1.50	3.00	Completely Weathered, Brownish, Sandstone.		CORE	5-12						43	20	W_5							2.79	2.77	2.78	0.28	0.76	627.3	-	-	-
3.00	4.50	Fresh, Brownish, Argillaceous Shale.		CORE	13-21						92	79	W_1							2.77	2.73	2.75	0.42	1.15	576.71	-	-	-
4.50	6.00			CORE	22-27						91	91	W_1															
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	28-42						99	70	W_2															-
7.50	9.00			CORE	43-54						99	67	W_2															-
9.00	10.50			CORE	55-67						97	70	W_2															
10.50	12.00	Fresh, Brownish, Argillaceous Shale.		CORE	68-78						99	84	W_1															
12.00	13.50			CORE	79-92						93	72	W_1															
13.50	15.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	93-101						95	63	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 10

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1120354** | **GROUND LEVEL (m) : 282.409**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.00 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.20 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 05.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 06.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS				SPECIFIC GRAVITY	IS CLASSIFICATION									
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %			SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.75	Filling with Clayey Silty Sand.																										
0.75	1.50				1-5						15	Nil	W_2															
1.50	1.95	Hard, Brownish, Inorganic Clay of low to Medium Plasticity.		SPT	1	10	14	19	-	33				19.07	10.76	55.81	14.36	2.4	CL									
1.95	3.00	Completely Weathered, Brownish, Argillaceous Shale.		CORE	6-24						85	Nil	W_5							2.68	2.58	2.62	1.46	3.77	-	2.91	-	
3.00	4.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	25-55						97	27	W_5							2.74	2.68	2.7	0.89	2.38	200.54	-	-	-
4.50	6.00	Completely Weathered, Brownish, Argillaceous Shale.		CORE	56-87						99	Nil	W_5															
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	88-110						100	32	W_2															
7.50	9.00			CORE	111-135						95	22	W_2															
9.00	10.00			CORE	136-146						100	72	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SANDSTONE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya Kadam** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 11

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1040, W-960** | **GROUND LEVEL (m) : 282.167**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.40** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 12.00 | **GROUND W.L BGL (m) : 1.00** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 11.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 13.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK							
						NO. OF BLOWS								GRAIN SIZE ANALYSIS													
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.60	Filling with Brownish Soil, Clay & Boulder.																										
0.60	1.50	Completely Weathered, Brown-White, Shale.		CORE	1-12						70	Nil								-	-	-	-	-	-	1.08	-	-
1.50	3.00	Moderately Weathered, Brown-White, Shale.		CORE	13-38						81	11	W_3							2.65	2.58	2.61	0.93	2.4	-	10.09	-	-
3.00	4.50	Slightly Weathered, Brown-White, Shale.		CORE	39-72						93	22	W_1							2.75	2.72	2.73	0.44	1.19	492.65	-	-	-
4.50	6.00			CORE	73-98						95	43	W_1															
6.00	7.50			CORE	99-116						99	57	W_1															
7.50	9.00			CORE	117-135						82	26	W_2															
9.00	10.50			CORE	136-149						96	60	W_2															
10.50	12.00	Fresh, Brown-White, Shale.		CORE	68-77						92	75	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 12

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1050, W-1170** | **GROUND LEVEL (m) : 282.177**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.50** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 14.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 15.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Brownish Soil, Clay & Boulder.																										
0.50	1.50	Completely Weathered, Brownish, Disintegrated Shale.		CORE	1-3						42	Nil	W_5															
1.50	3.00	Completely Weathered, Brown-White, Shale.		CORE	4-25						48	Nil	W_5							2.58	2.54	2.65	4.25	10.78	-	0.72	-	-
3.00	4.50			CORE	26-53						73	Nil	W_5							2.5	2.3	2.38	3.5	8.03	-	2.88	-	-
4.50	6.00			CORE	54-81						66	Nil	W_5							-	-	-	-	-	-	8.36	-	-
6.00	7.50			CORE	82-100						76	Nil	W_5							-	-	-	-	-	-	4.73	-	-
7.50	9.00	Moderately Weathered, Brown-White, Shale.		CORE	101-127						91	31	W_3															
9.00	10.50			CORE	128-142						75	18	W_3															
10.50	12.00	Slightly Weathered, Brown-White, Shale.		CORE	143-161						94	63	W_2															
12.00	13.50			CORE	162-175						92	65	W_2															
13.50	15.00	Fresh, Brown-White, Shale.		CORE	176-186						99	85	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 13

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -940[illegible]1775** | **GROUND LEVEL (m) : 282.071**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 12.00 | **GROUND W.L BGL (m) : 1.20** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 10.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 10.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK									
						NO. OF BLOWS								GRAIN SIZE ANALYSIS															
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	1.60	Completely Weathered, Brown-White, Shale.		CORE	1-5						22	7	W_5							Disintegrated Sample								
1.60	3.00	Completely Weathered, Brown-White, Shale.		CORE	6-26						78	Nil	W_5							Disintegrated Sample								
3.00	4.50	Moderately Weathered, Brown-White, Shale.		CORE	27-49						99	40	W_3							Sample Cracked During Cutting.								
4.50	6.00			CORE	50-65						95	45	W_3															
6.00	7.50	Slightly Weathered, Brown-White, Shale.		CORE	66-70						89	63	W_2															
7.50	9.00			CORE	71-91						100	45	W_2															
9.00	10.50			CORE	92-111						100	81	W_2															
10.50	12.00	Completely Weathered, Brown-White, Shale.		CORE	112-130						86	20	W_5															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 14

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -947, W-974** | **GROUND LEVEL (m) : 281.903**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 12.00 | **GROUND W.L BGL (m) : 1.20 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 08.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 08.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS				SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %											
0.00	0.50	Filling with Silty Soil and Boulder.																										
0.50	0.75																											
0.75	1.10	Very Stiff, Clay with Medium Plasticity.		UDS	1									9.18	14.37	63.49	12.96	2.59	Cl									
1.10	1.50	Very Stiff, Brownish, Clayey Gravels.																										
1.50	2.30			SPT	1	6	9	11	-	20				47.83	28.09	19.89	4.19	2.35	GC									
2.30	3.00	Moderately Weathered, Brown-White, Shale.		CORE	1-10						75	22	W_3															
3.00	4.50			CORE	11-45						84	9	W_3							Sample Cracked during Hardness Test								
4.50	6.00			CORE	46-66						90	17	W_3							-	2.66	Sample Cracked in Water.						
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	67-83						95	52	W_2															
7.50	9.00			CORE	84-101						94	50	W_2															
9.00	10.50	Moderately Weathered, Brown-White, Shale.		CORE	102-117						89	35	W_3															
10.50	12.00	Highly Weathered,Brown-White, Shale.		CORE	118-131						61	6	W_4															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya Kadam** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 15

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1020847** | **GROUND LEVEL (m) : 282.420**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 2.00 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.65** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 07.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 10.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK							
						NO. OF BLOWS								GRAIN SIZE ANALYSIS													
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Medium Dense, Brownish, Silty Gravels.		DS																								
0.50	1.50																											
1.50	2.00			SPT	1	3	5	8	-	13				75.93	9.8	14.27		2.58	GM									
2.00	3.00	Completely Weathered, Brownish, Argillaceous Shale.		CORE	1-16						75	Nil	W_5							2.46	2.21	2.31	4.46	9.87	-	2.5	-	-
3.00	4.50			CORE	17-45						86	7	W_5							-	-	-	-	-	-	3.27	-	-
4.50	6.00			CORE	46-75						68	Nil	W_5							-	-	-	-	-	-	9.6	-	-
6.00	7.50			CORE	76-98						72	Nil	W_5															
7.50	9.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	99-119						75	19	W_3															
9.00	10.50			CORE	120-139						78	30	W_3															
10.50	12.00			CORE	140-148						59	19	W_3															
12.00	13.50	Completely Weathered, Brown-White, Shale.		CORE	149-160						57	Nil	W_5															
13.50	12.00	Moderately Weathered, Brown-White, Shale.		CORE	161-169						60	15	W_3															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 16

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -936, W-824** | **GROUND LEVEL (m) : 282.103**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 3.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 2.00** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 11.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 12.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK									
						NO. OF BLOWS								GRAIN SIZE ANALYSIS				SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %											
0.00	0.50	Brownish Sandy Soil With Clay.		DS																								
0.50	0.75	Stiff, Brownish, Clay With High Plasticity.																										
0.75	1.05			UDS	1									18.2	42.16	29.91	9.73	2.44	CH									
1.05	1.50	Stiff, Brownish, Clay With Medium Plasticity.																										
1.50	1.95			SPT		2	3	5	-	8				17.54	49.84	26.47	6.15	2.38	CI									
1.95	3.00	Stiff, Brownish, Clay With Low Plasticity.		SP																								
3.00	3.45			SPT		6	13	12	-	25				21.29	19.14	54.35	5.22	2.44	CL									
3.45	4.55	Completely Weathered, Brownish, Argillaceous Shale.		SP							88	Nil	W_5															
4.55	6.00	Highly Weathered, Brownish, Argillaceous Shale.		CORE	1-11						95	8	W_4							Disintegrated Sample.								
6.00	7.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	12-29						87	40	W_4							-	-	-	-	-	-	21.33	-	-
7.50	9.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	30-47						97	43	W_4							-	-	-	-	-	-	36.62	-	-
9.00	10.50	Moderately Weathered, Brown-White, Shale.		CORE	48-64						90	7	W_3							-	-	-	-	-	254.86	-	-	-
10.50	12.00	Slightly Weathered, Brown-White, Shale.		CORE	65-80						98	53	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 17

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N-790 W-863** | **GROUND LEVEL (m) : 282.638**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 2.60** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 3.00 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 14.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 14.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS				SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT PLI	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %											
0.00	0.75	Filling with Silty soil.																										
0.75	1.05	Yellowish Silty Sand With Clay.		UDS	1									2.84	8.25	74.1	14.81	2.5	CH									
1.05	1.50																											
1.50	1.95			SPT	1	3	4	5	-	9				8.3	44.87	38.26	8.57	2.46	CH									
1.50	2.25																											
2.25	2.55			UDS	2									8.3	44.87	38.26	8.57	2.46	CH									
2.55	3.00																											
3.00	3.45			SPT	2	6	8	7	-	15				30.4	58.35	11.25		2.59	SW--SM									
3.45	4.50	Completely Weathered, Brownish, Argillaceous Shale.		CORE	1-4						31	Nil	W_5							-	2.45	Sample Cracked In Water.						
4.50	6.00	Completely Weathered, Brownish, Argillaceous Shale.		CORE	5-37						90	Nil	W_5							2.7	2.43	2.53	4.03	9.8	-	2.52	-	-
6.00	7.50			CORE	38-62						77	Nil	W_5							-	-	-	-	-	-	4.34	-	-
7.50	9.00			CORE	63-83						75	Nil	W_5							-	-	-	-	-	-	4.99	-	-
9.00	10.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	84-97						91	68	W_2															
10.50	12.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	98-106						70	7	W_3															
12.00	13.50	Moderately Weathered, Brown-White, Shale.		CORE	107-114						73	16	W_3															
13.50	15.00	Completely Weathered, Brown-White, Shale.		CORE	115-132						71	Nil	W_5															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 18

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N-792, W-506** | **GROUND LEVEL (m) : 282.117**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 6.90** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 6.20 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 06.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 10.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT PLI	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with soil & Boulder.																									
0.50	0.75	Very Stiff, Yellowish, Clay with Medium Plasticity.																									
0.75	1.05			UDS	1									4.6	9.9	76	9.5	2.3	Cl								
1.05	1.50																										
1.50	1.95			SPT	1	6	6	7	-	13				6	19	65	10	2.4	Cl								
1.95	2.25																										
1.05	2.55			UDS	2									4.6	13	73	9.5	2.3	Cl								
2.55	3.00																										
3.00	3.45			SPT	2	8	10	12	-	22				7.7	23	63	6.4	2.4	Cl								
3.45	4.50																										
4.50	4.95			SPT	3	9	11	15	-	26				0.8	31	59	8.6	2.5	Cl								
4.95	5.50																										
5.50	5.80			UDS	3									19	19	59	2.5	2.5	Cl								
5.80	6.10			SP																							
6.10	7.50	Completely Weathered, Yellow-White, Disintegrated Shale.		SP							20	Nil	W_5														
7.50	9.00			SP							26	Nil	W_5														
9.00	10.50			SP							27	Nil	W_5														
10.50	12.00			SP							36	Nil	W_5														
12.00	13.50			SP							53	Nil	W_5														
13.50	15.00			SP							65	Nil	W_5														

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 19

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N-879 W-450** | **GROUND LEVEL (m) : 281.869**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 6.30** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 6.00 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 07.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 08.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS				SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT PLI	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %											
0.00	0.75	Filling with soil & Boulder.																										
0.75	1.05			UDS	1									17.9	25.2	49.2	7.76	2.65	Cl								
1.05	1.50																										
1.50	1.95	Medium Stiff, Brownish, Clay With Medium Plasticity.		SPT	1	2	3	4	-	7				0.56	15.2	69	15.3	2.23	Cl								
1.95	2.25																										
2.25	2.55	Stiff, Brownish, Clay With Medium Plasticity.		UDS	2									2.81	10.4	65.9	21	2.37	Cl								
2.55	3.00																										
3.00	3.45			SPT	2	12	6	7	-	13				7.56	23	57.5	11.9	2.35	Cl								
3.45	4.50																										
4.50	4.95	Very Stiff, Brownish, Clay With Medium Plasticity.		SPT	3	10	10	11	-	21				46.6	13.3	32.1	8.08	17.4	Cl								
4.95	5.50																										
5.50	5.80			UDS	3									7.14	11.2	73.6	8.07	2.4	Cl								
5.80	6.10																										
6.10	7.50	Highly Weathered, Brownish,Argillaceous Shale.		CORE	1-16						99	Nil	W_5							-	-	-	-	-	-	2.88	-	-
7.50	9.00	Highly Weathered, Brown-White, Shale.		CORE	17-28						76	7	W_5							2.05	2.12	3.35	6.88	2.2	-	16.72	-	-
9.00	10.00			CORE	29-37						93	12	W_5							Sample Cracked During Cutting.								

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 20

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -987, W-527** | **GROUND LEVEL (m) : 282.290**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 06.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 06.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Silty Soil and Boulder.																										
0.50	1.40	Completely Weathered, Brownish, Disintegrated Argillaceous Shale.		CORE	1-15						58	12	W_5															
1.40	3.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	16-43						94	23	W_3							2.82	2.66	2.72	2.06	5.5	-	1.45	-	-
3.00	4.50			CORE	44-55						90	52	W_3							2.77	2.67	2.71	1.29	3.45	294.16	-	-	-
4.50	6.00	Fresh, Brownish, Argillaceous Shale.		CORE	56-64						100	77	W_1															
6.00	7.50			CORE	65-73						96	87	W_1															
7.50	9.00	Highly Weathered, Brown-White, Shale.		CORE	74-87						93	7	W_4															
9.00	10.00			CORE	88-102						73	11	W_4															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SANDSTONE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya Kadam** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 21

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1300, W-735** | **GROUND LEVEL (m) : 282.733**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 2.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 2.10 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 30.03.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 01.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Clayey Silty Sand.																										
0.50	1.50																											
1.50	1.95	Hard, Brownish, Clay with medium Plasticity.		SPT	1	10	13	18	-	31				16.17	7.5	58.27	18.06	2.64	Cl									
1.95	3.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	1-6						89	58	W_2							2.81	2.76	2.78	0.56	1.56	1033.8	-	-	-
3.00	4.50	Highly Weathered, Brownish, Argillaceous Shale.		CORE	7-10						31	15	W_4							2.72	2.69	2.7	0.44	1.19	-	63.63	-	-
4.50	4.95	Dense,Brownish, Silty Gravels.		SPT	2	12	18	22	-	40				56.76	18.78	23.42	1.04	2.63	GM									
4.95	6.00	Highly Weathered, Brownish, Argillaceous Shale.		CORE	11-15						78	12	W_5															
6.00	7.50			CORE	16-18						49	13	W_5															
7.50	9.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	19-23						70	67	W_3															
9.00	10.50	Slightly Weathered, Brownish,Argillaceous Shale.		CORE	24-31						85	72	W_2															
10.50	12.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	32-37						73	17	W_3															
12.00	13.50			CORE	38-43						72	57	W_3															
13.50	15.00	Fresh, Brownish, Argillaceous Shale.		CORE	44-52						90	84	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 22

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1240, W-610** | **GROUND LEVEL (m) : 282.946**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 30.03.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 01.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.60	Filling with Silty Sand & Boulder.																										
0.60	1.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	1-10						84	19	W_3															
1.50	3.00	Slightly Weathered, Brownish,Argillaceous Shale.		CORE	11-23						83	53	W_2							2.78	2.71	2.74	0.92	2.51	223.19	-	-	-
3.00	4.50			CORE	24-35						93	75	W_2							2.76	2.68	2.71	1.14	3.04	-	4.31	-	-
4.50	6.00			CORE	36-47						98	71	W_2															
6.00	7.50			CORE	48-60						96	67	W_2															-
7.50	9.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	61-82						97	47	W_3															-
9.00	10.50			CORE	83-100						94	44	W_3															
10.50	12.00			CORE	101-117						100	48	W_3															
12.00	13.50			CORE	118-136						99	41	W_3															
13.50	15.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	137-151						100	71	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 23

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1226, W-680** | **GROUND LEVEL (m) : 282.343**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 20.00 | **GROUND W.L BGL (m) : 1.20** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 17.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 18.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.70	Filling with Silty Soil and Boulder.																										
0.70	1.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	1-4						85	50	W_2							2.76	2.73	2.74	0.46	1.26	655.87	-	11935	0.01
1.50	3.00	Fresh, Brownish, Argillaceous Shale.		CORE	5-12						98	88	W_1							2.73	2.71	2.71	0.3	0.81	654.84	-	-	-
3.00	4.50			CORE	13-22						93	78	W_1							-	-	-	-	-	432.68	-	-	-
4.50	6.00			CORE	23-34						100	92	W_1															
6.00	7.50			CORE	35-49						99	81	W_1															
7.50	9.00			CORE	50-62						95	78	W_1															
9.00	10.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	63-83						88	31	W_2															
10.50	12.00			CORE	84-103						90	29	W_2															
12.00	13.50			CORE	104-121						93	40	W_2															
13.50	15.00			CORE	122-133						81	59	W_2															
15.00	16.50	Fresh, Brownish, Argillaceous Shale.		CORE	122-133						93	69	W_1															
16.50	18.00			CORE	122-133						97	82	W_1															
18.00	19.50			CORE	122-133						99	70	W_1															
19.50	20.00			CORE	122-133						85	78	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya Kadam** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 24

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1075, W-718** | **GROUND LEVEL (m) : 282.750**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 2.10 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 17.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 17.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	1.50	Filling with Silty Sand & Boulder.																										
1.50	1.95	Very Stiff, Brownish, Clay With Medium Plasticity.		SPT	1	7	11	15	-	26				12.35	32.96	46.72	7.97	2.39	Cl									
1.95	2.80	Completely Weathered, Brownish, Disintegrated Shale.		CORE	1-6						75	Nil	W_5															
2.80	4.50	Completely Weathered, Brownish, Argillaceous Shale.		CORE	7-31						93	Nil	W_5							2.54	2.08	2.26	8.65	18	-	1.45	-	-
4.50	6.00			CORE	32-59						91	9	W_5							2.37	2.12	2.23	5.02	10.64	-	2.3	-	-
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	60-80						98	34	W_2							-	-	-	-	-	-	2.52	-	-
7.50	9.00			CORE	81-92						87	61	W_2															
9.00	10.50			CORE	93-104						93	73	W_2															
10.50	12.00	Mooderately Weathered, Brownish, Argillaceous Shale.		CORE	105-118						82	17	W_3															
12.00	13.50	Completely Weathered, Brownish, Argillaceous Shale.		CORE	119-128						79	Nil	W_5															
13.50	15.00	Completely Weathered, Brown-White, Shale.		CORE	129-152						70	Nil	W_5															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 25

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1080, W-633** | **GROUND LEVEL (m) : 282.045**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 28.03.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 29.03.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.45	Filling with Silty Sand & Boulder.																										
0.45	1.50	Highly Weathered, Brownish, Argillaceous Shale.		CORE	1-16						71	Nil	W_4															
1.50	3.00			CORE	17-34						83	31	W_4							Cracked Sample.								
3.00	4.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	35-47						92	70	W_2							2.81	2.74	2.76	0.92	2.53	-	7.21	-	-
4.50	6.00			CORE	48-63						100	65	W_2															
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	64-74						93	68	W_3															
7.50	9.00			CORE	75-86						94	49	W_3															
9.00	10.50	Fresh, Brownish, Argillaceous Shale.		CORE	87-94						95	87	W_3															
10.50	12.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	95-103						88	68	W_3															
12.00	13.50	Fresh, Brownish, Argillaceous Shale.		CORE	104-110						100	97	W_3															
13.50	15.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	111-128						87	21	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 26

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1093, W-460** | **GROUND LEVEL (m) : 282.209**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 12.00 | **GROUND W.L BGL (m) : 1.30 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 07.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 07.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	1.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	1-23						92	30	W_2															
1.50	3.00			CORE	24-42						97	69	W_2							2.74	2.68	2.7	0.85	2.27	-	1.09	-	-
3.00	4.50	Fresh, Brownish, Argillaceous Shale.		CORE	43-54						91	83	W_1							2.77	2.65	2.69	1.63	4.3	-	6.49	-	-
4.50	6.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	55-73						91	23	W_3															
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	74-91						87	57	W_2															
7.50	9.00			CORE	92-105						95	82	W_2															
9.00	10.50			CORE	106-117						96	66	W_2															
10.50	12.00			CORE	118-135						87	51	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya Kadam** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 27

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -870, W-670** | **GROUND LEVEL (m) : 282.402**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 20.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 21.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 21.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.12	Filling with Soil and Concrete.																										
0.12	1.55	Completely Weathered, Brownish, Disintegrated Argillaceous Shale.		CORE	1-10						71	Nil	W_5							-	-	-	-	-	-	12.29	-	-
1.55	3.00			CORE	11-33						85	Nil	W_5							Sample Cracked In Water.								
3.00	4.50			CORE	34-58						83	Nil	W_5							2.44	2.23	2.32	3.79	8.47	-	1.81	-	-
4.50	6.00	Completely Weathered, Brownish, Argillaceous Shale.		CORE	59-79						71	Nil	W_5							-	-	-	-	-	-	5.41	-	-
6.00	7.50			CORE	80-97						67	Nil	W_5															
7.50	9.00			CORE	98-106						56	Nil	W_5															
9.00	10.50			CORE	107-115						66	Nil	W_5															
10.50	12.00	Moderately Weathered, Brown-White, Shale.		CORE	116-126						77	41	W_3															
12.00	13.50			CORE	127-133						65	24	W_3															
13.50	15.00			CORE	134-144						67	33	W_3															
15.00	16.50	Slightly Weathered, Brown-White, Shale.		CORE	145-158						80	41	W_2															
16.50	18.00			CORE	159-166						79	50	W_2															
18.00	19.50	Fresh, Brown-White, Shale.		CORE	167-181						93	53	W_1															
19.50	20.00			CORE	182-185						96	78	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya Kadam** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 28

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -90734W** | **GROUND LEVEL (m) : 282.304**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.20** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 11.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 12.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Brownish Silty Soil With Boulder & Concrete.		DS	1																							
0.50	1.60	Completely,Weathered, Disintegrated, Brownish, Argillaceous Shale		SP							45	NIL	W_5															
1.60	3.00	Completely,Weathered,Brownish, Argillaceous Shale		CORE	1-23						61	NIL	W_5							Sample Cracked In Water.								
3.00	4.50			CORE	24-43						67	NIL	W_5							-	-	-	-	-	-	5.33	-	-
4.50	6.00			CORE	44-51						50	NIL	W_5							-	-	-	-	-	-	9.27	-	-
6.00	7.50			CORE	52-57						50	NIL	W_5															-
7.50	9.00	Highly Weathered, Brown-White, Shale.		CORE	58-64						51	23	W_4															-
9.00	10.50			CORE	65-72						64	7	W_4															
10.50	12.00			CORE	73-77						49	NIL	W_4															
12.00	13.50			CORE	78-88						55	NIL	W_4															
13.50	15.00	Moderately Weathered, Brown-White, Shale		CORE	89-108						81	22	W_3															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 29

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -860, W-833** | **GROUND LEVEL (m) : 282.206**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.20** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 12.00 | **GROUND W.L BGL (m) : 1.00** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 12.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 12.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.70	Brownish Sandish Soil With Bolder																										
0.70	1.50	Completely Weathered, Brownish, Disintegrated Argillaceous Shale.		CORE	1-2						34	NIL	W_5							-	-	-	-	-	-	6.89	-	-
1.50	3.00			CORE	3-27						71	NIL	W_5							2.77	2.55	2.63	3.12	7.95	-	2.53	-	-
3.00	4.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	28-45						90	32	W_3							Sample Cracked During Cutting.								
4.50	6.00	Highly Weathered, Brownish, Argillaceous Shale.		CORE	46-69						83	9	W_4															
6.00	7.50			CORE	70-82						64	NIL	W_4															-
7.50	9.00	Moderately Weathered, Brown-White, Shale.		CORE	83-94						82	53	W_3															-
9.00	10.50			CORE	95-103						65	22	W_3															
10.50	12.00	Completely Weathered, Brown-White, Shale.		CORE	104-115						78	7	W_5															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 30

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -792, W-694** | **GROUND LEVEL (m) : 282.011**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 3.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 2.50** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 19.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 19.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.75	Filling, Brownish Silty Soil With Boulder.		DS	1																							
0.75	1.05	Brownish, Clayey Gravels.												46.52	26.17	21.85	5.46	2.5	GC									
1.05	1.50																											
1.50	1.95	Medium Stiff, Brownish, Clay With Medium Plasticity.		SPT	1	2	2	3	-	5				5.12	31.63	54.14	9.11	2.37	CI									
1.95	3.00																											
3.00	4.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	1-18						79	10	W_3							2.48	2.13	2.27	6.53	13.93	-	1.43	-	-
4.50	6.00	Completely Weathered, Brownish, Argillaceous Shale.		CORE	19-51						96	NIL	W_5							-	-	-	-	-	-	9.95	-	-
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale		CORE	52-65						85	46	W_2							-	-	-	-	-	-	6.13	-	-
7.50	9.00			CORE	66-75						75	59	W_2															
9.00	10.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	76-85						73	9	W_3															
10.50	12.00			CORE	86-92						80	9	W_3															
12.00	13.50			CORE	93-99						53	37	W_3															
13.50	15.00			CORE	100-113						79	9	W_3															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 31

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -550, W-1** | **GROUND LEVEL (m) : 282.090**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 0.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 0.00 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 07.04.23 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 10.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS															
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling Brownish Sandi Soil With Bolder.																										
0.50	1.50	Completely Weathered, Brown-White, Disintegrated Shale.		CORE	SP						35	Nil	W_5															
1.50	3.00			CORE	1-3						13	Nil	W_5							2.66	2.58	2.61	1.21	3.13	-	22.23	-	-
3.00	4.50	Completely Weathered, Brown-White, Shale.		CORE	4-5						21	Nil	W_5							2.56	2.51	2.53	0.81	2.03	-	31.29	-	-
4.50	6.00			CORE	6-10						20	Nil	W_5							-	-	-	-	-	-	37.59		
6.00	7.50			CORE	11-14						14	Nil	W_5															-
7.50	9.00			CORE	15						21	Nil	W_5															-
9.00	10.50			CORE	SP						13	Nil	W_5															
10.50	12.00			CORE	16-19						31	Nil	W_5															
12.00	13.50	Highly Weathered, Brown-White, Shale		CORE	20-22						26	17	W_4															
13.50	15.00	Completely Weathered, Brown-White, Shale.		CORE	23-27						32	Nil	W_5															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 32

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1330, W-413** | **GROUND LEVEL (m) : 287.381**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.20** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 20.04.23 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 20.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Blackish Soil With Clay Bolder.			DS																							
0.50	1.50	Slightly Weathered, Brown-White, Shale.		CORE	1-5						75	57	W_2							2.8	2.78	2.79	0.27	0.76	-	39.44	-	-
1.50	3.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	6-12						53	43	W_3							-	-	-	-	-	775.14	-	-	-
3.00	4.50			CORE	13-21						58	39	W_3							-	-	-	-	-	-	67.46	-	-
4.50	6.00	Fresh, Brownish, Argillaceous Shale.		CORE	22-27						97	91	W_1							-	-	-	-	-	-	66.88	-	-
6.00	7.50	Moderately Weathered, Brownish, Argillaceous Shale		CORE	28-39						92	69	W_3															
7.50	9.00	Fresh, Brownish,Argillaceous Shale.		CORE	40-51						100	88	W_1															
9.00	10.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	52-67						91	41	W_2															
10.50	12.00			CORE	68-83						87	29	W_2															
12.00	13.50			CORE	84-102						87	34	W_2															
13.50	15.00			CORE	103-115						90	43	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 33

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1340, W-760** | **GROUND LEVEL (m) : 282.710**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 3.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 3.00 M** | **DRILLING ORIENTATION: VERTICAL**

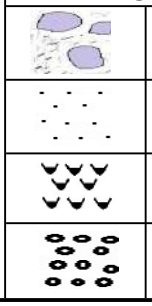
STARTED: 19.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 19.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	1.50	Filling, Brownish Silty Soil WithBoulder.		DS	1																							
1.50	1.95	Hard,Yellowish,Clay with Medium Plasticity.		SPT	1	7	11	14	-	25				9.09	29.23	56.07	5.61	2.79	-									
1.95	2.25																											
2.25	2.70			SPT	2	6	19	31	-	50				27.55	12.45	46.87	13.13	2.44	CI									
2.70	3.55																											
3.55	4.50	Slightly Weathered, Brown-White, Shale.		CORE	1-9						74	53	W_4							2.78	2.76	2.77	0.29	0.8	1106.47	-	79445	0.04
4.50	6.00	Fresh, Brown-White, Shale.		CORE	10-14						97	97	W_4							-	-	-	-	-	1045.77	-	-	-
6.00	7.50			CORE	15-21						93	87	W_3							-	-	-	-	-	-	40.37	-	-
7.50	9.00			CORE	22-28						90	90	W_3															
9.00	10.00			CORE	29-32						90	90	W_3															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY



Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 34

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1210, W-787** | **GROUND LEVEL (m) : 282.156**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : N.A** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.10 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 15.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 15.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	1.50	Moderately Weathered, Brown-White, Shale		CORE	1-5						60	28	W_3							2.79	2.78	2.78	0.21	0.57	749.79	-	-	-
1.50	3.00			CORE	6-15						99	87	W_1							2.75	2.72	2.73	0.43	1.16	961.57		102805	0.05
3.00	4.50	Fresh, Brown-White, Shale.		CORE	16-28						99	81	W_1							-	-	-	-	-	9.83	-	-	-
4.50	6.00			CORE	29-42						96	75	W_1															
6.00	7.50	Moderately Weathered, Brown-White, Shale		CORE	43-60						95	35	W_3															
7.50	9.00			CORE	61-73						96	75	W_1															-
9.00	10.00	Fresh, Brown-White, Shale.		CORE	74-82						98	82	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 35

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1261, W-932** | **GROUND LEVEL (m) : 283.260**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.50** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 19.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 19.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling Concrete With Boulder.		DS	1																							
0.50	1.50	Moderately Weathered, Brownish-White, Shale		CORE	1-2						69	51	W_3							-	-	-	-	-	855.00	-	-	-
1.50	3.00	Fresh, Brown-White, Shale.		CORE	3-8						96	88	W_1							2.76	2.75	2.75	0.14	0.39	579.43	-	-	-
3.00	4.50			CORE	9-13						91	91	W_1							-	-	-	-	-	582.84	-	-	-
4.50	6.00			CORE	14-16						97	97	W_1															
6.00	7.50	Slightly Weathered, Brown-White, Shale.		CORE	19-22						90	84	W_2															-
7.50	9.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	23-31						86	70	W_2															-
9.00	10.00	Fresh, Brownish, Argillaceous Shale.		CORE	32-36						92	92	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 36

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1177, W-987** | **GROUND LEVEL (m) : 282.860**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 2.20** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 17.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 18.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Brownish Silty Soil With Filling Bolder			DS1																							
0.50	1.50	Moderately Weathered, Brown-White, Shale		CORE	1-5						77	19	W_3							-	-	-	-	-	1775.54	-	-	-
1.50	3.00	Slightly Weathered, Brown-White, Shale.		CORE	6-15						76	51	W_2							2.68	2.67	2.68	0.15	0.39	1422.62	-	-	-
3.00	4.50			CORE	16-23						88	74	W_2							-	-	-	-	-	393.53	-	-	-
4.50	6.00	Fresh, Brown-White, Shale.		CORE	24-36						99	77	W_1															
6.00	7.50			CORE	37-48						97	81	W_1															-
7.50	9.00	Slightly Weathered, Brown-White, Shale.		CORE	49-63						93	49	W_2															-
9.00	10.00	Fresh, Brown-White, Shale.		CORE	64-72						98	79	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 37

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1001, W-1070** | **GROUND LEVEL (m) : 282.299**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.10** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.50** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 10.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 10.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling Brownish Silty Soil With Clay Boulder.		DS	1																							
0.50	1.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	1-12						85	14	W_3							2.73	2.66	2.69	0.93	2.48	-	2.86	-	-
1.50	3.00	Highly Weathered, Brownish, Argillaceous Shale.		CORE	13-43						90	NIL	W_4							-	-	-	-	-	-	20.07	-	-
3.00	4.50			CORE	44-72						90	7.3	W_4							-	-	-	-	-	-	3.98	-	-
4.50	6.00			CORE	73-100						93	NIL	W_4															
6.00	7.50	Moderately Weathered, Brownish, Argillaceous Shale		CORE	101-130						87	15	W_3															
7.50	9.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	131-161						91	NIL	W_3															
9.00	10.00			CORE	162-172						90	35	W_3															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 38

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -681, W-968** | **GROUND LEVEL (m) : 282.049**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 4.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.50** | **DRILLING ORIENTATION: VERTICAL**

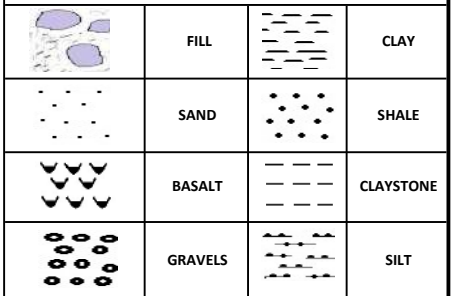
STARTED: 13.04.23 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 13.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK									
						NO. OF BLOWS								GRAIN SIZE ANALYSIS															
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling, Brownish Silty Soil With Clay.		DS																								
0.50	0.75																											
0.75	1.05			UDS	1									5.79	11.28	67.57	15.36	2.39	CH									
1.05	1.50																											
1.50	1.95			SPT	1	2	3	4	-	7				2.89	26.54	57.17	13.4	2.3	CH									
1.95	2.25																											
2.25	2.55	Medium Stiff, Brownish, Clay With High Plasticity.		UDS	2									22.76	13.55	47.28	16.41	2.45	CH									
2.55	3.00																											
3.00	3.45			SPT	2	3	12	46	-	58				19.08	21.9	50.67	8.35	2.37	CI									
3.45	4.50	Completely Weathered, Brown-White, Disintegrated Shale.		SP							48	NIL	W_5															
4.50	6.00	Moderately Weathered, Brown-White, Shale.		CORE	1-6						74	29	W_3							Sample Cracked During Cutting.									
6.00	7.50	Highly Weathered, Brown-White, Shale.		CORE	7-10						35	27	W_4							Sample Cracked During Cutting.									
7.50	9.00			CORE	11-12						41	NIL	W_4															
9.00	10.00			CORE	13-15						46	9	W_4															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY



Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 39

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -704, W-425** | **GROUND LEVEL (m) : 282.927**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 06.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 07.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Silty Sand and Boulders.		DS																								
0.50	1.50	Highly Weathered, Brown-White, Shale.		CORE	1-2						53	15	W_4															
1.50	3.00	Completely Weathered, Brown-White, Shale.		CORE	3-6						27	Nil	W_5							Testing Not Possible Due to Cracked Sample.								
3.00	4.50			CORE	7-9						26	Nil	W_5							2.36	2.31	2.33	0.93	2.15	-	18.8	-	-
4.50	6.00	Highly Weathered, Brown-White, Shale.		CORE	10-18						40	7	W_4															
6.00	7.50	Moderately Weathered, Brown-White, Shale.		CORE	19-32						69	17	W_3															
7.50	9.00	Fresh, Brown-White, Shale		CORE	33-41						91	75	W_1															
9.00	10.00			CORE	42-45						90	84	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 40

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -689, W-410** | **GROUND LEVEL (m) : 282.443**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 05.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 05.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Silty Soil and Boulder.																										
0.50	1.50	Completely Weathered, Brown-White, Shale.		CORE	1-2						65	Nil	W_5															
1.50	3.00	Slightly Weathered, Brown-White, Shale.		CORE	3-15						79	57	W_4							2.69	2.67	2.68	0.3	0.8	1097	-	-	-
3.00	4.50			CORE	16-25						87	73	W_4							-	2.75	Unsoak			620.09	-	-	-
4.50	6.00			CORE	26-36						90	67	W_2															
6.00	7.50	Fresh, Brown-White, Shale.		CORE	37-46						92	80	W_2															
7.50	9.00	Slightly Weathered, Brown-White, Shale		CORE	47-63						87	29	W_4															
9.00	10.00	Fresh, Brown-White, Shale.		CORE	64-66						95	89	W_4															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya Kadam** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 41

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -884, W-526** | **GROUND LEVEL (m) : 282.067**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 1.20 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 06.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 06.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Silty Soil and Boulder.																										
0.50	0.75																											
0.75	1.05	Very Stiff, Brownish, Clay with low Plasticity.												15.47	12.53	64.8	7.2	2.6	CL									
1.05	1.50	Completely Weathered, Brown-White, Shale.		CORE	1-4						65	Nil	W_5															
1.50	1.95	Very Stiff, Brownish, Clay with Medium Plasticity.		SPT	1	8	11	16	-	27				9.34	15.5	59.93	15.23	2.61	Cl									
1.95	2.30																											
2.30	3.00	Highly Weathered, Brown-White, Shale.		CORE	5-29						100	23	W_4							2.6	2.38	2.46	3.48	8.28	-	2.91	-	-
3.00	4.50			CORE	30-59						75	Nil	W_4							2.55	2.25	2.6	5.26	11.82	-	2.92	-	-
4.50	6.00	Slightly Weathered, Brown-White, Shale.		CORE	60-81						91	23	W_2							2.62	2.44	2.51	2.77	6.76	-	1.45	-	-
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	82-98						93	45	W_2															
7.50	9.00	Highly Weathered, Brown-White, Shale.		CORE	99-113						80	Nil	W_4															
9.00	10.00			CORE	114-125						61	Nil	W_4															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya Kadam** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 42

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -932, W-610** | **GROUND LEVEL (m) : 282.149**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.00 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 2.00 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 04.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 04.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	1.50	Completely Weathered, Brownish, Argillaceous Shale.		CORE	1-19						81	Nil	W_5															
1.50	3.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	20-39						90	39	W_2							2.72	2.64	2.67	1.14	3.01	-	0.72	-	-
3.00	4.50			CORE	40-56						95	54	W_2							2.78	2.65	2.7	1.77	4.7	799.83	-	-	-
4.50	6.00			CORE	57-74						92	36	W_2															
6.00	7.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	75-91						91	23	W_3															
7.50	9.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	92-108						97	46	W_2															
9.00	10.00			CORE	109-114						93	65	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya Kadam** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 43

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -986, W-621** | **GROUND LEVEL (m) : 283.501**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 05.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 05.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Silty Sand & Boulder.																										
0.50	1.50	Completely Weathered, Brownish, Disintegrated Argillaceous Shale		CORE	1-16						77	Nil	W_4															
1.50	3.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	17-39						92	44	W_2							2.65	2.56	2.59	1.33	3.4	-	0.72	-	-
3.00	4.50			CORE	40-62						91	37	W_2							2.8	2.68	2.72	1.61	4.3	-	1.81	-	-
4.50	6.00			CORE	63-74						96	81	W_2															
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	75-85						95	57	W_2															-
7.50	9.00			CORE	86-99						94	56	W_2															-
9.00	10.50	Fresh, Brownish, Argillaceous Shale.		CORE	100-103						93	73	W_1															
10.50	12.00			CORE	104-109						93	91	W_1															
12.00	13.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	110-128						94	39	W_2															
13.50	15.00	Slightly Weathered, Brown-White, Shale.		CORE	129-140						100	71	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 44

SOILTECH (INDIA) PRIVATE LIMITE
GROUND ENGINEERS & CONSULTAN

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -983, W-737** | **GROUND LEVEL (m) : 282.746**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 2.50** | **DRILLING METHOD: ROTARY DRILLIN**

TERMINATION DEPTH BGL (m) : 12.00 | **GROUND W.L BGL (m) : 2.00 M** | **DRILLING ORIENTATION: VERTICAL**

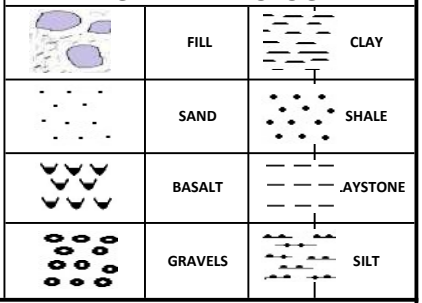
STARTED: 20.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 20.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	1.50	Filling Brownish Soil With Boulder.		DS	1																							
1.50	2.00	Brownish Silt Soil With Clay.																										
2.00	2.55			SPT	1	15	30	45	-	75				52.79	22.1	22.37	2.74	2.49	GM									
2.55	3.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	1-8						89	18	W_3							2.8	2.75	2.76	0.68	1.88	-	36.2	-	-
3.00	4.50	Completely Weathered, Brownish, Argillaceous Shale.		CORE	9-31						66	NIL	W_5							2.29	2.23	2.26	1.28	2.85	-	12.09		
4.50	6.00			CORE	32-54						74	NIL	W_5							-	-	-	-	-	-	1.8		-
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	55-65						85	63	W_2							-	-	-	-	-	-	8.15		-
7.50	9.00	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	66-86						83	19	W_3															
9.00	10.50	Moderately Weathered, Brown-White, Shale.		CORE	87-96						75	14	W_3															
10.50	12.00	Slightly Weathered, Brown-White, Shale.		CORE	97-111						100	51	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY



Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 45

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1160, W-709** | **GROUND LEVEL (m) : 282.138**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.50** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 24.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 24.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	1.50	Filling Brownish Silt Soil With Bolder		DS	1																							
1.50	3.00	Slightly Weathered, Brown-White, Shale.		CORE	1-18						93	61	W_2							Cracked During Cutting.								
3.00	4.50			CORE	19-31						95	72	W_2							2.71	2.6	2.64	1.6	4.15	-	7.57	-	-
4.50	6.00			CORE	32-43						90	58	W_2							-	-	-	-	-	698.27	-	-	-
6.00	7.50	Fresh, Brown-White, Shale.		CORE	44-55						95	85	W_1															
7.50	9.00			CORE	56-66						97	86	W_1															-
9.00	10.50			CORE	67-76						98	77	W_1															-
10.50	12.00			CORE	77-87						93	73	W_1															
12.00	13.50			CORE	88-101						93	50	W_1															
13.50	15.00	Slightly Weathered, Brown-White, Shale.		CORE	102-114						86	61	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 46

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1298, W-573** | **GROUND LEVEL (m) : 282.310**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 2.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 12.00 | **GROUND W.L BGL (m) : 1.60 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 04.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 05.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Silty Sand & Boulder.																										
0.50	1.50	Moderately Weathered, Brown-White, Shale.		CORE	1-4						75	50	W_3															
1.50	3.00	Slightly Weathered, Brown-White, Shale.		CORE	5-13						97	79	W_2							2.82	2.77	2.78	0.66	1.82	-	35.49	-	-
3.00	4.50			CORE	14-19						87	85	W_2							-	2.79	Unsoak			661.59	-	-	-
4.50	6.00	Moderately Weathered, Brown-White, Shale.		CORE	20-38						73	19	W_3															
6.00	7.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	39-49						75	60	W_2															-
7.50	9.00	Slightly Weathered, Brown-White, Shale.		CORE	50-61						89	26	W_2															-
9.00	10.50			CORE	62-72						88	51	W_2															
10.50	15.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	73-93						100	29	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 47

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1484, W-423** | **GROUND LEVEL (m) : 282.860**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 1.00** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.00** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 17.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 18.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS															
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Brownish Silty Soil With Filling Bolder		DS	1																							
0.50	1.50	Moderately Weathered, Brown-White, Shale		CORE	1-4						42	12	W_3							-	-	-	-	-	-	22.84		
1.50	3.00	Slightly Weathered, Brown-White, Shale.		CORE	5-8						69	67	W_2							-	-	-	-	-	-	19.13	-	-
3.00	4.50			CORE	9-14						95	90	W_2							2.66	2.61	2.63	0.66	1.73	-	45.63	-	-
4.50	6.00	Fresh, Brown-White, Shale.		CORE	15-26						96	81	W_1															
6.00	7.50			CORE	27-38						95	76	W_1															
7.50	9.00	Slightly Weathered, Brown-White, Shale.		CORE	39-47						89	63	W_2															
9.00	10.50			CORE	48-59						96	73	W_2															
10.50	12.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	60-79						100	51	W_2															
12.00	13.50			CORE	80-91						96	73	W_2															
13.50	15.00			CORE	92-104						97	73	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 48

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -516, W-1200** | **GROUND LEVEL (m) : 281.735**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 3.50** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 3.20** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 14.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 15.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling Brownish Sandish Soil With Clay.		DS	1																							
0.50	0.75	Brownish,Clay with High Plasticity.																										
0.75	1.05			UDS	1									17.98	24.22	43.02	14.8	2.44	CH							-	-	-
1.05	1.50	Completely Weathered, Brown-White, Disintegrated Pieces Of Shale.		SP							46	NIL	W_5													-	-	-
1.50	3.00			SP							13	NIL	W_5															
3.00	3.45	Brownish Silty Soil With Boulder.		SPT	1	18	19	22	-	41				24.94	42.7	27.88	4.48	2.51	-									-
3.45	4.50			SP																								-
4.50	4.95			SPT	2	15	18	25	-	43				75.29	11.69	13.02		2.52	GM									
4.95	6.00			SP																								
6.00	6.45			SPT	3	13	15	35	-	50				60.7	27.73	11.57			GW-GM									
6.45	7.50	Completely Weathered, Brown-White, Disintegrated Shale.		SP							14	NIL	W_5															
7.50	9.00			SP							10	NIL	W_5															
9.00	10.00			CORE	1-4						17	NIL	W_5							-	-	-	-	-	-	7.72	-	-

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 49

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1490, E -850** | **GROUND LEVEL (m) : 282**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 3.00** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 2.50 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 10.04.23 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 10.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling Brownish Silty Soil With Clay.		DS	1																							
0.50	1.50	Filling Brownish Sandish Soil With Bolder																										
1.50	3.00																											
3.00	4.50																											
4.50	6.00	Slightly Weathered, Brown-White, Shale.		CORE	1-10						86	70	W_2							2.84	2.82	2.83	0.31	0.89	-		23509	0.03
6.00	7.50	Fresh, Brown-White, Shale.		CORE	11-16						92	78	W_1							-	-	-	-	-	319.11	-	-	-
7.50	9.00	Highly Weathered, Brown-White, Shale		CORE	17-27						60	9	W_4															
9.00	10.00	Slightly Weathered, Brown-White, Shale.		CORE	28-35						93	76	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DBH - 50

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANT

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1430 E /-89** | **GROUND LEVEL (m) : 282**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 2.80** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 10.00 | **GROUND W.L BGL (m) : 2.00 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 24.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 25.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling Brownish Silty Soil With Clay.		DS	1																							
0.50	1.50	Filling Brownish Sandy & Silty Soil With Bolder																										
1.50	3.00																											
3.00	4.50																											
4.50	6.00	Moderately Weathered, Brown-White, Shale.		CORE	1-3						69	62	W_3							2.74	2.71	2.72	0.44	1.18	682.31	-	-	-
6.00	7.50	Fresh, Brown-White, Shale.		CORE	4-12						100	90	W_1							-	-	-	-	-	1589.72	-	98115	0.08
7.50	9.00	Fresh, Brownish, Argillaceous Shale		CORE	13-19						90	73	W_1							-	-	-	-	-	-	58.39		-
9.00	10.00			CORE	20-22						96	96	W_1															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DCHST- 01

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1238, W-642** | **GROUND LEVEL (m) : 282**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 0.80 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.10 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 30.03.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 31.03.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS															
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Brownish Soil, Clay & Boulder.																										
0.50	1.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	1-6						92	49	W_2							-	2.71	2.72	-	-	-	-	-	-
1.50	3.00			CORE	7-17						96	87	W_1															
3.00	4.50			CORE	18-28						97	80	W_1															
4.50	6.00			CORE	29-26						91	85	W_1															
6.00	7.50			CORE	27-43						91	81	W_1							-	2.55	2.57	-	-	-	-	-	-
7.50	9.00	Fresh, Brownish, Argillaceous Shale.		CORE	44-52						89	78	W_1															
9.00	10.50			CORE	53-65						100	76	W_1															
10.50	12.00			CORE	65-73						92	77	W_1															
12.00	13.50			CORE	74-81						94	81	W_1															
13.50	15.00			CORE	82-91						100	93	W_1							-	2.73	2.74	-	-	-	-	-	-

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DCHST- 1 A

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1238, W-642**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 0.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.10 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 31.03.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 01.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS															
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.70	Filling with Brownish Soil, Clay & Boulder.																										
0.70	1.50	Highly Weathered, Brownish, Argillaceous Shale.		CORE	1-10						71	NIL	W_4							-	2.39	2.45	-	-	-	-	-	-
1.50	3.00			CORE	11-24						93	50	W_2															
3.00	4.50			CORE	25-44						87	38	W_2															
4.50	6.00			CORE	45-59						94	67	W_2															
6.00	7.50			CORE	60-85						85	33	W_2							-	2.67	2.71	-	-	-	-	-	-
7.50	9.00	Slightly Weathered to Fresh, Brownish, Argillaceous Shale.		CORE	86-96						97	79	W_1															
9.00	10.50			CORE	97-111						95	61	W_2															
10.50	12.00			CORE	112-123						85	53	W_2															
12.00	13.50			CORE	124-137						92	67	W_2															
13.50	15.00			CORE	138-148						91	71	W_2							-	2.74	2.77	-	-	-	-	-	-

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DCHST- 1 B

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -1238, W-642**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 0.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.10 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 01.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 01.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Brownish Soil, Clay & Boulder.																										
0.50	1.50	Fresh, Brownish, Argillaceous Shale.		CORE	1-5						98	79	W_1							-	2.84	2.87	-	-	-	-	-	-
1.50	3.00			CORE	6-13						95	88	W_1															
3.00	4.50			CORE	14-22						95	83	W_1															
4.50	6.00			CORE	23-29						93	80	W_1															
6.00	7.50			CORE	30-38						95	84	W_1							-	2.66	2.68	-	-	-	-	-	-
7.50	9.00			CORE	39-50						93	79	W_1															
9.00	10.50			CORE	51-62						91	65	W_1															
10.50	12.00			CORE	63-75						90	63	W_1															
12.00	13.50			CORE	76-88						97	74	W_1															
13.50	15.00	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	89-102						73	28	W_2							-	2.7	2.73	-	-	-	-	-	-

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DCHST- 02

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -899, W-588**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 0.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.20 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 03.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 03.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS															
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.50	Filling with Brownish Soil, Clay & Boulder.																										
0.50	1.50	Slightly Weathered, Brownish, Argillaceous Shale.		CORE	1-16						94	21	W_2							-	2.63	2.67	-	-	-	-	-	-
1.50	3.00			CORE	17-38						87	36	W_2															
3.00	4.50			CORE	39-57						97	39	W_2															
4.50	6.00			CORE	58-77						95	46	W_2															
6.00	7.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	78-100						94	11	W_3							-	2.61	2.63	-	-	-	-	-	-
7.50	9.00			CORE	101-114						95	49	W_3															
9.00	10.50	Moderately Weathered, Brown-White, Shale.		CORE	115-133						94	31	W_3															
10.50	12.00			CORE	134-153						97	7	W_3															
12.00	13.50	Slightly Weathered, Brown-White, Shale.		CORE	154-162						84	27	W_2							-	2.41	2.47	-	-	-	-	-	-
13.50	15.00			CORE	163-172						91	53	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DCHST- 2A

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -899, W-588**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : 0.50 M** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.20 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 03.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 03.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
0.00	0.30	Filling with Brownish Soil, Clay & Boulder.																										
0.30	1.50	Completely Weathered, Brownish, Argillaceous Shale.		CORE	1-18						100	9	W_5							-	2.6	2.62	-	-	-	-	-	-
1.50	3.00			CORE	19-53						92	NIL	W_5															
3.00	4.50			CORE	54-88						96	NIL	W_5															
4.50	6.00			CORE	89-122						95	7	W_5															
6.00	7.50			CORE	123-145						89	7	W_5							-	2.41	2.47	-	-	-	-	-	-
7.50	9.00	Moderately Weathered, Brown-White, Shale.		CORE	146-163						99	33	W_3															
9.00	10.50			CORE	164-173						95	33	W_3															
10.50	12.00	Highly Weathered, Brown-White, Shale.		CORE	174-196						96	NIL	W_4															
12.00	13.50			CORE	197-205						98	22	W_4							-	2.31	Sample Cracked In Water.						
13.50	15.00			CORE	206-212						97	14	W_4															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

BORE LOG OF DRILL HOLE DCHST- 2B

SOILTECH (INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

PROJECT: GEOTECHNICAL INVESTIGATION WORK FOR PROPOSED SIPAT STPP STAGE-III, BILASPUR, CHATTISGARH.

CLIENT: NTPC LIMITED | **CO-ORDINATES : N -899, W-588**

LOCATION: SIPAT, CHATTISGARH. | **CASING DEPTH (m) : N.A.** | **DRILLING METHOD: ROTARY DRILLING**

TERMINATION DEPTH BGL (m) : 15.00 | **GROUND W.L BGL (m) : 1.20 M** | **DRILLING ORIENTATION: VERTICAL**

STARTED: 04.04.2023 | **CORE DIAMETER (mm) : 54** | **COMPLETED: 04.04.2023**

DEPTH (m)		DESCRIPTION OF STRATA	LITHOLOGY	TYPE OF SAMPLE	SERIAL NO OF CORE'S	SPT					ROCK DETAILS			LAB TEST ON SOIL						LAB TEST ON ROCK								
						NO. OF BLOWS								GRAIN SIZE ANALYSIS														
FROM	TO					15 cm	30 cm	45 cm	60 cm	"SPT N" VALUE	TCR %	RQD %	WEATHERING GRADE	GRAVELS %	SAND %	SILT %	CLAY %	SPECIFIC GRAVITY	IS CLASSIFICATION	SPECIFIC GRAVITY	DRY DENSITY g/cc	BULK DENSITY g/cc	WATER ABSORPTION %	POROSITY %	UNCONFINED COMPRESSIVE STRENGTH Kg/cm2	POINT LOAD INDEX Kg/cm2	MODULUS OF ELASTICITY	POISSON'S RATIO (μ)
#REF!	1.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	1-27						94	23	W_3							-	2.6	2.62	-	-	-	-	-	-
1.50	3.00			CORE	28-52						87	28	W_3															
3.00	4.50			CORE	53-72						95	39	W_3															
4.50	6.00	Highly Weathered, Brownish, Argillaceous Shale.		CORE	73-102						97	7	W_4															
6.00	7.50	Moderately Weathered, Brownish, Argillaceous Shale.		CORE	103-125						95	20	W_3							-	2.53	2.56	-	-	-	-	-	-
7.50	9.00			CORE	126-144						92	27	W_3															
9.00	10.50	Highly Weathered, Brown-White, Shale.		CORE	145-164						87	NIL	W_4															
10.50	12.00			CORE	165-181						93	8	W_4															
12.00	13.50	SlightlyWeathered, Brown-White, Shale.		CORE	182-188						91	55	W_2							-	2.57	2.61	-	-	-	-	-	-
13.50	15.00			CORE	189-196						95	89	W_2															

ABBREVIATION

SPT : STANDARD PENETRATION TEST
UDS : UNDISTURB SAMPLE
DS : DISTURB SAMPLE
RQD : ROCK QUALITY DESIGNATION
TCR : TOTAL CORE RECOVERY
SCR : SOLID CORE RECOVERY
R : SPT REFUSAL
WL : WATER LOSS

LEGEND : LITHOLOGY

	FILL		CLAY
	SAND		SHALE
	BASALT		CLAYSTONE
	GRAVELS		SILT

Site Engineer - Ramkaran | **Prepared By- Ajinkya K** | **Checked By - Rupa Jagdale**

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results				Atter. Limits			IS Classific-ation	Grain Size				Test Method
									Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	LL %	PL %	SL %		Gravl %	Sand %	Silt %	Clay %	
BH02	DS01	0.50	Reddish brown, clayey silt with decomposed rock fragments.													Fill	9	48	43	(Silt+Clay)	*See the notes
BH03	DS01	0.20	Brownish grey, clayey silt with decomposed rock.													Fill	4	44	52	(Silt+Clay)	Do
BH07	DS01	0.20	Reddish brown, clayey silt with decomposed rock fragments.										36	17		Fill					Do
BH12	DS01	0.50	Brownish grey, siltty sand with decomposed rock pieces.			2.60										CI*	2	31	67	(Silt+Clay)	Do
BH15	DS01	0.30	Brownish grey, siltty sand with decomposed rock pieces.													Fill	36	50	14	(Silt+Clay)	Do
BH16	DS01	0.40	Brownish grey, siltty sand with decomposed rock pieces.													Fill	53	32	15	(Silt+Clay)	Do
BH33	SPT01	1.50	Reddish grey, silty sand with rock pieces.										Non-Plastic			SM*					Do
BH35	SPT01	1.00	Reddish brown, silty clay with decomposed rock pieces.			2.58							38	19		CI		40	45	15	Do
BH38	DS01	0.20	Reddish brown, silty clay with decomposed rock pieces.													CI*	8	34	58	(Silt+Clay)	Do
BH44	DS01	0.50	Light brown, clayey silt with sand mixure.													CI*	6	37	57	(Silt+Clay)	Do

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results				Atter. Limits			IS Classific-ation	Grain Size				Test Method
									Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	LL %	PL %	SL %		Gravl %	Sand %	Silt %	Clay %	
BH45	SPT01	1.45	Brownish grey, clayey silt with sand mixture.										43	20		CI					Do
BH46	SPT01	1.50	Brownish grey, clayey silt with traces of sand mixture.			2.58										CI*		21	62	17	Do
BH48	SPT01	1.50	Reddish brown, silty clay with traces of kankars.										40	18		CI					Do
BH51	SPT01	2.00	Brownish grey, silty clay / clayey silt with sand mixture.			2.56										SM		70	26	4	Do
BH53	SPT01	1.00	Reddish brown, clayey silt with decomposed rock poeces.										41	20		CI					Do
BH55	DS01	0.50	Reddish brown, silty clay / clayey silt with traces of sand mixture and kankars.													CI*		15	85 (Silt+Clay)		Do
BH56	DS01	0.40	Brownish grey, silty sand with decomposed rock fragments.			2.59										SM	12	71	17 (Silt+Clay)		Do
BH60	SPT01	1.00	Brownish grey, silty clay.										51	19	8	CH		21	79 (Silt+Clay)		Do
BH63	DS01	0.50	Reddish brown, silty clay / clayey silt.													CI*		27	73 (Silt+Clay)		Do
BH63	SPT01	1.50	Reddish brown, silty clay / clayey silt.										42	18	13	CI					Do

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results				Atter. Limits			IS Classific-ation	Grain Size				Test Method
									Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	LL %	PL %	SL %		Gravl %	Sand %	Silt %	Clay %	
BH66	SPT01	1.00	Brownish grey, silty clay / clayey silt with traces of sand mixture.			2.65										CI*		18	64	18	Do
BH71	SPT01	1.40	Reddish brown, silty clay / clayey silt.										42	21	15	CI					Do
BH75	SPT01	1.00	Brownish grey, silty clay / clayey silt with traces of sand mixture.			2.46										CI*		9	63	28	Do
BH75	UDS01	2.00	Reddish brown, silty clay with kankars & traces of sand mixture.	2.10	1.76		19 S 19 T 12 C	0.463	TRSH-UU 3.00 2.00 1.00 UNCONFD 0.00 0.00 0.00 REMOULD 0.00 0.00 0.00	 0.728 0.720 0.673 0.573 0.576 0.656 0.452 0.509 0.523	0.71 0.60 0.50	0 0 0	47	21	8	CI					Do
BH75	SPT03	4.00	Brownish grey, silty clay / clayey silt with traces of sand mixture.			2.46										CI*		18	66	16	Do
BH76	SPT01	1.50	Deep brown, clayey silt.										55	21	19	CH					Do
BH81	DS01	0.20	Reddish brown, silty clay / clayey silt with decomposed rock pieces.													CI*	11	37	52 (Silt+Clay)		Do

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results				Atter. Limits			IS Classific-ation	Grain Size				Test Method
									Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	LL %	PL %	SL %		Gravl %	Sand %	Silt %	Clay %	
PMT08	SPT01	1.50	Brownish grey, clayey silt.			2.59										CI*		6	76	18	Do

* - Classification in this case is based on average layer properties

LABORATORY ROCK TEST RESULTS

BH No.	Run No.	Depth (M)	Description	Density (gm/cc)		Water Content	Porosity %	Specific Gravity	Unconfined Compressive strength (kg/sqcm)		Coefficient of softening	Point Load Strength Index (kg/sqcm)	Slake Durability Index (%)	Hardness (based on Mohr Scale)	Soundness (%) Loss	Deformability (kg/sqcm)	Impact Value (%)	Test Method
				Bulk	Dry	(%)			In-situ	Saturated								
1	2	2.00-2.75	Highly weathered, reddish brown, fine grained, fractured shale.	2.832	2.809	0.82	2.6395	--	--	--	--	4.87	--	--	18.28	--	--	**See the Notes
1	16	12.50-13.25	Moderately weathered, reddish brown, fine grained, fractured shale.	2.884	2.879	0.17	0.5450	2.895	801	647	0.808	--	--	--	--	--	--	Do
2	1	1.50-2.25	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	242	--	--	--	Soft	--	--	--	Do
2	24	18.75-19.50	Moderately weathered, reddish brown, fine grained, fractured shale.	2.786	2.759	0.98	3.1823	--	851	470	0.552	--	--	--	--	--	--	Do
3	2	1.05 - 1.80	Moderately weathered, reddish brown, fine grained, fractured shale.	2.688	2.670	0.68	3.4897	2.757	--	--	--	10.69	--	--	17.34	--	--	Do
4	8	6.25 - 7.00	Highly weathered, reddish brown, fine grained, moderately fractured shale.	--	--	--	--	--	--	--	--	--	98.08	--	--	--	--	Do
5	8	5.75 - 6.50	Moderately weathered, reddish brown, fine grained, fractured shale.	2.829	2.810	0.67	1.9532	2.747	--	782	--	14.60	98.69	--	--	--	--	Do
6	2	1.15 - 1.90	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	335	--	--	--	Soft	--	18519	--	Do
7	2	1.15 - 1.90	Highly weathered, reddish brown, fine grained, moderately strong fractured shale.	2.525	2.488	1.48	8.8687	--	--	--	--	--	90.41	--	19.29	--	--	Do
7	18	13.15 - 13.90	Moderately weathered, reddish brown, fine grained, moderately fractured shale.	--	--	--	--	--	--	241	--	--	--	--	23.64	--	--	Do
8	1	0.80 - 1.25	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.751	--	--	--	17.93	--	--	--	--	37.25	Do
8	18	13.25 - 14.00	Moderately weathered, light grey to dark grey, fractured shale.	--	--	--	--	--	542	361	0.666	--	--	--	--	--	--	Do
9	19	14.00 - 14.75	Moderately weathered, light grey to dark grey, fine garined, fractured shale.	2.533	2.485	1.91	11.5804	--	--	--	--	9.80	--	--	--	--	--	Do
10	2	4.75 - 5.50	Highly weathered, reddish brown, fine grained, fractured shale.	2.674	2.653	0.79	3.2231	--	--	--	--	--	98.82	Soft	16.32	--	--	Do
10	9	10.00 - 10.75	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	651	--	--	--	--	--	--	--	Do
11	2	1.75 - 2.50	Moderately weathered, reddish brown, fine grained, fractured shale.	2.818	2.812	0.25	0.7799	2.788	--	574	--	--	--	--	15.67	--	--	Do
12	2	2.25-3.00	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	43.37	98.15	Soft	--	--	35.93	Do
14	2	1.25 - 2.00	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	507	--	--	--	Soft	--	--	--	Do
15	1	0.50 - 1.25	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	447	--	--	--	--	19.16	30786	--	Do

BH No.	Run No.	Depth (M)	Description	Density (gm/cc)		Water Content	Porosity %	Specific Gravity	Unconfined Compressive strength (kg/sqcm)		Coefficient of softening	Point Load Strength Index (kg/sqcm)	Slake Durability Index (%)	Hardness (based on Mohr Scale)	Soundness (%) Loss	Deformability (kg/sqcm)	Impact Value (%)	Test Method
				Bulk	Dry	(%)			In-situ	Saturated								
15	7	5.00 - 5.75	Slightly weathered, reddish to greyish brown, fine grained, fractured shale.	--	--	--	--	--	--	816	--	--	--	--	--	--	--	Do
16	3	2.00 - 2.75	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	555	--	9.89	--	--	--	--	39.17	Do
16	14	10.25 - 11.00	Slightly weathered, reddish brown, fine garined, fractured shale.	--	--	--	--	--	539	493	0.914	48.65	--	--	--	--	31.42	Do
17	2	1.35 - 2.10	Fresh, yellowish to reddish brown, fine grained, fractured shale.	2.852	2.843	0.33	0.9819	2.764	701	508	0.725	--	99.28	--	--	41876	--	Do
18	2	1.15 - 1.90	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	666	574	0.861	--	--	Soft	13.67	34215	--	Do
19	1	0.70 - 1.45	Moderately weathered, reddish brown, fine grained, fractured shale.	2.780	2.751	1.04	3.0545	2.756	--	--	--	--	--	--	--	--	33.62	Do
20	1	0.40 - 1.15	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.760	--	--	--	4.05	--	Soft	--	--	--	Do
21	1	0.50 - 1.25	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	8.11	99.27	--	24.37	--	--	Do
21	15	11.00 - 11.75	Fresh, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	824	--	--	--	--	--	--	--	Do
22	8	5.75 - 6.50	Moderately weathered, reddish brown, fine grained, fractured shale.	2.744	2.718	0.95	2.9779	--	--	--	--	--	--	Soft	--	--	--	Do
22	18	13.25 - 14.00	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	381	--	--	--	--	--	19476	--	Do
23	6	4.15 - 4.90	Slightly weathered, reddish brown, fine garined, fractured shale.	2.805	2.793	0.43	1.2451	2.746	--	466	--	--	--	Soft	16.48	--	--	Do
23	13	9.40 - 10.15	Slightly weathered, reddish brown, fine garined, fractured shale.	--	--	--	--	--	649	358	0.552	87.97	--	--	--	35445	--	Do
24	6	4.15 - 4.90	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.792	--	--	--	--	--	--	21.49	--	--	Do
25	1	0.50 - 1.25	Highly weathered, reddish brown, fine grained, fractured shale.	2.659	2.643	0.61	2.3201	--	--	--	--	--	--	--	--	--	33.12	Do
26	18	13.45 - 14.20	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	543	--	45.41	--	--	--	35437	--	Do
27	2	1.50 - 2.25	Highly weathered, reddish brown, fine grained, fractured shale.	2.702	2.685	0.64	2.5731	2.830	--	--	--	--	--	--	15.67	--	36.75	Do
27	8	6.00 - 6.75	Moderately weathered, reddish brown, fine grained fractured shale.	--	--	--	--	--	--	--	--	20.81	--	--	--	--	--	Do
27	14	10.50 - 11.25	Slightly weathered, reddish brown, fine grained fractured shale.	--	--	--	--	--	--	458	--	--	--	--	--	--	--	Do
28	1	1.70 - 2.45	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	--	--	--	22.39	--	--	Do

BH No.	Run No.	Depth (M)	Description	Density (gm/cc)		Water Content	Porosity %	Specific Gravity	Unconfined Compressive strength (kg/sqcm)		Coefficient of softening	Point Load Strength Index (kg/sqcm)	Slake Durability Index (%)	Hardness (based on Mohr Scale)	Soundness (%) Loss	Deformability (kg/sqcm)	Impact Value (%)	Test Method
				Bulk	Dry	(%)			In-situ	Saturated								
29	2	0.75 - 1.50	Highly weathered, reddish brown, fine grained, highly fractured shale.	2.813	2.800	0.47	1.4406	2.799	--	--	--	4.45	--	Soft	23.18	--	--	Do
29	8	5.25 - 6.00	Highly weathered, reddish brown, fine grained, highly fractured shale.	2.838	2.823	0.53	1.5560	--	--	--	--	13.08	--	--	--	--	--	Do
30	1	0.60- 1.35	Moderately weathered, reddish to greyish brown, fine grained, fractured shale.	--	--	--	--	2.882	--	--	--	17.41	--	Soft	--	--	--	Do
31	2	3.75 - 4.50	Moderately weathered, reddish brown, fine grained, fractured shale.	2.875	2.862	0.46	1.4182	--	--	--	--	--	99.05	--	11.73	--	--	Do
32	1	4.70 - 5.25	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	408	--	--	9.21	--	--	--	--	--	Do
32	2	5.25 - 6.00	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	--	--	--	--	--	41.61	Do
32	6	8.25 - 9.00	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	836	--	100.55	--	--	--	--	--	Do
33	1	2.50- 3.25	Highly weathered, reddish brown, fine grained, fractured shale.	2.108	1.975	6.73	15.4913	2.537	--	--	--	11.00	91.38	Soft	--	--	--	Do
33	9	8.50- 9.25	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	19.88	--	Moderately hard	17.62	--	--	Do
34	7	7.25- 8.00	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	4.05	--	--	19.47	--	--	Do
35	2	2.00 - 2.75	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	24.52	81.67	--	--	--	--	Do
35	14	10.75 - 11.50	Moderately weathered, light grey to dark grey, fine grained, fractured shale.	2.569	2.529	1.57	6.6869	--	--	207	--	--	--	--	19.76	--	--	Do
36	1	0.80 - 1.50	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	--	--	Soft	--	--	39.55	Do
37	2	1.25 - 2.00	Moderately weathered, reddish brown, fine grained, fractured shale.	2.798	2.778	0.70	2.0835	2.773	--	--	--	0.81	98.78	--	--	--	--	Do
38	7	4.80 - 5.55	Slightly weathered, reddish brown, fine garined, fractured shale.	--	--	--	--	--	--	240	--	--	--	Soft	--	12179	--	Do
39	3	2.20 - 2.95	Slightly weathered, reddish brown, fine grained, fractured shale.	2.867	2.857	0.34	1.0271	--	--	370	--	--	--	Soft	17.93	--	--	Do
40	1	0.00- 0.75	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	10.72	93.64	--	--	--	--	Do
40	22	15.75- 16.50	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	593	350	0.590	--	--	--	--	32800	--	Do
41	11	7.50 - 8.25	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	709	--	--	--	--	--	--	--	Do
42	1	0.70 - 1.25	Highly weathered, reddish brown, fine grained, moderately strong, fractured shale.	--	--	--	--	2.742	--	--	--	9.73	--	--	--	--	--	Do

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				Bulk	Dry	(%)			In-situ	Saturated								
42	11	8.00 - 8.75	Moderately weathered, reddish brown, fine grained, moderately strong, fractured shale.	2.719	2.674	1.67	10.0285	--	297	210	0.707	--	--	--	--	23756	--	Do
43	1	0.40 - 1.00	Highly weathered, reddish brown, fine grained, fractured shale.	2.637	2.608	1.11	5.3482	2.741	--	--	--	15.05	--	--	--	--	37.98	Do
44	2	2.25- 3.00	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	--	--	Soft	--	--	42.49	Do
45	8	8.00- 8.75	Moderately weathered, reddish brown, fine grained, fractured shale.	2.812	2.802	0.36	1.0565	--	--	--	--	8.02	--	--	19.75	--	--	Do
46	1	2.80- 3.50	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.606	--	--	--	3.64	--	--	21.62	--	--	Do
47	16	12.75- 13.50	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	724	--	--	--	--	--	33000	32.71	Do
48	2	3.15 - 3.90	Highly weathered, reddish brown/greyish brown, fine grained, fractured shale.	2.450	2.386	2.67	7.9666	2.789	--	--	--	1.62	--	Soft	24.86	--	--	Do
49	13	10.00- 10.75	Moderately weathered, reddish brown, fine grained, fractured shale.	2.806	2.792	0.50	1.9894	--	--	373	--	--	--	Moderately hard	--	--	--	Do
50	3	4.50- 5.25	Highly weathered, dark grey to light grey, fine grained, fractured shale.	2.519	2.450	2.82	11.8657	--	--	--	--	0.81	80.62	--	--	--	--	Do
50	16	14.25- 15.00	Highly weathered, dark grery to light grey, fine grained, fractured shale.	--	--	--	--	2.794	--	--	--	--	--	--	16.52	--	--	Do
51	3	4.25- 5.00	Highly weathered, light grey, fine grained, fractured shale.	2.539	2.493	1.85	7.2000	2.686	--	141	--	--	--	--	--	12634	--	Do
51	10	9.50- 10.25	Highly weathered, light grey, fine grained, fractured shale.	2.558	2.517	1.63	7.7309	--	--	236	--	--	--	--	--	17342	--	Do
52	2	3.75- 4.50	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	6.45	91.47	--	--	--	--	Do
53	6	5.25 - 6.00	Moderately weathered, yellowish grey to light grey, fine grained, fractured shale.	--	--	--	--	--	--	--	--	--	--	Soft	15.48	--	--	Do
54	1	0.40 - 1.00	Moderately weathered, reddish brown, fine grained, fractured shale.	2.720	2.699	0.76	4.7748	--	--	311	--	--	--	Soft	--	18617	--	Do
54	7	4.75 - 5.50	Fresh, reddish brown, fine grained, fractured shale.	--	--	--	--	--	597	498	0.834	--	--	--	--	--	--	Do
55	3	3.00 - 3.75	Highly weathered, yellowish brown, fine grained, highly fractured shale.	2.649	2.597	1.97	7.1435	--	--	--	--	--	--	--	20.37	--	--	Do
56	12	9.00- 9.75	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.615	--	218	--	--	--	--	19.35	18661	--	Do
56	24	18.00- 18.75	Moderately weathered, reddish brown, fine grained, fractured shale.	2.788	2.775	0.47	1.4130	--	--	314	--	--	--	Moderately hard	--	--	--	Do
57	10	7.25- 8.00	Moderately weathered, reddish brown, fine grained, fractured shale.	2.795	2.773	0.79	2.2539	2.837	--	--	--	53.52	--	--	--	--	--	Do

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				Bulk	Dry	(%)			In-situ	Saturated								
58	8	8.00-8.75	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	884	768	0.869	--	--	--	13.84	39645	--	Do
59	2	1.75-2.50	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	--	95.41	Soft	--	--	--	Do
59	14	10.75-11.50	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.821	--	645	--	--	--	--	--	--	--	Do
60	8	7.55-8.30	Highly weathered, reddish brown, fine grained, fractured shale.	2.578	2.526	2.06	8.8518	--	261	--	--	--	--	--	--	--	--	Do
61	1	2.00-2.75	Completely weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	33.62	--	--	16.39	--	--	Do
62	14	11.95-12.70	Highly weathered, light greenish grey, fine grained, fractured shale.	2.546	2.481	2.62	10.2637	--	--	--	--	3.24	--	Moderately hard	--	--	40.82	Do
63	2	2.95-3.70	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	349	--	--	--	--	18.36	--	38.67	Do
65	2	1.55-2.30	Moderately weathered, reddish to greyish brown, fine grained, fractured shale.	--	--	--	--	--	724	580	0.801	--	--	Soft	15.73	42184	--	Do
66	10	8.55-9.30	Moderately weathered, reddish brown, fine grained, fractured shale.	2.821	2.799	0.79	2.2893	--	--	596	--	--	--	--	--	--	--	Do
67	17	13.50-14.25	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.898	789	458	0.580	--	--	--	--	--	--	Do
68	6	4.75 - 5.50	Highly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.739	--	431	--	--	--	--	--	35966	--	Do
69	1	0.80 - 1.50	Highly weathered, reddish brown, fine grained, fractured shale.	2.812	2.799	0.44	1.3639	--	--	--	--	--	99.27	--	11.91	--	--	Do
70	2	1.75-2.50	Highly weathered, reddish brown, fine grained, fractured shale.	2.794	2.786	0.29	2.0137	--	--	672	--	--	--	--	19.61	--	--	Do
70	16	12.25-13.00	Fresh, reddish brown, fine grained, fractured shale.	--	--	--	--	--	773	559	0.723	--	--	--	--	30463	--	Do
71	16	13.50-14.25	Highly weathered, reddish brown, fine grained, fractured shale.	2.834	2.823	0.39	1.3356	--	793	470	0.593	--	--	Moderately hard	--	--	--	Do
72	10	7.75-8.50	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	585	431	0.737	--	--	--	16.35	--	33.18	Do
73	1	1.00-1.75	Highly weathered, reddish brown, fine grained, fractured shale.	2.777	2.760	0.62	1.7503	--	--	--	--	44.15	--	--	--	--	--	Do
74	16	12.25-13.00	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	717	498	0.695	--	98.78	--	--	--	--	Do
75	7	9.20-9.95	Slightly weathered, reddish brown, fine grained, fractured shale.	2.830	2.817	0.46	2.6795	--	659	451	0.684	--	--	--	--	30719	--	Do
76	1	2.50-3.25	Slightly weathered, reddish brown, fine grained, fractured shale.	2.667	2.645	0.83	5.3754	--	--	--	--	--	--	--	17.62	--	36.85	Do

BH No.	Run No.	Depth (M)	Description	Density (gm/cc)		Water Content	Porosity %	Specific Gravity	Unconfined Compressive strength (kg/sqcm)		Coefficient of softening	Point Load Strength Index (kg/sqcm)	Slake Durability Index (%)	Hardness (based on Mohr Scale)	Soundness (%) Loss	Deformability (kg/sqcm)	Impact Value (%)	Test Method
				Bulk	Dry	(%)			In-situ	Saturated								
77	1	0.50-1.25	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.879	749	254	0.339	--	--	--	--	--	--	Do
78	7	5.00-5.75	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.927	--	--	--	7.30	--	--	--	--	--	Do
79	1	0.90-1.65	Moderately weathered, reddish brown, fine grained, fractured shale.	2.772	2.754	0.65	3.2893	--	401	--	--	14.60	--	Soft	21.92	33619	--	Do
79	6	4.65-5.40	Slightly weathered, reddish brown, fine grained, fractured shale.	2.784	2.770	0.51	1.6416	--	--	585	--	--	--	--	--	35658	--	Do
80	2	1.35-2.10	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	4.52	--	--	--	--	39.19	Do
80	9	6.60-7.35	Slightly weathered, reddish to greyish brown, fine grained, fractured shale.	2.808	2.796	0.43	1.3294	--	--	563	--	--	96.89	--	--	--	--	Do
80	15	11.10-11.85	Moderately weathered, reddish to greyish brown, fine grained, fractured shale.	--	--	--	--	--	908	744	0.819	--	--	--	13.75	--	--	Do
81	2	1.15-1.90	Moderately weathered, reddish to greyish brown, fine grained, fractured shale.	2.527	2.510	0.68	3.1855	--	--	--	--	4.28	--	Soft	--	--	43.12	Do
81	12	8.65-9.40	Slightly weathered, reddish to greyish brown, fine grained, fractured shale.	--	--	--	--	--	913	845	0.926	--	99.34	--	--	--	--	Do
82	1	0.40-1.15	Moderately weathered, reddish to greyish brown, fine grained, fractured shale.	2.763	2.748	0.55	2.3566	2.814	--	418	--	--	--	--	17.62	--	--	Do
82	9	6.40-7.15	Slightly weathered, reddish to greyish brown, fine grained, fractured shale.	--	--	--	--	--	--	--	--	8.91	95.67	--	--	--	34.52	Do
83	2	0.75-1.50	Slightly weathered, reddish brown, fine grained, fractured shale.	2.804	2.791	0.47	1.4015	--	803	664	0.827	--	--	Soft	12.85	--	--	Do
83	6	3.75-4.50	Moderately weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.855	835	621	0.744	--	--	--	--	--	--	Do
83	11	7.50-8.25	Slightly weathered, reddish brown, fine grained, fractured shale.	--	--	--	--	2.790	--	--	--	--	--	--	16.67	--	--	Do

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Summary of Rock Test Results

Client:	NTPC Limited	**Report No.**	SIPL/TCF-172, 232/RK-123-136, 179-220/2023
Project:	Geotechnical Investigation Work for Proposed Sipat STPP Stage-III at Bilaspur, Chattisgarh.	**Report Date:**	16.05.2023
ULR No.	TC635723000001632F to TC635723000001645F, TC635723000002227F to TC635723000002271F		

					Test Methods:	*IS:13030*					*IS:1122*	*IS:9143*	*IS:8764*
BH No.	Piece No.	Depth (m)	Sample Type	LAB No.	Condition	Dry Density *	Bulk Density *	Water Absorption	Porosity	Hardness	Specific Gravity	Unconfined Compressive Strength	Point Load Strength Index
						g/cc	g/cc	%	%	-	-	Kg/cm²	kg/cm²
DBH-1	2	3.00-4.50	Core	185/1	Soak	2.81	2.82	0.45	1.25	43.58	2.85	1330.10	-
DBH-1	7	4.50-6.00	Core	185/2	Unsoak	2.74	-	-	-	45.66	-	656.36	-
DBH-1	14	6.00-7.50	Core	185/3	Unsoak	-	-	-	-	-	-	-	51.40
DBH-2	1	1.95-3.00	Core	186/1	Soak	2.76	2.77	0.43	1.18	40.10	2.79	556.67	-
DBH-2	4	3.00-4.50	Core	186/2	Unsoak	-	-	-	-	-	-	-	34.89
DBH-2	11	4.50-6.00	Core	186/3	Soak	2.56	2.60	1.42	3.63	-	2.66	-	13.45
DBH-2	17	6.00-7.50	Core	186/5	Unsoak	-	-	-	-	-	-	-	29.00
DBH-3	1	0.50-1.50	Core	187/1	Unsoak	-	-	-	-	-	-	-	27.55
DBH-3	2	6.00-7.50	Core	187/2	Soak	2.74	2.76	0.72	1.98	-	2.80	-	43.62
DBH-3	12	7.50-9.00	Core	187/3	Unsoak	-	-	-	-	-	-	-	40.01
DBH-4	1	6.45-7.50	Core	188/1	Soak	2.63	2.66	1.10	2.89	38.55	2.71	506.28	-
DBH-4	3	7.50-9.00	Core	188/2	Unsoak	-	-	-	-	-	-	769.00	-
DBH-4	15	9.00-10.00	Core	188/3	Unsoak	-	-	-	-	-	-	-	31.51
DBH-5	1	4.50-6.00	Core	189/1	Soak	2.57	2.61	1.56	4.01	-	2.68	193.56	-
DBH-5	12	6.00-7.50	Core	189/2	Soak	2.74	2.75	0.41	1.13	-	2.77	229.36	-
DBH-5	22	7.50-9.00	Core	189/3	Unsoak	-	-	-	-	38.17	-	1083.72	-
DBH-6	2	3.00-4.50	Core	190/1	Unsoak	2.60	2.60	0.15	0.40	-	2.61	629.41	-
DBH-6	10	4.50-6.00	Core	190/2	Soak	-	-	-	-	35.62	-	288.67	-
DBH-6	18	6.00-7.50	Core	190/3	Unsoak	-	-	-	-	40.18	-	654.30	-
DBH-7	3	0.50-1.50	Core	191/1	Unsoak	-	-	-	-	42.80	-	1063.15	-
DBH-7	10	1.50-3.00	Core	191/2	Soak	2.74	2.75	0.59	1.62	38.86	2.78	367.43	-
DBH-7	23	3.00-4.50	Core	191/3	Unsoak	-	-	-	-	-	-	712.83	-
DBH-7	23	3.00-4.50	Core	191/3	Unsoak	Sample Cracked during Hardness Test							
DBH-8	2	1.95-3.00	Core	192/1	Soak	2.58	2.62	1.59	4.10	-	2.69	-	29.56
DBH-8	7	3.00-4.50	Core	192/2	Unsoak	-	-	-	-	37.71	-	1671.23	-

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Summary of Rock Test Results

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Project:	Geotechnical Investigation Work for Proposed Sipat STPP Stage-III at Bilaspur, Chattisgarh.	**Report Date:**	16.05.2023
ULR No.	TC635723000001632F to TC635723000001645F, TC635723000002227F to TC635723000002271F		

					Test Methods:	*IS:13030*					*IS:1122*	*IS:9143*	*IS:8764*
BH No.	Piece No.	Depth (m)	Sample Type	LAB No.	Condition	Dry Density *	Bulk Density *	Water Absorption	Porosity	Hardness	Specific Gravity	Unconfined Compressive Strength	Point Load Strength Index
						g/cc	g/cc	%	%	-	-	Kg/cm²	kg/cm²
DBH-9	7	1.50-3.00	Core	123/1	Soak	2.77	2.78	0.28	0.76	-	2.79	627.30	-
DBH-9	15	3.00-4.50	Core	123/2	Soak	2.73	2.75	0.42	1.15	-	2.77	576.71	-
DBH-10	10	1.50-3.00	Core	124/1	Soak	2.58	2.62	1.46	3.77	-	2.68	-	2.91
DBH-10	25	3.00-4.50	Core	124/2	Soak	2.68	2.70	0.89	2.38	-	2.74	200.54	-
DBH-11	3	0.50-1.50	Core	193/1	Unsoak	-	-	-	-	-	-	-	1.08
DBH-11	32	1.50-3.00	Core	193/2	Soak	2.58	2.61	0.93	2.40	-	2.65	-	10.09
DBH-11	50	3.00-4.50	Core	193/3	Soak	2.72	2.73	0.44	1.19	-	2.75	492.65	-
DBH-11	50	3.00-4.50	Core	193/3	Unsoak	-	-	-	-	35.72	-	-	-
DBH-11	73	4.50-6.00	Core	193/4	Unsoak	-	-	-	-	-	-	-	7.63
DBH-12	9	1.50-3.00	Core	194/1	Soak	2.54	2.65	4.25	10.78	-	2.85	-	0.72
DBH-12	40	3.00-4.50	Core	194/2	Soak	2.30	2.38	3.50	8.03	-	2.50	-	2.88
DBH-12	61	4.50-6.00	Core	194/3	Unsoak	-	-	-	-	-	-	-	8.36
DBH-12	88	6.00-7.50	Core	194/4	Unsoak	-	-	-	-	-	-	-	4.73
DBH-13	3	0.00-1.50	Core	195/1	-	Testing Not Possible due to Crumbled Sample							
DBH-13	6	1.50-3.00	Core	195/2	-	Testing Not Possible due to Cracked Sample							
DBH-13	47	3.00-4.50	Core	195/4	-	Sample Cracked during Cutting							
DBH-14	11	3.00-4.50	Core	125/1	Unsoak	2.74	Sample Cracked during Hardness Test						
DBH-14	66	4.50-6.00	Core	125/2	Soak	2.66	Sample Cracked In Water						
DBH-15	6	1.95-3.00	Core	196/1	Soak	2.21	2.31	4.46	9.87	-	2.46	-	2.50
DBH-15	26	3.00-4.50	Core	196/2	-	Testing Not Possible due to Cracked Sample							
DBH-15	57	4.50-6.00	Core	196/3	Unsoak	2.01	-	-	-	-	-	-	3.27
DBH-16	7	4.50-6.00	Core	197/1	-	Testing Not Possible due to Cracked Sample							
DBH-16	18	6.00-7.50	Core	197/2	Unsoak	-	-	-	-	-	-	-	21.33
DBH-16	33	7.50-9.00	Core	197/4	Unsoak	-	-	-	-	-	-	254.86	-

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Summary of Rock Test Results

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					Test Methods:	*IS:13030*					*IS:1122*	*IS:9143*	*IS:8764*
BH No.	Piece No.	Depth (m)	Sample Type	LAB No.	Condition	Dry Density *	Bulk Density *	Water Absorption	Porosity	Hardness	Specific Gravity	Unconfined Compressive Strength	Point Load Strength Index
						g/cc	g/cc	%	%	-	-	Kg/cm²	kg/cm²
DBH-17	1	3.45-4.50	Core	198/1	Soak	2.45	Sample Cracked In Water						
DBH-17	11	4.50-6.00	Core	198/2	Soak	2.43	2.53	4.03	9.80	-	2.70	-	2.52
DBH-17	43	6.00-7.50	Core	198/3	Unsoak	-	-	-	-	-	-	-	4.99
DBH-17	66	7.50-9.00	Core	198/4	-	Sample Cracked during Cutting							
DBH-19	3	6.00-7.50	Core	200/2	Unsoak	-	-	-	-	-	-	-	1.43
DBH-19	21	7.50-9.00	Core	200/3	Soak	2.05	2.12	3.35	6.88	-	2.20	-	16.72
DBH-19	33	9.00-10.00	Core	200/4	-	Sample Cracked during Cutting							
DBH-20	31	1.50-3.00	Core	126/1	Soak	2.66	2.72	2.06	5.50		2.82	-	1.45
DBH-20	52	3.00-4.50	Core	126/2	Soak	2.67	2.71	1.29	3.45		2.77	294.16	-
DBH-21	4	1.95-3.00	Core	127/1	Soak	2.76	2.78	0.56	1.56		2.81	1033.75	-
DBH-21	7	3.00-4.50	Core	127/2	Soak	2.69	2.70	0.44	1.19		2.72	-	63.63
DBH-22	14	1.50-3.00	Core	128/1	Soak	2.71	2.74	0.92	2.51		2.78	223.19	-
DBH-22	24	3.00-4.50	Core	128/2	Soak	2.68	2.71	1.14	3.04		2.76	-	4.31
DBH-23	3	0.12-1.50	Core	201/1	Soak	2.73	2.74	0.46	1.26	-	2.76	655.87	-
DBH-23	5	1.50-3.00	Core	201/2	Unsoak	2.71	2.71	0.30	0.81	-	2.73	654.84	-
DBH-23	14	3.00-4.50	Core	201/3	Unsoak	-	-	-	-	-	-	432.68	-
DBH-24	10	3.00-4.50	Core	202/1	Soak	2.08	2.26	8.65	18.00	-	2.54	-	1.45
DBH-24	12	3.00-4.50	Core	202/2	Soak	2.12	2.23	5.02	10.64	-	2.37	-	2.30
DBH-24	67	6.00-7.50	Core	202/4	Unsoak	-	-	-	-	-	-	-	2.52
DBH-25	30	1.50-3.00	Core	129/1	-	Testing Not Possible due to Cracked Sample							
DBH-25	40	3.00-4.50	Core	129/2	Soak	2.74	2.76	0.92	2.53		2.81	-	7.21
DBH-26	28	1.50-3.00	Core	130/1	Soak	2.68	2.70	0.85	2.27		2.74	-	1.09
DBH-26	43	3.00-4.50	Core	130/2	Soak	2.65	2.69	1.63	4.30		2.77	-	6.49

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Summary of Rock Test Results

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BH No.	Piece No.	Depth (m)	Sample Type	LAB No.	Condition	Dry Density *	Bulk Density *	Water Absorption	Porosity	Hardness	Specific Gravity	Unconfined Compressive Strength	Point Load Strength Index
						g/cc	g/cc	%	%	-	-	Kg/cm²	kg/cm²
DBH-27	1	0.12-1.50	Core	203/1	Unsoak	-	-	-	-	-	-	-	12.29
DBH-27	10	0.12-1.50	Core	203/3	Unsoak	-	-	-	-	-	-	-	5.09
DBH-27	16	1.50-3.00	Core	203/4	Soak	2.47	Sample Cracked In Water						
DBH-27	36	3.00-4.50	Core	203/5	Soak	2.23	2.32	3.79	8.47	-	2.44	-	1.81
DBH-27	66	4.50-6.00	Core	203/6	Unsoak	-	-	-	-	-	-	-	5.41
DBH-28	10	1.50-3.00	Core	204/1	Soak	2.52	Sample Cracked In Water						
DBH-28	37	3.00-4.50	Core	204/2	Unsoak	-	-	-	-	-	-	-	5.33
DBH-28	47	4.50-6.00	Core	204/3	Unsoak	-	-	-	-	-	-	-	9.27
DBH-28	55	6.00-7.50	Core	204/4	-	Sample Cracked during Cutting							
DBH-29	2	0.50-1.50	Core	205/1	Unsoak	-	-	-	-	-	-	-	6.89
DBH-29	14	1.50-3.00	Core	205/2	Soak	2.55	2.63	3.12	7.95	-	2.77	-	2.53
DBH-29	33	3.00-4.50	Core	205/3	-	Sample Cracked during Cutting							
DBH-29	59	4.50-6.00	Core	205/4	Unsoak	-	-	-	-	-	-	-	2.52
DBH-30	6	3.00-4.50	Core	206/1	Soak	2.13	2.27	6.53	13.93	-	2.48	-	1.43
DBH-30	26	4.50-6.00	Core	206/2	Unsoak	-	-	-	-	-	-	-	9.95
DBH-30	54	6.00-7.50	Core	206/3	Unsoak	-	-	-	-	-	-	-	6.13
DBH-31	1	1.50-3.00	Core	207/1	Soak	2.58	2.61	1.21	3.13	-	2.66	-	22.23
DBH-31	4	3.00-4.50	Core	207/2	Unsoak	2.51	2.53	0.81	2.03	-	2.56	-	31.29
DBH-31	6	4.50-6.00	Core	207/4	Soak	-	-	-	-	-	-	-	37.59
DBH-32	2	0.50-1.50	Core	208/1	Soak	2.78	2.79	0.27	0.76	-	2.80	-	39.44
DBH-32	6	1.50-3.00	Core	208/3	Unsoak	-	-	-	-	-	-	-	67.46
DBH-32	13	3.00-4.50	Core	208/4	Unsoak	-	-	-	-	-	-	-	66.88
DBH-33	7	3.00-4.50	Core	209/1	Soak	2.76	2.77	0.29	0.80	35.95	2.78	1106.47	-
DBH-33	10	4.50-6.00	Core	209/2	Unsoak	-	-	-	-	35.74	-	1045.77	-
DBH-33	15	6.00-7.50	Core	209/3	Unsoak	-	-	-	-	-	-	-	40.37

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TC-6357

Summary of Rock Test Results

Client:	NTPC Limited	**Report No.**	SIPL/TCF-172, 232/RK-123-136, 179-220/2023
Project:	Geotechnical Investigation Work for Proposed Sipat STPP Stage-III at Bilaspur, Chattisgarh.	**Report Date:**	16.05.2023
ULR No.	TC635723000001632F to TC635723000001645F, TC635723000002227F to TC635723000002271F		

						Test Methods:	*IS:13030*				*IS:1122*	*IS:9143*	*IS:8764*
BH No.	Piece No.	Depth (m)	Sample Type	LAB No.	Condition	Dry Density *	Bulk Density *	Water Absorption	Porosity	Hardness	Specific Gravity	Unconfined Compressive Strength	Point Load Strength Index
						g/cc	g/cc	%	%	-	-	Kg/cm²	kg/cm²
DBH-34	1	0.00-1.50	Core	210/1	Soak	2.78	2.78	0.21	0.57	37.79	2.79	749.79	-
DBH-34	9	1.50-3.00	Core	210/2	Soak	2.72	2.73	0.43	1.16		2.75	961.57	-
DBH-34	9	1.50-3.00	Core	210/2	Unsoak	Sample Cracked during Hardness Test							
DBH-34	10	1.50-3.00	Core	210/3	Unsoak	-	-	-	-	-	-	983.16	-
DBH-34	17	3.00-4.50	Core	210/4	Unsoak	-	-	-	-	37.10	-	-	-
DBH-34	17	3.00-4.50	Core	210/4	-	Sample Cracked during Cutting							
DBH-35	1	0.50-1.50	Core	211/1	Unsoak	-	-	-	-	39.02	-	855.00	-
DBH-35	4	1.50-3.00	Core	211/2	Soak	2.75	2.75	0.14	0.39	-	2.76	579.43	-
DBH-35	4	1.50-3.00	Core	211/2	Unsoak	Sample Cracked during Hardness Test							
DBH-35	9	3.00-4.50	Core	211/3	Unsoak	-	-	-	-	-	-	582.84	-
DBH-36	5	0.50-1.50	Core	212/1	Unsoak	-	-	-	-	37.87	-	1775.54	-
DBH-36	6	1.50-3.00	Core	212/2	Unsoak	2.67	2.68	0.15	0.39	-	2.68	1422.62	-
DBH-36	6	1.50-3.00	Core	212/2	Unsoak	-	-	-	-	35.74	-	-	-
DBH-36	18	3.00-4.50	Core	212/3	Soak	-	-	-	-	-	-	393.53	-
DBH-37	4	0.50-1.50	Core	213/1	Soak	2.66	2.69	0.93	2.48	-	2.73	-	2.86
DBH-37	18	1.50-3.00	Core	213/2	Unsoak	-	-	-	-	-	-	-	20.07
DBH-37	45	3.00-4.50	Core	213/4	Unsoak	-	-	-	-	-	-	-	1.82
DBH-37	54	3.00-4.50	Core	213/6	-	Testing Not Possible due to Cracked Sample							
DBH-38	4	4.50-6.00	Core	214/1	-	Sample Cracked during Cutting							
DBH-38	7	6.00-7.50	Core	214/2	-	Sample Cracked during Cutting							
DBH-38	14	7.50-9.00	Core	214/4	Unsoak	-	-	-	-	-	-	-	13.08
DBH-39	6	1.50-3.00	Core	131/1	-	Testing Not Possible due to Cracked Sample							
DBH-39	8	3.00-4.50	Core	131/2	Soak	2.31	2.33	0.93	2.15		2.36	-	18.80
DBH-40	7	1.50-3.00	Core	132/1	Soak	2.67	2.68	0.30	0.80		2.69	1097.81	-
DBH-40	16	3.00-4.50	Core	132/2	Unsoak	2.75	-	-	-		-	620.09	-
DBH-41	2	1.05-1.95	Core	133/1	Soak	2.38	2.46	3.48	8.28		2.60	-	2.91
DBH-41	22	1.95-3.00	Core	133/2	Soak	2.25	2.36	5.26	11.82		2.55	-	2.92
DBH-41	32	3.00-4.50	Core	133/3	Soak	2.44	2.51	2.77	6.76		2.62	-	1.45

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TC-6357

Summary of Rock Test Results

Client:	NTPC Limited	**Report No.**	SIPL/TCF-172, 232/RK-123-136, 179-220/2023
Project:	Geotechnical Investigation Work for Proposed Sipat STPP Stage-III at Bilaspur, Chattisgarh.	**Report Date:**	16.05.2023
ULR No.	TC635723000001632F to TC635723000001645F, TC635723000002227F to TC635723000002271F		

					Test Methods:	*IS:13030*					*IS:1122*	*IS:9143*	*IS:8764*
BH No.	**Piece No.**	**Depth (m)**	**Sample Type**	**LAB No.**	**Condition**	**Dry Density ***	**Bulk Density ***	**Water Absorption**	**Porosity**	**Hardness**	**Specific Gravity**	**Unconfined Compressive Strength**	**Point Load Strength Index**
						g/cc	g/cc	%	%	-	-	Kg/cm²	kg/cm²
DBH-42	31	1.50-3.00	Core	134/1	Soak	2.64	2.67	1.14	3.01		2.72	-	0.72
DBH-42	44	3.00-4.50	Core	134/2	Soak	2.65	2.70	1.77	4.70		2.78	799.83	-
DBH-43	24	1.50-3.00	Core	135/1	Soak	2.56	2.59	1.33	3.40		2.65	-	0.72
DBH-43	62	3.00-4.50	Core	135/2	Soak	2.68	2.72	1.61	4.30		2.80	-	1.81
DBH-44	1	2.45-3.00	Core	215/1	Unsoak	2.75	2.76	0.68	1.88	-	2.80	-	36.20
DBH-44	10	3.00-4.50	Core	215/2	Soak	2.23	2.26	1.28	2.85	-	2.29	-	12.09
DBH-44	36	4.50-6.00	Core	215/3	Unsoak	-	-	-	-	-	-	-	1.80
DBH-44	56	6.00-7.50	Core	215/4	Unsoak	-	-	-	-	-	-	-	8.15
DBH-45	11	1.50-3.00	Core	216/1	-	Sample Cracked during Cutting							
DBH-45	20	3.00-4.50	Core	216/2	Soak	2.60	2.64	1.60	4.15	-	2.71	-	7.57
DBH-45	33	4.50-6.00	Core	216/3	Unsoak	-	-	-	-	-	-	698.27	-
DBH-46	7	1.50-3.00	Core	136/1	Soak	2.77	2.78	0.66	1.82		2.82	-	35.49
DBH-46	14	3.00-4.50	Core	136/2	Unsoak	2.79	-	-	-		-	661.59	-
DBH-47	3	0.50-1.50	Core	217/2	Unsoak	-	-	-	-	-	-	-	19.13
DBH-47	5	1.50-3.00	Core	217/3	Soak	2.61	2.63	0.66	1.73	-	2.66	-	45.63
DBH-48	1	9.00-10.00	Core	218/1	Unsoak	-	-	-	-	-	-	-	7.72
DBH-48	3	9.00-10.00	Core	218/2	Unsoak	-	-	-	-	-	-	-	7.78
DBH-49	7	4.50-6.00	Core	219/1	Unsoak	2.82	2.83	0.31	0.89	-	2.84	703.36	-
DBH-49	7	4.50-6.00	Core	219/1	Unsoak	Sample Cracked during Hardness Test							
DBH-49	12	6.00-7.50	Core	219/2	Unsoak	-	-	-	-	-	-	319.11	-
DBH-50	3	4.50-6.00	Core	220/1	Soak	2.71	2.72	0.44	1.18	-	2.74	682.31	-
DBH-50	3	4.50-6.00	Core	220/1	Unsoak	-	-	-	-	35.89	-	-	-
DBH-50	6	6.00-7.50	Core	220/2	Soak	-	-	-	-	42.49	-	1589.72	-
DBH-50	13	7.50-9.00	Core	220/3	Unsoak	-	-	-	-	-	-	-	58.39

Note : Test marked with " * " is not NABL Accredited.

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Summary of Impact Value Test Results

Client:	**NTPC Limited**	**Report No.**	**SIPL/RK-Impact Value/2023**
Project:	**Geotechnical Investigation Work for Proposed Sipat STPP Stage-III at Bilaspur, Chattisgarh**	**Report Date:**	**31.05.2023**
		Test Methods:	***IS:2386 (P4)***

BH No.	Piece No.	Depth (m)	Sample Type	LAB No.	Impact Value %
DBH-5	22	7.50-9.00	Core	189/4	25.07
DBH-6	18	6.00-7.50	Core	190/5	26.74
DBH-16	27	6.00-7.50	Core	197/5	28.22
DBH-23	14	3.00-4.50	Core	201/4	26.14
DBH-28	37	3.00-4.50	Core	204/6	27.69
DBH-30	54	6.00-7.50	Core	206/4	28.55
DBH-33	15	6.00-7.50	Core	209/5	29.12
DBH-34	1	0.00-1.50	Core	210/5	26.87
DBH-36	6	1.50-3.00	Core	212/4	28.93
DBH-38	7	6.00-7.50	Core	214/5	28.10

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Summary of Slake Durability Test Results

Client:	**NTPC Limited**	**Report No.**	**SIPL/RK-Slake Durability/2023**
Project:	**Geotechnical Investigation Work for Proposed Sipat STPP Stage-III at Bilaspur, Chattisgarh**	**Report Date:**	**31.05.2023**
	Test Methods:		***IS:10050***

BH No.	Piece No.	Depth (m)	Sample Type	LAB No.	Slake Durability Index (I_{d2})	Slake Durability Index (I_{d1})
					%	%
DBH-1	7	4.50-6.00	Core	185/4	99.17	99.54
DBH-2	1	1.95-3.00	Core	186/6	98.52	99.06
DBH-6	18	6.00-7.50	Core	190/4	98.19	99.47
DBH-33	7	3.00-4.50	Core	209/4	99.03	99.26
DBH-50	3	4.50-6.00	Core	220/4	98.20	98.62

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2.10. ELECTRICAL RESISTIVITY TEST:

Twenty three (23) nos. Electrical Resistivity Tests were carried out at the following locations around Plant Area. The test procedure and results are presented under Section-8.

ERT No.	Co-ordinates		Reduced Level (M)	ERT No.	Co-ordinates		Reduced Level (M)
	Easting	Northing			Easting	Northing	
ERT-1	(-)879.00	1630	282.655	ERT-13	(-)755.00	868	282.780
ERT-2	(-)488.00	1466	282.315	ERT-14	(-)688.00	781	282.480
ERT-3	(-)471.000	1341	282.200	ERT-15	(-)824.00	720	282.265
ERT-4	(-)721.000	1326	284.510	ERT-16	(-)511.00	694	282.112
ERT-5	(-)643.000	1338	282.560	ERT-17	(-)926.00	571	282.719
ERT-6	(-)529.000	1284	282.360	ERT-18	(-)1035.00	362	282.670
ERT-7	(-)869.000	1296	282.570	ERT-19	(-)1532.00	945	283.170
ERT-8	(-)575.000	1200	282.460	ERT-20	(-)460.00	1666	282.218
ERT-9	(-)769.000	1125	282.290	ERT-21	148.00	1814	282.454
ERT-10	(-)772.000	1018	282.820	ERT-22	36.00	1620	282.110
ERT-11	(-)669.000	1008	282.482	ERT-23	(-)607.00	1514	283.072
ERT-12	(-)605.000	969	282.920				

2.11. CROSS HOLE SHEAR TEST:

Five (05) nos. Cross Hole Shear Test were carried out to determine the dynamic properties of the layer for the construction of machine foundations at the following locations. The test procedure and results are presented and discussed under Section-9.

GEOLOGY:

The study area belongs to the Chhattisgarh Basin. The succession of the basin (~2500 m thick) comprises dominantly of sandstones, shale, and carbonates with subordinate conglomerate and tuffs at different stratigraphic levels. The succession is designated as Chhattisgarh Supergroup, which is further classified into different groups. Shale is the only rock type encountered in the study area. The color of the shale varies from reddish brown to olive green depending on degree of weathering. The upper reaches of the rock layer is weathered and fractured. This rock layer is conformably underlies by filled up soil or clayey soil.

Summarized result of the resistivity measurements at different locations in the area are given in the following tables.

It may be indicated here that in case of highly resistive formations, current penetrates much deeper into the earth than when the subsurface formations are conducting. Further, in the present investigation only apparent resistivity is measured which may be taken (as a first approximation) as the weighted average of the true resistivity of the subsurface formations in which current lines flow.

APPARENT RESISTIVITY VALUES

ERT No. 01

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	85.59	85.75	85.44	85.75	85.63
2	1	49.01	49.95	49.64	49.95	49.64
3	2	35.06	35.18	35.18	35.18	35.15
4	3	31.10	31.01	30.82	31.10	31.01
5	4	31.79	31.79	32.04	31.92	31.89
6	5	35.18	35.66	35.03	35.66	35.38
7	6	39.39	39.77	39.96	39.77	39.72
8	7	45.74	46.18	46.18	45.52	45.91
9	8	49.01	49.01	48.76	49.76	49.13
10	10	59.06	59.06	58.75	60.00	59.22

Mean Resistivity at ERT-01 is 46.27 Ohm - m.

ERT No. 02

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	30.50	30.50	30.53	30.48	30.50
2	1	27.27	27.24	27.27	27.36	27.28
3	2	35.94	35.94	35.81	35.94	35.91
4	3	42.79	42.98	42.88	43.35	43.00
5	4	49.01	49.38	49.26	48.76	49.10
6	5	53.72	53.25	53.25	53.41	53.41
7	6	60.13	60.88	60.70	60.51	60.55
8	7	60.70	60.91	61.13	61.57	61.08
9	8	67.61	67.35	66.85	66.35	67.04
10	10	76.34	75.08	75.71	76.03	75.79

Mean Resistivity at ERT-02 is 50.37 Ohm - m.

ERT No. 03

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	17.78	17.78	17.75	17.79	17.77
2	1	19.41	19.38	19.45	19.41	19.41
3	2	25.89	26.26	25.82	26.20	26.04
4	3	31.67	32.04	32.04	31.85	31.90
5	4	38.70	38.20	38.20	37.82	38.23
6	5	43.82	43.82	43.98	44.30	43.98
7	6	50.52	50.89	50.70	51.27	50.85
8	7	56.74	57.40	57.62	57.40	57.29
9	8	62.83	63.33	63.59	63.33	63.27
10	10	66.29	66.60	66.60	66.91	66.60

Mean Resistivity at ERT-03 is 41.53 Ohm - m.

ERT No. 04

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	197.88	197.88	191.88	197.41	196.26
2	1	163.99	163.99	163.67	164.93	164.14
3	2	101.16	102.41	101.16	103.67	102.10
4	3	59.94	60.41	60.13	60.32	60.20
5	4	60.57	60.69	61.20	60.57	60.76
6	5	56.86	57.02	56.86	56.86	56.90
7	6	52.40	53.16	53.16	53.34	53.01
8	7	53.88	53.66	53.88	55.20	54.15
9	8	57.30	57.80	57.55	58.56	57.80
10	10	57.18	56.23	56.86	56.55	56.70

Mean Resistivity at ERT-04 is 86.20 Ohm - m.

ERT No. 05

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	24.22	24.19	24.20	24.19	24.20
2	1	28.02	27.99	27.96	27.99	27.99
3	2	19.80	20.17	20.23	20.23	20.11
4	3	19.04	18.85	19.04	18.75	18.92
5	4	21.24	21.49	21.36	21.36	21.36
6	5	22.93	22.93	22.93	22.62	22.85
7	6	26.20	26.58	26.95	26.77	26.62
8	7	29.25	29.91	29.47	29.25	29.47
9	8	34.93	34.93	33.44	35.94	34.81
10	10	41.47	41.78	42.41	43.67	42.33

Mean Resistivity at ERT-05 is 26.87 Ohm - m.

ERT No. 06

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	21.34	21.36	21.37	21.36	21.36
2	1	27.36	27.39	27.39	27.39	27.39
3	2	48.63	48.57	48.38	54.98	50.14
4	3	57.58	57.87	57.68	57.87	57.75
5	4	57.68	58.43	57.80	58.18	58.02
6	5	60.00	59.69	60.16	59.69	59.88
7	6	66.73	67.10	66.73	67.67	67.06
8	7	68.17	69.05	68.61	69.93	68.94
9	8	72.38	73.14	72.13	72.13	72.44
10	10	76.34	76.65	76.63	76.65	76.57

Mean Resistivity at ERT-06 is 55.95 Ohm - m.

ERT No. 07

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	25.18	25.13	25.17	25.16	25.16
2	1	32.58	32.64	32.77	32.64	32.66
3	2	39.71	39.90	39.90	39.90	39.85
4	3	47.31	47.22	47.40	47.40	47.33
5	4	53.87	54.28	53.78	53.91	53.96
6	5	59.53	59.69	59.85	60.00	59.77
7	6	66.92	66.92	67.10	67.10	67.01
8	7	75.87	76.75	75.21	75.43	75.81
9	8	81.93	81.68	82.18	82.43	82.06
10	10	94.25	95.82	94.25	95.19	94.87

Mean Resistivity at ERT-07 is 57.85 Ohm - m.

ERT No. 08

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	28.94	28.93	28.96	29.04	28.97
2	1	26.39	26.48	26.51	26.48	26.47
3	2	37.82	37.70	37.89	37.63	37.76
4	3	41.47	42.03	42.03	42.03	41.89
5	4	51.52	51.77	51.52	51.65	51.61
6	5	56.86	56.86	57.02	57.02	56.94
7	6	62.77	62.77	62.96	63.33	62.96
8	7	71.00	71.03	69.93	71.25	70.80
9	8	79.42	80.17	79.17	79.67	79.61
10	10	96.13	95.19	96.13	96.76	96.05

Mean Resistivity at ERT-08 is 55.31 Ohm - m.

ERT No. 09

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	30.07	30.06	30.07	30.06	30.07
2	1	23.75	23.81	23.84	23.91	23.83
3	2	30.03	30.03	30.16	30.28	30.13
4	3	39.30	38.82	39.02	39.30	39.11
5	4	47.50	47.88	47.25	47.37	47.50
6	5	58.59	58.43	57.18	57.02	57.80
7	6	65.97	66.54	66.54	66.35	66.35
8	7	67.73	66.85	67.73	67.73	67.51
9	8	72.38	72.13	72.13	72.13	72.19
10	10	87.33	87.02	87.96	87.65	87.49

Mean Resistivity at ERT-09 is 52.20 Ohm - m.

ERT No. 10

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	22.93	22.98	22.93	22.94	22.94
2	1	27.14	27.08	27.14	27.11	27.12
3	2	35.25	35.25	35.25	35.31	35.26
4	3	47.88	47.40	47.97	47.22	47.62
5	4	52.02	52.02	52.65	52.02	52.18
6	5	62.83	62.67	62.52	62.52	62.63
7	6	72.01	72.19	72.01	71.25	71.86
8	7	73.45	73.23	73.67	73.23	73.39
9	8	75.40	76.40	76.15	75.90	75.96
10	10	92.05	92.99	92.05	94.25	92.83

Mean Resistivity at ERT-10 is 56.18 Ohm - m.

ERT No. 11

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	117.79	116.88	117.32	116.85	117.21
2	1	83.56	85.13	83.56	83.25	83.88
3	2	74.33	74.14	74.33	74.52	74.33
4	3	66.25	66.44	66.35	66.07	66.28
5	4	55.54	55.67	55.54	55.54	55.57
6	5	66.44	67.07	66.13	67.86	66.87
7	6	57.68	57.11	57.68	58.06	57.63
8	7	63.11	63.33	63.99	63.99	63.61
9	8	70.87	71.12	70.87	70.37	70.81
10	10	84.82	86.71	86.39	86.08	86.00

Mean Resistivity at ERT-11 is 74.22 Ohm - m.

ERT No. 12

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	43.66	43.82	43.35	43.66	43.62
2	1	34.96	35.00	35.03	34.96	34.99
3	2	42.85	42.98	42.98	42.91	42.93
4	3	45.43	45.33	45.24	45.24	45.31
5	4	53.78	54.28	54.41	54.79	54.32
6	5	52.62	52.62	52.31	52.46	52.50
7	6	55.79	56.36	56.36	55.98	56.12
8	7	53.22	53.22	53.66	53.22	53.33
9	8	58.31	59.06	57.80	58.06	58.31
10	10	69.43	68.80	69.11	70.68	69.51

Mean Resistivity at ERT-12 is 51.09 Ohm - m.

ERT No. 13

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	38.32	37.85	38.01	37.85	38.01
2	1	33.33	33.36	33.33	33.39	33.35
3	2	35.18	35.31	35.18	35.06	35.18
4	3	32.70	32.80	32.80	33.08	32.84
5	4	33.68	34.05	34.56	34.30	34.15
6	5	34.71	34.87	35.18	35.34	35.03
7	6	37.70	36.95	38.45	37.32	37.60
8	7	38.92	38.70	39.36	39.36	39.09
9	8	40.46	41.47	42.47	40.97	41.34
10	10	39.90	40.21	39.90	40.21	40.05

Mean Resistivity at ERT-13 is 36.67 Ohm - m.

ERT No. 14

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	26.45	26.45	26.46	26.40	26.44
2	1	30.16	30.16	30.22	30.22	30.19
3	2	37.76	38.14	37.51	37.57	37.74
4	3	33.83	33.93	33.55	33.55	33.72
5	4	30.41	30.91	31.29	31.04	30.91
6	5	36.13	35.66	36.13	36.76	36.17
7	6	40.90	40.90	41.09	41.09	41.00
8	7	44.20	44.20	45.08	43.98	44.37
9	8	50.77	51.52	51.27	50.77	51.08
10	10	62.20	63.46	61.89	61.57	62.28

Mean Resistivity at ERT-14 is 39.39 Ohm - m.

ERT No. 15

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	109.78	109.94	110.09	109.62	109.86
2	1	85.13	85.76	85.45	85.76	85.53
3	2	97.01	96.82	96.82	96.82	96.87
4	3	85.39	85.29	85.57	85.76	85.50
5	4	93.11	93.11	92.99	93.49	93.18
6	5	97.23	97.70	97.86	97.39	97.54
7	6	91.23	90.85	90.85	91.80	91.18
8	7	101.38	101.38	101.16	101.60	101.38
9	8	110.08	110.58	100.08	110.58	107.83
10	10	126.29	125.98	126.29	125.35	125.98

Mean Resistivity at ERT-15 is 99.48 Ohm - m.

ERT No. 16

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	83.24	83.24	82.92	83.08	83.12
2	1	125.03	125.66	125.66	125.66	125.50
3	2	116.86	117.05	116.80	116.93	116.91
4	3	89.82	89.88	89.91	89.82	89.85
5	4	80.67	80.67	80.92	46.75	72.25
6	5	58.59	59.06	59.06	58.43	58.78
7	6	43.73	43.73	44.67	44.11	44.06
8	7	31.45	31.23	31.67	32.11	31.61
9	8	30.91	30.91	31.92	31.67	31.35
10	10	32.99	33.61	33.61	33.61	33.46

Mean Resistivity at ERT-16 is 68.69 Ohm - m.

ERT No. 17

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	172.283	173.226	173.069	172.755	172.83
2	1	126.288	125.66	136.602	124.446	128.25
3	2	87.773	88.212	87.898	87.962	87.96
4	3	65.971	66.065	66.015	66.065	66.03
5	4	54.662	55.164	55.415	54.787	55.01
6	5	60.002	30.159	60.316	60.473	52.74
7	6	69.366	69.554	69.931	69.931	69.70
8	7	78.97	79.607	79.607	79.607	79.45
9	8	87.209	86.958	87.209	86.455	86.96
10	10	103.209	103.356	103.042	102.414	103.01

Mean Resistivity at ERT-17 is 90.19 Ohm - m.

ERT No. 18

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	94.54	94.23	94.30	94.23	94.33
2	1	76.65	77.28	76.65	76.65	76.81
3	2	63.46	63.46	63.27	63.46	63.41
4	3	58.43	58.24	58.43	58.34	58.36
5	4	66.73	67.23	66.98	66.47	66.85
6	5	73.67	73.83	74.14	72.88	73.63
7	6	82.94	83.69	82.37	82.56	82.89
8	7	94.34	94.56	93.90	95.00	94.45
9	8	101.79	101.03	101.28	101.54	101.41
10	10	125.35	125.66	124.41	125.98	125.35

Mean Resistivity at ERT-18 is 83.75 Ohm - m.

ERT No. 19

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	48.37	48.37	47.59	48.21	48.14
2	1	26.95	27.05	27.05	27.05	27.02
3	2	35.69	35.69	35.75	35.69	35.70
4	3	47.78	47.78	47.50	47.40	47.62
5	4	53.28	53.53	53.78	53.66	53.56
6	5	54.35	53.41	53.88	54.03	53.92
7	6	49.01	50.52	50.52	48.95	49.75
8	7	51.68	52.56	52.78	52.39	52.35
9	8	52.28	52.53	54.03	53.03	52.97
10	10	61.57	63.46	63.46	62.20	62.67

Mean Resistivity at ERT-19 is 48.37 Ohm - m.

ERT No. 20

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	59.68	59.99	59.99	59.99	59.91
2	1	65.66	65.97	65.03	65.03	65.42
3	2	77.78	77.72	77.72	77.85	77.77
4	3	86.89	86.52	86.14	86.42	86.49
5	4	95.50	95.12	94.87	94.50	95.00
6	5	102.26	101.16	101.00	100.69	101.27
7	6	112.72	112.34	111.97	112.34	112.34
8	7	109.96	109.30	109.30	109.30	109.46
9	8	115.36	115.86	114.60	115.11	115.23
10	10	131.95	131.32	131.32	131.63	131.55

Mean Resistivity at ERT-20 is 95.45 Ohm - m.

ERT No. 21

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	94.54	93.92	93.92	94.23	94.15
2	1	86.39	87.33	87.65	87.02	87.10
3	2	78.54	78.41	78.22	78.35	78.38
4	3	81.90	81.71	81.52	81.80	81.73
5	4	89.47	89.72	89.47	84.97	88.41
6	5	96.92	97.07	97.23	96.92	97.03
7	6	104.80	104.80	104.61	104.80	104.76
8	7	114.35	113.03	113.03	113.69	113.53
9	8	118.63	118.63	118.12	118.37	118.44
10	10	143.57	144.20	144.51	144.83	144.28

Mean Resistivity at ERT-21 is 100.78 Ohm - m.

ERT No. 22

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	132.24	132.08	132.55	132.39	132.31
2	1	94.87	95.50	94.56	95.50	95.11
3	2	76.72	77.85	77.91	77.91	77.59
4	3	67.48	67.57	67.29	67.10	67.36
5	4	78.16	78.54	78.54	78.03	78.32
6	5	84.19	83.88	84.19	84.51	84.19
7	6	93.68	93.30	93.68	94.06	93.68
8	7	96.76	96.76	96.98	96.76	96.82
9	8	102.54	102.29	103.29	102.79	102.73
10	10	121.89	122.21	99.12	121.58	116.20

Mean Resistivity at ERT-22 is 94.43 Ohm - m.

ERT No. 23

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW-SE)	Mean
1	0.5	173.25	173.54	174.33	173.23	173.59
2	1	188.49	187.23	187.23	188.18	187.78
3	2	174.04	174.67	175.92	173.41	174.51
4	3	153.62	153.62	154.56	154.56	154.09
5	4	126.04	126.04	125.91	125.91	125.97
6	5	100.84	100.21	101.00	100.37	100.61
7	6	89.72	89.91	90.48	90.67	90.19
8	7	98.96	98.30	98.74	98.30	98.57
9	8	107.32	108.07	107.06	107.32	107.44
10	10	127.86	127.55	127.55	127.55	127.62

Mean Resistivity at ERT-23 is 134.04 Ohm - m.

The above Mean Resistivity values are summarized below.

Sl No.	ERT No.	Mean Resisivity Values Ohm-m.
1	ERT-01	46.27
2	ERT-02	50.37
3	ERT-03	41.53
4	ERT-04	86.20
5	ERT-05	26.87
6	ERT-06	55.95
7	ERT-07	57.85
8	ERT-08	55.31
9	ERT-09	52.20
10	ERT-10	56.18
11	ERT-11	74.22
12	ERT-12	51.09
13	ERT-13	36.67
14	ERT-14	39.39
15	ERT-15	99.48
16	ERT-16	68.69
17	ERT-17	90.19
18	ERT-18	83.75
19	ERT-19	48.37
20	ERT-20	95.45
21	ERT-21	100.78
22	ERT-22	94.43
23	ERT-23	134.04

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 29.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -2784.001, W-422.001

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 281.764

DERT →		1																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, **a**	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	50.000	471.2	56.300	530.6	69.700	656.9	61.400	578.7	50.000	471.2	56.300	530.6	69.700	656.9	61.400	578.7	559.36
2	3	36.700	691.8	36.300	684.2	34.800	656.0	38.100	718.2	36.700	691.8	36.300	684.2	34.800	656.0	38.100	718.2	687.54
3	6	26.900	1014.1	27.100	1021.6	25.400	957.6	26.400	995.3	26.900	1014.1	27.100	1021.6	25.400	957.6	26.400	995.3	997.14
4	9	23.000	1300.6	21.600	1221.5	22.300	1261.0	23.800	1345.9	23.000	1300.6	21.600	1221.5	22.300	1261.0	23.800	1345.9	1282.24
5	12	18.850	1421.3	17.140	1292.3	16.400	1236.5	18.420	1388.8	18.850	1421.3	17.140	1292.3	16.400	1236.5	18.420	1388.8	1334.74
6	15	15.850	1493.8	15.400	1451.4	16.220	1528.7	11.130	1049.0	15.850	1493.8	15.400	1451.4	16.220	1528.7	11.130	1049.0	1380.73
7	18	14.260	1612.8	13.370	1512.1	15.140	1712.3	13.930	1575.4	14.260	1612.8	13.370	1512.1	15.140	1712.3	13.930	1575.4	1603.15
8	21	12.270	1619.0	12.560	1657.3	13.830	1824.8	11.010	1452.7	12.270	1619.0	12.560	1657.3	13.830	1824.8	11.010	1452.7	1638.45
9	24	10.060	1517.0	11.040	1664.8	13.460	2029.7	10.540	1589.4	10.060	1517.0	11.040	1664.8	13.460	2029.7	10.540	1589.4	1700.23
10	27	8.680	1472.5	9.830	1667.6	8.560	1452.2	9.410	1596.4	8.680	1472.5	9.830	1667.6	8.560	1452.2	9.410	1596.4	1547.17
11	30	14.260	2687.9	8.050	1517.4	6.980	1315.7	7.210	1359.1	14.260	2687.9	8.050	1517.4	6.980	1315.7	7.210	1359.1	1720.02

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 29.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

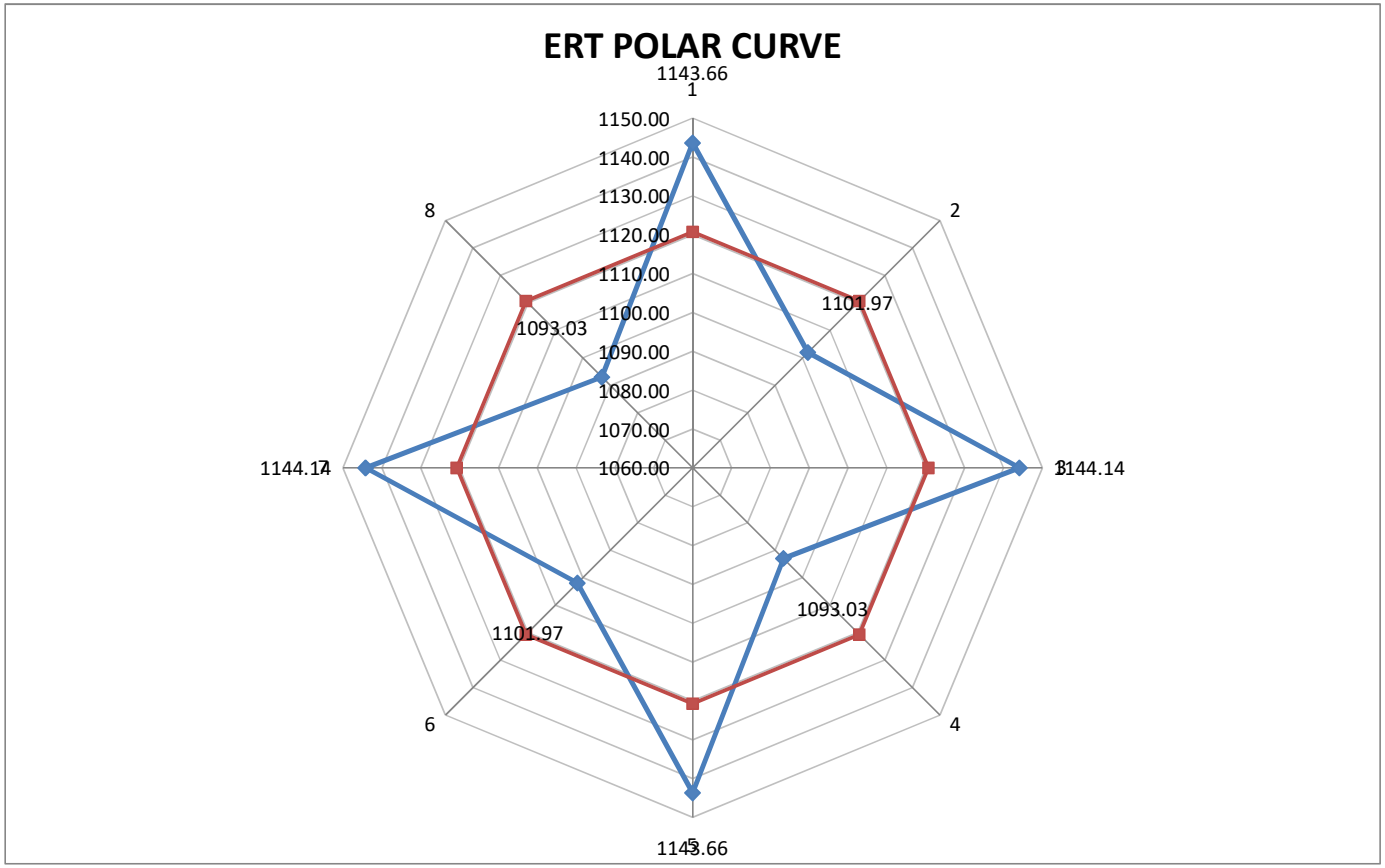
LOCATION : SIPAT

CO-ORDINATES : N -2784.001, W-422.001

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 281.764

POLAR CURVE



Mean Resistivity = 994.79 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 29.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -2491.360, W-419.634

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 281.639

ERT →		2																
Direction →		N		NE		E		SE		S		SW		W		NW		Average Apparent Resistivity ρ_{avg}
Sr. No.	Electrodes Spacing, a	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	35.800	337.4	33.100	312.0	38.200	360.0	31.500	296.9	35.800	337.4	33.100	312.0	38.200	360.0	31.500	296.9	326.57
2	3	10.390	195.8	13.000	245.0	13.240	249.6	13.130	247.5	10.390	195.8	13.000	245.0	13.240	249.6	13.130	247.5	234.49
3	6	5.280	199.1	6.100	230.0	5.860	220.9	5.190	195.7	5.280	199.1	6.100	230.0	5.860	220.9	5.190	195.7	211.40
4	9	3.750	212.1	4.080	230.7	3.480	196.8	3.980	225.1	3.750	212.1	4.080	230.7	3.480	196.8	3.980	225.1	216.16
5	12	2.970	223.9	3.030	228.5	3.020	227.7	3.090	233.0	2.970	223.9	3.030	228.5	3.020	227.7	3.090	233.0	228.27
6	15	2.570	242.2	2.300	216.8	2.310	217.7	2.430	229.0	2.570	242.2	2.300	216.8	2.310	217.7	2.430	229.0	226.43
7	18	2.190	247.7	2.000	226.2	2.110	238.6	2.090	236.4	2.190	247.7	2.000	226.2	2.110	238.6	2.090	236.4	237.22
8	21	1.871	246.9	1.663	219.4	1.788	235.9	1.734	228.8	1.871	246.9	1.663	219.4	1.788	235.9	1.734	228.8	232.75
9	24	1.613	243.2	1.652	249.1	2.090	315.2	1.660	250.3	1.613	243.2	1.652	249.1	2.090	315.2	1.660	250.3	264.46
10	27	1.474	250.1	1.449	245.8	1.650	279.9	1.580	268.0	1.474	250.1	1.449	245.8	1.650	279.9	1.580	268.0	260.96
11	30	1.447	272.8	1.499	282.6	1.703	321.0	1.460	275.2	1.447	272.8	1.499	282.6	1.703	321.0	1.460	275.2	287.88

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 29.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

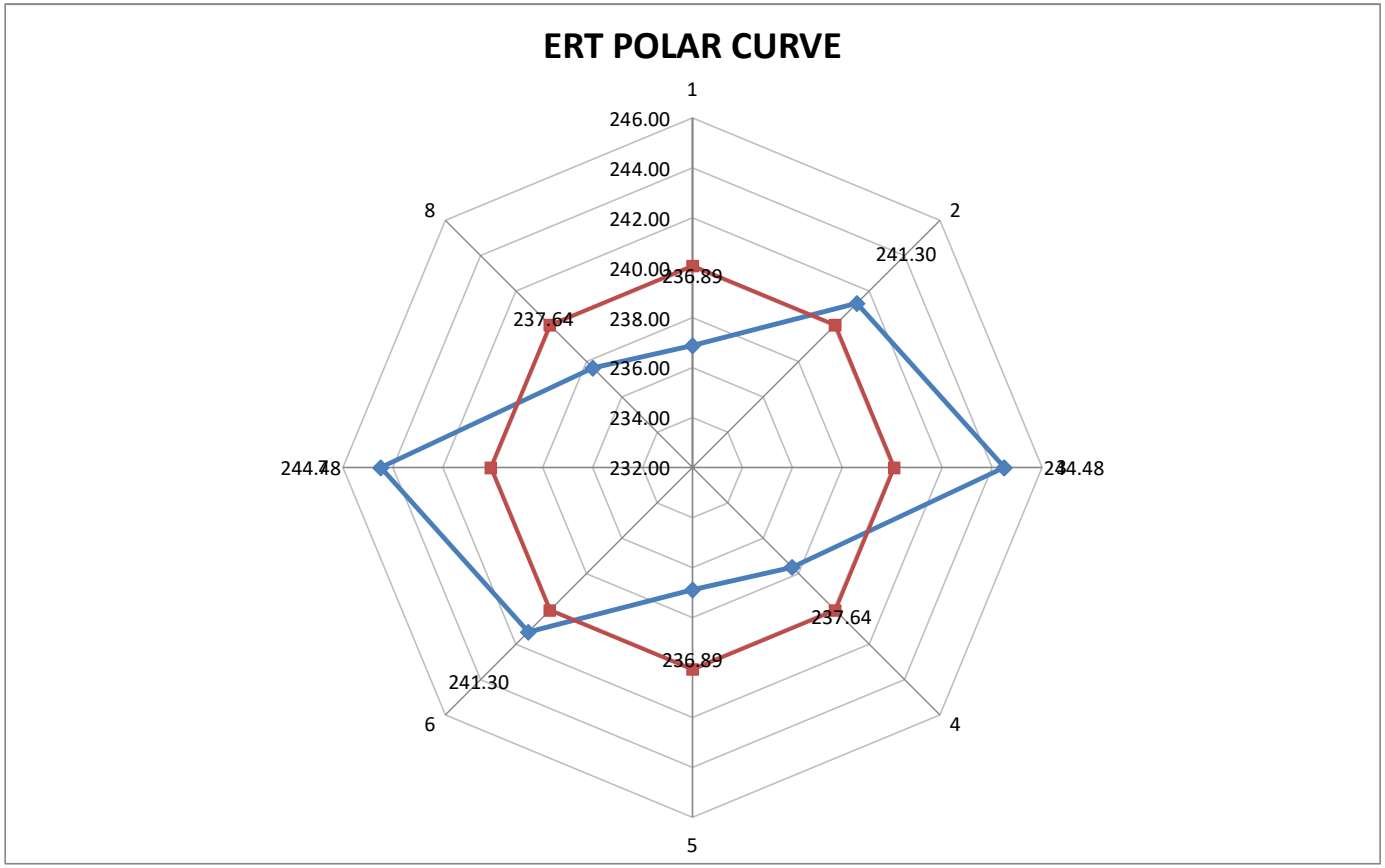
LOCATION : SIPAT

CO-ORDINATES : N -2491.360, W-419.634

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 281.639

POLAR CURVE



Mean Resistivity = 213.44 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 24.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /02**

LOCATION : SIPAT **CO-ORDINATES :** N -1428.183, W-540.489

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 281.764

DERT →		3																
Direction →		N		NE		E		SE		S		SW		W		NW		Average Apparent Resistivity ρ_{avg}
Sr. No.	Electrodes Spacing, a	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	44.000	414.690	54.600	514.6	36.400	343.1	36.700	345.9	44.000	414.7	54.600	514.6	36.400	343.1	36.700	345.9	404.56
2	3	16.210	305.6	10.850	204.5	7.700	145.1	6.770	127.6	16.210	305.6	10.850	204.5	7.700	145.1	6.770	127.6	195.71
3	6	1.473	55.5	0.945	35.6	0.968	36.5	0.911	34.3	1.473	55.5	0.945	35.6	0.968	36.5	0.911	34.3	40.50
4	9	0.772	43.7	0.842	47.6	0.711	40.2	0.761	43.0	0.772	43.7	0.842	47.6	0.711	40.2	0.761	43.0	43.63
5	12	0.645	48.6	0.725	54.7	0.654	49.3	0.637	48.0	0.645	48.6	0.725	54.7	0.654	49.3	0.637	48.0	50.16
6	15	0.629	59.3	0.653	61.5	0.578	54.5	0.594	56.0	0.629	59.3	0.653	61.5	0.578	54.5	0.594	56.0	57.82
7	18	0.612	69.2	0.638	72.2	0.608	68.8	0.585	66.2	0.612	69.2	0.638	72.2	0.608	68.8	0.585	66.2	69.07
8	21	0.485	64.0	0.505	66.6	0.594	78.4	0.550	72.6	0.485	64.0	0.505	66.6	0.594	78.4	0.550	72.6	70.39
9	24	0.600	90.5	0.692	104.4	0.569	85.8	0.536	80.8	0.600	90.5	0.692	104.4	0.569	85.8	0.536	80.8	90.36
10	27	0.489	83.0	0.559	94.8	0.559	94.8	0.574	97.4	0.489	83.0	0.559	94.8	0.559	94.8	0.574	97.4	92.50
11	30	0.605	114.0	0.546	102.9	0.479	90.3	0.531	100.1	0.605	114.0	0.546	102.9	0.479	90.3	0.531	100.1	101.83

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 24.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /02

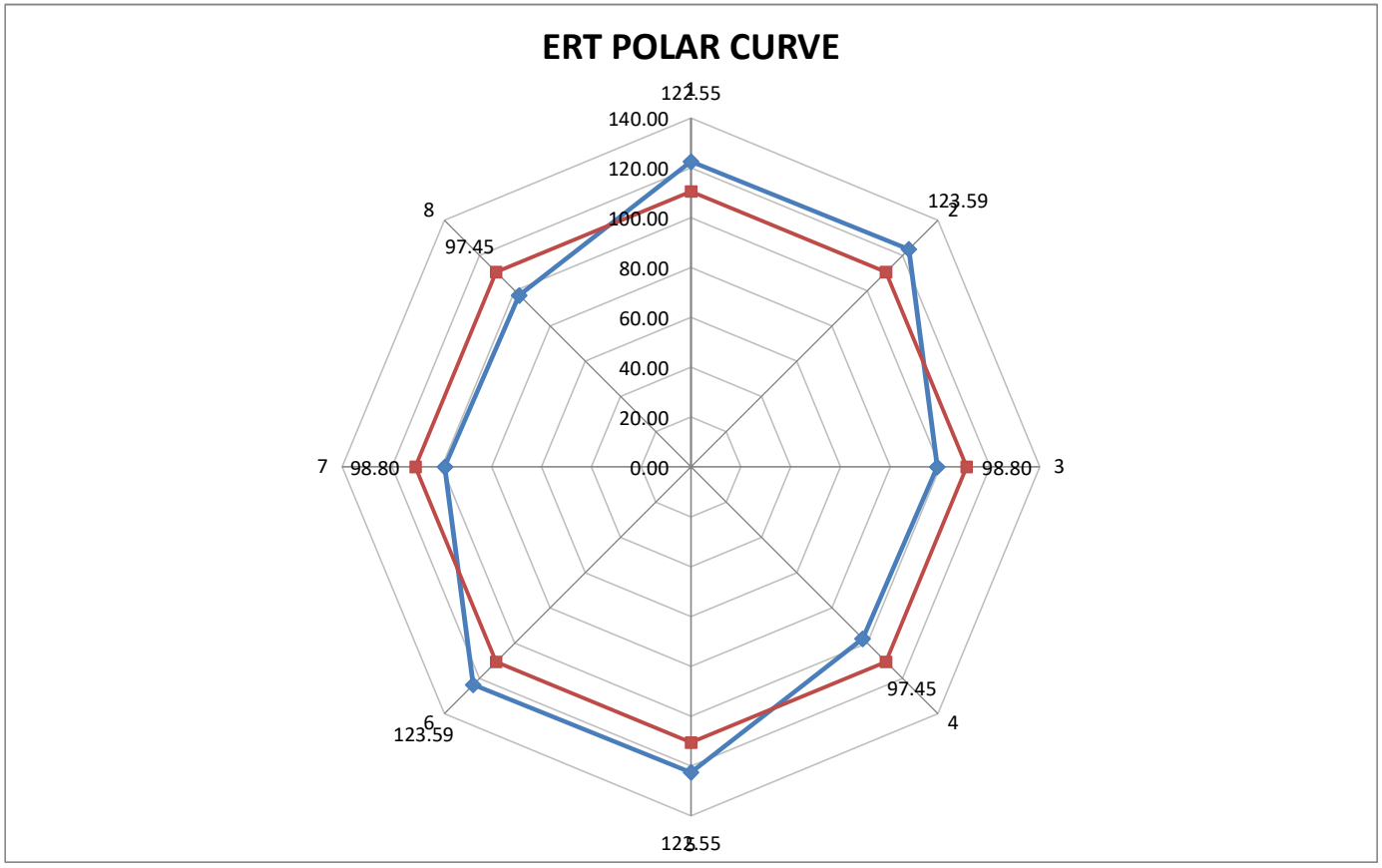
LOCATION : SIPAT

CO-ORDINATES : N -1428.183, W-540.489

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 281.764

POLAR CURVE



Mean Resistivity =	98.33	Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 24.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1397.934, W-489.536

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 283.167

DERT →		4																
Direction →		N		NE		E		SE		S		SW		W		NW		Average Apparent Resistivity ρ_{avg}
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	21.600	203.6	22.400	211.1	26.500	249.8	21.200	199.8	21.600	203.6	22.400	211.1	26.500	249.8	21.200	199.8	216.06
2	3	10.190	192.1	11.800	222.4	8.600	162.1	16.660	314.0	10.190	192.1	11.800	222.4	8.600	162.1	16.660	314.0	222.66
3	6	2.210	83.3	1.480	55.8	1.130	42.6	1.302	49.1	2.210	83.3	1.480	55.8	1.130	42.6	1.302	49.1	57.70
4	9	0.833	47.1	0.880	49.8	0.797	45.1	0.973	55.0	0.833	47.1	0.880	49.8	0.797	45.1	0.973	55.0	49.24
5	12	0.612	46.1	0.748	56.4	0.708	53.4	0.772	58.2	0.612	46.1	0.748	56.4	0.708	53.4	0.772	58.2	53.53
6	15	0.651	61.4	0.648	61.1	0.606	57.1	0.651	61.4	0.651	61.4	0.648	61.1	0.606	57.1	0.651	61.4	60.22
7	18	0.550	62.2	0.638	72.2	0.722	81.7	0.609	68.9	0.550	62.2	0.638	72.2	0.722	81.7	0.609	68.9	71.22
8	21	0.544	71.8	0.520	68.6	0.613	80.9	0.629	83.0	0.544	71.8	0.520	68.6	0.613	80.9	0.629	83.0	76.07
9	24	0.607	91.5	0.668	100.7	0.682	102.8	0.622	93.8	0.607	91.5	0.668	100.7	0.682	102.8	0.622	93.8	97.23
10	27	0.722	122.5	0.644	109.3	0.562	95.3	0.569	96.5	0.722	122.5	0.644	109.3	0.562	95.3	0.569	96.5	105.90
11	30	0.620	116.9	0.642	121.0	0.653	123.1	0.514	96.9	0.620	116.9	0.642	121.0	0.653	123.1	0.514	96.9	114.46

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 24.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

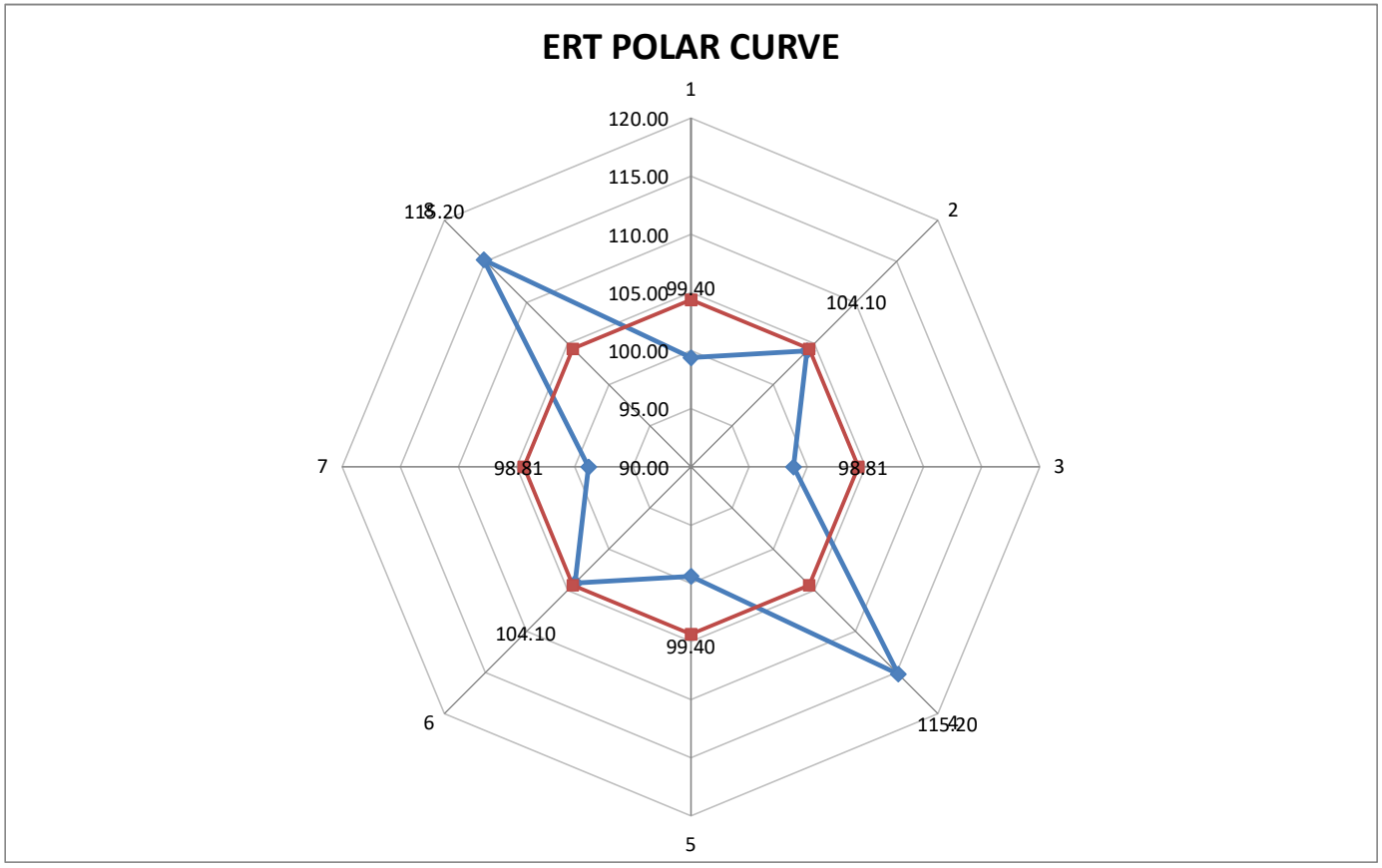
LOCATION : SIPAT

CO-ORDINATES : N -1397.934, W-489.536

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 283.167

POLAR CURVE



Mean Resistivity =	92.17	Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 24.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1348.354, W-517.275

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.690

DERT →		5																
Direction →		N		NE		E		SE		S		SW		W		NW		Average Apparent Resistivity ρ_{avg}
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	18.460	174.0	27.800	262.0	18.880	177.9	17.950	169.2	18.460	174.0	27.800	262.0	18.880	177.9	17.950	169.2	195.78
2	3	8.415	158.6	11.670	220.0	8.550	161.2	9.070	171.0	8.415	158.6	11.670	220.0	8.550	161.2	9.070	171.0	177.68
3	6	4.310	162.5	4.770	179.8	5.110	192.6	4.870	183.6	4.310	162.5	4.770	179.8	5.110	192.6	4.870	183.6	179.64
4	9	3.810	215.5	3.290	186.0	4.100	231.8	3.810	215.5	3.810	215.5	3.290	186.0	4.100	231.8	3.810	215.5	212.20
5	12	2.440	184.0	2.510	189.2	3.620	272.9	2.810	211.9	2.440	184.0	2.510	189.2	3.620	272.9	2.810	211.9	214.51
6	15	2.960	279.0	2.160	203.6	3.090	291.2	2.340	220.5	2.960	279.0	2.160	203.6	3.090	291.2	2.340	220.5	248.58
7	18	2.040	230.7	2.300	260.1	2.140	242.0	2.390	270.3	2.040	230.7	2.300	260.1	2.140	242.0	2.390	270.3	250.79
8	21	1.980	261.3	2.140	282.4	2.080	274.4	1.755	231.6	1.980	261.3	2.140	282.4	2.080	274.4	1.755	231.6	262.41
9	24	1.600	241.3	1.920	289.5	1.595	240.5	1.375	207.3	1.600	241.3	1.920	289.5	1.595	240.5	1.375	207.3	244.67
10	27	1.413	239.7	1.740	295.2	1.615	274.0	1.435	243.4	1.413	239.7	1.740	295.2	1.615	274.0	1.435	243.4	263.08
11	30	1.411	266.0	1.688	318.2	1.245	234.7	1.188	223.9	1.411	266.0	1.688	318.2	1.245	234.7	1.188	223.9	260.69

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 24.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

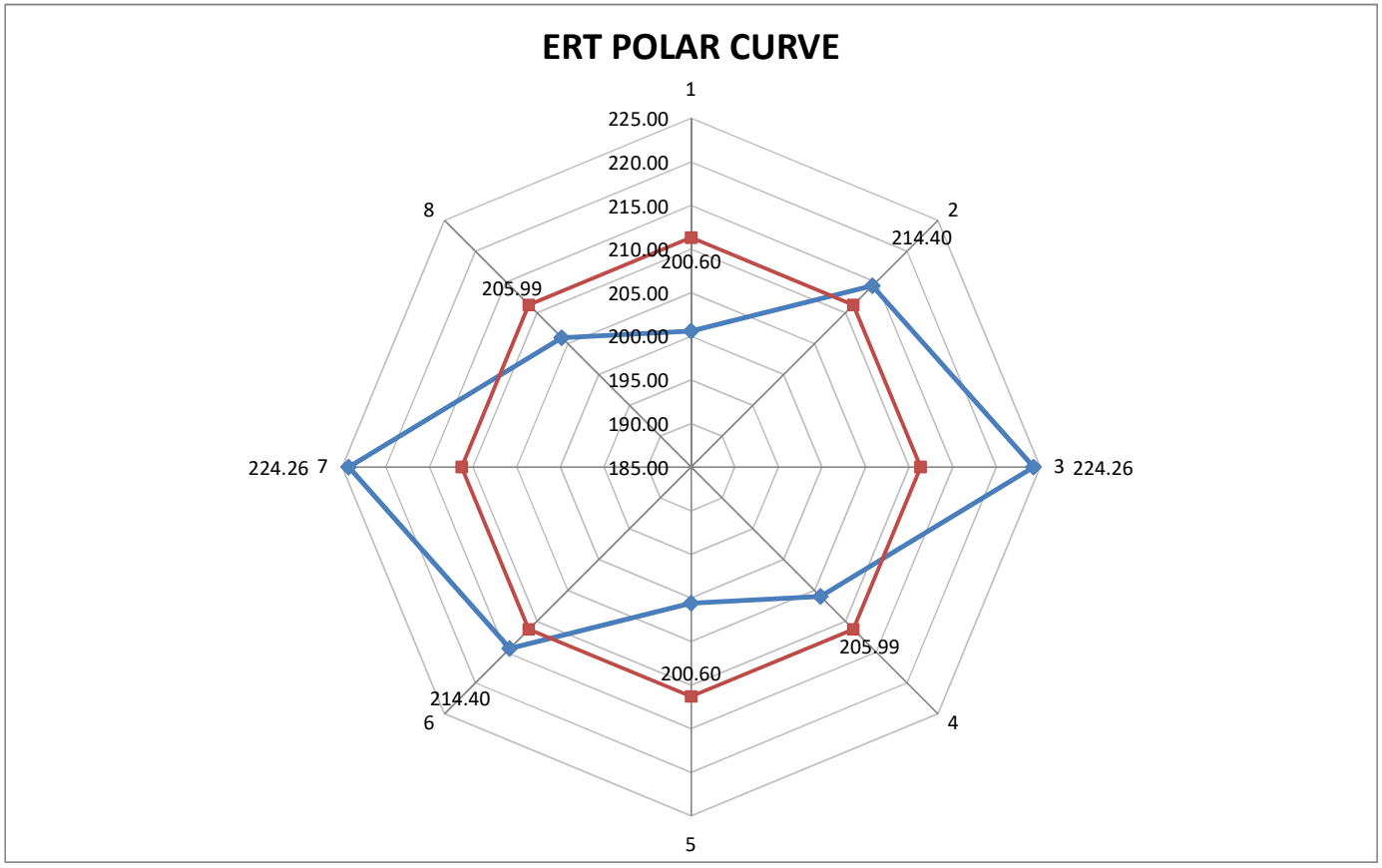
LOCATION : SIPAT

CO-ORDINATES : N -1348.354, W-517.275

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 282.690

POLAR CURVE



Mean Resistivity = 188.55 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 28.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1140.998, W-1088.005

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.117

DERT →		6																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	0.133	1.3	0.261	2.5	0.275	2.6	0.198	1.9	0.133	1.3	0.261	2.5	0.275	2.6	0.198	1.9	2.04
2	3	0.049	0.9	0.028	0.5	0.037	0.7	0.278	5.2	0.049	0.9	0.028	0.5	0.037	0.7	0.278	5.2	1.85
3	6	4.180	157.6	2.460	92.7	1.474	55.6	0.186	7.0	4.180	157.6	2.460	92.7	1.474	55.6	0.186	7.0	78.23
4	9	0.692	39.1	0.875	49.5	0.793	44.8	0.765	43.3	0.692	39.1	0.875	49.5	0.793	44.8	0.765	43.3	44.18
5	12	0.422	31.8	0.648	48.9	0.504	38.0	0.669	50.4	0.422	31.8	0.648	48.9	0.504	38.0	0.669	50.4	42.28
6	15	0.335	31.6	0.526	49.6	0.194	18.3	0.345	32.5	0.335	31.6	0.526	49.6	0.194	18.3	0.345	32.5	32.99
7	18	0.366	41.4	0.542	61.3	0.296	33.5	0.368	41.6	0.366	41.4	0.542	61.3	0.296	33.5	0.368	41.6	44.45
8	21	0.315	41.6	0.182	24.0	0.143	18.9	0.285	37.6	0.315	41.6	0.182	24.0	0.143	18.9	0.285	37.6	30.51
9	24	0.302	45.5	0.242	36.5	0.097	14.6	0.214	32.3	0.302	45.5	0.242	36.5	0.097	14.6	0.214	32.3	32.23
10	27	0.263	44.6	0.863	146.4	0.080	13.6	0.680	115.4	0.263	44.6	0.863	146.4	0.080	13.6	0.680	115.4	79.99
11	30	0.234	44.1	0.243	45.8	0.297	56.0	0.276	52.0	0.234	44.1	0.243	45.8	0.297	56.0	0.276	52.0	49.48

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 28.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

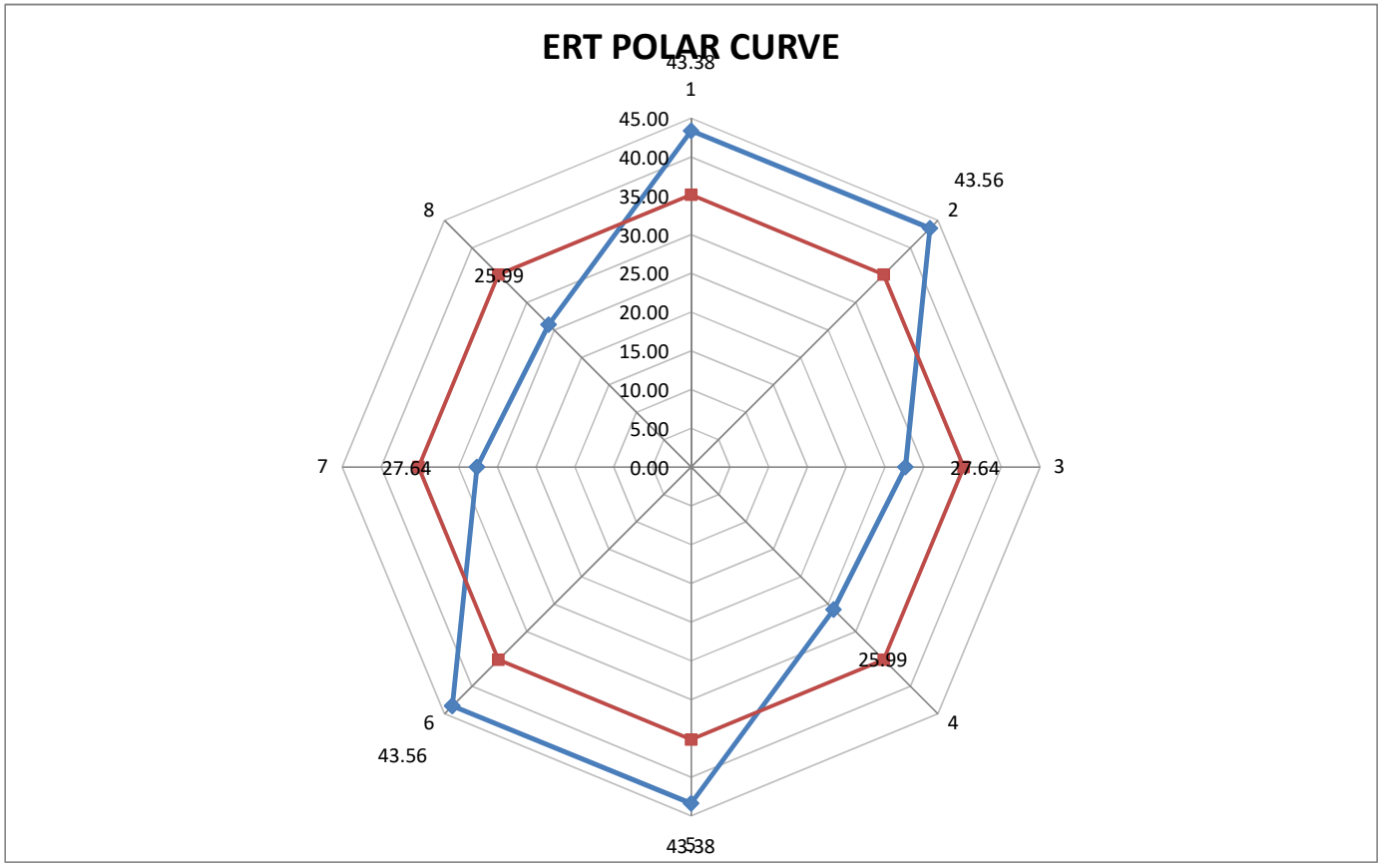
LOCATION : SIPAT

CO-ORDINATES : N -1140.998, W-1088.005

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 282.117

POLAR CURVE



Mean Resistivity =	31.38	Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 28.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1138.009, W-829.997

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.878

ERT →		7																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	26.500	249.8	22.400	211.1	20.400	192.3	0.166	1.6	26.500	249.8	22.400	211.1	20.400	192.3	0.166	1.6	163.68
2	3	11.050	208.3	10.400	196.0	9.965	187.8	0.174	3.3	11.050	208.3	10.400	196.0	9.965	187.8	0.174	3.3	148.86
3	6	2.960	111.6	2.410	90.9	3.430	129.3	0.040	1.5	2.960	111.6	2.410	90.9	3.430	129.3	0.040	1.5	83.32
4	9	1.704	96.4	1.841	104.1	1.431	80.9	0.004	0.2	1.704	96.4	1.841	104.1	1.431	80.9	0.004	0.2	70.40
5	12	1.425	107.4	1.506	113.5	1.231	92.8	0.001	0.1	1.425	107.4	1.506	113.5	1.231	92.8	0.001	0.1	78.47
6	15	1.234	116.3	1.246	117.4	1.113	104.9	0.001	0.1	1.234	116.3	1.246	117.4	1.113	104.9	0.001	0.1	84.68
7	18	0.965	109.1	0.986	111.5	0.946	107.0	1.260	142.5	0.965	109.1	0.986	111.5	0.946	107.0	1.260	142.5	117.54
8	21	1.226	161.8	1.130	149.1	1.460	192.6	1.310	172.9	1.226	161.8	1.130	149.1	1.460	192.6	1.310	172.9	169.09
9	24	0.960	144.8	0.980	147.8	1.139	171.8	1.206	181.9	0.960	144.8	0.980	147.8	1.139	171.8	1.206	181.9	161.54
10	27	1.346	228.3	1.460	247.7	1.140	193.4	1.053	178.6	1.346	228.3	1.460	247.7	1.140	193.4	1.053	178.6	212.02
11	30	1.116	210.4	0.960	181.0	0.946	178.3	0.896	168.9	1.116	210.4	0.960	181.0	0.946	178.3	0.896	168.9	184.63

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 28.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

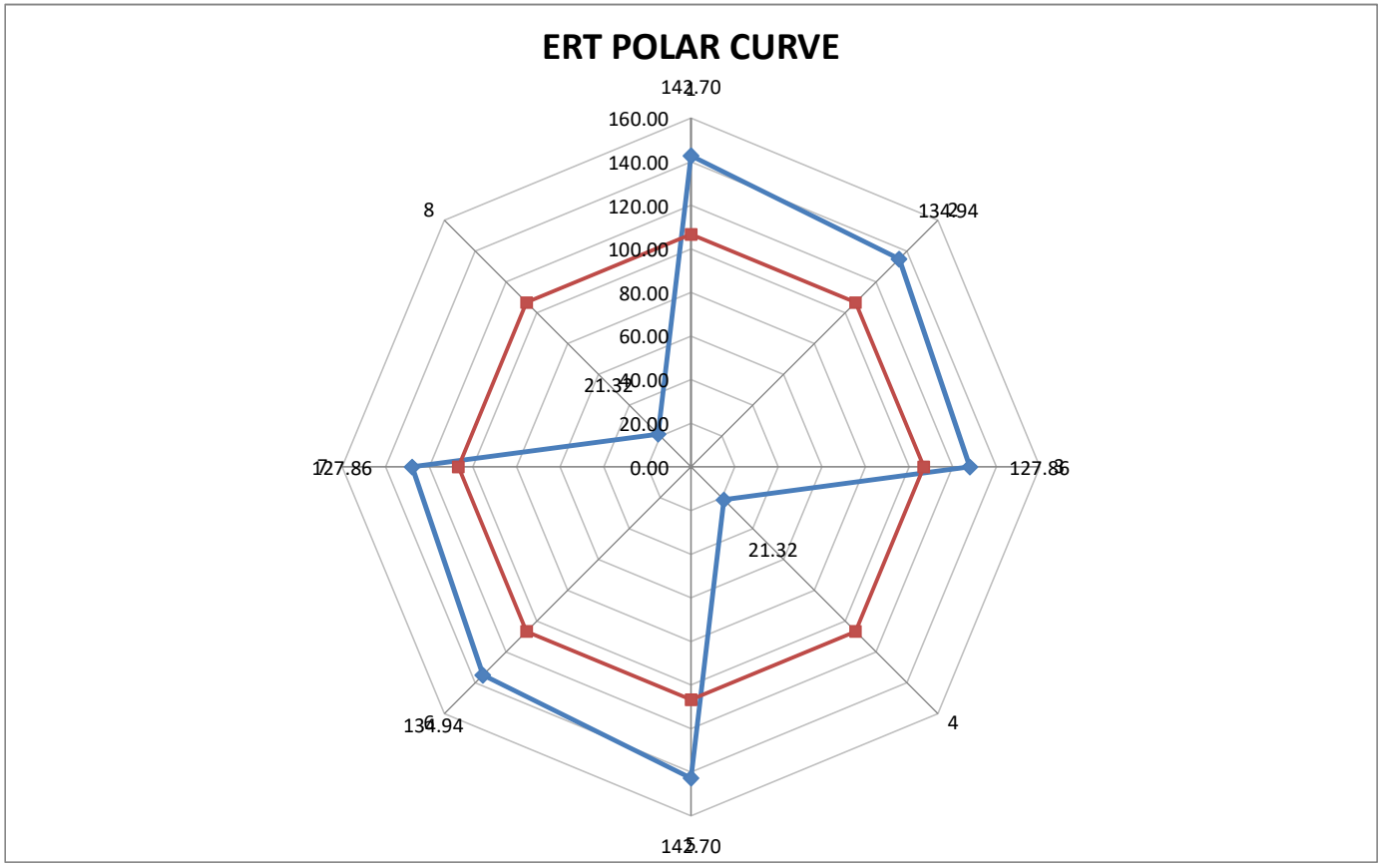
LOCATION : SIPAT

CO-ORDINATES : N -1138.009, W-829.997

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 282.878

POLAR CURVE



Mean Resistivity = **95.78** **Ohm M**

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 28.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -988.999, W-1160.001

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.113

ERT →		8																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	11.490	108.3	11.720	110.5	11.860	111.8	12.460	117.4	11.490	108.3	11.720	110.5	11.860	111.8	12.460	117.4	111.99
2	3	5.640	106.3	6.310	118.9	6.450	121.6	5.310	100.1	5.640	106.3	6.310	118.9	6.450	121.6	5.310	100.1	111.73
3	6	2.920	110.1	3.380	127.4	2.860	107.8	3.090	116.5	2.920	110.1	3.380	127.4	2.860	107.8	3.090	116.5	115.45
4	9	1.949	110.2	2.140	121.0	1.960	110.8	2.080	117.6	1.949	110.2	2.140	121.0	1.960	110.8	2.080	117.6	114.92
5	12	1.711	129.0	1.735	130.8	1.810	136.5	1.730	130.4	1.711	129.0	1.735	130.8	1.810	136.5	1.730	130.4	131.68
6	15	1.332	125.5	1.422	134.0	1.443	136.0	1.300	122.5	1.332	125.5	1.422	134.0	1.443	136.0	1.300	122.5	129.52
7	18	1.339	151.4	1.327	150.1	1.380	156.1	1.360	153.8	1.339	151.4	1.327	150.1	1.380	156.1	1.360	153.8	152.85
8	21	1.077	142.1	1.079	142.4	1.110	146.5	1.090	143.8	1.077	142.1	1.079	142.4	1.110	146.5	1.090	143.8	143.69
9	24	1.145	172.7	1.161	175.1	1.260	190.0	1.490	224.7	1.145	172.7	1.161	175.1	1.260	190.0	1.490	224.7	190.61
10	27	0.993	168.5	0.928	157.4	0.967	164.0	0.843	143.0	0.993	168.5	0.928	157.4	0.967	164.0	0.843	143.0	158.24
11	30	1.026	193.4	0.957	180.4	0.936	176.4	0.868	163.6	1.026	193.4	0.957	180.4	0.936	176.4	0.868	163.6	178.46

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 28.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

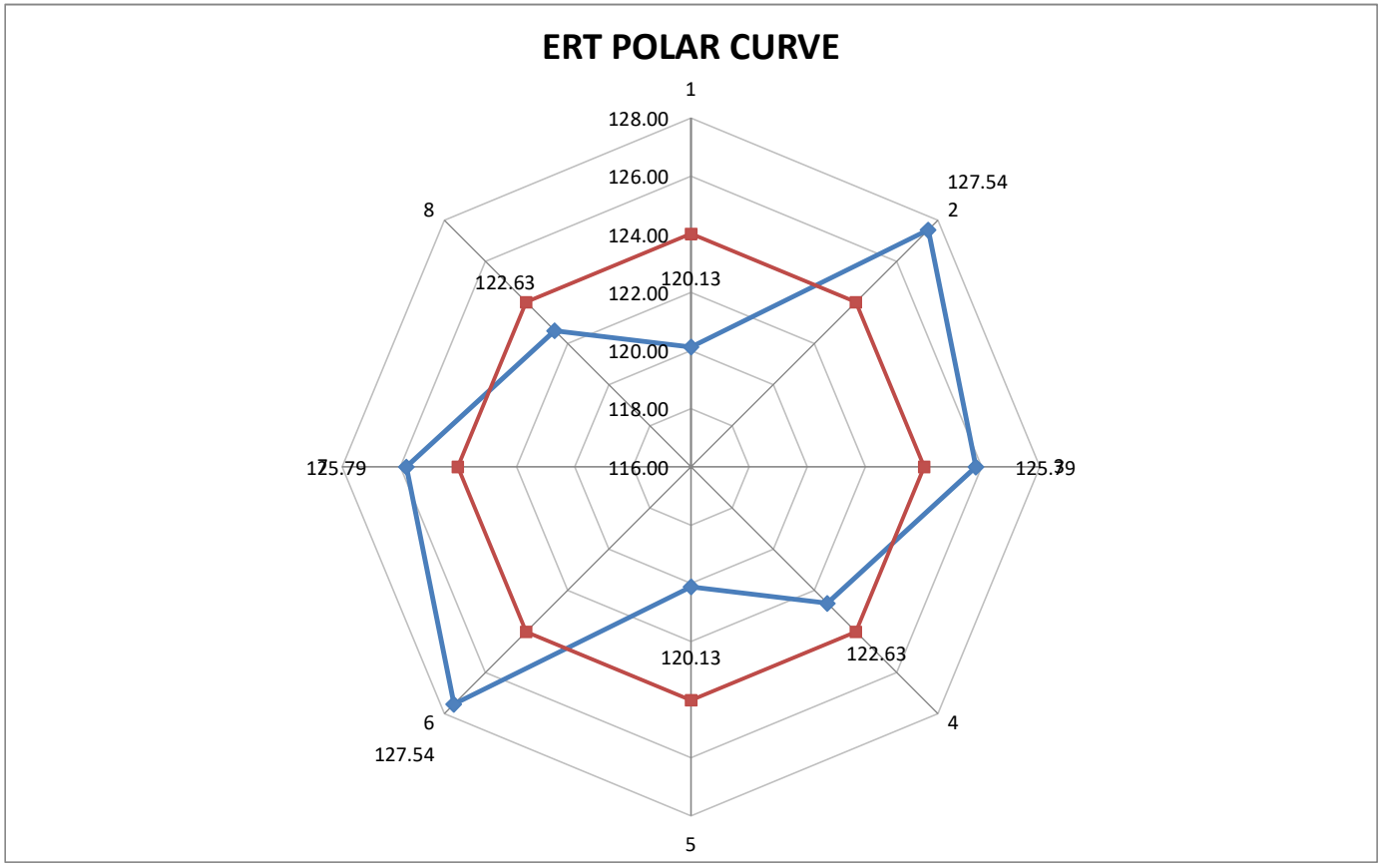
LOCATION : SIPAT

CO-ORDINATES : N -988.999, W-1160.001

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 282.113

POLAR CURVE



Mean Resistivity = 110.40 **Ohm M**

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 28.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES : N -1060.001, W-974.001**

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) : 282.128**

DERT →		9																
Direction →		N		NE		E		SE		S		SW		W		NW		Average Apparent Resistivity ρ_{avg}
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	7.400	69.7	7.940	74.8	8.480	79.9	8.580	80.9	7.400	69.7	7.940	74.8	8.480	79.9	8.580	80.9	76.34
2	3	3.030	57.1	2.980	56.2	2.190	41.3	3.460	65.2	3.030	57.1	2.980	56.2	2.190	41.3	3.460	65.2	54.95
3	6	2.160	81.4	2.460	92.7	1.825	68.8	2.020	76.2	2.160	81.4	2.460	92.7	1.825	68.8	2.020	76.2	79.78
4	9	1.347	76.2	1.680	95.0	1.561	88.3	1.388	78.5	1.347	76.2	1.680	95.0	1.561	88.3	1.388	78.5	84.48
5	12	1.200	90.5	1.360	102.5	1.212	91.4	1.161	87.5	1.200	90.5	1.360	102.5	1.212	91.4	1.161	87.5	92.98
6	15	0.988	93.1	1.100	103.7	1.128	106.3	1.173	110.6	0.988	93.1	1.100	103.7	1.128	106.3	1.173	110.6	103.41
7	18	1.123	127.0	1.056	119.4	1.018	115.1	1.045	118.2	1.123	127.0	1.056	119.4	1.018	115.1	1.045	118.2	119.94
8	21	1.063	140.3	0.956	126.1	1.055	139.2	0.968	127.7	1.063	140.3	0.956	126.1	1.055	139.2	0.968	127.7	133.33
9	24	1.003	151.2	0.843	127.1	0.872	131.5	0.973	146.7	1.003	151.2	0.843	127.1	0.872	131.5	0.973	146.7	139.15
10	27	0.797	135.2	0.814	138.1	0.958	162.5	0.938	159.1	0.797	135.2	0.814	138.1	0.958	162.5	0.938	159.1	148.74
11	30	0.814	153.4	0.805	151.7	0.858	161.7	0.838	158.0	0.814	153.4	0.805	151.7	0.858	161.7	0.838	158.0	156.22

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 28.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

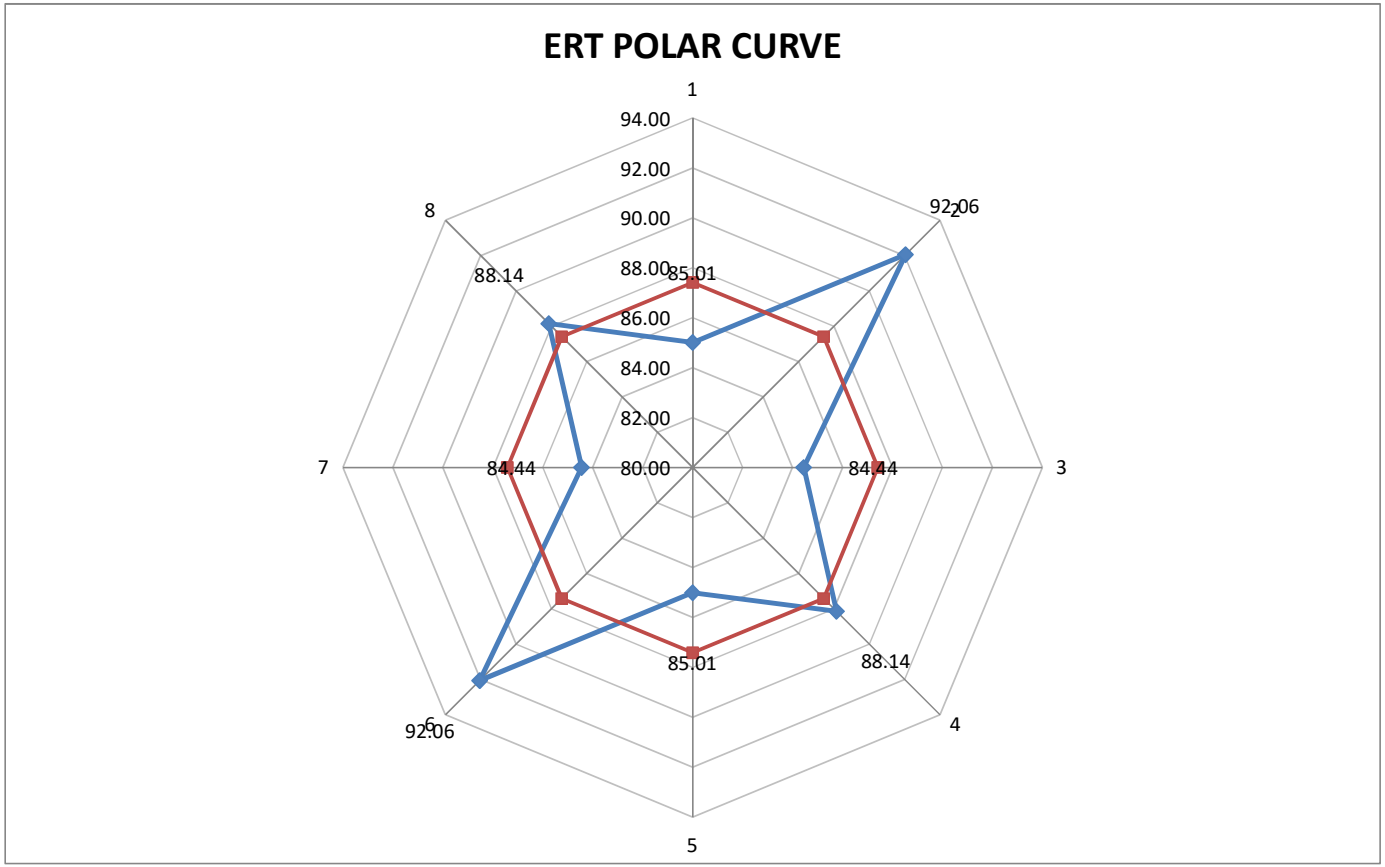
LOCATION : SIPAT

CO-ORDINATES : N -1060.001, W-974.001

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 282.128

POLAR CURVE



Mean Resistivity =	77.65	Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 28.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -697.498, W-1014.627

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 281.908

DERT →		10																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	5.340	50.3	4.980	46.9	4.420	41.7	4.640	43.7	5.340	50.3	4.980	46.9	4.420	41.7	4.640	43.7	45.66
2	3	1.674	31.6	1.630	30.7	1.483	28.0	1.580	29.8	1.674	31.6	1.630	30.7	1.483	28.0	1.580	29.8	30.00
3	6	0.737	27.8	0.789	29.7	0.807	30.4	0.746	28.1	0.737	27.8	0.789	29.7	0.807	30.4	0.746	28.1	29.02
4	9	0.552	31.2	0.618	34.9	0.624	35.3	0.604	34.2	0.552	31.2	0.618	34.9	0.624	35.3	0.604	34.2	33.90
5	12	0.511	38.5	0.500	37.7	0.482	36.3	0.496	37.4	0.511	38.5	0.500	37.7	0.482	36.3	0.496	37.4	37.49
6	15	0.525	49.5	0.459	43.3	0.387	36.5	0.401	37.8	0.525	49.5	0.459	43.3	0.387	36.5	0.401	37.8	41.75
7	18	0.405	45.8	0.494	55.9	0.433	49.0	0.416	47.0	0.405	45.8	0.494	55.9	0.433	49.0	0.416	47.0	49.42
8	21	0.418	55.2	0.413	54.5	0.372	49.1	0.364	48.0	0.418	55.2	0.413	54.5	0.372	49.1	0.364	48.0	51.69
9	24	0.391	59.0	0.385	58.1	0.424	63.9	0.396	59.7	0.391	59.0	0.385	58.1	0.424	63.9	0.396	59.7	60.17
10	27	0.440	74.6	0.406	68.9	0.337	57.2	0.346	58.7	0.440	74.6	0.406	68.9	0.337	57.2	0.346	58.7	64.85
11	30	0.396	74.6	0.401	75.6	0.370	69.7	0.367	69.2	0.396	74.6	0.401	75.6	0.370	69.7	0.367	69.2	72.29

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

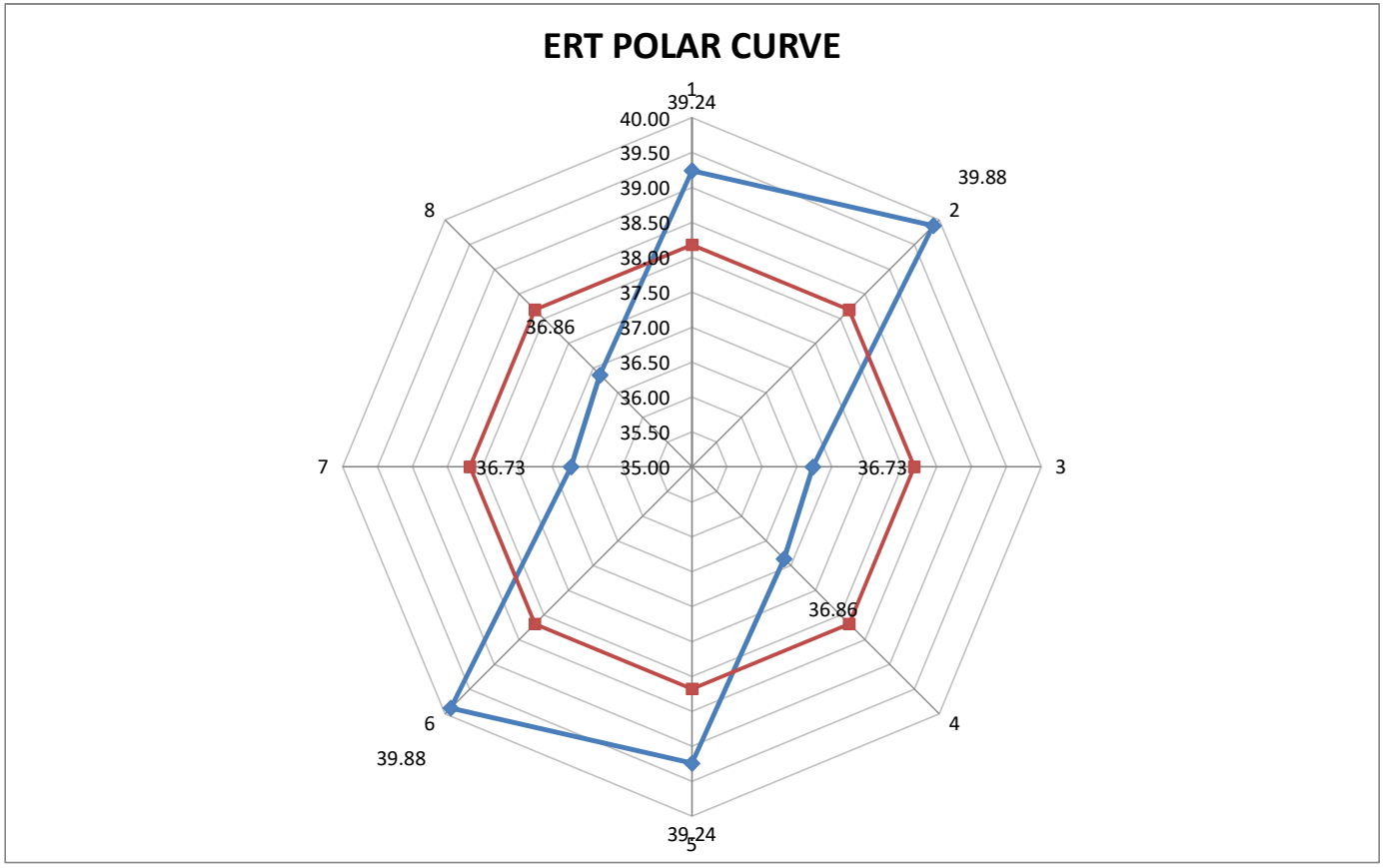
CLIENT : NTPC **Date : 28.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES : N -697.498, W-1014.627**

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) : 281.908**

POLAR CURVE



Mean Resistivity = 33.90 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -867.1440, W-638.080

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 281.946

DERT →		11																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	24.400	230.0	21.900	206.4	26.400	248.8	28.500	268.6	24.400	230.0	21.900	206.4	26.400	248.8	28.500	268.6	238.45
2	3	12.610	237.7	14.100	265.8	12.410	233.9	11.050	208.3	12.610	237.7	14.100	265.8	12.410	233.9	11.050	208.3	236.42
3	6	5.630	212.2	6.270	236.4	5.630	212.2	2.910	109.7	5.630	212.2	6.270	236.4	5.630	212.2	2.910	109.7	192.64
4	9	3.670	207.5	4.160	235.2	1.460	82.6	1.704	96.4	3.670	207.5	4.160	235.2	1.460	82.6	1.704	96.4	155.42
5	12	2.690	202.8	2.930	220.9	1.340	101.0	1.425	107.4	2.690	202.8	2.930	220.9	1.340	101.0	1.425	107.4	158.05
6	15	2.220	209.2	2.340	220.5	1.210	114.0	1.247	117.5	2.220	209.2	2.340	220.5	1.210	114.0	1.247	117.5	165.33
7	18	1.957	221.3	1.733	196.0	1.060	119.9	0.959	108.5	1.957	221.3	1.733	196.0	1.060	119.9	0.959	108.5	161.42
8	21	1.675	221.0	1.690	223.0	1.010	133.3	1.226	161.8	1.675	221.0	1.690	223.0	1.010	133.3	1.226	161.8	184.76
9	24	1.450	218.7	1.457	219.7	0.964	145.4	0.970	146.3	1.450	218.7	1.457	219.7	0.964	145.4	0.970	146.3	182.50
10	27	1.248	211.7	1.473	249.9	1.040	176.4	1.305	221.4	1.248	211.7	1.473	249.9	1.040	176.4	1.305	221.4	214.86
11	30	1.169	220.4	1.316	248.1	1.090	205.5	1.119	210.9	1.169	220.4	1.316	248.1	1.090	205.5	1.119	210.9	221.20

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 27.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

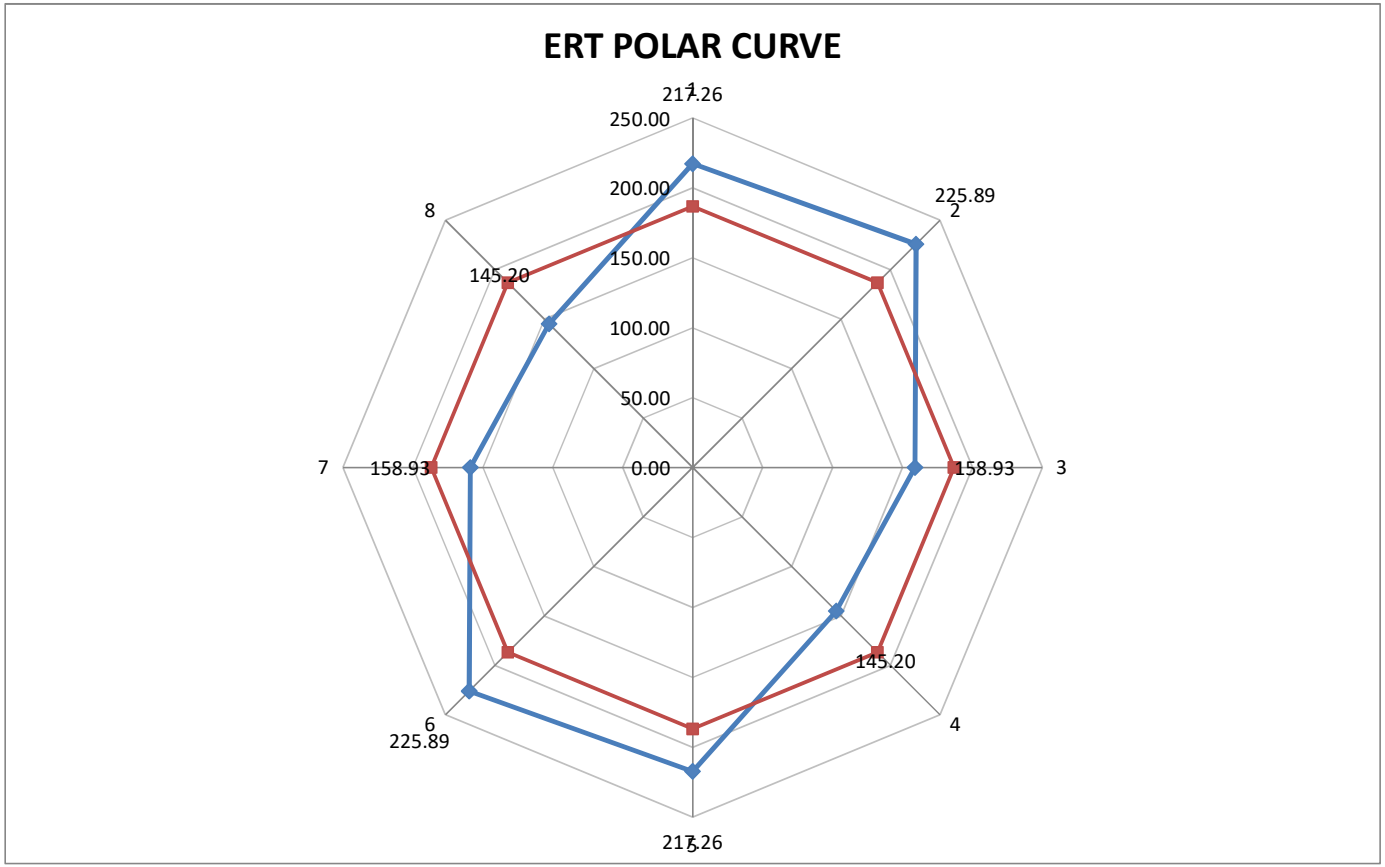
LOCATION : SIPAT

CO-ORDINATES : N -867.1440, W-638.080

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 281.946

POLAR CURVE



Mean Resistivity = 166.95 **Ohm M**

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -915.855, W-788.320

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.263

DERT →		12																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	7.760	73.1	7.760	73.1	10.210	96.2	9.610	90.6	7.760	73.1	7.760	73.1	10.210	96.2	9.610	90.6	83.27
2	3	4.470	84.3	4.860	91.6	4.650	87.7	4.860	91.6	4.470	84.3	4.860	91.6	4.650	87.7	4.860	91.6	88.78
3	6	2.120	79.9	2.410	90.9	2.310	87.1	2.890	109.0	2.120	79.9	2.410	90.9	2.310	87.1	2.890	109.0	91.70
4	9	1.487	84.1	1.860	105.2	1.636	92.5	1.890	106.9	1.487	84.1	1.860	105.2	1.636	92.5	1.890	106.9	97.16
5	12	1.215	91.6	1.220	92.0	1.225	92.4	1.460	110.1	1.215	91.6	1.220	92.0	1.225	92.4	1.460	110.1	96.51
6	15	0.969	91.3	0.996	93.9	1.042	98.2	1.118	105.4	0.969	91.3	0.996	93.9	1.042	98.2	1.118	105.4	97.19
7	18	0.832	94.1	0.841	95.1	0.884	100.0	1.090	123.3	0.832	94.1	0.841	95.1	0.884	100.0	1.090	123.3	103.12
8	21	0.638	84.2	0.674	88.9	0.824	108.7	0.740	97.6	0.638	84.2	0.674	88.9	0.824	108.7	0.740	97.6	94.87
9	24	0.691	104.2	0.605	91.2	0.650	98.0	0.640	96.5	0.691	104.2	0.605	91.2	0.650	98.0	0.640	96.5	97.49
10	27	0.541	91.8	0.586	99.4	0.615	104.3	0.598	101.4	0.541	91.8	0.586	99.4	0.615	104.3	0.598	101.4	99.24
11	30	0.597	112.5	0.546	102.9	0.517	97.5	0.538	101.4	0.597	112.5	0.546	102.9	0.517	97.5	0.538	101.4	103.58

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

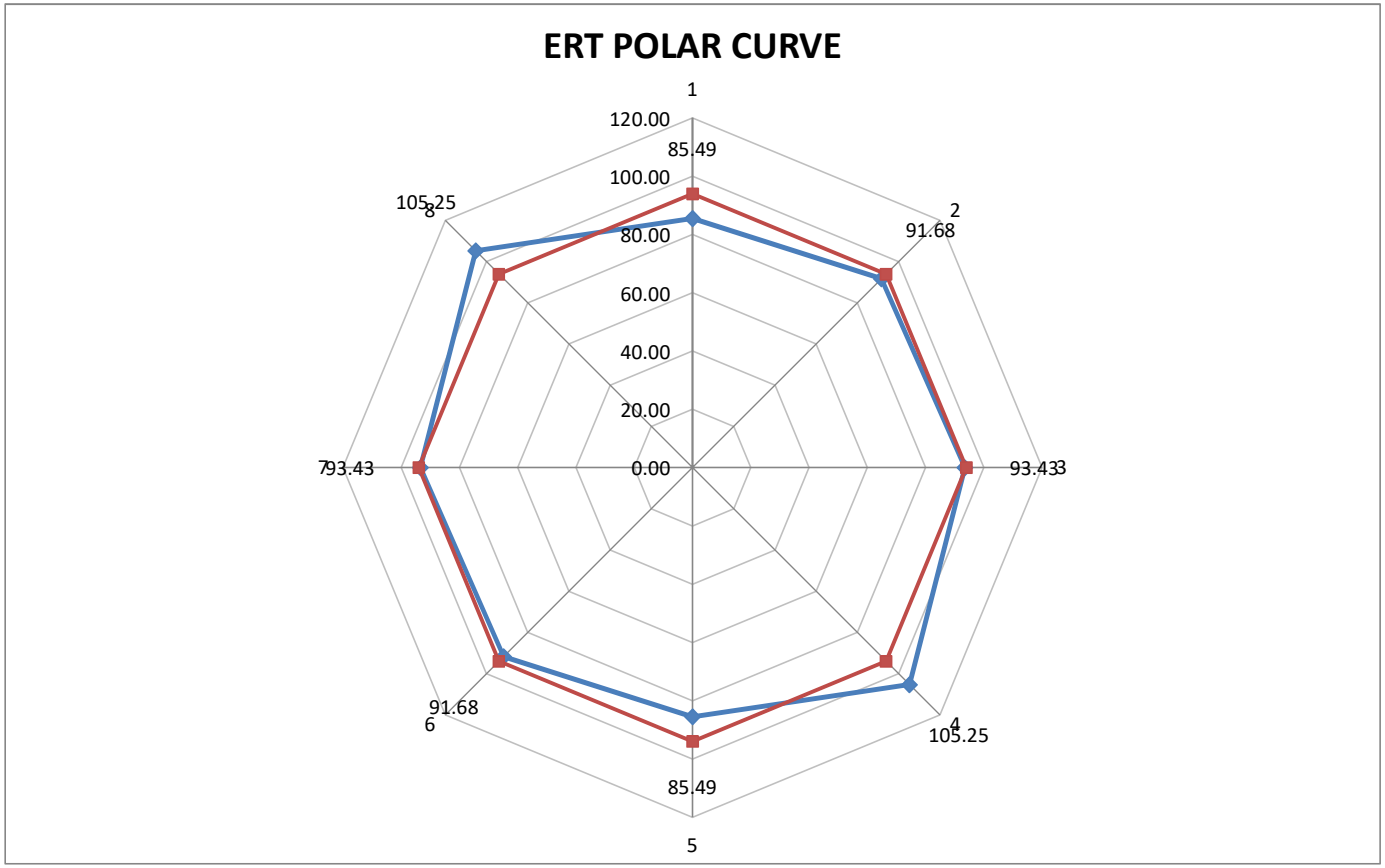
CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -915.855, W-788.320

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.263

POLAR CURVE



Mean Resistivity =	83.17	Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -937.119, W-746.517

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.122

DERT →		13																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	13.980	131.8	12.730	120.0	15.380	145.0	14.840	139.9	13.980	131.8	12.730	120.0	15.380	145.0	14.840	139.9	134.14
2	3	6.050	114.0	5.440	102.5	5.690	107.3	5.490	103.5	6.050	114.0	5.440	102.5	5.690	107.3	5.490	103.5	106.83
3	6	2.650	99.9	2.830	106.7	2.880	108.6	2.550	96.1	2.650	99.9	2.830	106.7	2.880	108.6	2.550	96.1	102.82
4	9	1.711	96.8	2.000	113.1	1.927	109.0	1.653	93.5	1.711	96.8	2.000	113.1	1.927	109.0	1.653	93.5	103.07
5	12	1.446	109.0	1.430	107.8	1.566	118.1	1.543	116.3	1.446	109.0	1.430	107.8	1.566	118.1	1.543	116.3	112.81
6	15	1.261	118.8	1.207	113.8	1.182	111.4	1.209	113.9	1.261	118.8	1.207	113.8	1.182	111.4	1.209	113.9	114.49
7	18	1.058	119.7	1.092	123.5	1.083	122.5	1.086	122.8	1.058	119.7	1.092	123.5	1.083	122.5	1.086	122.8	122.12
8	21	0.894	118.0	0.943	124.4	0.842	111.1	1.032	136.2	0.894	118.0	0.943	124.4	0.842	111.1	1.032	136.2	122.41
9	24	0.738	111.3	0.826	124.6	0.865	130.4	0.764	115.2	0.738	111.3	0.826	124.6	0.865	130.4	0.764	115.2	120.37
10	27	0.627	106.4	0.780	132.3	0.686	116.4	0.783	132.8	0.627	106.4	0.780	132.3	0.686	116.4	0.783	132.8	121.98
11	30	0.594	112.0	0.674	127.0	0.662	124.8	0.583	109.9	0.594	112.0	0.674	127.0	0.662	124.8	0.583	109.9	118.42

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,

R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 27.03.2023

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

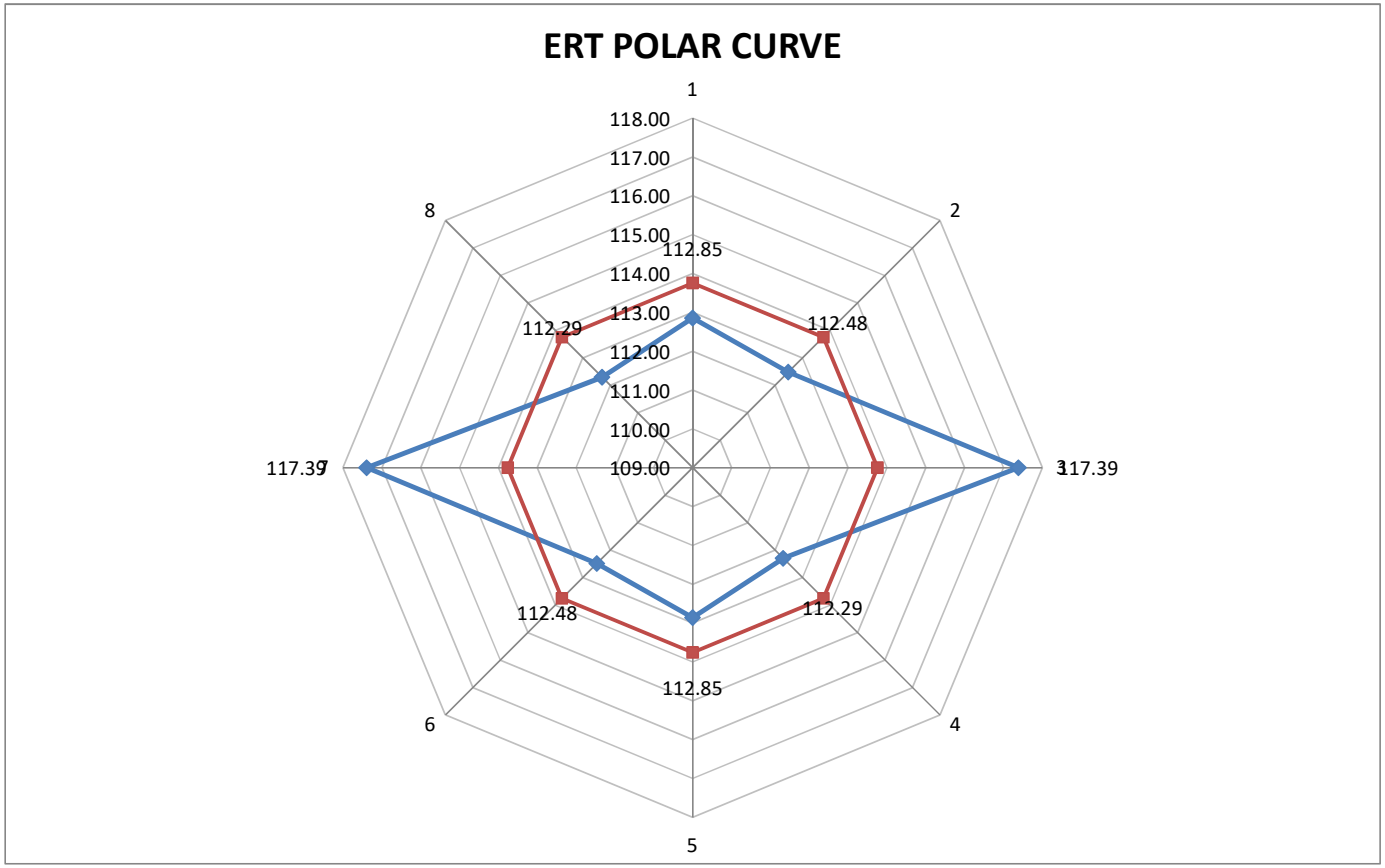
LOCATION : SIPAT

CO-ORDINATES : N -937.119, W-746.517

Method Used: Wenner Four Pin Equal Probe Spacing.

GROUND LEVEL (m) : 282.122

POLAR CURVE



Mean Resistivity = 101.11 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT

Method Used: Wenner Four Pin Equal Probe Spacing.

ERT →		14																
Direction →		N		NE		E		SE		S		SW		W		NW		Average Apparent Resistivity ρ_{avg}
Sr. No.	Electrodes Spacing, a	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	29.200	275.2	35.400	333.6	27.200	256.4	22.700	213.9	29.200	275.2	35.400	333.6	27.200	256.4	22.700	213.9	269.78
2	3	12.940	243.9	12.740	240.1	10.030	189.1	11.780	222.0	12.940	243.9	12.740	240.1	10.030	189.1	11.780	222.0	223.79
3	6	4.930	185.9	4.750	179.1	4.230	159.5	5.060	190.8	4.930	185.9	4.750	179.1	4.230	159.5	5.060	190.8	178.79
4	9	3.240	183.2	3.160	178.7	2.880	162.9	3.210	181.5	3.240	183.2	3.160	178.7	2.880	162.9	3.210	181.5	176.57
5	12	1.884	142.1	2.110	159.1	2.350	177.2	2.070	156.1	1.884	142.1	2.110	159.1	2.350	177.2	2.070	156.1	158.60
6	15	1.630	153.6	1.602	151.0	1.950	183.8	1.825	172.0	1.630	153.6	1.602	151.0	1.950	183.8	1.825	172.0	165.10
7	18	1.310	148.2	1.341	151.7	1.547	175.0	1.455	164.6	1.310	148.2	1.341	151.7	1.547	175.0	1.455	164.6	159.83
8	21	1.194	157.5	1.191	157.1	1.449	191.2	1.220	161.0	1.194	157.5	1.191	157.1	1.449	191.2	1.220	161.0	166.71
9	24	0.982	148.1	1.014	152.9	1.152	173.7	1.056	159.2	0.982	148.1	1.014	152.9	1.152	173.7	1.056	159.2	158.49
10	27	0.940	159.5	0.908	154.0	0.983	166.8	0.947	160.7	0.940	159.5	0.908	154.0	0.983	166.8	0.947	160.7	160.23
11	30	0.797	150.2	0.796	150.0	0.678	127.8	0.739	139.3	0.797	150.2	0.796	150.0	0.678	127.8	0.739	139.3	141.84

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC

Date : 27.03.2023

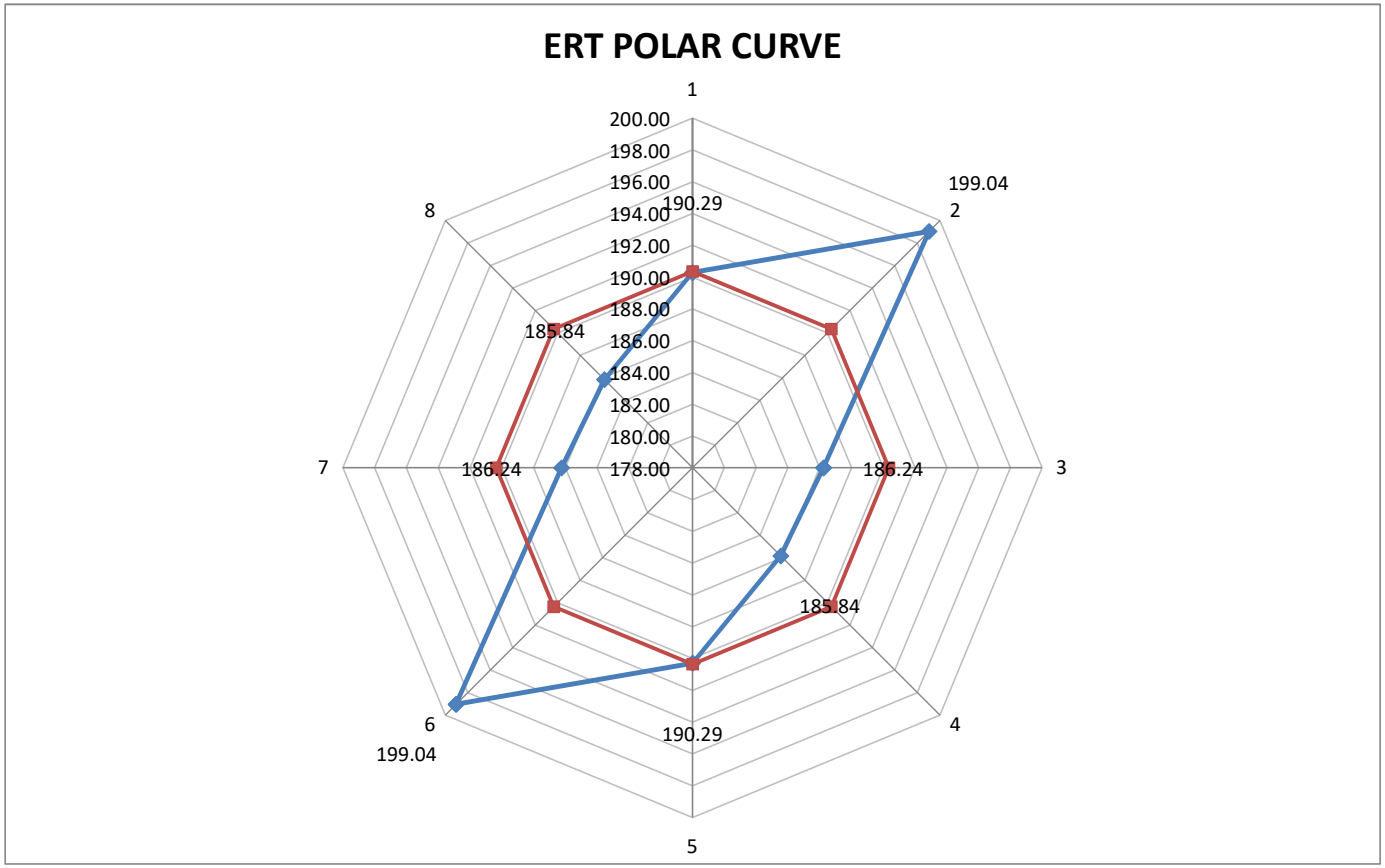
PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT.

SIPL/23-24 /2

LOCATION : SIPAT

Method Used: Wenner Four Pin Equal Probe Spacing.

POLAR CURVE



Mean Resistivity = **169.23** **Ohm M**

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1070.615, W-713.222

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 283.056

ERT →		15																
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	Average Apparent Resistivity ρ_{avg}
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	23.100	217.7	22.400	211.1	24.300	229.0	27.400	258.2	23.100	217.7	22.400	211.1	24.300	229.0	27.400	258.2	229.02
2	3	8.990	169.5	7.340	138.4	8.460	159.5	9.410	177.4	8.990	169.5	7.340	138.4	8.460	159.5	9.410	177.4	161.16
3	6	3.870	145.9	3.610	136.1	3.340	125.9	3.440	129.7	3.870	145.9	3.610	136.1	3.340	125.9	3.440	129.7	134.40
4	9	2.860	161.7	2.170	122.7	2.090	118.2	2.410	136.3	2.860	161.7	2.170	122.7	2.090	118.2	2.410	136.3	134.73
5	12	1.990	150.0	1.873	141.2	2.030	153.1	1.970	148.5	1.990	150.0	1.873	141.2	2.030	153.1	1.970	148.5	148.21
6	15	1.840	173.4	1.730	163.0	1.780	167.8	1.930	181.9	1.840	173.4	1.730	163.0	1.780	167.8	1.930	181.9	171.53
7	18	1.730	195.7	1.700	192.3	1.730	195.7	1.711	193.5	1.730	195.7	1.700	192.3	1.730	195.7	1.711	193.5	194.27
8	21	1.540	203.2	1.680	221.7	1.640	216.4	1.540	203.2	1.540	203.2	1.680	221.7	1.640	216.4	1.540	203.2	211.12
9	24	1.480	223.2	1.610	242.8	1.600	241.3	1.360	205.1	1.480	223.2	1.610	242.8	1.600	241.3	1.360	205.1	228.08
10	27	1.310	222.2	1.531	259.7	1.490	252.8	1.260	213.8	1.310	222.2	1.531	259.7	1.490	252.8	1.260	213.8	237.12
11	30	1.290	243.2	1.370	258.2	1.340	252.6	1.210	228.1	1.290	243.2	1.370	258.2	1.340	252.6	1.210	228.1	245.52

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

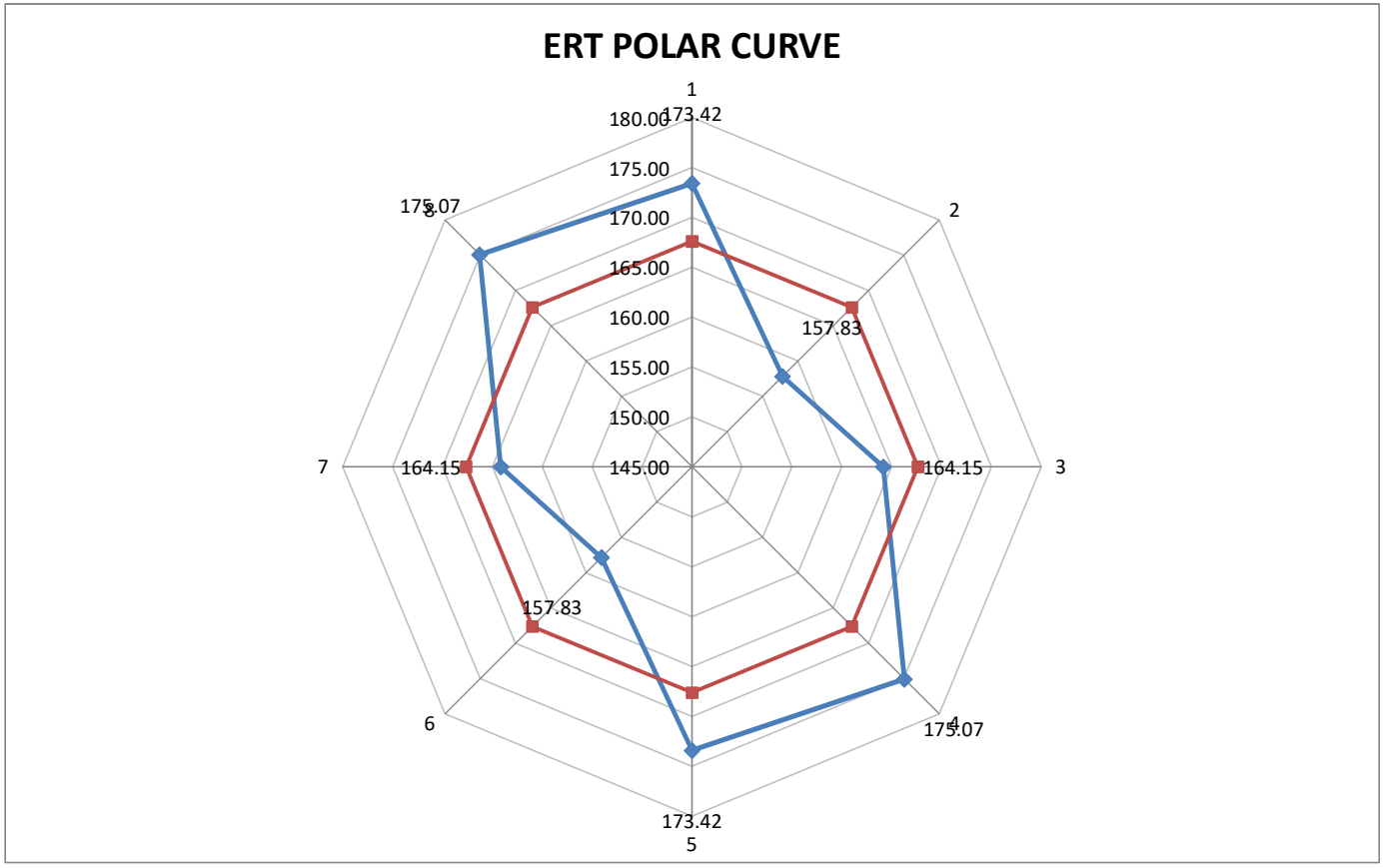
CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES : N -1070.615, W-713.222**

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) : 283.056**

POLAR CURVE



Mean Resistivity = 147.91 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1187.000, W-706.997

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.231

DERT →		16																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	21.400	201.7	24.000	226.2	23.400	220.5	20.600	194.2	21.400	201.7	24.000	226.2	23.400	220.5	20.600	194.2	210.64
2	3	8.820	166.3	8.690	163.8	10.200	192.3	10.480	197.5	8.820	166.3	8.690	163.8	10.200	192.3	10.480	197.5	179.97
3	6	4.230	159.5	3.380	127.4	3.640	137.2	3.800	143.3	4.230	159.5	3.380	127.4	3.640	137.2	3.800	143.3	141.84
4	9	2.710	153.2	2.430	137.4	2.560	144.8	2.500	141.4	2.710	153.2	2.430	137.4	2.560	144.8	2.500	141.4	144.20
5	12	1.913	144.2	2.230	168.1	2.090	157.6	1.946	146.7	1.913	144.2	2.230	168.1	2.090	157.6	1.946	146.7	154.17
6	15	1.769	166.7	1.951	183.9	1.823	171.8	1.714	161.5	1.769	166.7	1.951	183.9	1.823	171.8	1.714	161.5	170.99
7	18	1.738	196.6	1.657	187.4	1.597	180.6	1.489	168.4	1.738	196.6	1.657	187.4	1.597	180.6	1.489	168.4	183.25
8	21	1.711	225.8	1.637	216.0	1.616	213.2	1.355	178.8	1.711	225.8	1.637	216.0	1.616	213.2	1.355	178.8	208.44
9	24	1.531	230.9	1.359	204.9	1.463	220.6	1.388	209.3	1.531	230.9	1.359	204.9	1.463	220.6	1.388	209.3	216.43
10	27	1.361	230.9	1.361	230.9	1.520	257.9	1.310	222.2	1.361	230.9	1.361	230.9	1.520	257.9	1.310	222.2	235.47
11	30	1.274	240.1	1.329	250.5	1.447	272.8	1.306	246.2	1.274	240.1	1.329	250.5	1.447	272.8	1.306	246.2	252.40

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

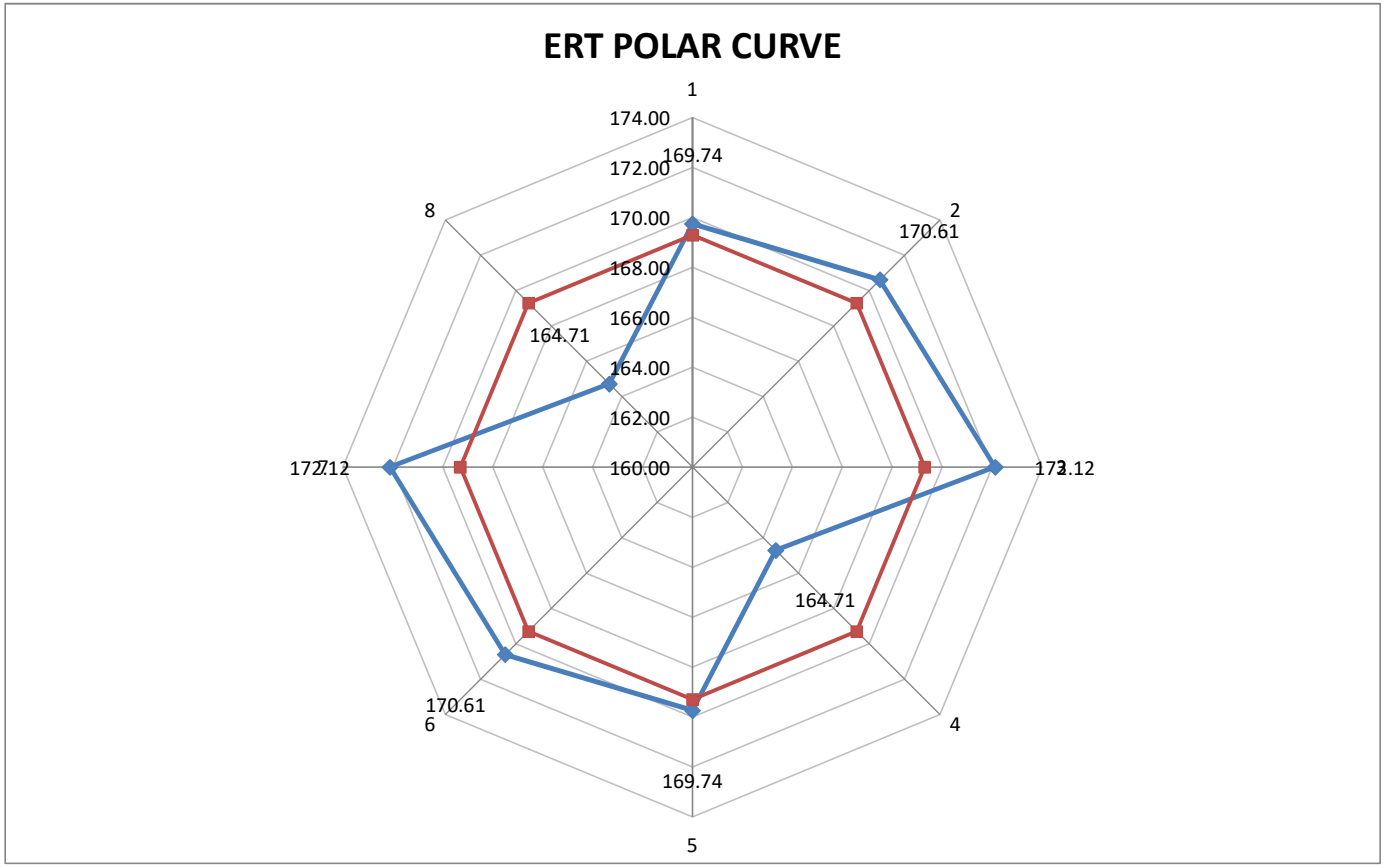
CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES : N -1187.000, W-706.997**

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) : 282.231**

POLAR CURVE



Mean Resistivity = 150.51 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1126.001, W-597.998

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.544

DERT →		17																Average Apparent Resistivity ρ_{avg}
Direction →		N		NE		E		SE		S		SW		W		NW		
Sr. No.	Electrodes Spacing, a	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	41.000	386.4	56.400	531.6	48.400	456.2	55.900	526.8	41.000	386.4	56.400	531.6	48.400	456.2	55.900	526.8	475.24
2	3	38.100	718.2	33.100	623.9	34.800	656.0	34.600	652.2	38.100	718.2	33.100	623.9	34.800	656.0	34.600	652.2	662.56
3	6	13.670	515.3	12.720	479.5	14.180	534.6	17.550	661.6	13.670	515.3	12.720	479.5	14.180	534.6	17.550	661.6	547.77
4	9	9.150	517.4	8.290	468.8	9.440	533.8	9.820	555.3	9.150	517.4	8.290	468.8	9.440	533.8	9.820	555.3	518.83
5	12	6.360	479.5	6.120	461.4	6.940	523.3	6.980	526.3	6.360	479.5	6.120	461.4	6.940	523.3	6.980	526.3	497.63
6	15	5.090	479.7	4.830	455.2	5.160	486.3	5.350	504.2	5.090	479.7	4.830	455.2	5.160	486.3	5.350	504.2	481.37
7	18	4.210	476.1	4.000	452.4	4.160	470.5	4.150	469.4	4.210	476.1	4.000	452.4	4.160	470.5	4.150	469.4	467.09
8	21	3.630	479.0	3.490	460.5	3.330	439.4	3.760	496.1	3.630	479.0	3.490	460.5	3.330	439.4	3.760	496.1	468.74
9	24	3.210	484.1	3.090	466.0	3.190	481.0	3.230	487.1	3.210	484.1	3.090	466.0	3.190	481.0	3.230	487.1	479.53
10	27	6.170	1046.7	2.990	507.2	2.680	454.7	2.990	507.2	6.170	1046.7	2.990	507.2	2.680	454.7	2.990	507.2	628.96
11	30	2.440	459.9	2.680	505.2	2.310	435.4	2.480	467.5	2.440	459.9	2.680	505.2	2.310	435.4	2.480	467.5	467.00

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

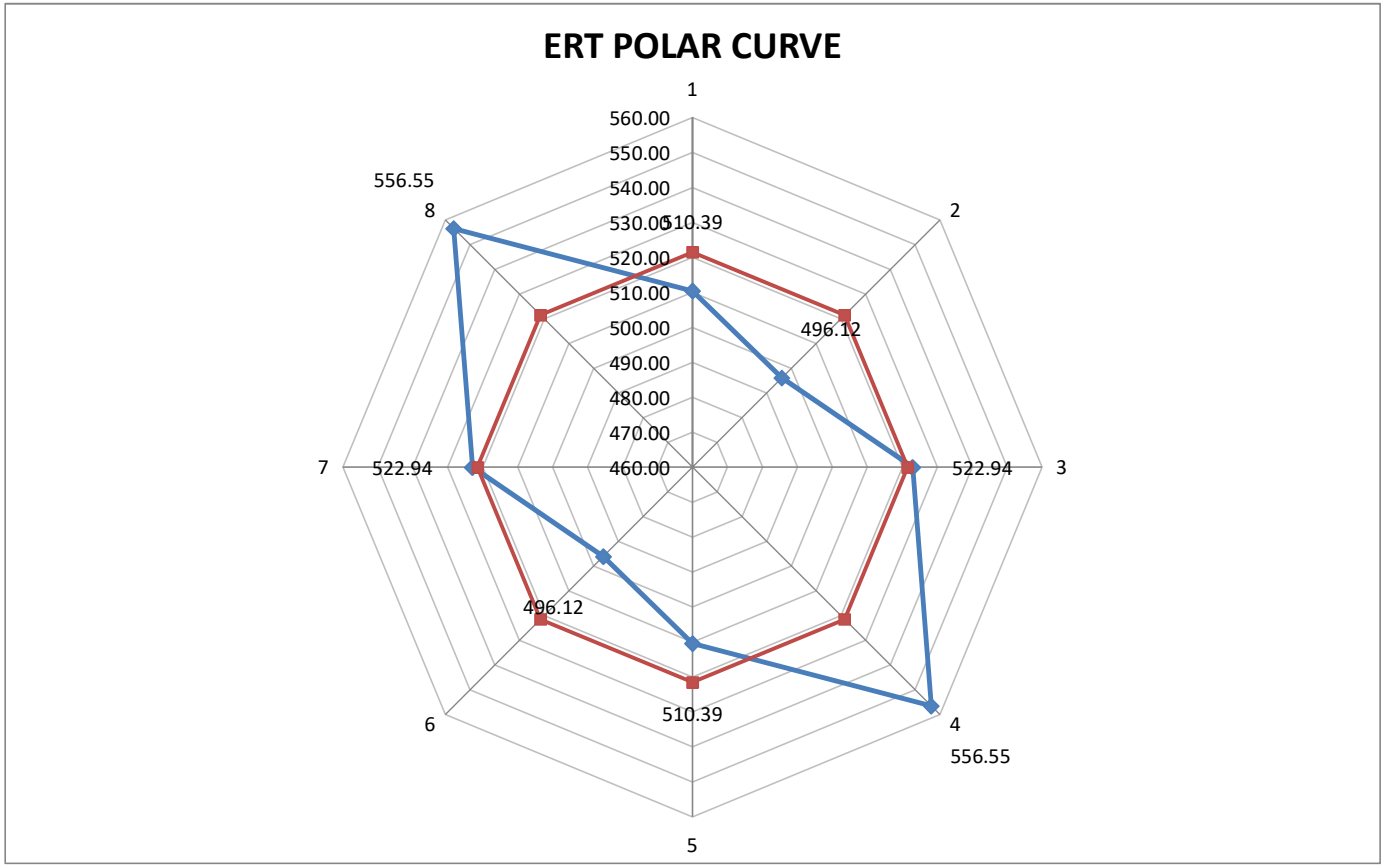
CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES : N -1126.001, W-597.998**

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) : 282.544**

POLAR CURVE



Mean Resistivity = 461.37 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1247.999, W-692.996

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.544

DERT →		18																
Direction →		N		NE		E		SE		S		SW		W		NW		Average Apparent Resistivity ρ_{avg}
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	30.600	288.4	22.400	211.1	24.300	229.0	27.400	258.2	30.600	288.4	22.400	211.1	24.300	229.0	27.400	258.2	246.69
2	3	8.550	161.2	7.340	138.4	8.460	159.5	9.410	177.4	8.550	161.2	7.340	138.4	8.460	159.5	9.410	177.4	159.09
3	6	2.710	102.2	3.610	136.1	3.340	125.9	3.440	129.7	2.710	102.2	3.610	136.1	3.340	125.9	3.440	129.7	123.46
4	9	2.120	119.9	2.170	122.7	2.090	118.2	2.410	136.3	2.120	119.9	2.170	122.7	2.090	118.2	2.410	136.3	124.27
5	12	2.110	159.1	1.873	141.2	2.030	153.1	1.970	148.5	2.110	159.1	1.873	141.2	2.030	153.1	1.970	148.5	150.48
6	15	1.869	176.1	1.730	163.0	1.780	167.8	1.930	181.9	1.869	176.1	1.730	163.0	1.780	167.8	1.930	181.9	172.21
7	18	1.910	216.0	1.700	192.3	1.730	195.7	1.711	193.5	1.910	216.0	1.700	192.3	1.730	195.7	1.711	193.5	199.36
8	21	1.771	233.7	1.680	221.7	1.640	216.4	1.540	203.2	1.771	233.7	1.680	221.7	1.640	216.4	1.540	203.2	218.73
9	24	1.697	255.9	1.610	242.8	1.600	241.3	1.360	205.1	1.697	255.9	1.610	242.8	1.600	241.3	1.360	205.1	236.26
10	27	1.536	260.6	1.531	259.7	1.490	252.8	1.260	213.8	1.536	260.6	1.531	259.7	1.490	252.8	1.260	213.8	246.71
11	30	1.380	260.1	1.370	258.2	1.340	252.6	1.210	228.1	1.380	260.1	1.370	258.2	1.340	252.6	1.210	228.1	249.76

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

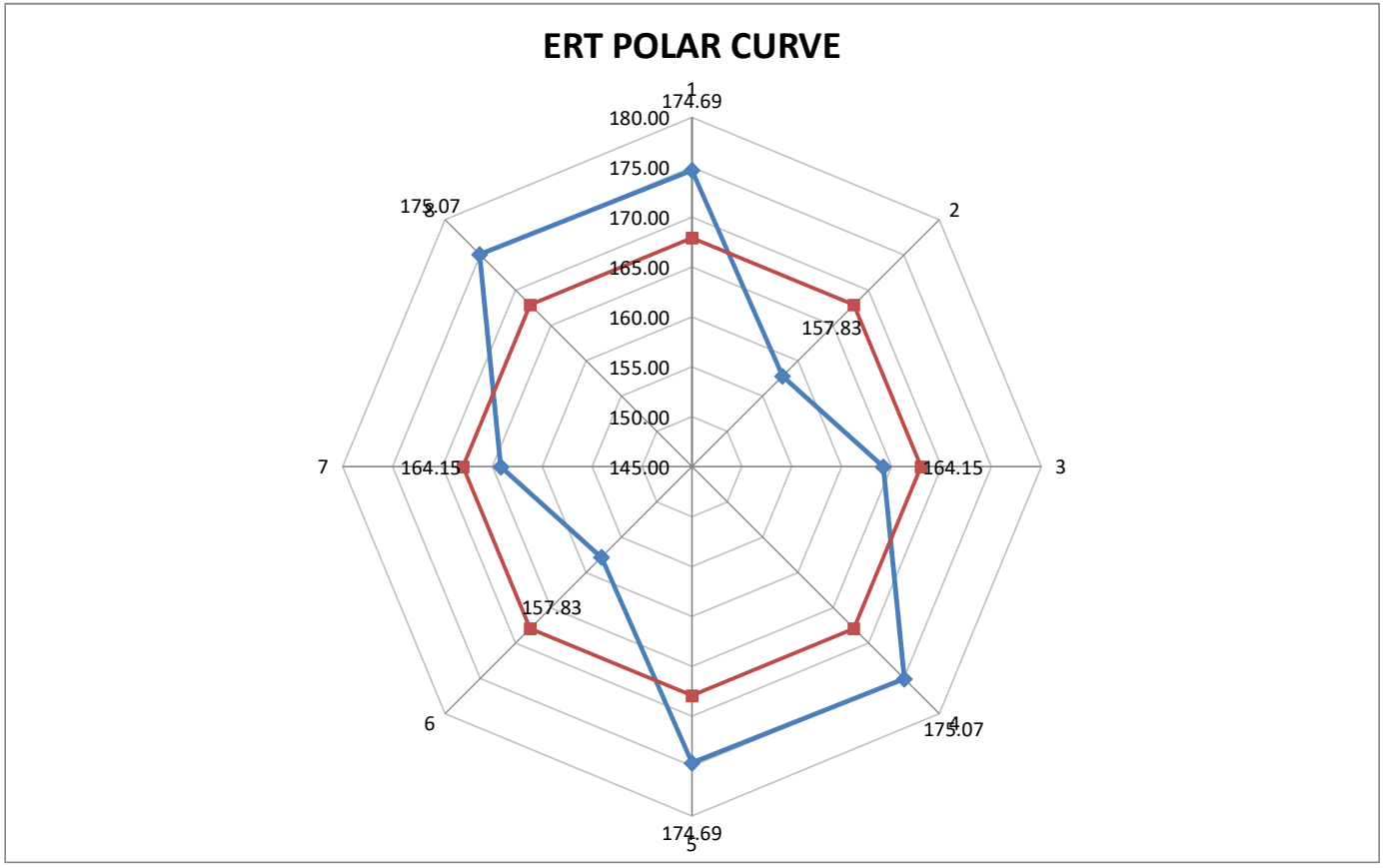
CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES : N -1247.999, W-692.996**

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) : 282.544**

POLAR CURVE



Mean Resistivity = 148.15 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1263.356, W-626.173

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.659

DERT →		19																
Direction →		N		NE		E		SE		S		SW		W		NW		Average Apparent Resistivity ρ_{avg}
Sr. No.	Electrodes Spacing, a	Resistance	ρ (N)	Resistance	ρ (NE)	Resistance	ρ (E)	Resistance	ρ (SE)	Resistance	ρ (S)	Resistance	ρ (SW)	Resistance	ρ (W)	Resistance	ρ (NW)	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	48.600	458.0	42.300	398.7	58.400	550.4	41.300	389.2	48.600	458.0	42.300	398.7	58.400	550.4	41.300	389.2	449.09
2	3	34.300	646.5	33.400	629.6	33.410	629.8	38.810	731.6	34.300	646.5	33.400	629.6	33.410	629.8	38.810	731.6	659.36
3	6	12.400	467.5	10.310	388.7	17.410	656.3	10.480	395.1	12.400	467.5	10.310	388.7	17.410	656.3	10.480	395.1	476.89
4	9	9.400	531.6	8.910	503.8	9.560	540.6	9.980	564.4	9.400	531.6	8.910	503.8	9.560	540.6	9.980	564.4	535.09
5	12	6.610	498.4	6.490	489.3	6.740	508.2	6.090	459.2	6.610	498.4	6.490	489.3	6.740	508.2	6.090	459.2	488.77
6	15	5.100	480.7	5.360	505.2	4.890	460.9	4.960	467.5	5.100	480.7	5.360	505.2	4.890	460.9	4.960	467.5	478.54
7	18	4.310	487.4	4.810	544.0	4.840	547.4	4.280	484.1	4.310	487.4	4.810	544.0	4.840	547.4	4.280	484.1	515.72
8	21	3.440	453.9	3.000	395.8	3.940	519.9	3.060	403.8	3.440	453.9	3.000	395.8	3.940	519.9	3.060	403.8	443.34
9	24	2.880	434.3	2.470	372.5	2.040	307.6	2.730	411.7	2.880	434.3	2.470	372.5	2.040	307.6	2.730	411.7	381.52
10	27	2.980	505.5	3.010	510.6	2.310	391.9	2.470	419.0	2.980	505.5	3.010	510.6	2.310	391.9	2.470	419.0	456.77
11	30	1.110	209.2	2.730	514.6	2.080	392.1	2.410	454.3	1.110	209.2	2.730	514.6	2.080	392.1	2.410	454.3	392.54

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

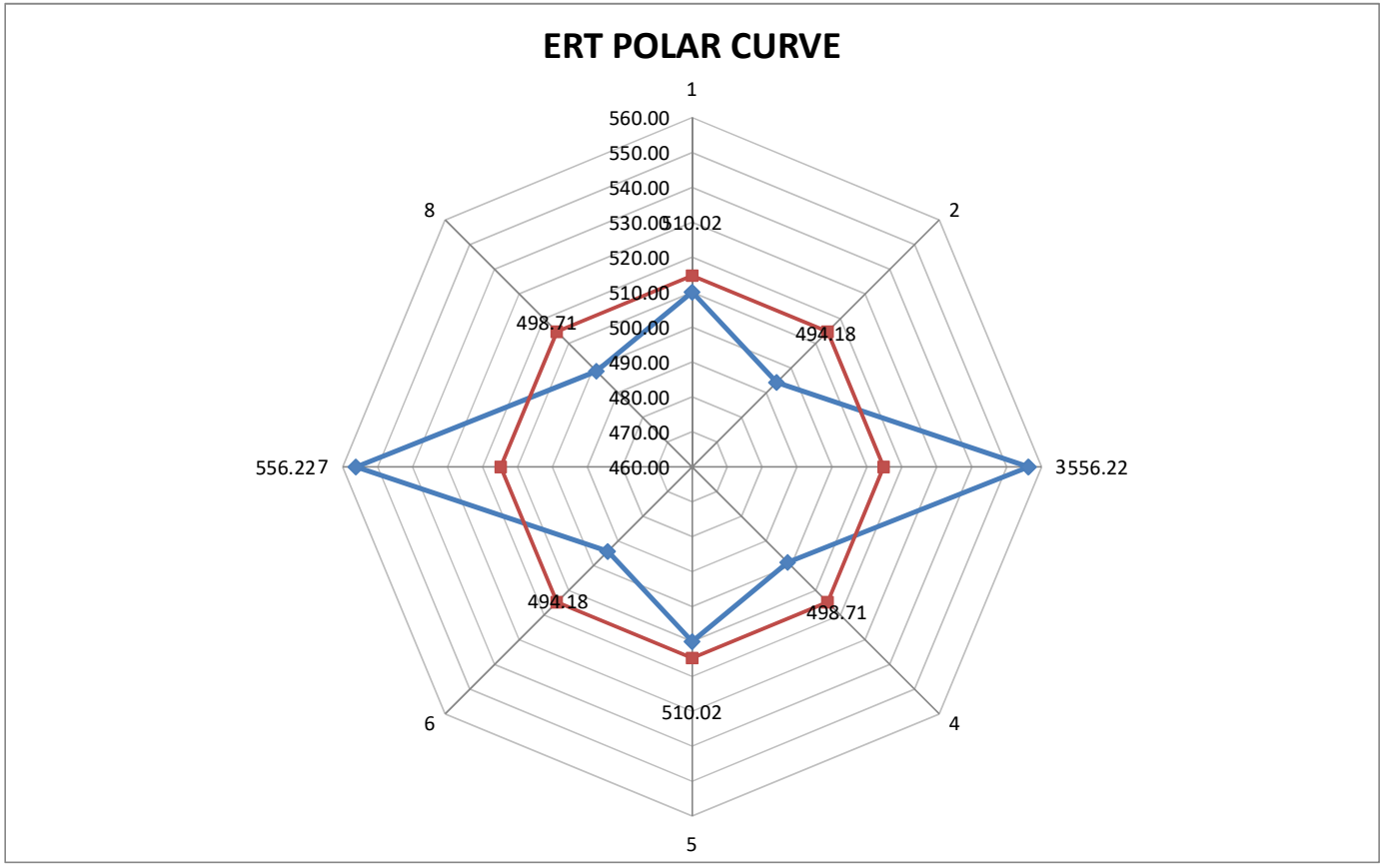
CLIENT : NTPC **Date : 27.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES : N -1263.356, W-626.173**

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) : 282.659**

POLAR CURVE



Mean Resistivity = 457.88 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

CLIENT : NTPC **Date : 24.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES :** N -1225.000, W-610.003

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) :** 282.900

DERT →		20																
Direction →		N		NE		E		SE		S		SW		W		NW		Average Apparent Resistivity ρ_{avg}
Sr. No.	Electrodes Spacing, a	Resistance	$\rho_{(N)}$	Resistance	$\rho_{(NE)}$	Resistance	$\rho_{(E)}$	Resistance	$\rho_{(SE)}$	Resistance	$\rho_{(S)}$	Resistance	$\rho_{(SW)}$	Resistance	$\rho_{(W)}$	Resistance	$\rho_{(NW)}$	
	(m)	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	Ohm	Ohm-m	
1	1.5	25.200	237.5	18.460	174.0	16.600	156.5	18.410	173.5	25.200	237.5	18.460	174.0	16.600	156.5	18.410	173.5	185.36
2	3	12.720	239.8	11.640	219.4	11.880	223.9	11.440	215.6	12.720	239.8	11.640	219.4	11.880	223.9	11.440	215.6	224.69
3	6	7.460	281.2	8.310	313.3	8.620	325.0	8.430	317.8	7.460	281.2	8.310	313.3	8.620	325.0	8.430	317.8	309.32
4	9	6.030	341.0	6.410	362.5	6.640	375.5	6.890	389.6	6.030	341.0	6.410	362.5	6.640	375.5	6.890	389.6	367.14
5	12	5.220	393.6	5.460	411.7	5.530	417.0	5.910	445.6	5.220	393.6	5.460	411.7	5.530	417.0	5.910	445.6	416.95
6	15	4.340	409.0	4.060	382.6	3.960	373.2	3.840	361.9	4.340	409.0	4.060	382.6	3.960	373.2	3.840	361.9	381.70
7	18	3.560	402.6	3.680	416.2	3.470	392.4	3.340	377.7	3.560	402.6	3.680	416.2	3.470	392.4	3.340	377.7	397.25
8	21	3.240	427.5	3.240	427.5	2.990	394.5	3.060	403.8	3.240	427.5	3.240	427.5	2.990	394.5	3.060	403.8	413.32
9	24	2.730	411.7	2.410	363.4	2.700	407.2	2.360	355.9	2.730	411.7	2.410	363.4	2.700	407.2	2.360	355.9	384.53
10	27	2.540	430.9	2.340	397.0	2.260	383.4	2.210	374.9	2.540	430.9	2.340	397.0	2.260	383.4	2.210	374.9	396.55
11	30	2.210	416.6	2.140	403.4	2.180	410.9	2.090	394.0	2.210	416.6	2.140	403.4	2.180	410.9	2.090	394.0	406.21

Resistivity , $\rho = 2 \pi a R$

Where, a= Distance between successive electrodes in metres,
R =megger reading in ohm

For SOILTECH INDIA PVT. LTD.

EARTH RESISTIVITY TEST

IS: 3043 - 2018

SOILTECH
(INDIA) PRIVATE LIMITED
GROUND ENGINEERS & CONSULTANTS

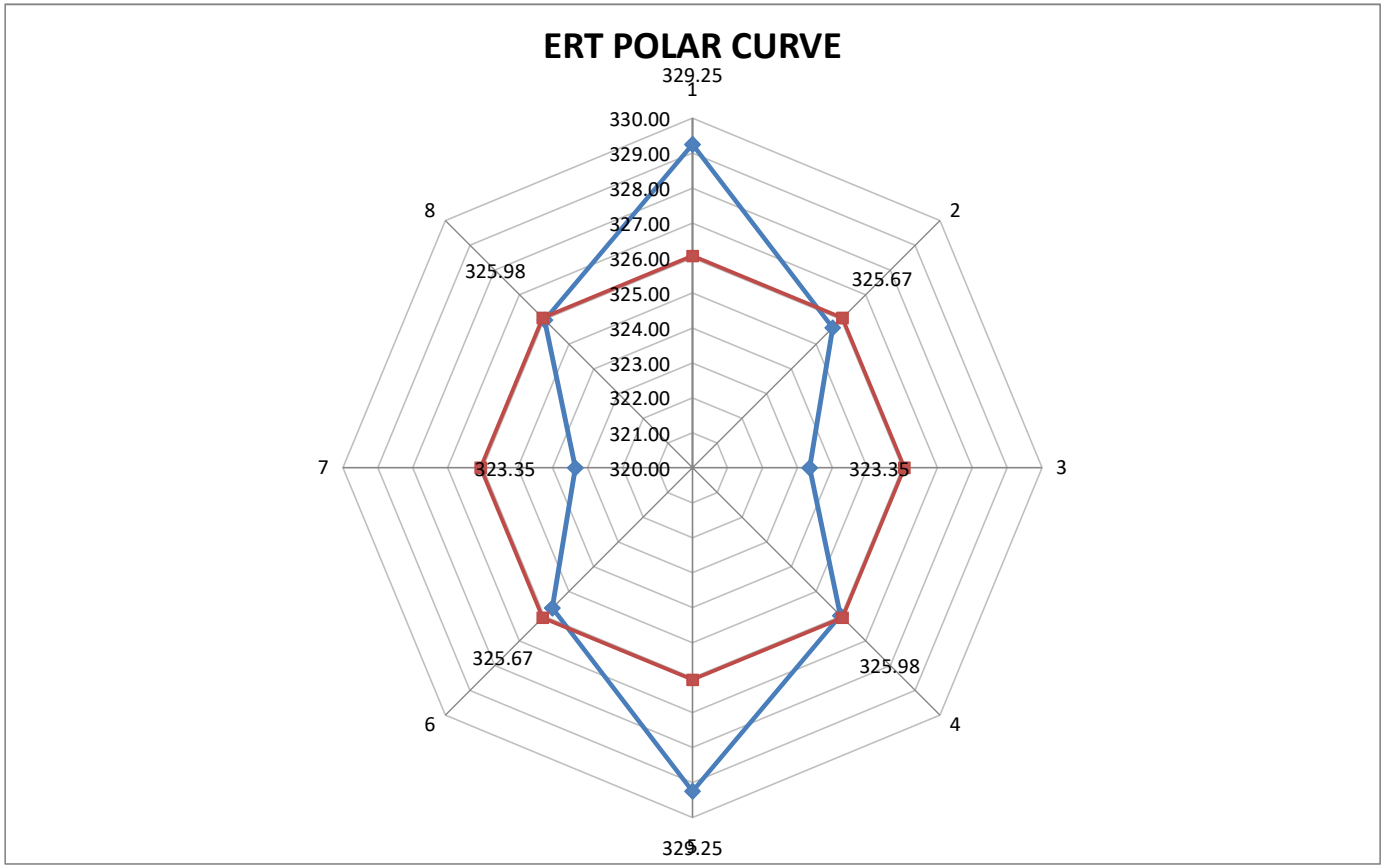
CLIENT : NTPC **Date : 24.03.2023**

PROJECT : ELECRTICAL RESISITIVITY TEST FOR PROPOSED PROJECT AT SIPAT. **SIPL/23-24 /2**

LOCATION : SIPAT **CO-ORDINATES : N -1225.000, W-610.003**

Method Used: Wenner Four Pin Equal Probe Spacing. **GROUND LEVEL (m) : 282.900**

POLAR CURVE



Mean Resistivity = 289.20 Ohm M

Note: 1=N, 2=NE, 3=E, 4=SE, 5=S, 6=SW, 7=W, 8=NW

For SOILTECH INDIA PVT. LTD.

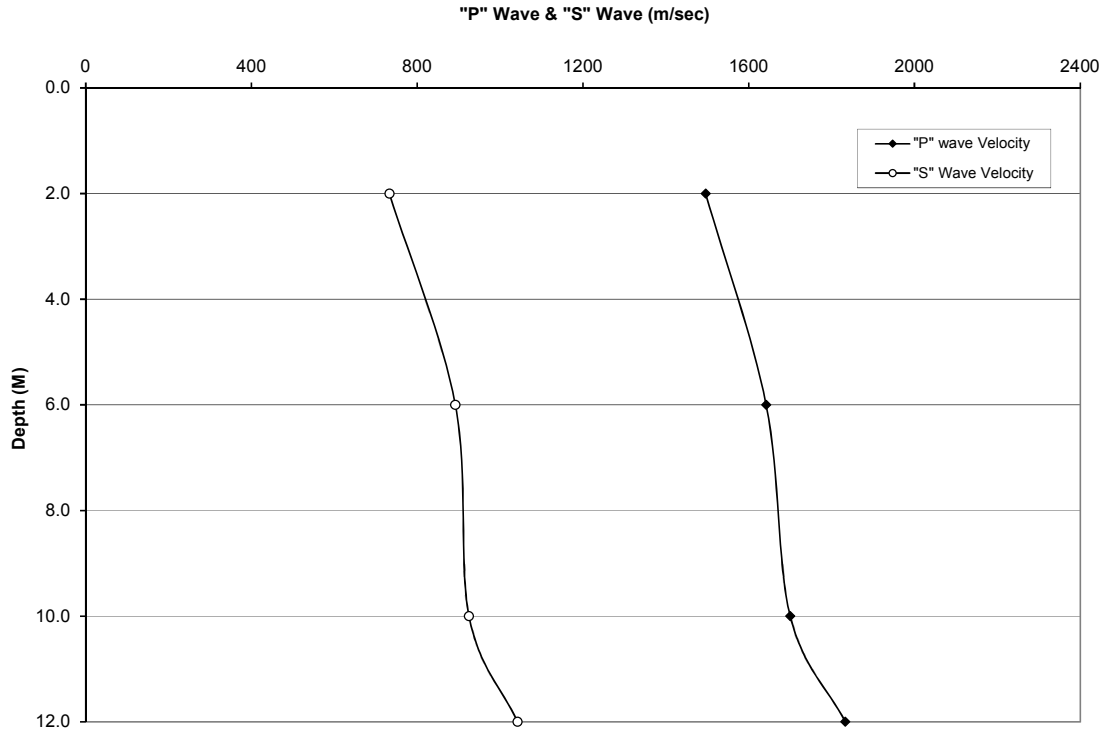
CST No.	Co-ordinates		R. L. (M)
	E	N	
CHST-01	(-)594	1311	283.460
CHST-02	(-)660	1253	282.482
CHST-03	(-)709	1150	282.482
CHST-04	(-)697	867	281.520
CHST-05	(-)523	857	282.250

.

Cross Hole Shear Test: CHST-1

Calculated Values of Dynamic Parameters

Depth (M) BGL	V_p (m/s)	V_s (m/s)	Mass Density ($kN.s^2/m^4$)	m = V_p/V_s	Poisson Ratio, σ	Young's Modulus (kN/m^2)	Young's Modulus (MPa)	Shear Modulus (kN/m^2)	Shear Modulus (MPa)
2.0	1496	733	2.55	2.0409	0.342	3675148	3675.1	1369238	1369.2
6.0	1642	892	2.55	1.8408	0.291	5234146	5234.1	2027686	2027.7
10.0	1700	925	2.55	1.8378	0.290	5624396	5624.4	2180492	2180.5
12.0	1833	1042	2.55	1.7591	0.261	6979873	6979.9	2766983	2767.0

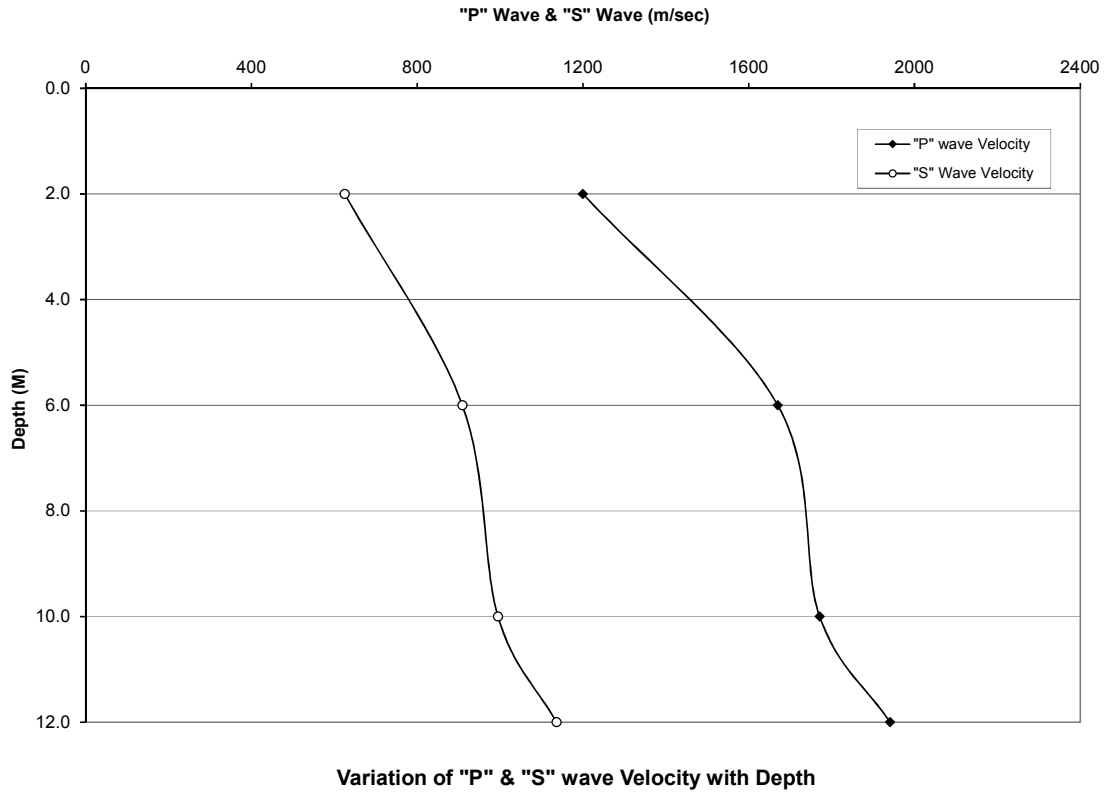


Variation of "P" & "S" wave Velocity with Depth

Cross Hole Shear Test: CHST-2

Calculated Values of Dynamic Parameters

Depth (M) BGL	V_p (m/s)	V_s (m/s)	Mass Density ($kN.s^2/m^4$)	m = V_p/V_s	Poisson Ratio, σ	Young's Modulus (kN/m^2)	Young's Modulus (MPa)	Shear Modulus (kN/m^2)	Shear Modulus (MPa)
2.0	1200	625	2.55	1.9200	0.314	2615868	2615.9	995477	995.5
6.0	1670	909	2.55	1.8372	0.289	5430609	5430.6	2105711	2105.7
10.0	1771	995	2.55	1.7799	0.269	6405276	6405.3	2522999	2523.0
12.0	1941	1136	2.55	1.7086	0.240	8152769	8152.8	3288726	3288.7

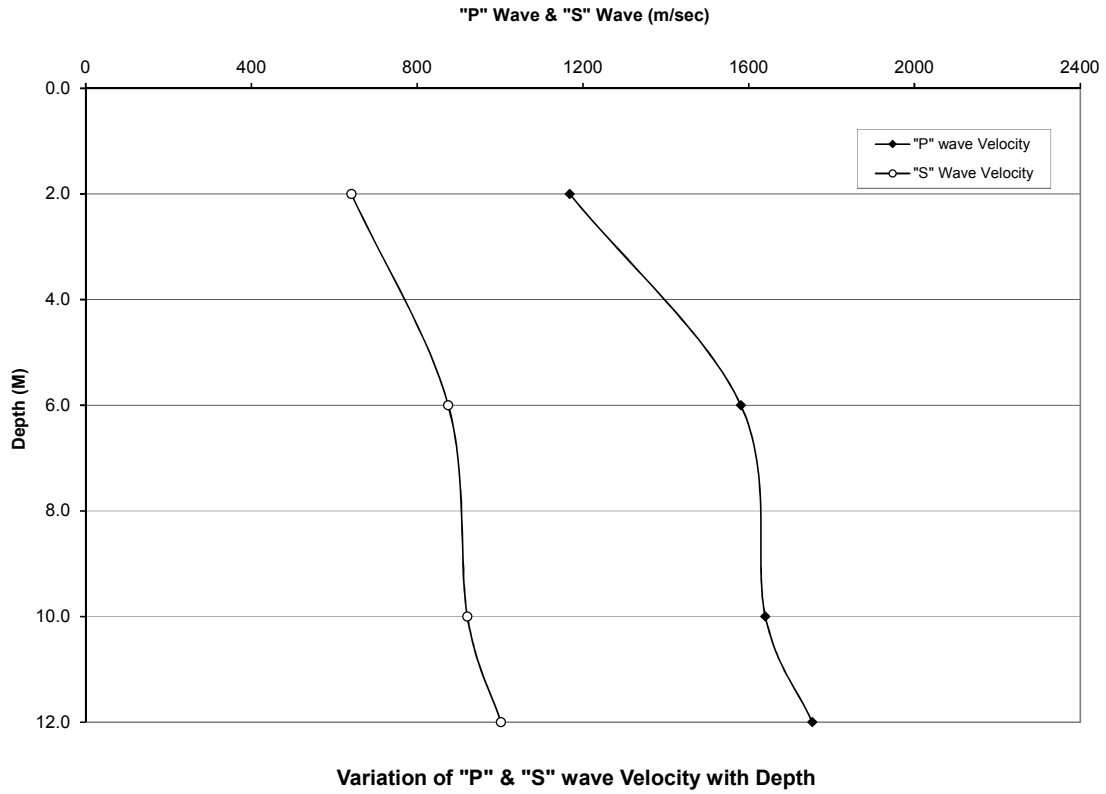


Variation of "P" & "S" wave Velocity with Depth

Cross Hole Shear Test: CHST-3

Calculated Values of Dynamic Parameters

Depth (M) BGL	V_p (m/s)	V_s (m/s)	Mass Density ($kN.s^2/m^4$)	m = V_p/V_s	Poisson Ratio, σ	Young's Modulus (kN/m^2)	Young's Modulus (MPa)	Shear Modulus (kN/m^2)	Shear Modulus (MPa)
2.0	1168	641	2.55	1.8222	0.285	2690004	2690.0	1047097	1047.1
6.0	1581	875	2.55	1.8069	0.279	4991873	4991.9	1951134	1951.1
10.0	1640	921	2.55	1.7807	0.270	5489225	5489.2	2161674	2161.7
12.0	1753	1002	2.55	1.7495	0.257	6434275	6434.3	2558624	2558.6

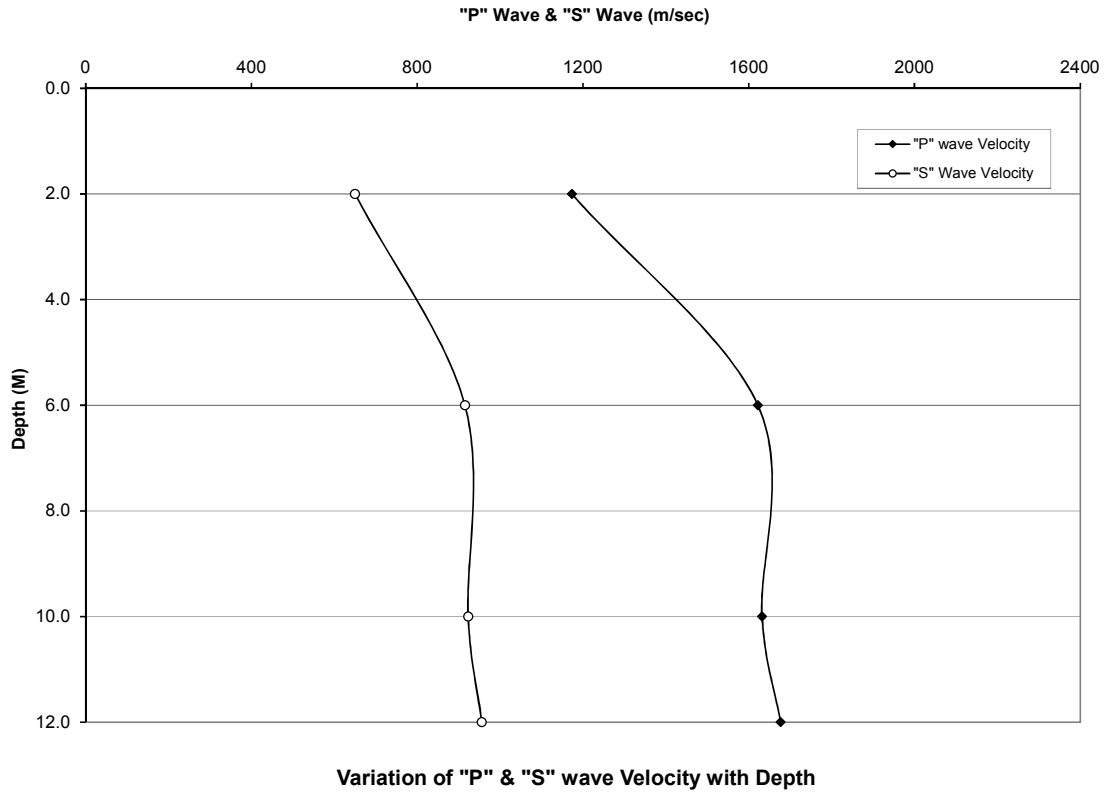


Variation of "P" & "S" wave Velocity with Depth

Cross Hole Shear Test: CHST-4

Calculated Values of Dynamic Parameters

Depth (M) BGL	V_p (m/s)	V_s (m/s)	Mass Density ($kN.s^2/m^4$)	m = V_p/V_s	Poisson Ratio, σ	Young's Modulus (kN/m^2)	Young's Modulus (MPa)	Shear Modulus (kN/m^2)	Shear Modulus (MPa)
2.0	1173	650	2.55	1.8046	0.278	2752993	2753.0	1076707	1076.7
6.0	1622	915	2.55	1.7727	0.267	5404903	5404.9	2133601	2133.6
10.0	1632	923	2.55	1.7681	0.265	5492184	5492.2	2171073	2171.1
12.0	1677	956	2.55	1.7542	0.259	5865992	5866.0	2329093	2329.1

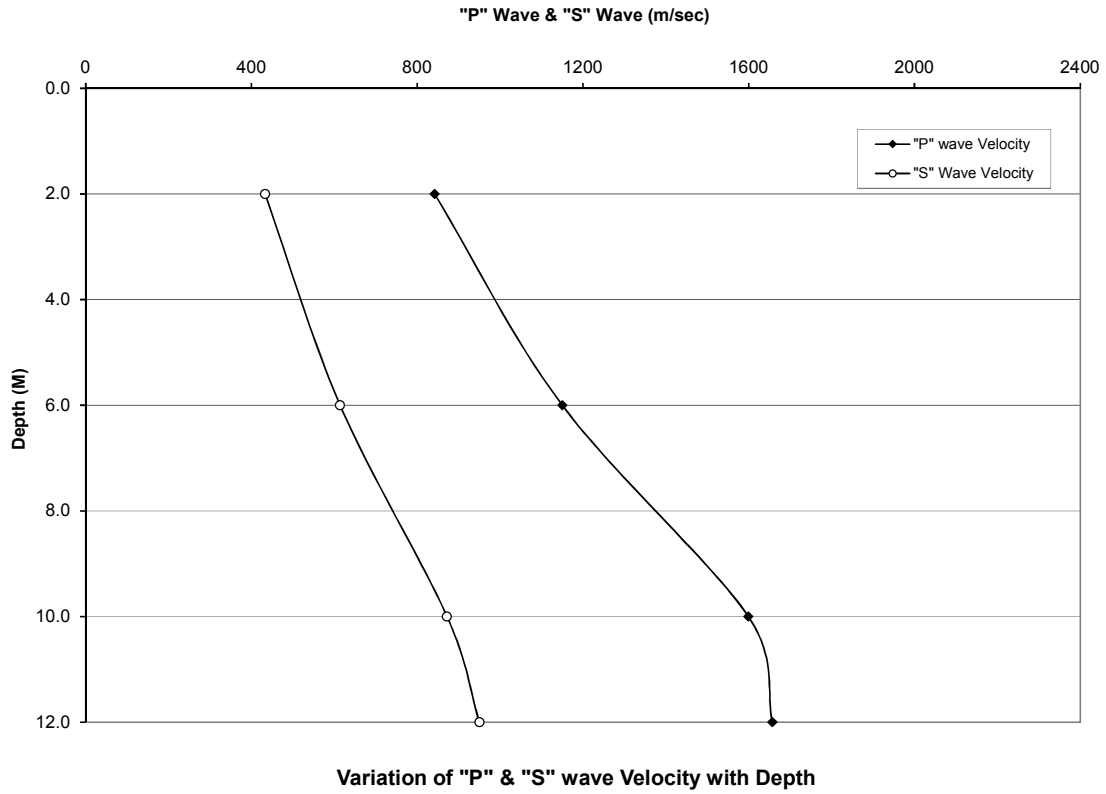


Variation of "P" & "S" wave Velocity with Depth

Cross Hole Shear Test: CHST-5

Calculated Values of Dynamic Parameters

Depth (M) BGL	V_p (m/s)	V_s (m/s)	Mass Density ($kN.s^2/m^4$)	m = V_p/V_s	Poisson Ratio, σ	Young's Modulus (kN/m^2)	Young's Modulus (MPa)	Shear Modulus (kN/m^2)	Shear Modulus (MPa)
2.0	842	433	2.55	1.9446	0.320	1261616	1261.6	477801	477.8
6.0	1150	614	2.55	1.8730	0.301	2499160	2499.2	960744	960.7
10.0	1599	872	2.55	1.8337	0.288	4993114	4993.1	1937778	1937.8
12.0	1657	950	2.55	1.7442	0.255	5773674	5773.7	2299949	2299.9



Variation of "P" & "S" wave Velocity with Depth

CROSSHOLE SONIC TEST RESULTS

Depth, m	Measured Compression Wave Velocity, V_p (m/s)	Measured Shear Wave Velocity, V_s (m/s)	Bulk Density, γ (kg/m^3)	Mass Density, ρ (kg.s^2/m^3)	Calculated Poisson's Ratio, μ	Dynamic Young's Modulus		Dynamic Shear Modulus		Coefficient of Elastic Uniform Compression, c_u (kg/cm^3)	Coefficient of Elastic Uniform Shear, c_τ (kg/cm^3)	Coefficient of Elastic Non-Uniform Compression, c_φ (kg/cm^3)	Coefficient of Elastic non-uniform Shear, c_ψ (kg/cm^3)	UBC Classification
						MPa	kg/cm^2	MPa	kg/cm^2					
CHST - 1														
2.0	1643	709	2700	275	0.39	3834	39082	1384	14103	1609.3	965.6	3340.9	5011.3	Sc
6.0	2100	821	2700	275	0.41	5231	53321	1855	18911	2246.4	1347.8	4663.5	6995.2	Sb
10.0	2277	837	2700	275	0.42	5483	55895	1928	19655	2383.6	1430.2	4948.4	7422.6	Sb
12.0	2328	936	2700	275	0.40	6769	69000	2411	24580	2889.4	1733.6	5998.4	8997.6	Sb
CHST - 2														
2.0	1855	945	2700	275	0.32	6512	66383	2458	25055	2601.4	1560.8	5400.5	8100.8	Sb
6.0	1901	962	2700	275	0.33	6764	68955	2547	25964	2708.4	1625.0	5622.6	8433.8	Sb
10.0	1949	993	2700	275	0.32	7190	73295	2714	27665	2872.2	1723.3	5962.6	8943.9	Sb
12.0	2351	1047	2700	275	0.38	8305	84657	3017	30755	3457.2	2074.3	7177.1	10765.7	Sb

Measured Wave Velocities and Computed Dynamic Parameters at the two Crosshole Seismic Test Locations

NTPC SIPAT

D-1-12(D)

Annexure- (D)

CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

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

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

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

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

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

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

Damping in Structures

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

a) Welded steel structures : 1.0%

b) Bolted steel structures/RCC structures : 2.0%

c) Prestressed concrete structures : 1.6%

d) Steel stacks : As per IS:6533 & CICIN Model Code whichever is more critical.

ANNEXURE-B

SITE SPECIFIC DESIGN PARAMETERS

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

a) The basic wind speed “Vb” at ten meters above the mean ground level : 47 meters/second

b) The risk coefficient “K1” : 1.07

c) Category of terrain : Category-2

D-1-12(E)

Annexure-(E)

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

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

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

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

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

Damping in Structures

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

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

Method of Analysis

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

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

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

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

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 : 0.14g

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 special moment resisting steel frames designed and detailed as per IS:800 : 0.035

   b) For special concentrically braced steel frames designed and detailed as per IS:800 : 0.026

   c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.021

   d) for RCC chimney, RCC Natural Draft Cooling Tower : 0.07

   e) for liquid retaining tanks (ground supported) : 0.042

   f) for steel chimney, Absorber tower, Vessels : 0.0525

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 : 0.07

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 SIPAT STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.60%	2%	3%	5%
≤ .04	1.0	1.0	1.0	1.0	1.0	1.0
.05	1.2262	1.1579	1.1467	1.1392	1.1299	1.1009
.06	1.4516	1.3487	1.3272	1.3104	1.2892	1.2449
.07	1.8388	1.6845	1.6345	1.5944	1.5666	1.5076
.08	2.3009	2.1316	2.0801	1.9571	1.8387	1.7396
.09	3.6683	3.3390	2.9378	2.6591	2.1409	1.9978
.10	4.5596	3.8254	3.3886	3.1526	2.4177	2.1830
.12	5.1376	4.4231	3.9292	3.6907	2.8694	2.4421
.14	5.4416	4.7467	4.2463	4.0499	3.2878	2.6563
.16	5.6857	5.0086	4.4829	4.2566	3.4812	2.8190
.18	5.8457	5.2097	4.6616	4.4118	3.5682	2.8920
.20	5.8971	5.3013	4.7794	4.5035	3.5972	2.9322
.22	5.9439	5.3612	4.8599	4.5652	3.6281	2.9490
.24	5.9729	5.3977	4.9076	4.5942	3.6383	2.9528
.26	5.9860	5.4369	4.9319	4.5793	3.6299	2.9406
.28	5.9850	5.4398	4.9291	4.5540	3.6028	2.9172
.30	5.9579	5.4239	4.8917	4.4231	3.5308	2.8770
.40	5.4248	4.7794	4.1453	3.5701	2.9584	2.5122
.50	3.8946	3.6309	3.1978	2.8761	2.4290	2.0867
.60	3.1651	3.0098	2.6638	2.4215	2.0334	1.7509
.70	2.6956	2.5674	2.3270	2.0885	1.7378	1.4899
.80	2.3345	2.2232	2.0418	1.8510	1.5498	1.3300
.90	2.0633	1.9548	1.8407	1.6892	1.4366	1.2224

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for SIPAT STPP

Period (Sec)	Damping Factor (as a percentage of critical damping)					
	0.80%	1%	1.60%	2%	3%	5%
1.00	1.8884	1.7874	1.6957	1.5844	1.3590	1.1532
1.10	1.7602	1.6695	1.5825	1.4899	1.2851	1.1037
1.20	1.6518	1.5564	1.4825	1.3955	1.2103	1.0503
1.30	1.5498	1.4619	1.3908	1.3104	1.1467	1.0148
1.40	1.4600	1.3730	1.3048	1.2281	1.0896	.9746
1.50	1.3693	1.2917	1.2281	1.1551	1.0373	.9344
1.60	1.2935	1.2112	1.1532	1.0887	.9821	.8923
1.70	1.2178	1.1411	1.0887	1.0176	.9372	.8549
1.80	1.1514	1.0812	1.0242	.9587	.8885	.8165
1.90	1.0850	1.0111	.9606	.9044	.8455	.7782
2.00	1.0204	.9549	.9072	.8567	.7969	.7426
2.10	.9690	.8988	.8577	.8118	.7482	.6996
2.20	.9185	.8511	.8147	.7772	.7062	.6519
2.30	.8801	.8109	.7810	.7389	.6669	.6154
2.40	.8455	.7782	.7473	.7090	.6285	.5771
2.50	.8090	.7445	.7155	.6744	.5995	.5387
2.75	.7333	.6706	.6407	.6014	.5341	.4536
3.00	.6566	.6061	.5808	.5406	.4714	.3910
3.25	.5920	.5509	.5210	.4798	.4162	.3535
3.50	.5369	.4976	.4705	.4302	.3732	.3227
3.75	.4910	.4602	.4312	.3910	.3311	.2956
4.00	.4536	.4228	.3966	.3564	.3012	.2750

D-1-12(F)

Annexure-(F)

QA REQUIREMENT

All Civil, Structural and Architectural construction work at the project shall be executed strictly in accordance with the Quality Assurance guidelines specified in separate part of the Specification.

D-1-12(G)

Specification For High Performance Moisture Compatible Corrosion Resistant Coating System

a) Providing & applying **High Performance Moisture Compatible Corrosion Resistant Coating System** manufactured as per technical specifications of Central Electrochemical Research Institute, Karaikudi, (C.S.I.R. affiliate Institute), Tamil Nadu, Pin - 630 006.

b) The coating system shall be water compatible, compatible for applying in wet conditions also and shall be tolerant to under-prepared surfaces and existing residual tar / paint. The system shall also be quick curing so as to be suitable for application during shut downs.

The coating material shall be stored in the manner as per recommendations of the manufacturer until ready for use. The coating material shall be used within the manufacturer's written recommended shelf life.

c) The coating system shall conform to the following :

PROPERTIES OF PAINT

Base	High Performance Moisture Compatible Corrosion Resistant Coating System CECRI know-how system
Volume Solids	70%
Specific Gravity (ASTM-D-1475)	1.25 ± 0.1
Dry Film Thickness (ASTM-D-1186)	160 ± 10 µm per coat
Coverage	4 - 4.5 sq.m/ ltr
Touch Dry	2 Hours
Recoating	24 Hours

PROPERTIES OF COATING

Salt Spray (ASTM-B 117)	2000 Hours
Resistance to sea water (Carried out upto 6 months)	Passes
Coating Resistance (Carried out upto 6 months)	10^9 Ω. cm^2
Adhesion (ASTM-D 4541)	4.5 N/mm Sq
Flexibility (ASTM-D-522) Elongation	1/8" passes 33%
Impact (ASTM G 14–04)	45 cm passes

d) Paint material & its application method shall be obtained from any manufacturer who has been granted License by CECRI, Karaikudi for technical know how for **High Performance Moisture Compatible Corrosion Resistant Coating System**. The application method of coating shall be got duly approved from CECRI, Karaikudi.

NTPC Limited

(A Government of India Enterprise)

SIPAT SUPER THERMAL POWER PROJECT
STAGE - III (1x800MW)

PART - D

ERECTION CONDITIONS OF CONTRACT

SECTION – VIB

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

BIDDING DOCUMENT NO.: CS-8003-001-2

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

PART - D

ERECTION CONDITIONS OF CONTRACT

1.00.00 GENERAL

1.01.00 The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract which is to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.

1.02.00 The Contractor upon signing of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the Works to be performed at Site. Such a person shall function from the Site office of the Contractor during the pendency of Contract.

2.00.00 REGULATION OF LOCAL AUTHORITIES AND STATUTES

2.01.00 In addition to the local laws and regulations, the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.

2.02.00 All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully pay-able under the provisions of the Indian Boiler Regula-tions and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the Contractor.

3.00.00 WELDING OF PRESSURE PARTS AND HIGH PRESSURE PIPING

The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements:

3.01.00 Qualification of Weld Procedures

Only qualified welding procedures as per ASME Section IX shall be used by contractor at site. Procedure qualification records along with WPS shall be submitted to NTPC for review. Welding procedure shall indicate all essential and non-essential parameters as per ASME Section IX. Makes of welding consumables shall be subject to employer's approval.

3.02.00 Welder's Qualification

Only welders who are qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts and its attachment welding. In addition to such statutory qualification requirements, the welders shall also undergo a satisfactory pre-production qualification test to be conducted by the Contractor at site as per ASME Sec IX in presence of employer's representative(s), prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders.

All the welders carrying out welding at site shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested

and authorised to carry out welding.

3.03.00 **Records**

Welders performance shall be monitored regularly and record of their performance shall be maintained by contractor in a manner acceptable to the employer. Contractor shall maintain such records including record of procedure qualification & welder qualification and hand-over to the employer at the end of work.

3.04.00 **MARKING**

On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.

3.05.00 Welding Equipment for high pressure (Boiler , PCP) -

For GTAW process: HF Welding machines to be used.

For SMAW process: Inverter based welding machine are to be used.

Main contractor to ensure the availability of sufficient nos of welding equipment during the each phase of project construction so as not to impede the progress of the project

4.00.00 HEAT TREATMENT

4.01.00 Heat Treatment -Pre-heating, post-heating and post-weld heat treatment operations of all welds, shall be performed in accordance with the requirements of applicable code and WPS . Local post weld heat treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils as acceptable to employer. Oxyacetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of chartless recorder / IIOT sensors duly password protected with a connectivity to remote server /Cloud . All hardware and software required to meet above intent shall be in the scope of bidder.

4.02.00 After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (as specified at clause no 7.00.00- of this chapter) etc.

4.03.00 Heat Treatment - weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding. Schedule shall be mentioned on data for identification.

5.00.00 WELD EDGE PREPARATION

Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used.

6.00.00 CLEANING AND SERVICING

6.01.00 The inside of all tubes, pipes, valves and fittings shall be free from dirt, and loose scales before being erected. All the pipelines shall be thoroughly blown and/or flushed. Each steam and water tubes shall be blown with compressed air and shall be subjected to 'ball test' before erection to ensure that no obstructions exist. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested.

6.02.00 All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and serviced prior to pre-commissioning tests and/or Initial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced.

6.03.00 All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations.

7.00.00 FIELD WELDING SCHEDULE

The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field-welding schedule to be issued by the Contractor shall contain the following:

(a.) Drawing No (s)

(b.) Location of the weld

(c.) Size of the weld (outside diameter and thickness)

(d.) Type of joints

(e.) Material specifications

(f.) Size of fillet on backing ring, when the type of joint is with backing ring

(g.) Electrode/ filler metal specifications

(h.) Number of welds per unit

(i.) Quantity of filler metal per weld

(j.) Indication of required Non-destructive Examination (NDE) for each weld

(k.) Pre-heat temperatures for welding

(l.) Process of welding

(m.) Post-welding heat treatment temperature ranges, duration, under as specified at clause no 4.00.00 of this chapter entitled "Heat Treatment".

(n.) Qualification details of weld procedures to be adopted as specified at clause no 3.01.00 of this chapter entitled 'Qualification of Weld Procedures'.

8.00.00 SITE RUN MISCELLANEOUS PIPING

Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of such site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located convenient for operation by the operating personnel. Pipe runs shall be plumb or level except where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipes between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.

9.00.00 THERMAL EXPANSIONS

All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.

10.00.00 PIPING SUPPORTS

10.01.00 Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly levelled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.

10.02.00 The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.

11.00.00 PRESSURE TESTING

11.01.00 On completion of erection of pressure parts, a hydraulic test in accordance with the requirements of the Indian Boiler Regulations shall be performed by the Contractor.

11.02.00 All the valves, high pressure pipes and inter-connected pipes connecting the pressure parts shall be tested along with pressure parts. All blank flanges or any removable plugs required for openings not closed by the valves, and piping provided, shall be furnished by the Contractor. The pressurization equipment including water piping from the supply, needed for the above test shall also be furnished by the Contractor. Any defects noticed during the testing are to be rectified and the unit re-tested. If any welding is done on the pressure parts after the Hydraulic test, the Hydraulic test for that portion of pressure parts shall be repeated.

11.03.00 Thy hydraulic test shall be considered successful only on certification to that effect

by the concerned inspecting Authority as per the provisions of the Indian Boiler Regulations and the Employer.

12.00.00 THERMOWELLS AND FLOW NOZZLES

12.01.00 All the thermowells and flow nozzles in the equipment furnished under the technical specifications shall be installed as a part of this work.

12.02.00 All thermowell connections incorporated in the steam service shall be plugged during the pressure testing and the blow out of steam piping systems. Upon completion of the blow out operation, all thermowells shall be installed and seam welded. Similarly, all flow nozzles in the steam lines shall also be installed only on completion of steam blowing operations unless otherwise agreed to by the Employer, depending upon the sequence of cleaning and purging operations to be adopted by the Contractor at the field.

13.00.00 INSULATION, LAGGING AND CLADDING

The provision of insulation, lagging and cladding of the various equipments and portion of the equipment covered under the Contract, shall be furnished by the Contractor as specified elsewhere or agree to separately in writing. Welds required for holding insulation on pressure parts shall be carried out by IBR qualified welder.

13.01.00 **Piping, Pipe Fittings & Valves**

All piping insulation and metal cladding furnished with the equipment to be erected shall be applied as specified herein.

13.01.01 **Piping**

The insulation on piping shall be applied using wire loops on 150mm centres. These wire loops shall be thoroughly embedded into the outer insulation surface and all cracks, voids and depressions shall be filled with insulating cement suitable for the piping temperature so as to form a smooth base for application of cladding. The wires used for piping insulation shall be of 16 SWG. The surface shall be smooth and uniform before applying the outer covering. All piping insulation ends shall be terminated at a sufficient distance from flanges to facilitate removal of bolts.

13.01.02 **Flanges**

Insulation on flanges shall be by means of blocks of insulating material securely bound to the flange by wire loops. Such blocks of insulation shall be long enough to

overlap the adjacent pipe insulation by an amount equal to the thickness of adjacent pipe insulation. Smooth finish shall be obtained by the application of insulating cement. Alternatively, sectional pipe insulation of proper diameter may be used. Insulation on flanges shall not be done until the pipe and equipment have been in service during the initial operation and till all the flange bolts have been retightened.

13.01.03 **Bends and Elbows**

Insulation on bends and elbows shall be cut into sections sufficiently short to form a reasonable smooth external surface. After the application of insulation material in place, it shall be smoothly coated with insulating cement. Elbows may be insulated as above or alternatively by means of specially moulded insulation enclosures.

13.01.04 **Cladding**

Cladding shall be of aluminium sheet of thickness as per details given in detail Technical Specification or will be provided during detail engineering shall be machine rolled and formed to accurately fit insulation curvatures. Cladding shall be secured using self-tapping screws. Screws shall be adequate number and so located as to produce tight joints. The spacing of screws shall be as far as possible uniform and on centres not exceeding 150 mm. For outside diameters less than 230 mm, spacing of screws shall be on centres not exceeding 100 mm. adequate number of screws shall be provided for fixing the cladding and be so placed in such locations, as to produce a smooth cladding finish without bellying'. Insulated elbows having insulated diameters less than 330 mm shall be provided with preformed smooth aluminium elbow jackets. Wherever possible, all joints should be lapped a minimum of 50 mm with joints facing downwards and so placed that they are obscured from normal points of vision. All the joints in the cladding shall be made with suitable provisions for expansions. All butt joints such as those at piping tees shall be made using rolled seams. In addition, to prevent galvanic corrosion, suitable action, as specified at clause no 13.02.00 of this chapter, shall be taken.

13.01.05 **Valves and Fittings**

All valves and fittings (above valve size of 2 inches) installed in the pipelines shall also be applied with insulation and furnished with suitably shaped boxes so as to facilitate easy dismantling of the fittings. The insulation thickness for valves, valve fittings etc., shall be same as that used on the line on which they are installed. All voids shall be properly filled up with insulating material and as per the directions of the Employer.

13.02.00 **Protection of Equipment during Insulation Applications**

All equipment and structures shall be suitably protected from damage while applying insulation after completion of insulation. All equipment and structures shall be thoroughly cleaned and remove insulating materials which might have fallen on them.

14.00.00 CODE REQUIREMENTS

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Electricity Rules & Codes, Indian Boiler Regulations, ASME codes and accepted good practices, the

Employer's Drawings and other applicable Indian recognised codes and laws and regulations of the Government of India.

15.00.00 ELECTRICAL SAFETY REGULATIONS

15.01.00 In no circumstances will the Contractor interfere with fuses and electrical equipment belonging to the other Contractor or Employer.

15.02.00 Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall:

(a) Satisfy the Employer that the appliance is in good working condition.

(b) Inform the Employer of the maximum current rating,voltage and phase of the appliances.

(c) Obtain permission of the Employer detailing the socket to which the appliances may be connected.

The Employer will not grant permission to connect unitl he is satisfied that

(d) The appliance is in good condition and is fitted with suitable plug

(e) The appliance is fitted with a suitable cable having two earth conductors,one of which shall be an earthened metal sheath surrounding the cores.

15.03.00 No electric cable in use by the other Contractor/Employer will be disturbed without permission.No weight of any description willl be imposed on any such cable and ladder or similar equipment will rest against or to be attached with it.

15.04.00 No reapir work shall be carried out on any live equipment.The equipment must be declared safe by the Employer and a permit to work issued before any work is carried out.

15.05.00 The Contractor shall employ the necessary number of qualified,full time electricians to maintain his temporary electrical installation..

16.00.00 REMOVAL OF MATERIAL

No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Employer.

17.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in Part - C of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.

18.00.00 ACCESS TO SITE AND WORKS ON SITE

18.01.00 Suitable access to site and permission to work at the Site shall be accorded to the Contractor by the Employer in reasonable time.

18.02.00 In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the Site, except by the special permission, in writing by the Employer or his representative.

19.00.00 CONTRACTOR'S SITE OFFICE ESTABLISHMENT

The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.

20.00.00 CO-OPERATION WITH OTHER CONTRACTORS

20.01.00 Contractor, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the works under the Contract. The Contractor shall also arrange to perform his work as to minimise, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the same shall be dealt in accordance with GCC.

Employer shall have full access to visit the contractor's site at any time for inspection and surveillance checks.

20.02.00 The Employer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.

21.00.00 DISCIPLINE OF WORKMEN

The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site, if in the opinion of the Employer such employee has mis-conducted himself or is incompetent, negligent or otherwise unde-sirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.

22.00.00 CONTRACTOR'S FIELD OPERATION

22.01.00 The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Employer

	or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.
22.02.00	The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all persons employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.
23.00.00	**PHOTOGRAPHS AND PROGRESS REPORT**
23.01.00	The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.
23.02.00	The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.
23.03.00	Project Management System to be implemented as defined in Annexure-A to sub section IIC (Project Management) of technical specifications Section VI, Part A.
24.00.00	**MAN-POWER REPORT**
24.01.00	The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.
24.02.00	The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill- wise and the areas of employment of such labour.
25.00.00	**PROTECTION OF WORK**
	The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the as specified at clause no 20.00.00- of this chapter entitled "Co-operation with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The

Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.

26.00.00 EMPLOYMENT OF LABOUR

26.01.00 In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work its employees with relevant skills and experience of the particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be deployed. The deployment shall be in compliance of all the applicable labour laws.

26.02.00 All travelling expenses including provisions of all necessary transport to and from Site, lodging allow-ances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.

26.03.00 The hours of work on the Site shall be decided by the Principal Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.

26.04.00 Contractor's employees shall wear identification badges while on work at Site.

26.05.00 In case the Principal Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contact Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Principal Employer may make such payments and shall recover the same from the Contractor's Bills.

27.00.00 FACILITIES TO BE PROVIDED BY THE EMPLOYER

27.01.00 Communication

The Employer will extend the telephone facilities, if available at Site, for purposes of Contract. The Contractor shall be charged at actuals for such facili-ties.

27.02.00 Railway Siding

Railway siding shall be provided by owner (up to plant entry point) for coal transportation to site. However the same may not be available to the bidder for material/supplies transport etc. Bidder has to plan its own arrangement for movement of ODC consignment to plant site.

Further, irrespective of readiness of railway siding, owner reserves the option of coal supply in stackyard before the synchronization of first unit for which bidder has to ensure readiness of coal supply system up to mill bunker.

28.00.00 FACILITIES TO BE PROVIDED BY THE CONTRACTOR

28.01.00 Contractor's site office Establishment

The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC. The site office will include one conference meeting room (250-300 Sq Ft) for site meetings between the Contractor and the Employer. The contractor shall also provide four (4) furnished office rooms (150-250 SqFt) for use by the Employer to facilitate effective co-ordination during the tenancy of the contract.

28.02.00 Tools, tackles and scaffoldings

The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailer, etc. for the purpose of fabrication, erection and commissioning.

28.03.00 **Testing Equipment and Facilities:**

The contractor shall provide the necessary testing, equipment and facilities.

28.04.00 **Site laboratory for civil works:**

Contractor shall provide and maintain a site laboratory for the testing of construction material under the direction and general supervision of employer.

28.05.00 **First-aid**

28.05.01 The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.

28.05.02 As per NTPC Safety rules, ambulance is to be provided by the contractor, however, in case of any emergency, employer may provide the services of an ambulance for transportation to the nearest hospital.

28.06.00 **Cleanliness**

28.06.01 The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.

28.06.02 Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.

28.07.00 **Not used**

28.08.00 **Electricity**

Refer to construction power, as envisaged at Clause 1.15.00 of Sub Section-II-B, Part A, Sec VI of Technical specification.

28.09.00 **Water**

Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite/colony. However, drawal of construction/potable water from bore-well shall be permitted if

found suitable. Any statutory clearance required shall be obtained by the contractor. Assistance, if required shall be provided by the owner.

29.00.00 LINES AND GRADES

All the Works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the Works. Basic horizontal and vertical control points will be established and marked by the Employer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Employer well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense.

30.00.00 FIRE PROTECTION

30.01.00 The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.

30.02.00 Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.

30.03.00 All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.

30.04.00 The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time.

31.00.00 SECURITY

The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.

32.00.00 CONTRACTOR'S AREA LIMITS

The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contactor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Employer.

33.00.00 CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER

In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and installed by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.

34.00.00 PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES

34.01.00 **GENERAL**

34.01.01 The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. All pre-commissioning/commissioning activities considered essential for such readiness of the equipment/systems including those mutually agreed and included in the Contractor's quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the contractor.

34.01.02 The pre-commissioning and commissioning activities including Guarantee/ demonstration/acceptability tests, checks and trial operations of the equipment/ systems furnished and installed by the contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor’s workmen required for the above test shall always be present at site during such operations.

34.01.03 The following activities shall be carried out by the contractor, 18 month prior to schedule date of commissioning of the equipment/systems installed by him.

(a.) The contractor shall furnish the organization chart of his operation and commissioning engineers for the acceptance of employer. Adequate number of operation and commissioning engineers shall be deployed by the

contractor to effectively meet the requirement of round the clock operation in shifts also, till the plant is taken over by the employer.

(b.) The contractor shall submit the bio-data containing the details of experience of his operation and commissioning engineers for the acceptance of employer.

(c.) The contractor shall furnish the deployment schedule of his operation and commissioning engineers for the acceptance of the employer.

(d.) Apart from above, contractor shall ensure deployment of sufficient skilled/semi-skilled/unskilled manpower during pre-commissioning and commissioning activities.

34.01.04 It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment/systems which are installed by him.

34.01.05 The Contractor shall also be responsible for flushing and initial filling of all oils and lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications and documents.

34.02.00 **COMMISSIONING DOCUMENTATION**

34.02.01 The contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules, commissioning schedules and commissioning networks for various equipment/ systems covered under the contract, for the approval of employer.

34.02.02 Standard checklist, as the name suggests, shall be a fairly general documents, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking. An indicative list of such equipment is enclosed as Annexure I.

34.02.03 The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system (for example Boiler Feed Pump, condensate pump, compressor etc) Commissioning schedule is a document envisaged for commissioning of a system (for example feed system, Condensate system, Compressed Air system, Fire water system, Unit commissioning etc). The testing/Commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting. A brief write up on the contents of the Testing Schedule/Commissioning Schedule is enclosed as Annexure-II.

34.02.04 The contractor shall submit the list of commissioning documentation to be submitted by him, alongwith their submission schedule for various equipment/systems covered under the contract, with in 6(six) month from the date of award of contract, for the acceptance of employer.

34.02.05 The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least 18 months before the scheduled date of commissioning of the equipment/systems.

34.03.00 **COMMISSIONING ACTIVITIES**

34.03.01 Upon completion of pre-commissioning activities/tests, the contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the facilities.

34.03.02	Contractor shall carry out the checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified.
34.03.03	Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.
34.03.04	The Contractor shall also demonstrate the performance of all C&I equipment, the tests on main equipment of prior to that as the case may be.
34.03.05	Other tests shall be conducted, if required by the Employer, to establish that the plant equipment are in accordance with requirements of the specifications.
34.03.06	The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all electrical and C&I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied and installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications.
34.05.00	**Initial Operation**
	Upon completion of system checking/Tests as above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation as stipulated in General Technical Requirements.
35.00.00	**MATERIALS HANDLING AND STORAGE**
35.01.00	All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.
35.02.00	Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
35.03.00	The Contractor shall maintain an accurate and exhaus-tive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.
35.04.00	All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equip-ment at Site.
35.05.00	All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings,

	commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.
35.06.00	All the electrical equipment such as motors, genera-tors, etc. shall be tested for insulation resistance as per OEM Practice. Storage of EHV/Generator transformers under Nitrogen /Dry air shall not exceed the time duration as defined by OEM practice.
35.07.00	The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.
35.08.00	The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or dete-rioration in quality by storage.
35.09.00	All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame-proof covering material wherever applicable.
35.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.
35.11.00	The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.
35.12.00	Sound Storage Management system need to be followed for storage of material. First in First Out method (FIFO) to be adopted to avoid longtime storage. Storage duration of any material at site shall not be more than 3 months. Accordingly supply of material in sequence of erection at site to be ensured. To achieve the same, following is to be adopted: a. Dispatch clearance is to be given in order of sequence of erection. To achieve the goal, proper tags shall be maintained in ascending order. The tag shall be self-explanatory. b. MDCC shall be issued by RIO based on clearance from Site FQA head, Main contractor, Erection head for dispatch and supply of material. Strict adherence to sequential supply of material as per supply schedule.
35.13.00	An automated storage and retrieval system consists of a variety of computer-controlled systems for automatically placing and retrieving of material may be adopted. Accordingly, each material shall be marked with unique identification code.
36.00.00	**CONSTRUCTION MANAGEMENT**
36.01.00	The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the

Employer shall not be a cause for extra compensation or extension of time for the Contractor.

36.02.00 The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.

36.03.00 Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

36.04.00 The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

36.05.00 **Site management during construction phase till handing over of plant**

Bidder shall ensure that the plant site within the plant boundary is managed in a coordinated and professional way all through the construction phase till handing over of plant, ensuring safe, easy & unhindered working conditions and a healthy & hygienic working environment at site. He shall ensure the following measures at site while executing the project.

a) Unhindered motorable road access to all work areas and facilities both during the construction/erection and as they get completed progressively. Required temporary access roads other than the permanent roads shall also be provided. Bidder shall prioritize the construction of approach roads, roads around the main plant block, roads to office & storage areas and the offsite areas from the start of project itself. He shall finalize and submit the complete road layout plan along with priority and completion schedule immediately after the award for review by the Employer .He shall ensure that the roads are promptly repaired and maintained against any damages due to movement of traffic/heavy trailers & cranes etc providing motorable access at all times. Adequate onsite stock of road materials shall be kept and maintained disturbed over the site for repairs especially before the monsoon period.

b) Proper drainage of rain water, ground water from excavations, water flows from batching plant / construction sites etc. He shall prioritize the construction of permanent drains from the start of the project itself. Till such time the permanent drainage network is done, he shall construct adequate temporary drains to ensure that there is no accumulation /stagnation of water in the plant site. Bidder may consider providing pre-cast RCC drains for temporary/ permanent drain construction for faster construction of drains. The drain construction shall be matched with progress of road construction for preventing damage to roads. Bidder shall provide and maintain adequate

number of drainage pumps (both electrical and diesel operated) of suitable capacity for pumping out accumulated water especially during the monsoon periods. All drain diversions required shall be undertaken at the start of the project itself.

c) The plant site is fully secured against unauthorized access.

d) Proper housekeeping by systematic and proper disposal of earth from excavations(separately for usable & surplus earth), muck (from pile bores or otherwise), wastes (from dismantling of pile tops, concrete works etc), packing & insulation wastes, steel scrap, cable wastes etc generated during construction / erection works. Suitable disposal sites for each of above shall be identified in the layout and at site in the beginning of the project itself. It shall be ensured that all agencies engaged by the bidder follow the discipline to dispose off of earth spoils and wastes at the designated places. Preferably once in a week suitable time slot will be identified for housekeeping by all agencies and suitable instructions shall be issued in this regard. Bidder may engage a separate agency or identify a gang for collection of wastes and disposal to designated places. Suitable arrangement / tie-up will also be made for periodic disposal of wastes/ scrap from the designated places.

e) All fabrication areas shall be suitably hard crusted to provide a water free and proper working platforms. Suitable sheds preferably pre-engineered structures to be provided for paint shops, fabrication workshops etc for ensuring all weather work conditions for onsite structural works. For the main plant and auxiliary buildings, bidder should preferably plan the works in such a way that structural fabrication is done in suppliers' offsite works / workshops and onsite fabrication works are avoided / kept minimum.

f) Suitable onsite maintenance workshop for day to day breakdown maintenance heavy plant and equipment like batching plants, cranes, earth moving equipment, welding equipment etc. The workshop shall have stock of frequently needed spares and suitable repair facilities with experienced technicians/mechanics. A central test laboratory equipped with test equipment for routine tests like tests on soil, concrete, bricks, aggregates, welds etc with experienced staff shall be established at the start of the project itself.

g) All office and covered store buildings of the bidder and its agencies shall be of prefab/ pre-engineered / porta cabin construction. Shabby semi-finished constructions in brickwork/ GI / asbestos roof etc shall not be permitted.

h) First aid facilities and amenities like rest rooms, suitable pre-engineered toilets (separate for men and women), drinking water fountains/tanks, canteen, crèche for women workers shall be planned and established at the beginning of the project itself. These facilities shall be distributed over the plant area to enable easy access by the construction workers and staff and shall be marked on the plant layout. Suitable treatment for toilet discharge, like bio digesters etc shall be planned and conventional septic tanks / soak pits etc shall be avoided.

i) Proper lighting of all construction / erection areas. Bidder shall erect adequate number of high lighting masts in main plant, offsite, office and store areas for lighting during night. DG sets of adequate capacity shall be provided for emergency backup. The street lighting along the roads shall also

be prioritized along with road construction. The construction power ring main shall be planned and erected immediately after the award.

j) Well planned and coordinated storage and movement of plant, equipment and construction materials. System wise / agency wise storage / laydown areas shall be planned and marked on the plant layout at the beginning itself. Bidder shall ensure that all its agencies comply to the areas allocated to them and follow the designated storage and movement plans. Adequate covered storage shall be constructed for storage of critical equipments like switchgears, MCCs, insulation etc.

k) Proper access control for construction workers, staff and visitors. Bidder shall ensure that suitable electronic based gate pass system is in place from start of project itself to keep record and track of all workers, staff and visitors entering/exiting the plant premises shift wise on daily basis.

l) Compliance to all safety requirements as specified in this document. Bidders shall establish a safety centre at the start of the project itself. It shall have a 24X7 manned safety control room in addition to a permanent safety equipment display room, separate training / lecture hall with AV facilities for safety training, store room with adequate stock of specified safety equipment, a first aid room and other amenities. Bidder shall install 25 Nos. CCTV cameras at all strategic locations in the plant area which shall be linked to the safety control room."

m) Compliance to all environment and other conditions stipulated by the concerned statutory authorities while according clearance / NOC (No objection certificate) to the project. Bidder shall ensure adequate sprinkling of water by deploying water tankers to prevent the fugitive dust nuisance during construction.

n) Development of suitable landscape & green belt areas and rainwater harvesting within the plant premises. Bidder shall plan to develop the landscape & green belt areas and rainwater harvesting from the start of the project itself. The landscape and rain water harvesting plan shall be finalized immediately after award of work and suitable work plan with priority and schedule shall also be finalized thereafter. Top soil before excavation shall be suitably preserved and stacked for landscape and green belt development.

o) Provision of adequate shelters, water supply, sanitation and lighting in construction workers and staff camps. No camps for workers and staff shall be permitted within the plant premises and Bidder shall make separate arrangement outside the plant premises for locating and development of camps for construction workers and staff. The designated areas shall be suitably developed with infrastructure like roads, drains, water supply and sewerage and shall be free from water logging. Suitable low cost shelters will be provided for the workers. Complete area shall be secured by fencing and shall be provided adequate area lighting. Suitable waste disposal, shopping and recreation facilities will be developed in these camps.

Bidder shall ensure that due importance is given to site management as discussed above and a detailed work plan considering the above aspects is finalized immediately after the award. A senior level executive shall be identified who shall be responsible for implementation of the work plan. Suitable format for progress reporting on site management plan shall be

developed and made part of the project progress report. The progress on implementation of above work plan shall be reviewed along with project progress in the monthly project review meetings with Employer. In case the progress on site management plan is unsatisfactory, and in the opinion of Employer, bidder's actions on site management aspects is not adequate, Employer may get the relevant work executed through a separate agency and deduct the expenses incurred from Bidder's bill along with overheads in line with GCC.

p) If Employer decides to retain or withhold any amount from the Contractor, the Employer shall clearly articulate and share with contractor, the reasons and justifications for the retention or withholding of funds. Additionally, specific conditions for releasing the withheld amount shall also be established and communicated at the time of withholding. Upon rectification of the identified issues or deficiencies by the Contractor to the satisfaction of the Employer, the Employer shall promptly release the withheld amount. The release shall be made in accordance with the terms and conditions specified in the contract agreement.

36.06.00 **QUALITY CONTROL ROOM**

Bidder to refer clause no 1.01.00 -G of section IV -Part-A.

36.07.00 Welder Training Center -Contractor shall setup a small welding training center 3 -4 welding booths equiped with GTAW & SMAW setup in a pota cabin/suitable enclosed space to train & hone skill of high pressure welders who are giving high rate of welding defect.

36.08.00 **SMART STORAGE AREA/YARD MONITORING**

Bidder to refer clause no 1.01.00 -F of section IV -Part-A.

37.00.00 FIELD OFFICE RECORDS

The Contractor shall maintain at his Site Office up-to- date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.

38.00.00 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE

38.01.00 The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

38.02.00	The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days' notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose of any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.
38.03.00	After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under as specified at clause no 38.02.00- of this chapter and credit the proceeds thereto to the account of the Contractor.
39.00.00	**PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY**
39.01.00	The Contractor shall be responsible for any damage resulting from his operations. He shall also be re-sponsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.
39.02.00	The Contractor will ensure provision of necessary safety equipment such as barriers, sign - boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utili-ties when such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.
40.00.00	**PAINTING**
	For painting refer Part-A, sub section-III, Section VI of Technical specification.
	Painting for structures shall conform to the painting specification specified in Part-B under Civil.
	Painting for piping shall conform to the painting specification given in Part-B of the respective chapter.
	Painting for Electrical equipments/systems shall conform to the painting specification given in Electrical portion of Part-A and Part-B of technical specifications.
41.00.00	**INSURANCE**
41.01.00	In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.
41.02.00	**Workmen's Compensation Insurance**
	This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his

Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than the following:

Workmen's Compensation	-	As per Statutory Provisions
Employee's Liability	-	As per Statutory Provisions

41.03.00 **Comprehensive Automobile Insurance**

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated:

Fatal Injury	:	Rs.100, 000 each person
	:	Rs.200, 000 each occurrence
Property Damage	:	Rs.100, 000 each occurrence

41.04.00 **Comprehensive General Liability Insurance**

41.04.01 The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Loss of or Damage to Property; Accident or Injury to workers; Indemnification" in Section General Conditions of Contract (GCC).

41.04.02 The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.

41.05.00 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.

42.00.00 UNFAVOURABLE WORKING CONDITIONS

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavorable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavorable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

43.00.00 PROTECTION OF MONUMENTS AND REFERENCE POINTS

The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the

Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be performed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.

44.00.00 WORK & SAFETY REGULATIONS

44.01.00 General

i) The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.

ii) The Contractor shall follow NTPC Safety Rules as specified in GCC with respect to safety in construction & erection.

iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge.

iv) Thecontractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees and workers, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents for approval as per the format of Safety plan as annexed at Annexure - III.

Bidder shall furnish the Safety Plan, duly filled in as per EMPLOYER's Format.

The above proposed "Safety Plan" shall be further discussed/ finalized at Site, in line with the NTPC safety rules, and shall be approved by Project Manager/ Head of Project before start of work at Site.

v) The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site.

vi) All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard.

vii) The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and

adaptability. The contractor should also ensure these before their use at worksite.

viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.

ix) The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NTPC and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of NTPC safety documents as stated above.

x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured.

The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 0f The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health records shall be maintained accordingly and to be submitted to Engineer I/c when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer I/c. The medical fitness certificate to be submitted to Engineer (I/c).

xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.

44.01.01 **Emergency Action Plan**

The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.

44.01.02 **Scaffolding**

The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and it erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.

44.01.03 **Opening**

The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.

44.01.04 **Explosives**

The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.

44.02.00 **Fencing of Machinery**

The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery.

The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.

44.03.00 **Carrying of Excessive Weight by a Worker**

The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.

44.04.00 **Dangerous and Harmful Gases / Equipment**

The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc.

The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.

44.05.00 **Overhead Protection**

The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person.

Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

44.06.00 **Working at Heights**

All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping.

Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work.

Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.

Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (fall arrestors) for climbing/getting down through ladders to prevent fall from height.

44.07.00 **Handling of Hazardous Chemicals**

The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NTPC shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by NTPC and NTPC shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed.

Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NTPC, the Contractor shall use alternative methods with the approval of the NTPC without any cost implication to the NTPC or extension of work schedule.

Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.

The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.

The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.

As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.

44.08.00 **Eye Protection**

The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.

44.09.00 **Excavation**

The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides.

Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.

44.10.00 **Electrical Hazards**

The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules.

The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.

The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools.

The contractor should also ensure that all temporary electrical installations at the

construction works are provided with earth leakage circuit breakers.

44.11.00 **Vehicular Traffic**

The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.

44.12.00 **Lifting Appliances, Tools & Tackles, Lifting Gear And Pressure Plant & Equipment etc.**

The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will

be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.

44.13.00 **Excessive Noise, Vibration**

The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The ambient noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and Control) Rules, 2000. Generally for brownfield projects background noise is in the range of 58-60 DB, however it shall be responsibility of contractor to collect and measure the latest noise data at site.

44.14.00 **Electrical Installations**

44.14.01 The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment.

Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NTPC, he shall

i) Satisfy the Engineer I/C that the appliance is in good working condition;

ii) Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances;

iii) Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected.

The Engineer I/C will not grant permission to connect until he is satisfied that:

The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.

Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.

iv) No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NTPC / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers.

v) The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation. The installations are provided with suitable ELCBs and RCCBs wherever required.

44.15.00 **Safety Organisation**

44.15.01 The contractor shall employ full time safety officer(s) as per requirement stipulated in NTPC Safety Rules, exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NTPC Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub-contractor shall also be considered as the contractor's employees/workmen for the above purpose.

44.15.02 The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.

44.16.00 **Reporting of Accident and Investigation**

In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C, NTPC Safety Officer with a copy to NTPC Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.

44.17.00 **Right to stop Work**

44.17.01 The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.

44.17.02 The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (I)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.

44.18.00 **Fire Protection**

The contractor shall provide sufficient fire extinguishers at place /s of work. The fire

extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment.

44.19.00 **Penalties**

I If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c shall have the right to regulate the payment in accordance with provisions of GCC. Further such defaulting worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor.

II If two or more fatal accidents occur at same NTPC site under the control of contractor during the period of contract and he has

(1) not complied with keeping adequate PPEs in stock or

(2) defaulted in providing PPEs to his workmen

(3) not followed statutory requirements / NTPC safety rules

(4) been issued warning notice/s by NTPC head of the project on nonobservance of safety norms

(5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident.

The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.

44.20.00 The Contractor will make available minimum quantity of all safety equipments and safety PPEs of required specifications as per suggestive list included bidding documents as a part of "List of minimum T & P". Further Contractor will ensure availabilitty of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion.

44.21.00 The Contractor shall abide by the following during Construction and Erection activities:

I. Chain pulley block shall not be used for loads more than 2 (Two) tonne.

II. Hydra shall not be used for material transport.

III. Cage shall necessarily be provided to Monkey ladders of height more than 4 m.

IV. Fencing shall be provided to all Electrical Distribution boards and transformers etc.

44.22.00 Contractor shall ensure following regarding implementation of Safety:

a) Two Tier Safety Monitoring System:
Separate Safety Consultancy contract shall be awarded by NTPC for assisting and guiding overall Plant Safety during Construction. The safety consultant shall induct and engage manpower required as per specific requirements of project.
For Construction safety, Contractor shall engage certified safety team in consultation with NTPC Safety team /safety Consultant for each package/area.

b) Risk level of different area of plant shall be evaluated by NTPC Safety & Safety consultant. Based on the severity of risk level, total project area shall be categorized into different safety zones and each zone will be identified with different color coding.

c) Dedicated Project Safety Manager of Safety Consultant will be deployed. Contractor to deploy area/ system wise safety representative for each system/ area of project e.g. SG area, TG Main Power House area and similarly in other BOP Systems.

d) The Safety Officer can stop work of any contractor if safety rules are violated.

e) There should also be safety clearance in Quarterly RA bills in addition to the clearances being presently taken from HR and Quality dept.

f)	PPEs, scaffoldings, safety nets, testing tools etc. should be monitored by NTPC Safety Manager to control and maintain the uniformity of Quality for Safety equipment/ PPEs.
g)	There should be 24/7 Safety Control room equipped with IP Camera, AI Input alarms and proper communication system for monitoring safety. All CCTV footage shall be available to control room. Drone based safety monitoring shall be done during day. The safety control room shall be operated & managed by NTPC through safety consultant.
h)	Safety management plan for the Project must be submitted for approval before start of work.
i)	In line with the Project Planning, Safety planning will be done jointly by Project Team and Consultants.
j)	Availability of Fire Tender shall be ensured by contractor before start of construction work.
k)	**Number of Safety Stewards**: Each area (e.g. SG, TG, etc.) should have minimum 5 safety Stewards from Main Agency and 5 from the sub agency.
l)	Contractor should provide scaffolding material, pipes, clamps, boards and scaffolding of standard quality.
m)	Uses of Safety net, Fire blankets and fall arrester shall be adequate.
n)	Construction Elevators shall be used during erection phase.
o)	Material transport through Hydra shall be avoided.
p)	Good Quality and new PPEs and tools and machinery shall be used.
q)	All Agency /Sub Agency will deploy Safety manpower after getting approval from Head of safety Consultant.
r)	Contractor Safety officer shall take approval of JSA /HIRA of each area from Safety consultant. Before Start of work in a particular area, concerned Safety consultant clearance is must.
s)	Inspect the site to ensure it is a hazard-free environment & promotes safe practices at the job site.
t)	Verifies that injury logs and reports are completed and submitted to NTPC.
u)	Receives reports from and responds to orders issued by NTPC and Labor inspectors.
v)	Serve as primary contact for project site incident and injury notification, investigation, and follow-up.
w)	Organize and maintain necessary project safety documentation.
x)	Training Setup to be created for giving basic education of Safety to workers.
y)	Safety Park and work simulation facility to be created at site.
z)	Health Check Up facility of workers.
aa)	Vendor Safety circle (with max 25 nos person) and monthly safety award to be created.

bb)	24/7 first aid center (common for all agency) and expenditure on contribution basis which is decided by NTPC safety department.
45.00.00	**FOREIGN PERSONNEL**
45.01.00	The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.
45.02.00	Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.
45.03.00	No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.
45.04.00	The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.
45.05.00	The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time nor full-time nor shall they take part in any local politics.
45.06.00	The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.
46.00.00	**FOUNDATION DRESSING & GROUTING FOR EQUIPMENT/ EQUIPMENT BASES**
46.01.00	The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.
46.02.00	All the equipment/ equipment bases, shall be grouted and finished by bidder as per these specifications unless otherwise recommended by the equipment manufacturer.
46.03.00	The concrete foundation surfaces shall be properly prepared by bidder by chipping, grinding as required to bring the top of such foundation to the required level, to

provide the necessary roughness for bondage and to assure enough bearing strength.

46.04.00 **Grout**

The grout for equipment foundation shall be high strength grout having a minimum characteristic compressive strength of 60 N/mm2 at 28 days. The grout shall be ready mix non-shrink, chloride - free, cement based, free flowing, non-metallic grout as recommended by equipment manufacturer. The ready mix grout shall be of reputed make as approved by the Employer.

The Grout shall have good flowability even at very low water/ grout powder ratio.

The Grout shall have characteristics of controlled expansion to be able to occupy its original volume to fill the voids and to compensate for shrinkage. Grout shall be of pre-mix variety so that only water needs to be added before use.

The mixing of the Grout shall conform to the recommendations of the manufacturer of the Grout.

46.05.00 **Placing of Grout**

46.05.01 After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipu-lation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back & forth to push the grout into every part of the space under the base.

46.05.02 The grout shall be poured either through grout holes if provided or shall be poured at one side or at two adjacent sides to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.

46.05.03 In addition to the above, recommendations of Grout manufacturer shall also be followed.

46.06.00 **Finishing of the Edges of the Grout**

The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothened with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.

46.07.00 **Checking of Equipment After Grouting**

After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place

during grouting. The values recorded prior to grouting shall be used during such post grouting check- up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Employer.

47.00.00 SHAFT ALIGNMENTS

All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall conform to Zone A of ISO 10816. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

48.00.00 DOWELLING

All the motors and other equipment shall be suitably doweled after alignment of shafts with tapered machined dowels as per the direction of the Employer.

49.00.00 CHECK OUT OF CONTROL SYSTEMS

After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

50.00.00 COMMISSIONING SPARES

50.01.00 It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However. such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.

50.02.00 These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.

51.00.00 CABLING

51.01.00 All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Employer.

51.02.00 Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in

such a way that cables are accessible for any maintenance and for easy identification.

51.03.00 Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulted cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.

51.04.00 In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.

51.05.00 Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to the Employer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.

51.06.00 The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

52.00.00 EQUIPMENT DELIVERY AND ERECTION

52.01.00 General Requirements

(a.) This part covers Contractor's responsibilities for packing, shipping, ware-housing and the installation of all equipment and materials furnished and installed under this specification.

(b.) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following:

(1.) Instructions for packing, shipping, receiving handling, ware-housing and storage.

(2.) Instructions for location and installation of equipment furnished by this specification.

(3.) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.

(4.) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.

(5.) Check lists and quality assurance hold points.

(6.) Format for all related documentation.

(c.) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering.

(d.) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engg.

52.02.00 **Crating**

(a.) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.

(b.) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted.

(c.) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping.

(d.) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified.

(e.) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior.

(f.) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.

(g.) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number:

a) Export case markings
b) Case number
c) Gross weight and net weight in Kilograms
d) Dimensions in centimeters
e) Complete description of material

(h.) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.

(i.) Electrical equipment, control and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.

(j.) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures.

(k.) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired.

(l.) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit.

(m.) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site.

(n.) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

(o.) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.

52.03.00 **Factory Assembly**

(a.) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismounted from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels.

(b.) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing.

A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.

52.04.00

Equipment Installation

(a.) General Requirements

(1.) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all equipments furnished under this specification.

(2.) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval.

(3.) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer.

(4.) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications.

(b.) Installation Materials

All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor.

(c.) Regulatory Requirements

All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.

(d.) Cleaning

All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown.

(e.) Equipment Assembly

Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications.

(f.) Equipment Setting

Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.

Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that

operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level.

(g.) **Free-Standing Equipment**

Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.

(h.) **Non-free Standing Equipment**

(1.) Non-free standing local enclosures and cabinets shall be mounted in

accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner.

(2.) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part.

(i.) **Equipment Location**

(1.) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer.

(2.) Solenoid valves not located in enclosures or mounted on valves shall

be mounted in easily accessible protected locations near the components with which they are associated.

(3.) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.

(4.) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.

(5.) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion.

(6.) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections.

For location of C&I related equipment/devices, the requirement specified elsewhere in the technical specification may be referred.

(j.) **Installation of Field Mounted Instruments and Devices**

The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These

drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage.

In addition to above relevant Portion as specified elsewhere in technical specification may be referred.

(k.) **Piping Connections**

(1.) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.

(2.) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.

(l.) **Equipment Checkout**

(1.) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.

(2.) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.

(m.) **Defects**

(1.) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work

under these specifications.

(2.) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications.

(n.) **Equipment Protection**

(1.) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.

(2.) The equipment shall be protected during storage as described herein.

(3.) Equipment shall be protected from weld spatter during construction.

(4.) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.

(5.) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable

means. Broken, stolen, or lost components shall be replaced by the Contractor.

(6.) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.

53.00.00 WELDING - SPECIAL REQUIREMENTS

If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.

54.00.00 DEVIATIONS DISPOSITIONING:

Any deviation to the contract and employer approved documents shall be properly recorded in the format prescribed by NTPC. All the deviations shall be brought to the knowledge of employer's representative for suitable dispositioning.

55.00.00 NON-DESTRUCTIVE TESTING (NDT):

The contractor shall record results of NDTs carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & correlated to the job shall be handed over to the employer. Sensitivity of all the test equipment shall be compatible to the job & acceptance norms agreed.

Computed RT shall be used as an advanced Engineering Practice. Main contractor to ensure minimum 10% computed radiography of weld joint to be performed in construction phase for scope agreed in FWS for boiler pressure parts. Main contractor to ensure the transfer & storage of these records in Server

55.01.00 Sub contracting of NDT & PWHT / SR Agencies- NDT & PWHT / SR contract shall be directly awarded by the main contractor to their approved NDT & PWHT / SR agencies .

56.00.00 TESTING EQUIPMENT & FACILITIES:

Contractor shall provide the testing equipment and facilities necessary to carry out tests & inspections.

ANNEXURE-I

STANDARD CHECKLIST

COMMISSIONING/TESTING ESSENTIAL PRE-REQUISITE

1. MECHANICAL

(A.) **VALVES**

(1.) MANUALLY OPERATED VALVE

(2.) ELECTRICALLY OPERATED VALVE

(3.) PNEUMATICALLY ACTUATED VALVE

(4.) HYDRAULICALLY ACTUATED VALVE

(5.) SAFETY VALVE

(6.) ELECTROMATIC RELIEF VALVE

(7.) STEAM TRAP

(8.) BUTTERFLY VALVE (ELECTRICALLY OPERATED)

(9.) BUTTERFLY VALVE (MANUALLY OPERATED)

(10.) BUTTERFLY VALVE (FOUR WAY-ELECTRICAL)

(11.) NON-RETURN VALVE (INCLUDING HYDRAULIC/PNEUMATIC FCNRVS)

(12.) THREE WAY CONTROL VALVE

(13.) RELIEF VALVE

(14.) DIFFERENTIAL PRESSURE REGULATING VALVE

(15.) FLOAT OPERATED VALVES

(B.) TANKS AND PRESSURRE VESSELS

(1.) TANKS (METAL) UPTO 20 M2

(2.) TANKS (LARGE STORAGE)

(3.) PRESSURE VESSEL (BELOW 17 BARS)

(4.) AIR RECEIVER

(5.) PRESSURE VESSEL-ACCESS DOOR

(6.) TURBINE MAIN OIL TANK

(C.) PUMPS

(1.) PUMP LOW PRESSURE CENTRIFUGAL (MOTOR DRIVEN)

(2.) PUMP UP TO 350 HP (260 KW)

(3.) PUMP SUMP INSTALLATION

(4.) GEAR PUMP/SCREW PUMP

(D.) PIPE WORK SYSTEM

(1.) STEAM SERVICES

(2.) WATER SERVICES
(3.) OIL/FIRE RESISTANT FLUID SYSTEM
(4.) AIR SERVICES (COMPRESSOR)
(5.) HIGH PRESSURE SERVICES
(6.) CONSTANT LOAD SUPPORT
(7.) SPRING SUPPORTS
(8.) HANGERS AND OTHER SUPPORTS

(E.) STRAINER AND FILTER
(1.) STRAINER/FILTER BASKET TYPE
(2.) STRAINER ROTARY (LOW PRESSURE)
(3.) FILTER & STRAINERS CENTRIFUGAL SEPARATORS
(4.) FILTER & STRAINER Y-TYPE
(5.) FILTER & STRAINER (PLATE TYPE)
(6.) PURIFIER
(7.) FILTER-COMPRESSED AIR LINE

(F.) HEAT EXCHANGER
(1.) HEAT EXCHANGER (GENERAL)
(2.) HEAT EXCHANGER-OIL/WATER
(3.) ROTARY AIR HEATER

(G.) FANS AND COMPRESSORS
(1.) FANS-NON-PRESSURE LUBRICATED
(2.) FANS-AXIAL FLOW PRESSURE LUBRICATED
(3.) COMPRESSORS-GENERAL
(4,) DAMPERS & GATES

(H.) CRANES AND ELEVATORS
(1.) AUXILIARY OVERHEAD/GANTRY CRANE
(2.) TRAVEL SUPPORT STRUCTURE FOR CRANE
(3.) LONG TRAVEL & CROSS TRAVERSE MOTION OF CRANE
(4.) MAIN AUX. HOIST MOTION (CRANE)
(5.) ELECTRIC HOIST

(I.) POWER TRANMISSION
(1.) POWER TRANSMISSION GEAR BOX
(2.) BEARING
(3.) FLUID COUPLINGS

2. ELECTRICAL

(1.) SWITCHYARD

(2.) POWER TRANSFORMERS, LT INDOOR TRANSFORMERS, OUTDOOR TRANSFORMERS.

(3.) BATTERY CHARGERS, DC BATTERIES, DG SETS, STATION LIGHTING, OVERHEAD LINES.

(4.) MV BUS DUCTS

(5.) D.C. MOTOR

(6.) HV SQUIRREL CAGE INDUCTION MOTOR

(7.) 415 V SQUIRREL CAGE INDUCTION MOTOR

(8.) MOTOR OPERATED ACTUATORS

(9.) LT SWITCHGEARS/MCC

- (I.) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM
- (II.) PT CARRIAGE AND CUBICLES
- (III.) CABLE/BUS DUCT/BUS BARS
- (IV.) CONTRACTOR MODULE
- (V.) SWITCH FUSE MODULE
- (VI.) MASTER PANEL OF LUBE OIL PANEL
- (VII.) FEEDER PANEL OF LUBE OIL PANEL
- (VIII.) SPACE HEATER AND CABLE MODULE
- (IX.) CONTROL TRANSFORMER MODULE
- (X.) HT CIRCUIT BREAKER
- (XI.) 415 V CIRCUIT BREAKER

(10.) POWER CABLE

(11.) CONTROL CABLE

(12.) AUXILIARY CABLE

(13.) D.C. CABLE

(14.) EXPLOSION PROOF ELECTRICAL EQUIPMENT

(15.) JUNCTION BOX

(16.) CONTROL TRANSFORMER MODULE

(17.) BRUSH GEAR ASSEMBLY

(18.) AUX. CONTROL AND RELAY PANEL DESK

(19.) INDICATING INSTRUMENT

(20.) RECORDING INSTRUMENT

(21.) INTEGRATING INSTRUMENT

3. CONTROL & INSTRUMENTATION

(A.) CONDUCTIVITY ANALYSING EQUIPMENT INCLUDING TEST PROCEDURES

(B.) PH ANALYSER INCLUDING TEST PROCEDURE

(C.) SILICA ANALYSER

(D.) LEVEL SWITCH (FLOAT ACTUATED)

(E.) LEVEL SWITCH (ELECTRODE TYPE)

(F.) LEVEL SWITCH (DISPLACER ACTUATED)

(G.) TRANSMITTER (FLOAT OPERATED PNEUMATIC OUTPUT) INCLUDING TESTING PROCEDURE

(H.) LEVEL INDICATOR (FLOAT/PULLEY TYPE)

(I.) LOCAL TEMPERATURE INDICATORS INCLUDING TEST PROCEDURE

(J.) RESISTANCE THERMOMETER ELEMENT INCLUDING TEST PROCEDURE

(K.) THERMOCOUPLE ELEMENT AND CONNECTING CABLE

(L.) THERMOCOUPLE AND RESISTANCE THERMOMETER CONVERTOR/TRANSMITTER INCLUDING TEST PROCEDURES.

(M.) TEMPERATURE SWITCH/THERMOSTAT INCLUDING TEST PROCEDURES

(N.) COLD JUNCTION BOXES

(O.) ZENER BARRIER

(P.) O2 ANALYSER

(Q.) O2 IN HYDROGEN INCLUDING TEST PROCEDURES

(R.) PRESSURE AND VACUUM GAUGE

(S.) PRESSURE AND VACUUM SWITCH INCLUDING TEST PROCEDURE

(T.) DIFFERENTIAL PRESSURE TRANSMITTER INCLUDING TEST PROCEDURE

(U.) DIFFERENTIAL PRESSURE SWITCH INCLUDING TEST PROCEDURE.

(V.) FLOW INDICATOR (VARIABLE AREA)

(W.) ORIFICE PLATE

(X.) TURBINE FLOW TRANSMITTER

(I.) FLOW SWITCH

(II.) WEIR

(III.) NOZZLE

(IV.) FLOW INDICATOR (PNEUMATIC INPUT) INCLUDING TEST PROCEDURE

(V.) FLOW INTEGRATOR (PNEUMATIC INPUT) INCLUDING TESTPROCEDURE

(VI.) FLOW INDICATOR (FLOAT OPERATED) INCLUDING TEST PROCEDURE

(VII.) VENTURI (FLUID)

(VIII.) FLOW SWITCH (MAGNETIC TYPE)

(IX.) AVERAGING INLET

(X.) LIMIT SWITCHES

(Y.) TURBINE SUPERVISORY MEASURING SYSTEM

(Z.) POSITION MEASUREMENT AND INDICATION INCLUDING TEST PROCEDURES

(AA.) TACHOMETER

(BB.) VIBRATION MEASUREMENT

(CC.) DIGITAL INDICATOR

(DD.) MOVING COIL INDICATOR INCLUDING TEST PROCEDURE

(EE.) RECORDER INCLUDING TEST PROCEDURE

(FF.) FLAME SCANNER

(GG.) ELECTRICAL AUTO MANUAL CONTROL STATION

(HH.) PUSH BUTTON MODULE

(II.) ALARM ANNUNCIATOR EQUIPMENT INCLUDING TEST PRO

(JJ.) TEST PROCEDURE FOR ELECTRONIC MODULES OF DDCMIS

KK.) THERMO CONTROL VALVE

(LL.) TEST PROCEDURE FOR ADJUSTMENT OF MODULATING CONTROLLER - PID TERMS

(MM.) TEST PROCEDURE INDICATING CONTROLLER-ELECTRICAL INPUT AND PNEUMATIC OUTPUT

Note: The items which are not part of this specification may be considered as not applicable.

ANNEXURE-II

BRIEF WRITE UP ON THE CONTENTS OF TESTING SCHEDULE / COMMISSIONING SCHEDULE

Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices.

Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting.

Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self-contained one:

1. Plant Details/Design data
2. Testing Objective/Proposals
3. State of the Plant
   a) Erection Status with respect to Mech. Elect and C&I
   b) Availability of the services required
   c) Safety requirements as per Manufacturer's
4. Test method including completion/acceptance criteria
5. Results
6. Appendix
   a) Testing Programme
   b) Mech/Elect/C&I -Plant item completing list
   c) List of Drawing/documents required for carrying out the testing.

ANNEXURE - III

SAFETY PLAN

01. Safety Policy of the Contractor to be enclosed:
02. When was the Safety Policy last reviewed:
03. Details of implementation procedure / methods to implement Safety Policy / Safety Rules:
04. Name, Qualification, experience of Safety Officer
05. Review of Accidents Analysis Method, Methods to ensure Safety and Health:
06. Unit executive responsible to ensure Safety at various levels in work area:
07. List of employees trained in safety employed before execution of the job. Give the details of training:
08. Safety Training Targets, Schedules, methods adopting to providing safety training to all employees:
09. Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed):
10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed:
11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity:
12. Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up:
13. Provision for treatment of injured persons at work site:
14. Review of overall safety by top Management and Periodicity:
15. System for Implementation of Statutory legislations:
16. Issue of PPEs to employees, Periodicity / stock on hand etc:

Signature

Head of the Organisation with date & stamp

ANNEXURE-IV

Health Safety and Environment (HSE) Policy and HSE Management Manual

1. INTRODUCTION

1.1 Background

NTPC safety policy and various safety requirement has already been indicated in the site regulation and safety section of GCC. This document shall be supplementary to above document and shall be read in conjunction with site regulation and safety section of GCC. In case of any contradiction, the stringent of the two requirements (in the opinion of the employer) shall prevail.

NTPC being India's largest power utility and a responsible corporate entity, the statement of policy on health and safety at work sets out the commitment of NTPC to manage health and safety effectively, and what shall be achieved by NTPC, the Contractor and any appointed sub- contractor.

NTPC, the Contractor and any appointed sub-contractor is committed to provide and maintain a safe and healthy workplace for all staff, and to provide the information, training and supervision needed to achieve this.

All involved parties are committed to protect the fundamental rights of all appointed workers and feel obliged to create a sound worker-management relationship as a key ingredient in a sustainable and successful project execution.

All involved parties will have to assume the responsibility for H&S procedures, and need to be made aware of their responsibilities and to comply with NTPC's H&S Policy.

The following requirements are mandatory for each worker in maintaining a safe and healthy workplace through:

- Being involved in the workplace H&S System;
- Sticking to correct procedures and equipment;
- Wearing protective clothing and equipment whenever required;
- Reporting any pain or discomfort as soon as possible;
- Ensuring that all accidents and incidents are reported;
- Helping new workers, trainees and visitors to the workplace understand the right safety procedures and why they exist;
- Telling the responsible managers immediately of any H&S concerns;
- Keeping the work place tidy to minimise the risk of any accidents.

The aim of all the stake holders is to achieve the following goals:

- Zero fatalities of workers, visitors or the public;
- Zero accidents and incidents of workers, visitors or the public;
- Zero harmful, hazardous or dangerous situations or occurrences;
- Zero environmental concerns or impacts;
- Continuous improvement of the health & safety performance at site under practical conditions.

1.2 **Definition of Occupational Health & Safety**

Since 1950, the International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. It was adopted by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950 and revised at its twelfth session in 1995 and is defined as follows:

Occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job.

"The main focus in occupational health is on three different objectives:

- the maintenance and promotion of workers' health and working capacity;
- the improvement of working environment and work to become conducive to safety and health and
- the development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings.

The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking."

Workers safety has to be understood as the practice of an employer using preventative measures to prevent hazards to the employees' personal safety. This practice includes creating plans and procedures for employees and managers in the workplace. In addition, workplace safety involves creating policies and keeping emergency materials available for employee and manager use while at a work site.

1.3 **Purpose of the H&S Management Manual**

The present H&E Management Manual shall delineate the Health and safety Requirements, incl. policies and guidelines, and outline the roles and responsibilities of the different parties involved in the implementation and oversight of Health, Safety and Environment Measures to ensure community, worker and public health and safety during construction.

The H&S Management Manual considers the applicable national occupational health, safety and welfare legislation as well as guidelines and standards established by the relevant Ministries and Authorities.

The H&S Management Manual other than Site Regulation and Safety provisions provided in Bidding Documents takes the following applicable IFC Performance Standards (PS) into account:

- PS 2: Labour and Working Conditions, dated January 1, 2012
- PS 3: Resource Efficiency and Pollution Prevention, dated January 1, 2012
- PS 4: Community, Health, Safety and Security, dated January 1, 2012.

The H&S Management Manual includes the Occupational Health & Safety Requirements and arrangements that are mandatory for the Contractor for consideration and implementation.

In case the provisions in Site Regulation and Safety provisions provided in Bidding Documents are superior than the provisions indicated in this manual, the provisions provided in Site Regulation and Safety provisions provided in Bidding Documents shall prevail.

The defined H&S Standards are part of the contractual obligations, and no changes are possible without a prior written approval by NTPC.

1.4 Content of the H&S Management Manual

The H&S Management Manual contains an outline of the required H&S Organization at site and to be implemented by the Contractor.

It describes the overall H&S Management required for the organization of a safe and healthy working environment for the workers and to ensure that the public will not be affected by the construction activities. In addition to the organizational arrangements roles and responsibilities of the required H&S Staff of the Contractor are defined.

Attention is paid to the need for training to be implemented by the Contractor. It starts with the evaluation of training needs and defines the requirement of developing a training schedule as well as workers and visitorinduction.

Communication procedures are addressed and needed H&S Reporting is specified for the entire construction period.

As one of the most important subjects, the entire risk management process is comprehensively described, specifying the risk management process, the hierarchy of control and the safe system of work.

Reporting and monitoring procedures are developed for the fulfillment bythe Contractor and the standards for PPE are included.

The H&S Management Manual shall highlight the entire H&S Management System and also provide information on the H&S Standards to be followed by the Contractor.

2. HEALTH & SAFETY MANAGEMENT SYSTEM

An H&S Management System is implemented for the Project. The management system comprises of different components to be developed bythe Contractor.

That the Contractor must implement human resource policies and procedures that set out the approach to manage workers consistent with the requirements of IFC PS 2 as well as the applicable national laws and standards.

2.1 Health & Safety Management Manual

Contractor will implements this H&S Management Manual in order to delineate the Project's H&S Requirements, Policies and Guidelines as well as to outline the roles and responsibilities of the different parties involved in the implementation and oversight of measures to ensure community, worker and public health and safety during construction.

2.2 Contractor's H&S Plans

All Contractors shall establish an effective project specific H&S Plan. TheH&S Plan will be subject of NTPC's written approval. The H&S Plan shall be submitted by the Contractor not later than 4 weeks prior to any commencement of works at site.

Any work at site, incl. mobilization to the site will not be allowed to commence until NTPC deems the Contractor's H&S plan to be suitableand sufficient.

The H&S Plan shall describe how health and safety will be managed at site, incl. mobilization and transport to the site, and how the specified H&S Standards will be applied in practice. In

addition the Contractor shall ensure adequate communication of these requirements throughout the supply chain,its supervision, and the workers themselves.

The H&S Plan shall specify the management arrangements for carrying outthe work including but not limited to:

- Overview of the project;
- Clearly identified risks associated with the scope of works;
- Program and milestones;
- Site management and organization;
- Key contractors and sub-contractors;
- Communication, Cooperation and Co-ordination;
- Site security;
- Traffic management;
- Welfare facilities and provision;
- Arrangements for supervision of contractors on site;
- Arrangements for information, instruction and training includinginduction;
- Management of hazards on site;
- Arrangements for identification of hazards, assessment of risk and production of Method Statements;
- Arrangements for hazardous undertakings e.g. confined space, work at height, hot work, excavations, cofferdams etc.;
- Permit to work system;
- Site rules;
- Arrangements for managing plant and equipment;
- Management or lifting operations;
- Management of temporary works;
- Arrangements for monitoring and auditing etc.;
- Requirements as defined by relevant statutory planning authorities e.g. traffic, noise, working hours etc.;
- Incident & accident investigation.

The H&S Plan shall also consider the site rules outlining the H&S Requirements for all workers. The site rules shall include but should not belimited to:

- Site access;
- Access to and transport on the site;
- Entering and leaving the site;
- Use of mobile phones;
- Smoking;
- PPE requirements;
- General behaviour;
- Transport to the site;
- Vehicle traffic within the site area;
- Access to the site and Working Areas;
- Restricted areas.

The H&S Plan shall consider related plans and the corresponding direct and indirect H&S Requirements. This refers especially to the following related plans and assessments:

- Hazardous materials and waste management plan;

A checklist for the review and approval of project specific H&S Plans shall be developed prior to the construction contract. The checklist shall define the minimum requirements to be met by the Contractor.

2.3 Contractor's H&S Procedures

The Contractor is requested to develop workplace specific H&S Procedures. In this matter, it should be noted that procedures are similar to method statements probably better known by Contractors. The required content of H&S Procedures is described below.

H&S Procedures are part of the Project framework for effective H&S Management. The H&S Policy states the intention to provide a safe andhealthy workplace, and states the H&S goals of a workplace.

Specific health & safety workplace procedures shall address particular issues or hazards and the measures how to control those identified hazards. The procedures should be used together with other hazard control measuresto eliminate or reduce the risks of accidents and incidents and illness and/orinjuries at the working place.

H&S Procedures shall be developed for the following activities expected to apply during construction:

- Site access control and site security procedure;
- Health & safety protection at transmission line worksites;
- Isolation and lock-out;
- Use of hazardous chemicals;
- Simultaneous activities;
- Live line work;
- Shift work, shift rotation and fatigue;
- X-ray and NDT;
- Risk assessment;
- Job Safety Analysis;
- Working at height;
- Working in confined spaces;
- Use of personal protective equipment;
- Excavation works;
- Hot works;
- Welding;
- Emergency response procedure;
- Evacuation procedure (if applicable);
- First aid;
- Working in water (if applicable);
- Use of electrical equipment;
- Work on high voltage.

This checklist shall define the minimum requirements to be met by the Contractor.

2.4 Contractor's Safe Work Instructions

Safe work instructions shall be developed by the Contractor identifying the health and safety issues that may arise from use of the machinery and equipment. The safe work instruction must be based on the H&S Plan.

A safe work instruction should identify:

- the hazard associated with the use of a specific tool or equipment;
- the required control measures to be checked to ensure a safe use of a specific tool or piece of equipment;
- the specific training and/or qualification required;
- the personal protective equipment to be worn.

Safe work instructions do not replace the requirement for a risk assessment, preparation of a workplace procedure, the need of a permit to work or the need for training.

A risk assessment of the equipment must be performed before developing safe work instruction procedures to identify the hazards and risk controls.

A checklist for the review and approval of project specific Safety Work Instructions will be developed by the PIC prior to the first construction contract. The checklist will define the minimum requirements to be met by the Contractor.

2.5 Contractor's H&S Forms

The Contractor must develop forms like checklists for risk assessment etc. to support the support the use of workplace procedures, instructions, audits etc.

These forms must be attached to the respective documents, and must be read in closed conjunction with the corresponding document(s).

The checklists shall be subject of an update and revision in case improvements or needed changes were found suitable and required.

The checklists must be subject of project documentation, in the same way and considering the same procedure that is applicable for the project documentation in general.

H&S Forms have to comprise the following subjects as a minimum:

- Contractor Audit Questionnaire
- Basic Risk Assessment
- Permit to Work
- Workplace Inspection Checklist
- Accident/Incident Report/Investigation
- Fire Risk Assessment
- Hazardous Substance Risk Assessment
- Ladder Inspection Checklist.

The forms to be used by the Contractor must include all pertinent information. Additional forms like inspection checklists, workplace inspection checklists might be necessary and should be prepared by the Contractor and are subject of approval by NTPC.

2.6 Contractor's Grievance Management System

2.6.1 Workers Grievance Management System

The Contractor must implement a grievance management system to enable the workers to raise complaints and to inform about non-compliances with the implemented H&S Management System. The grievance management system should provide the possibility to issues complaints in case of discrimination and/or the non-consideration of equal opportunities.

The grievance management system shall consider the possibility to contact directly a member of the H&S Staff. The contacted staff members must take a note of the reported complaint or non-compliance and must report it to thesite manager and the H&S Manager.

The H&S Management is requested to solve a complaint or non-compliancewithin 3 working days. In case the problem could not be solved an action procedure specifying the needed activities together with a final deadline until the problem is expected to be solved must be prepared and submitted to NTPC.

The Contractor is requested to provide the possibility for the workers to notify a complaint or non-compliance in a confidential way.

2.6.2 Public Grievance Management System

The grievance management system shall also be open for public complaints.

A respective procedure must be developed by the Contractor for review and approval. The grievance management system for the public must consider areporting procedure to the local authority to demonstrate to the administrative body that the complaint was identified, noted, managed and solved.

The responsible authorities at the community level must be identified by the Contractor 4 weeks prior to the start of the construction activities or 4 weeksprior to the mobilization to the site.

The reporting procedure should be discussed and agreed upon together with the administrative body and specific attention should be paid to any specific requirements to be announced by the authority. The contact with the authority should be established by having a face-to-face meeting. This meeting should be attended by an H&S Representative of the Contractor.

2.7 H&S Committee

It shall be governed by site regulation and safety requirement as stipulated in GCC

3. ROLES, RESPONSIBILITIES AND ACCOUNTABILITY

It shall be governed by site regulation and safety requirement as stipulated in GCC

3.2.1 Child Labour

The contractor shall not deploy any person below the age of 18 years.

3.2.2 Pregnant Woman

Pregnant employees have the following four major prerogatives:

- paid time off for antenatal care
- maternity leave
- maternity pay
- protection against unfair treatment, discrimination or dismissal.

In addition, the contractor must not change a pregnant employee's contract terms and conditions without agreement. If this will be done by a contractor, it has to be handled as a breach of contract.

It's illegal for contractor to refuse to give pregnant employees time off for antenatal care or refuse to pay their normal rate for this time off.

The following rights shall be considered:

- Pregnancy-related illnesses
  If the employee is off work for a pregnancy-related illness in the 4 weeks before the expected date of birth of the child, maternity leave and statutory maternity pay by the employer has to start automatically.
- Compulsory maternity leave
  In case the employee does not take statutory maternity leave, they must take 4 weeks off after the child is born.
- Telling the contractor about the pregnancy
  Employees are obliged to inform their contractor about the pregnancy at least 15 weeks before the beginning of the week of the expected date of birth or, in case of unawareness of the pregnancy during this timeframe, the contractor must be told as soon as possible.

  Employees must also tell the contractor when they want to start their statutory maternity leave and pay.
- Health and safety for pregnant employees
  After the receipt of information about the pregnancy of an employee, the employer should assess the risks to the woman and her baby.

  Risks could be caused by:

  - heavy lifting or carrying
  - standing or sitting for long periods without adequate breaks
  - exposure to toxic substances
  - long working hours
  - vibration and mechanical shocks
  - extreme heat
  - noise
  - ionising radiation
  - non-ionising (electromagnetic) radiation
  - carbon monoxide
  - lead
  - polychlorinated Byphenyls
  - organic solvents
  - pesticides and herbicides
  - tobacco smoke.

The MSDS to be provided together with each chemical substance to be in use or to be delivered at the construction site, storage area etc. should highlight the category.

Where there are risks, the contractor should take reasonable steps to remove the risks or by offering the employee different work or work places or by changing the working hours by the adaption of sufficient breaks.

In case the contractor can't remove any risks, the contractor must suspend the employee on full pay and without any reduction.

Pregnant worker who think they're at risk but their employer disagrees should report to NTPC's H&S Manager during a site audit.

The contractor is obliged to inform every pregnant employee about theirrights in writing and this information must be recorded.

Apart from above, all the provisions of Maternity Benefit Act, 1961 as applicable from time to time, shall be complied with by the contractor.

4. TRAINING

It shall be governed by site regulation and safety requirement as stipulated in GCC

5. HEALTH & SAFETY REPORTING

5.1 Contractors Reporting Obligations

Independent from the general requirement and contractual obligations to implement a reporting scheme with respect to the progress, construction schedule and project reporting in general, the Contractor will be obliged to implement an H&S Reporting.

The H&S Reporting should provide an overview of the H&S Performancewithin a particular timeframe and with specific topics as mentioned below:

The H&S Reports should be submitted to NTPC Project Manager

5.1.1 Health & Safety Performance

5.1.1.1 Weekly Reports

The Contractor shall prepare weekly H&S reports. The weekly reports shall be submitted by close of business on the first working day after a completed working week, e.g. the reporting timeframe is from Monday to Saturday and the respective following working day is the upcoming Tuesday, if not a public holiday.

The weekly reports shall comprise of the following information with respect to the reporting timeframe:

- Originator
- Name of the project
- Activities performed
- Health occurrences
- Safety occurrences
- Resulting accidents, incidents or dangerous situations
- Undertaken measures.

5.1.1.2 Monthly Reports

The Contractor shall prepare monthly H&S reports. The monthly reports shall be submitted by close of business of the last working day of the first working week after the reporting timeframe, e.g. the reporting timeframe is from 1st of January until 31 of January and the due day of the submission ofthe report is the Friday of the first working week in February, if not a publicholiday.

The weekly reports shall comprise of the following information with respectto the reporting timeframe:

- Originator
- Name of the project
- Activities performed

- Health occurrences
- Safety occurrences
- Resulting accidents, incidents or dangerous situations
- Investigation results
- Undertaken measures
- Lessons learned
- Informed authorities and resulting obligations/conditions
- Results of workplace inspections.

5.1.2 **Hazards Reporting**

The H&S Staff of the contractor is requested to undertake workplace inspections. In case that hazards and risks are identified during workplace inspections, it is needed that the identified hazard or risk has to be solved immediately and without delay during the inspection.

In case that the problem could not be solved, a written report has to be prepared and issued to the H&S Manager or site manager highlighting:

- a description of the problem;
- the reason why it could not be solved during the inspection;
- the needed action;
- the responsible person;
- the associated hazards and risks;
- the deadline until the problem must be solved.

The occurrence must be reported in the monthly H&S Report.

Any other reporting requirements with respect to H&S, e.g. audit reports,weekly and monthly H&S Reports, remain unchanged.

6. **HEALTH & SAFETY RISK MANAGEMENT**

The risk management process with specifically requested forms requires a careful document administration and control. The Contractor should be aware that the documents resulting from the risk management process, in particular, the risk assessments, permits to work and job safety analysis, must be available during construction site audits and/or exemplary as part of a monthly report.

6.1 Risk Management Process

Risk management is the identification, assessment and prioritization of risks to avoid impacts on workers and the public.

The Contractor has to implement a suitable and appropriate risk management process to enable his site staff to prevent any non-compliances resulting in critical, harmful or dangerous situations followed by incidents, accidents or fatalities.

Alternatively suggested risk management processes shall be provided in theH&S Plan.

6.2 Hierarchy of Control

The first part of evaluating the risk stage, consideration must be given how likely each hazard could cause harm. When the potential for harm has been decided, the existing control measures should be identified. In this course, each step of the activity has to determine what control measures might already in place. When evaluating a risk it is imperative to check the applicable legislation and to ensure that everything required by law is in place or has to be done.

When considering current controls and further required control measures, the general principles of control should be applied:

Eliminate

- It has to be checked if the risk associated with the hazard could be eliminated.

Reduce

- It has to be assessed if the possible amount of the hazard or the exposure to the hazard could be reduced.

Isolate

- It must be evaluated if the hazard could be isolated. Isolating is the principle of preventing the contact with the hazard.

Control

- It must be assessed if a safe system of work, permit to work and/or procedures are in place to control the hazard to prevent that some bodybecomes injured.

Personal Protective Equipment

- As a final result of running through the hierarchy of control, the supply of personal protective equipment is the final result of controlling the hazard. The provision of PPE must not be the first and final stage of risk mitigation.

6.3 Safe System of Work

6.3.1 Risk Register

The Contractor is requested to develop and prepare a risk register. A risk register is a document that summarizes and defines the possible risks resulting from a particular activity, in the present case from particular construction or construction related activities. The concept of a risk register recognises that risk elements arising from proposed or actual activities fall into one of following three categories:

- Risks which are deemed to have a low risk and do not need to be managed;
- Risks that have a medium or high risk and will need to be managed;
- Risks which have an extreme risk and therefore the activity should probably not proceed.

The risk register records details all the risks identified for the construction phase and associates them in terms of likelihood of occurring and seriousness of impact.

The risk register to be prepared should identify:

- a description of each risk and its potential consequences;
- factors that may impact upon the likelihood and severity of the risk;
- an assessed risk ranking, such as
  - low,
  - medium
  - high or
  - very high;
- whether the risk ranking is acceptable or not;
- actions and controls that currently exist to mitigate risks

The definition of the risks from low to very high is explained in the following risk ranking table:

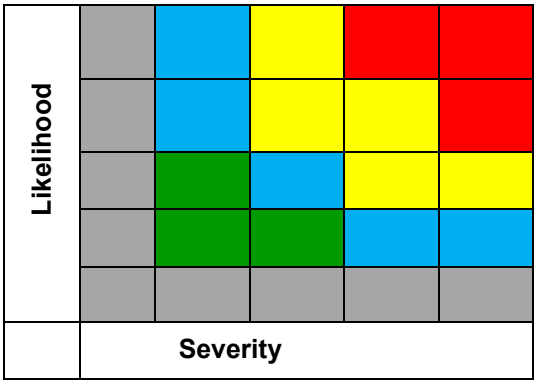


Table 6-1: Risk ranking table

It is recommended to develop the risk register at the beginning stage before start of a construction site by following the following steps:

- Identification of potential risks;
- Identification of the consequences;
- Identification of the likelihood and severity that the risk would result in adverse consequences;

Where risks have been ranked as medium, high or very high, mitigation measures must be addressed:

- **Medium (Risk ranking 3 to 4):** Mitigation actions to reduce the likelihood and severity should be identified and appropriate actions mustbe endorsed.

- **High (Risk ranking 6 to 9):** If uncontrolled, a risk event at this level may have a significant impact for the actions and tasks at a construction site as a whole. Mitigating actions need to be very reliable and should be approved and monitored by the Contractor. Even with mitigating actions in place, the construction site staff potentially exposed to that risk shouldbe advised of identified or potential risks which have been graded at this level.

- **Very High (Risk ranking 12 to 16):** Activities and projects with unmitigated risks at this level should be avoided or terminated. Mitigation actions of these types of risks may outweigh the benefits of the execution method. This is because risk events graded at this level have the potential to have significant adverse effects with the potential to cause serious accidents and incidents resulting in fatalities.

It needs to be identified if any risk mitigation procedures are in place.

If it is found that there are none, procedures must be developed consideringthe following:

- Planned actions:
  Reduction the likelihood a negative risk will occur and/or reduce theseriousness should it occur (What should you do now?)
- Contingency actions:
  Planned actions to reduce the immediate seriousness of a negative riskwhen it does occur. (What should you do when?)
- Recovery actions:
  Planned actions taken once a negative risk has occurred to allow you to move on. (What should you do after?)
- Risk Transfer:
  e.g. through assignment of contractual responsibilities or insurance.
- Actions:
  Necessary to ensure the realisation of opportunities (positive risks).

A risk register for every single construction site must be developed by the responsible Contractor considering as well the tasks and activities to be undertaken and execute by sub-contractors. The risk register has to be prepared by a competent and experienced group of engineers and workers approx. 4 weeks before mobilization to the site and start of any works at site even if they deemed to be of general nature and without having a risk potential. The risk register has to consider as well every transportation activity to the construction site.

The risk register will be subject of review and approval by NTPC.

6.3.2 **Risk Assessment**

The Contractor is requested to undertake a risk assessment for all activitiesassessed to be of a medium, high or very high risk.

The risk assessment has to be carried out with the participation of the staffexperienced with the tasks and activities and the equipment:

- the responsible H&S Manager or a H&S Supervisor
- the foreman for the execution of the activity
- the worker(s) asked to undertake the activity.

The risk assessment has to be performed prior to the execution of the activity and it must be done in written. The written risk assessment must bedocumented and stored in the project file.

The risk assessment has to be undertaken in a simple and comprehensive way, understandable by each participant.

6.3.3 **Permit to Work**

It shall be governed by site regulation and safety requirement as stipulated in GCC

Stage 1- Highlight Potential Hazards:

Worker(s) and the foreman guided by the H&S Advisor highlight potential hazards of a task and identify all necessary safety measures. The hazard identification must

consider all required electrical and mechanical equipment. Stage 1 has to be carried out in writing.

Work is not permitted to commence until Stage 4.

Stage 2-Application of Permit:

The Foreman applies for permission to start work on a prescribed form and submit the application to the H&S Advisor only when all requirements and conditions described in the permit to work have been fulfilled. The Foreman has to indicate in the written permit to work that risk assessment was conducted. The risk assessment must be attached to the permit to work.

Stage 3-Evaluation of Permit:

The H&S Advisor will evaluate and verify that all safety conditions specified in the permit to work have been fulfilled and are adequate described. He may also recommend additional measures in the permit to work when necessary. He will need to inspect the location of work wherethe permit to work has been applied for, with the Foreman during this process.

Only when all safety requirements and conditions stated in the permit to work are fulfilled, the H&S Advisor will then endorse the permit to workform and forward to the Health & Safety Manager.

Stage 4-Approval of Permit:

The H&S Manager may approve and issue the permit to work only when heis satisfied that:

- Proper evaluation of risk and hazards for the work concerned has beenconducted;
- No incompatible work will be carried out in the same time and locationof the permit to work, which may pose a risk to the persons at work;
- All reasonably practicable safety measures have been taken and all persons involved in the work have been informed of the work hazardsunder the PTW;
- All electrical and mechanical equipment is demonstrable checked and in safe conditions.

A work permit is valid for one working day and for the specified working time. In case the tasks could not be finalised within the validity of the permitto work, the permit to work must be renewed before commencement of work on the day the work may continue.

The permit to work form must include at least the following information:

- Originator
- Date
- Description of task activity
- Duration of the task
- Needed equipment
- Security certificates of equipment
- Risk Assessment
- Already implemented mitigation measures
- Further mitigation measures
- Needed training or induction
- Approved by

- Date and time of approval.

6.3.4 Job Safety Analysis (JSA)

The Contractor has to undertake a JSA which is a procedure to integrate safety and health principles and practices into a particular job operation. In a JSA, each basic step of the job related hazards has to be identified and recommendations have to be provided to choose the safest way to do the job.

For conducting a JSA four main steps have to be considered:

- selecting the job to be analyzed
- breaking the job down into a sequence of steps
- identifying potential hazards
- determining preventive measures to overcome these hazards.

The Contractor must provide a specific methodology for conducting a JSA .

7. EMERGENCY RESPONSE

7.1 Emergency Response Procedures

An emergency is a serious, unexpected, often dangerous situation that requires immediate action. The emergency procedure is the strategy of actions to be outlined in the emergency response plan to response to anemergency event.

This could include, but not limited to rescue:

- from working at height;
- in confined spaces, shafts and tunnels;
- from fire & smoke, etc.

7.2 Emergency Response Plan (ERP)

The Contractor has to develop an ERP for review and approval by NTPC.

The ERP has to consider at least the following information and instruction for an adequate management of emergency situations:

- Result of a risk assessment to determine the most probably emergencysituation;
- Identification of suitable emergency response procedures, such as:
  - Determination of safe evacuation areas;
  - Determination of safe evacuation routes;
  - Determination of accurate and suitable fire fighting equipment;
  - Determination of fire brigade;
  - Training and induction of emergency response procedure.

Note: Specific attention should be paid to the investigation of the nearest hospital or first aid station. The contact numbers of the hospital or first aid station together with at least one contact of a medically examined staff team member of the hospital or first aid station must be included in the ERP in case of injuries at night-time hours or during weekends or during bank holidays.

7.3 **First Aid at Site**

It shall be governed by site regulation and safety requirement as stipulated in GCC

7.4 **Fire Protection and Control**

The Contractor shall undertake a suitable and adequate fire risk assessment for whatever is applicable under the scope of work of the respective construction contract.

The Contractor shall ensure that the necessary fire prevention, protection and control measures are installed and maintained. This shall commence during mobilisation and updated accordingly.

The Contractor shall nominate certain of his employees who shall be trained in fire fighting duties. Nominated fire fighting personnel shall be available at all times during ongoing works on site.

7.4.1 **Fire Prevention, Protection & Control**

The following requirements apply with respect to fire prevention, protection& control and must be considered wherever applicable:

- Adequate and suitable means for extinguishing fire shall be provided and maintained.
- All stocks of inflammable substances shall be kept in a fire resisting store or in a safe place outside any occupied building.
- Provided that no such store shall be so situated as to endanger the means of escape from the workplace or from any part thereof in the event of a fire occurring in the store.
- Chemical fire-extinguishers shall be freshly charged at intervals not greater than those specified by the manufacturers, or otherwise once annually, and tested by the application of such hydraulic pressure thereto as shall be suited to the type of extinguisher tested, at intervals of not more than four years; and the dates of recharging the extinguisher and the last hydraulic test shall be clearly marked on the body of the extinguisher or on a tab securely attached thereto.
- Install a temporary or permanent water supply with sufficient flow volume and duration to supply the standpipes, hose stations, and sprinkler systems, before the construction of the facility to be protected. In permanent structures under contract in which standpipes are installed, connect the standpipe to the water supply, install the standpipe concurrently with construction of the structure, and maintain the standpipe in operable condition for fire protection use. Provide the standpipes with fire department connections on the outside of the structure, conspicuously marked, and located in an accessible location at street or road level.
- No fire, flame, open light or other agent likely to ignite volatile and inflammable substances shall be allowed or used in any part of a workplace in which volatile and inflammable substances are used.
- No person shall smoke in any part of a workplace where volatile and inflammable substances are used, and a notice prohibiting smoking shall be posted in a conspicuous place in every such part of the workplace.
- Inform workers of the fire hazards of the materials and processes to which they are exposed. Brief new workers on the parts of the plan that is essential for their protection and emergency evacuations.
- Provide additional training for personnel assigned tasks that require them to remain in a facility during a fire emergency.
- When working in potentially explosive atmospheres, safe non-electric tools and apparatus suitable for the use in such areas shall be employed.
- No plant, tank or vessel which contains or has contained any explosive or inflammable

substance shall be subjected to any welding, brazing or soldering operation, or to any cutting operation which involves the application of heat, until all practicable steps have been taken to remove the explosive or inflammable substance and any fumes arising there from, or to render them non-explosive or non-inflammable; and if any plant, tank or vessel has been subjected to any such operation as aforesaid, no explosive or inflammable substance shall be allowed to enter the plant, tank or vessel until the metal has cooled sufficiently to prevent any risk of igniting the substance.

7.4.2 Means of Fire Escape

Every workplace shall have adequate means of escape in case of fire.and must be properly maintained and kept free from obstruction.

7.4.3 Fire Alerts

The Contractor has to set up a system to alert workers on site and the public in the neighbourhood. This should be a permanent installed fire alarm (which must be tested on a weekly basis), a klaxon, an air horn or a whistle,depending on the size and complexity of the site.

Any warning needs to be distinctive, audible above other noise andrecognizable by everyone in case of fire.

8. HEALTH, SAFETY MANAGEMENT & MEASUREMENT

8.1 Noise Management

The Contractor is requested to develop a working noise monitoring plan to identify those areas at site where noise levels are occurring in a harmful range.

Generally, a reasonable mitigation measure, of more importance than wearing hearing protection devices, is the reduction of noise levels to a levelas low as reasonable possible. Avoidance has always the priority in comparison to passive reduction.

Noise levels must be kept below 80 dB (A) wherever possible. In case of exceeding this value, hearing protections must be provided to the workers and warning signs must be installed.

The noise monitoring must be repeated every week in case that the location of the construction site remains unchanged. In case of a change of the site, the noise monitoring has to be undertaken after implementation of site arrangements.

In case that a construction site could not be demarked in detail, the noisemonitoring has to be done for different activities.

The following table provides the standards, exposure times and need forpersonal protective equipment.

dB(A)	Exposure time[1)]		Need for PPE	Comment
	hours	minutes		

80	25	24	No	
85	8	0	No	
86	6	21	Yes	Suitable hearing protection must be provided. The hearing protection must be able to insulate the noise level to a value of 89 dB(A) or below.
87	5	2	Yes	
88	4	0	Yes	
89	3	10	Yes	
90	2	31	Yes	
95	0	47	Yes	
100	0	15	Yes	
105	0	4	Yes	
110	0	1	Yes	

Table 8-1: Noise standards, exposure times and need for PPE

1) Applicable to a 8h-working-shift

Source: US Department of Health and Human Services, Occupational Noise Exposure, page 18, dated June 1998.

Contractor shall ensure at a construction site that adequate measures are taken to protect workers against the harmful effects of excessive noise or vibration at such construction site and the noise level in no case exceeds the limits laid down in BOCW act 1996 and Chhattisgarh Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Rules, 2008. Additionally, compliance of The Noise Pollution (Regulation and Control) Rules, 2000) is to be ensured by the agency w.r.t ambient noise level.

8.2 Air Quality Management

The air quality at site could be affected by different emissions resulting from combustion engines or resulting from the generation of dust during dryweather conditions.

Emissions from combustion engines are difficult to reduce. Some efforts notto affect the air quality are the switch-off of machines whenever possible and to limit the number of machines and equipment to a level as low as reasonable possible. The Contractor is requested to consider these recommendations during the construction phase.

Considering this requirement, the Contractor must undertake all necessary actions to reduce the generation of dust to the lowest possible levels. Project specific measures shall be included in the H&S Plan.

Mitigation measures to prevent increased dust generation include using

dust-suppressing water spray in areas of active earthmoving and on unpaved roads, using aggregate-covered access roads to minimize dust emissions and minimizing the areas of exposed soil or cleared of vegetation. Truck beds should be covered with a tarp or similar material to minimize dust during the transport.

Mitigation measures during project activities to prevent increased air emissions would include using requiring emission control devices on equipment, maintaining properly tuned engines, avoiding unnecessary idling, using electric motors instead of internal combustion engines, usinglow-sulfur diesel fuel where available, preparing asphalt away from populated areas.

8.3 Pre-employment Health Assessment

Pre-employment health checks for construction site workers shall be mandatory. These checks shall ensure that in no case the state of health ofemployed workers can be impaired by possible pre-existing diseases. TheContractor shall deploy a suitable experienced medic and appropriate materials and premises for these checks.

Workers shall be checked, and all the results shall be analysed, before his first workday, in order to mitigate any risk.

Therefore, the Contractor shall provide the abovementioned medical staff and material during the entire year. Usage of hospital capacities is an often used option to fulfil these requirements, where those capacities are available. Only personnel with appropriate health condition with respect totheir particular job shall be employed.

All workers who are subject to an exposure to occupational health risksshall undergo periodic medical surveillance. This would be required forworkers:

- exposed to noise levels exceeding 85dB(A);
- exposed to hazardous materials, e.g. chemicals;
- carrying heavy loads.

In addition to the pre-employment health checks and periodic medical surveillance, the Contractor shall enable the site workers to pass an exit medical check after finishing their jobs on site. The exit medical check shallbe provided to all workers who worked more than 3 months constantly on the construction site.

All pre-employment, periodic or exit health checks must be documented foreach worker. The assessment records must be kept confidential and for the use by the project management only. The workers will have the right to askfor the results of the health checks.

The workers will have the right to decline any pre-employment, periodic or exit medical checks. In this case they will not have the possibility to apply for any compensation in case of health interferences resulting from their work activities in connection to existing diseases.

All pre-employment, periodic or exit health checks must be provided to the workers free of charge. The application for a health check must not result in a negative treatment of the respective worker.

The Contractor must ensure that any health checks requiring specific facilities, equipment or medical staff will be available at the constructionsite or in a reachable distance to travel.

8.4 **Covid-19 Prevention**

Contractor shall take all necessary measures related to Covid-19 prevention as per guidelines issued by Government authorities as well as NTPC guidelines (if any).

8.5 **Health Surveillance**

8.5.1 **Management of Alcohol and Drugs**

Smoking shall be prohibited at all times at the construction site, at worker's camp and at storage and fabrication areas. This includes the operating or use of all electrical or manual work equipment.

Smoking shall be restricted to clearly defined and highly visible areas, only.

The presence and consumption of non prescription drugs and alcohol is strictly prohibited at all areas.

Drug and, especially, alcohol testing shall be arranged after weekends and especially for workers appointed for works consisting of potentially high-risk activities. The drug and alcohol test shall be undertaken in case of indications of a respective consumption.

Until the result of the test is public, the worker(s) must refrain from anywork at site.

In case of a positive test result, the worker has to be expelled from the sitewithout any undue delay until the completion of the project.

9. PERSONAL PROTECTIVE EQUIPMENT

It shall be governed by site regulation and safety requirement as stipulated in GCC

10. INCIDENT & ACCIDENT MANAGEMENT

It shall be governed by site regulation and safety requirement as stipulated in GCC

11. HEALTH & SAFETY REVIEWS

11.1 MCA H&S Audits and Reviews

Prior to commencement of the main construction phase, NTPC will conduct a pre-construction phase H&S Review to ensure that all the necessary arrangements are in place and suitable for the work being undertaken at that time. This will include compliance with this H&S Standards document, the project H&S Plan and country specific legislation.

NTPC will conduct site specific H&S Reviews on a regular basis and formal H&S Audits of the Contractor and its supply chain. Formal H&S Audits will be conducted at least, every 6 months. The duration of this audit will be a minimum of 1 day and will require the full co-operation of the Contractors project management team.

In addition to H&S Reviews to be undertaken by NTPC, it is possible thatfurther H&S Audits and Reviews will be carried out by relevant stakeholders i.e. Ministry of Labour or Ministry of Health etc.

The Contractor is obliged to provide any necessary support to the stakeholders to enable them to undertake their tasks and duties and to allowthe access to the sites for undertaking the audits and reviews.

11.2 Contractors Health & Safety Review Programme

The Contractor shall implement an H&S Review Programme applicable for his construction site(s) that shall include a systematic evaluation of the implemented management system, compliance with this H&S Standards document, and the project H&S Plan and local legislative requirements.

11.2.1 Contractors H&S Audits

H&S Construction Site Audits must be undertaken on a monthly basis. The audits should be performed by the Site Manager, the H&S Manager and theH&S Advisor.

The audits should comprise the construction site itself, material andequipment storage areas, workshop areas and accommodation areas(Worker's camp area).

These audits shall be recorded and the results should be slipped into the monthly H&S Reports. A copy of the audit report must be attached to themonthly report.

11.2.2 Contractors H&S Inspections

H & S Inspections must be carried out on specific work areas and work places associated with the project on a weekly basis but independent thereofif they are assessed as medium or high risk areas or workplaces according to the risk register. The results of the inspections must be considered in the weekly H&S reports to be submitted to NTPC. A copy of the H&S Inspection report must be attached to the weekly report. The H&S

Inspections shall be executed by the H&S Manager together with the H&S Advisor.

11.2.3 Contractors Health & Safety Surveys

H & S Surveys shall be conducted by the Contractors' H&S Advisor on a daily basis. The date and time of the surveys must be documented but the results must not be recorded in a written report but significant findings mustbe communicated to the H&S Manager.

11.2.4 Contractors Management Surveys

Management surveys to be undertaken by the Contractors General Manager or his representatives shall be conducted at least every 3 months. The surveys must not be done by the responsible Site Manager, H&S Manager or H&S Advisor of the particular construction site. The results shall be recorded.

11.3 Reporting

The results of H&S Audits and H&S Inspections must be recorded and the reports must be submitted to NTPC within 3 working days after finalisation of the audit or inspection respectively. Forms to be used for the audits and audit reports respectively, inspections and surveys will be provided by NTPC.

The reports must include all relevant subjects according to the purpose of the H&S Reviews, but at least the results and the needed corrective actions.

An reporting schedule for each particular construction site must be developed by the Contractor and should be submitted to NTPC for reviewand approval.

11.4 Corrective Actions

The H&S Review reports must include the need for corrective actions. The list corrective actions must include the following information:

- Identified risks and non-compliances;
- Needed corrective actions;
- Needed personal and material resources;
- Responsible person;
- Date for latest finalisation.

The effectiveness of the corrective actions will be subject of NTPC'sH&S Audits.

11.5 Compliance Reviews

One week after the implementation of the corrective actions, the H&S Manager is requested to undertake a compliance review. After observation of the full compliance of the corrective actions, the H&S Manager has to report the finalisation to NTPC.

12. SITE H&S REQUIREMENTS

It shall be governed by site regulation and safety requirement as stipulated in GCC.

13. STAYING & FOOD ARRANGEMENT FOR WORKERS

The contractor may consider providing hygienic food, beverages and refreshments during period of Project construction which may enhance the productivity level of the workers.

The contractor shall also arrange quarters in workers habitat area for accommodation of workers during period of stay at SIPAT STPP. The proper cleaning and hygiene shall be maintained in quarters. The random checks for hygiene and cleanliness shall be done by Employer and any violation on cleanliness shall not be acceptable. Employer may take action for the same as deemed fit.

CLARIFICATION-05B FOR SIPAT-III (1X800 MW) EPC PACKAGE (UNDER BULK TENDER)

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	Employer's Response
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
430	VI/A	IIB	9 of 20	1.16.02	765 kV Overhead Transmission Line	Laying of transmission line including cable which is outside plant boundary (approx. 2 Km), has been kept in purview of Bidder's scope. NTPC may kindly note that these are works which are not the core business of Main plant power contractor and is vendor dependent works. Further, being outside plant boundary, it will require lot of interactions with local authorities for which Main plant Contractor will likely to face issues in seeking approvals, clearances etc. apart from resolving law and order issues, in case so arise(s). Therefore, NTPC is requested to delete this outside transmission line scope from bidder's scope.	Bidder to note that the subject transmission line is for the connection of 765kV Generator Transformers to the bays in generation switchyard having approximate length of 1.7Kms only. Further, considering the small line length and based on the bidder's request, the provenness criteria for Transmission Line was also removed. Bidder to refer preliminary transmission line route survey which is attached as part of the technical specifications, wherein, all the transmission line towers are feasibly located inside the land boundary of Sipat STPP except for a small portion of Line stringing. The required RoW permission and clearances for this portion of the line which falls outside the plant boundary shall be taken by NTPC after detailed engineering based on final tower spotting data. Further, no cable associated with Sipat STPP Stage-III under the scope of EPC package is being considered outside the land boundary of Sipat STPP. Accordingly, Bidder to consider the same and comply with tender specification requirements.

CLARIFICATION-04B FOR SIPAT-III (1X800 MW) EPC PACKAGE (UNDER BULK TENDER)

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	Employer's Response
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
426	VI/B	G-01	4 of 4	1.06.00	Further, Contractor will share the detailed design documents for establishing the changes done in the design for ensuring continuous operation at 40 % TMCR Load.	It is confirmed that the offered Steam Turbine shall be capable of continuous operation at 40 % TMCR Load as per CEA Gazette. However, the detailed design documents for establishing the changes done in the design are proprietor in nature and cannot be shared.	Noted.
427	VI/B	G-07			Data Sheet: Steam Turbine.	Many data / information asked are not required for operation and maintenance of the machine. These are proprietary design information of the designer and not required for the utilities. This creates trouble during execution and contract closing. Hence for maintaining the design confidentiality, such information cannot be divulged with.	Noted.
428	VI/B	A-07	1 of 25	1.04.00 (d)	Critical speed of composite rotor and blade assembly shall not be within - 10% and +15% of rated speed.	OEM design guideline and the design of the modules cannot be altered. Same guideline has been followed in all 660 & 800 MW machines which are running without any trouble on this account. Hence our deviation stands.	Noted.
429	VI/A	IIA-06 (Errata to Section VI Technical Specification; Amdt-01, TG-01)	10 of 10	16.00.00	Steam Turbine Generator & Auxiliaries and associated systems shall be designed for 40% Technical Minimum Load (TML); for meeting this mandatory requirement and ensuring the design life of Turbine including its auxiliaries, necessary changes in design to be made. Design changes to be considered shall include but not limited to the following. 1. Changes required in LP Turbine last stage and second last stage blades (as applicable) to take care of increased flow separation at 40% TML. 2. Bidder shall consider state of art design with respect to blade metallurgy and effective moisture separation methodology to avoid blade erosion & failures at 40% load continuous operation of Turbine. Bidder shall submit thermal stress analysis report of Turbine components at 40% TML operation. 3. Increased thermal stress in Turbine stages: To enable continuous operation of turbine at 40% load, Bidder shall take care of the increased stresses (due to ventilation) in turbine design and ensure that design life of turbine and its components is not reduced. Further, turbine and auxiliaries shall also be designed for complying the requirements related to flexibilization as mentioned in CEA (Flexible Operation of Coal based Thermal Power Generating Units) Regulations, 2023 in addition to the requirement specified elsewhere.	It is confirmed that the offered Steam Turbine shall be capable of continuous operation at 40 % TMCR Load as per CEA Gazette. However, the detailed design documents for establishing the changes done in the design are proprietor in nature and cannot be shared.	Noted.

CLARIFICATION-03B FOR SIPAT-III (1X800 MW) EPC PACKAGE (UNDER BULK TENDER)

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	Employer's response
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
220	VI D	ECC	14 of 64	35.12.00	.....Storage duration of any material at site shall not be more than 3 months. Accordingly supply of material in sequence of erection at site to be ensured. To achieve the same, following is to be adopted: a. Dispatch clearance is to be given in order of sequence of erection. To achieve the goal, proper tags shall be maintained in ascending order. The tag shall be self-explanatory. b. MDCC shall be issued by RIO based on clearance from Site FQA head, Main contractor, Erection head for dispatch and supply of material.	Based on experience in projects being executed at present by bidder on EPC basis, we propose to delink storage clearance with inspection and issue of MDCC by NTPC. Bidder should be given flexibility to either store the materials in it's manufacturing plant or project site based on the requirement of material for erection. This will help in making our Ordering / Manufacturing / Erection plan to meet the project timelines.	Provision of bidding documents shall prevail.
221	VI/B	SUB SECTION- G-04 STANDARD PG TEST PROCEDURE	58 of 227	METHOD OF COMPUTATION OF AUXILIARY POWER CONSUMPTION FOR ESP: -	Electrostatic Precipitator with all TR sets, all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes working and rapping system in normal operation. During the test all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes will be kept in continuously ON condition at 100% duty condition and set point temperature shall be kept 5 degrees Celsius above the Design flue gas temperature/ operating flue gas temp whichever is higher.	It is understood that tender specification is intended to specify that the hopper heaters will be kept in "ON" condition and the thermostat will trip the heater once it reaches the set point temperature. Further, the design capacity of the heaters specified in tender is for 100% BMCR condition and the 100% duty condition means 100% TMCR normal operating condition. **Hence, Bidder suggests that the tender condition shall be modified as follows:** "During the test all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes will be kept in continuously ON condition at 100% TMCR guarantee point condition and set point temperature shall be kept at design flue gas temperature at guarantee point condition"	Bidder to refer to Amendment to technical specification Sl .no. SG-02B in this regard.
222	SECTION VI/ PART-C		16 of 119	8.03.04 a(iv)	The complete 3D data (editable model) which shall be utilised for all future detailed engineering related to maintenance, operation, R&M, efficiency improvement of the project etc. Complete 3D model along with as built GADs, layout, isometrics, reports extracted and 3D models for all disciplines , with any other document generated from 3D model and naming conventions with as-built updates along with complete reference databases, component catalogues for all the size range shall be handed over to owner. Apart from the 3D Model, all drawings like GADs, Isometrics etc. extracted from the model shall also be submitted by the Contractor in Electronic form. 3D model along with complete Project databases shall be submitted at each model review stage and as final as-built. The contractor shall also submit all the configuration files, customization files, templates and all referenced databases. Further, two Licenses of the used 3D Modelling Software (One for Engineering View and One for Site View) shall be provided along with compatible Hardware for possible review and study of the Model Files being submitted by the Bidder Time to time. All software and hardware shall be supplied by bidder within 3 months of NOA. The 3D modelling software shall preferably be the same software bidder will be using for preparation of 3D model or it shall have all editable features to edit the model supplied by bidder on time to time basis. Database backup shall be taken every month and handed over to NTPC. All software provided shall necessarily include cost for perpetual license(s) for use on all the machines and an Annual maintenance contract (AMC) which shall include software upgrades as & when released by the software agency for a period of three years after warranty/guarantee period .	The OEM of the 3D modelling software (used by bidder) has expressed inability to provide perpetual licenses for ongoing NTPC tenders as his business model allows only subscription based licenses. (Further, as a special case, the OEM allowed perpetual licenses for NTPC TALCHER & LARA projects for which the supply of the licenses is under progress) In view of the above, NTPC is requested to review the requirement of perpetual licenses and allow the supply of subscription based licenses. As per prevailing industry practice, complete project database is provided after the completion of Engineering and 3D review models are shared for approvals. Accordingly 3D model will be provided at the end of Engineering and 3D review models will be shared time to time for approvals of layout drawings.	Bidder to follow specification requirement .
	EMPLOYERS RESPONSE TO TYPICAL BIDDER'S QUERIES ON SECTION VI TECHNICAL SPECIFICATIONS Sl.No. #1				**NTPC REPLY:** Data to be submitted to NTPC during detailed engineering as per the provisions of Bidding documents, are not proprietary in nature. Hence Bidder's proposal of providing only the non editable 3D (review) model is not acceptable. Bidder to further note that there are suppliers available in market who are prepared to provide software with perpetual license. As such, Bidder to comply with Technical specification requirements in entirety.		
223	SECTION-VI PART-A	SUB-SECTION-VI CHAPTER-02	9 of 34	B/IX/8	Exciter/brush gear (if applicable) Air Cooler: 1 No each type	Bidder will suuply 1no. Exciter Air Cooler. Brush Gear Air Cooler is Not Applicable. NTPC to accept.	Specification is clear that 1no.each type of air cooler for exciter/brush gear (if applicable) shall be aupplied as mandatory spares . Same shall be decided during detailed engineering as per offered exciter by the successful bidder.

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	Employer's response
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
224	VI/B (Mechanical)	G-01	4 of 4	1.06.00	Further, Contractor will share the detailed design documents for establishing the changes done in the design for ensuring continuous operation at 40 % TMCR Load. Bidder's query- Such Design document are proprietor in nature and cannot be shared. NTPC is requested to delete the clause. NTPC reply- 40% Technical minimum load operation to be ensured in line with latest CEA Gazette. Bidder may please note that this is mandatory requirement and is to be ensured by owner. Bidder to comply with the specification requirements.	It is confirmed that the offered Steam Turbine shall be capable of continuous operation at 40 % TMCR Load as per CEA Gazette. However the detailed design documents for establishing the changes done in the design are proprietor in nature and cannot be shared.	As per CEA Gazette Notification dated 25.01.2023, it is mandatory compliance for utilities to have their machines designed for flexibilisation which includes 40% technical minimum load, ramping requirements as specified in tender specifications and also two shift operation as per CEA notification dated 23.12.2022 on technical standards. Utilities may be asked to submit supporting document in this regard regarding design changes carried out in the OEM supplied machines towards compliance of these mandatory requirement. In view of the above, Bidder proposal is not acceptable and Bidder is requested to comply specification requirements.
225	VI/B (Mechanical)	G-07	3 of 8	2.05.00	Data Sheet: Steam Turbine. Bidder's query- Technical data of Steam Turbine required for operation, maintenance and information purpose shall only be furnished in O&M Manual. Data / information which are proprietary in nature, shall not be furnished. NTPC Reply- The data / information sought are not proprietary in nature and these information are provided in past also. Bidder to comply specification requirements.	Many data / information asked are not required for operation and maintenance of the machine. These are proprietary design information of the designer and not required for the utilities. This creates trouble during execution and contract closing. Still NTPC has not approved this documents in many old projects like North Karanpura, Patratu etc. Hence for maintaining the design confidentiality, such information cannot be divulge with.	The data / information sought are not proprietary in nature and these information are provided in past also. Bidder to comply specification requirements.
226	VI/B (Mechanical)	A-07	1 of 25	1.04.00 (d)	Critical speed of composite rotor and blade assembly shall not be within - 10% and +15% of rated speed. Bidder's query- Critical speed of composite rotor and blade assembly shall not be within ± 10% of rated speed. This is as per OEM's in house design guidelines NTPC Reply- Bidder's proposal is not acceptable. Bidder to comply technical specification requirement.	OEM design guideline and the design of the modules cannot be altered. Same guideline has been followed in all 660 & 800 MW machines which are running without any trouble on this account. Hence our deviation stands.	Bidder's deviation is not acceptable. Bidder to comply with the requirements of Technical Specification.
227	VI/A Amendment 01,TG-1	IIA-06	New Clause added	16.00.00	16.00.00: Steam Turbine Generator & Auxiliaries and associated systems shall be designed for 40% Technical Minimum Load (TML); for meeting this mandatory requirement and ensuring the design life of Turbine including its auxiliaries, necessary changes in design to be made. Design changes to be considered shall include but not limited to the following. 1. Changes required in LP Turbine last stage and second last stage blades (as applicable) to take care of increased flow separation at 40% TML. 2. Bidder shall consider state of art design with respect to blade metallurgy and effective moisture separation methodology to avoid blade erosion & failures at 40% load continuous operation of Turbine. Bidder shall submit thermal stress analysis report of Turbine components at 40% TML operation. 3. Increased thermal stress in Turbine stages: To enable continuous operation of turbine at 40% load, Bidder shall take care of the increased stresses (due to ventilation) in turbine design and ensure that design life of turbine and its components is not reduced. Further, turbine and auxiliaries shall also be designed for complying the requirements related to flexibilization as mentioned in CEA (Flexible Operation of Coal based Thermal Power Generating Units) Regulations, 2023 in addition to the requirement specified elsewhere.	Machine is capable of running at part load upto 40% TMCR subject to the condition that guidelines of O&M manual are strictly adhered. Further submission of any design analysis / report etc are not envisaged as they are proprietary in nature.	As per CEA Gazette Notification dated 25.01.2023, it is mandatory compliance for utilities to have their machines designed for flexibilisation which includes 40% technical minimum load, ramping requirements as specified in tender specifications and also two shift operation as per CEA notification dated 23.12.2022 on technical standards. Utilities may be asked to submit supporting document in this regard regarding design changes carried out in the OEM supplied machines towards compliance of these mandatory requirement. In view of the above, Bidder proposal is not acceptable and Bidder is requested to comply specification requirements.
228	VI/B	G-01	2 of 4	1.01.00 (n) & 1.03.00	Plant Life 25 years with Number of Starts : Hot : 6700, Warm : 1000, Cold : 150. The plant shall be capable of daily 2 load cycling from 100% to 50% & 1 load cycling bellow 50% TMCR which implies 13400 & 6700 cycles in design life.	The requirements of 7850 number of starts along with daily 3 load cycling and daily starts & stops are not practical. 7850 starts in 25 yrs means 314 starts in a year i.e. One startup in every 1.16 days. NTPC to reconsider the practicability and clarify the design requirement.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 1277 of Clarification 02.
229	VI/B	G-07	2 of 27		Tentative Master Drawing List	Master Drawing List will be agreed and finalised after order.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 181 of Clarification-02 of the same.
230	VI/B	A-02	3 of 67	1.05.00	*Type of Starts:* Hot start (after 8 hours of unit shut down) Warm start (after 36 hours of unit shut down) Cold start (after 72 hours of unit shut down)	For Start up curve preparation, we will consider the following condition as per standard practice. Hot start (after 8 hours of unit shut down) Warm start (after 48 hours of unit shut down) Cold start (after around 200 hours of unit shut down)	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 1278 of Clarification 02.
231	VI/B	A-07	3 of 25	1.11.00	TG Protection: Advisory trips by Operator shall be avoided. … Apart from mandatory turbine protection, these protections shall include, but not be limited to following: a. TG Bearing temperature b. TG Shaft/bearing vibration c. Differential Expansion d. Low Main steam temperature e. Any other safety requirement as required	Only alarm on Differential Expansion & Low Main Steam Temp is available. Auto Protection is not envisaged as per OEM standard practice.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirements.

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232	VI/B	A-07	7 of 25	1.19.00	Furnish turbine clearance diagram indicating values for radial & axial clearances and leakage rate from glands.	Submission of leakage rate is not envisaged.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 183 of Clarification 02.
233	VI/B	A-07	7 of 25	1.20.00	Type Test of Metallic expansion Joints of Steam Turbine	Type Test of Metallic expansion Joints are not envisaged.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 182 of Clarification 02.
234	VI/B	A-08,A-09			LOW PRESSURE PIPING POWER CYCLE PIPING (HIGH PRESSURE PIPING)	What is the pressure range in bar categorizing low pressure piping? What is the pressure range in bar categorizing power cycle piping (high pressure piping)?	Please refer the corresponding PART-A of the specification for services / system considered in Low pressure and Power cycel pipng.Technical specifications are clear in this regard. Bidder to comply the specification requirements.
235	VI/A	I	5 of 8	3.00.00	The tender drawings are enclosed along with the specification as Part-E, Section-VI and shall supplement the requirements specified in these technical specifications. The scope and terminal points of the equipment to be furnished under this EPC package shall be as identified in these drawings read in conjunction with text of the specification.	We understand that tender drawings for Steam Turbine & auxiliaries are only indicative and for information only. These are not binding.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 184 of Clarification 02.
236	VI/A	IV	1 of 73	1.00.01 (f)	The Contractor shall make the plant ready for the performance guarantee tests before start of Initial Operation. All CAT-1 Performance Guarantee tests shall be conducted along with initial operation.	All the efforts will be made to make unit ready for performance guarantee test before start of Initial Operation, however CAT-1 performance guarantee test shall be conducted after stabilization of Unit as per satisfaction of both parties.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 185 of Clarification-02 of the same.
237	VI/A	IV	2 of 73	1.00.01 (i-1)	For Cat-I Performance / Acceptance tests to be conducted along with the initial operation: After the conductance……. The contractor shall submit the detailed test evaluation report of Performance test results to Employer promptly but not later than 7 days from the date of conductance of Performance test.	All the efforts will be made to make unit ready for performance guarantee test before start of Initial Operation, however CAT-1 performance guarantee test shall be conducted after stabilization of Unit as per satisfaction of both parties. Separate report shall be furnished to Customer as per agreement during MOM of TG-PG test.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 1279 of Clarification-02 of the same.
238	VI/A	IV	10 of 73	1.01.03.01 (2)	In case any of the above correction curves are not submitted along with price bid , no negative corrections shall be allowed on turbine Heat rate on this account .Positive corrections if required to be applied, the amount shall be decided by Employer. Further, no positive corrections shall be allowed on turbine output on this account. Negative corrections if required to be applied, the amount shall be decided by Employer.	Correction Curves shall be generated after approval of Heat Balance Diagrams and shall be submitted for Approval and inclusion in TG-PG test procedure.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 186 of Clarification 02.
239	VI/A	IV	10 of 73	1.01.03.01 (2)	Variation in power factor, frequency, generator hydrogen pressure and voltage	Generator is not allowed to operate with variation in Hydrogen pressure & any variations in pressure shall be taken care during operation from safety aspects. Hence, no correction curve is envisaged for the same. It may be noted that same practice is also followed in all supercritical projects like Barh, Gadarwara, Mauda, North Karanpura, Khurja, Talcher etc. Hence Hydrogen Pressure Correction Curve is not applicable.	Bidder proposal is acceptable.
240	VI/A	IV	50 of 73	2.02.02	No shutdown shall be allowed for installation of PG test instrument/ flow nozzle etc. Any advanced class instrument system such as those using electronic devices or mass flow technique shall be arranged by the contractor, if required. However, same shall be installed before start of initial operation of unit. For determination of primary flow to the turbine, a calibrated low Beta-ratio throat-tap nozzle assembly shall be installed permanently in condensate line prior to initial operation, same shall be also used for process control. All the instruments including the flow nozzle shall be calibrated by the contractor before initial operation in a reputed international institute. All calibrations reports shall be made available prior to the start of initial operation and calibration certificates in original submitted to Employer. All instruments including flow nozzles as necessary for conductance of PG tests shall be installed prior to the start of initial operation.	PG test instruments are with special accuracy class and shall be calibrated before start of actual PG test and will be installed in running unit. Flow Nozzle shall be installed just before start of TG-PG test to ensure accuracy of flow measurement and its reading will be recorded in separate data logger.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 1280 of Clarification 02.

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241	VI/A	IV	51 of 73	2.03.00	The Contractor shall prepare test reports in which the methods followed, instrument readings, graphs, observations, final results obtained online, etc., shall be recorded. Soft copies of each test report shall be submitted to Employer for Approval.	TG-PG test report shall be generated as per standard format and will be submitted to Customer within shortest possible as per agreement during MOM of TG-PG test.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 1281 of Clarification 02.
242	VI/B	G-04	9 of 227	3.3	The turbine generator performance test is carried out according to ASME PTC 6-2004 or latest revision and technical specification. Uncertainty on the test results is not applicable on account of measuring instruments inaccuracy & Fluctuation of parameters during the conductance of test. Ageing correction is not applicable for TG Cycle Heat Rate & Output test. Test will be conducted during trial operations. No shutdown will be allowed on account of PG Test preparations.	Aging is a physical phenomenon and once steam enters into the cycle the aging of the components starts. Hence the aging period will be considered from the date of first synchronization to the conductance of PG test.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 188 of Clarification 02.
243	VI/B	G-04	9 of 227	3.4	Condensate flow nozzle (ASME PTC 6) will be installed by vendor Prior to initial operations. Condensate flow data will be available during performance test. Average value of test data of the specified test period will be collected for evaluation purpose. Vendor to ensure calibration validity of all instruments used for PG Test. Calibration certificates of test instruments shall be submitted to Employer at least 15 days before the conductance of performance test. Instrument Calibration to be carried out in a NABL accredited Laboratory.	Flow Nozzle shall be installed just before start of TG-PG test to ensure accuracy of flow measurement and its reading will be recorded in separate data logger.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 1282 of Clarification 02.
244	VI/B	G-04	14 of 227	4.7	Duration of test run shall be two hours. One hour as minimum is necessary before the test run to confirm whether the plant is at satisfactory condition for the test.	Duration of test shall be two hours, out of which most stable 1 hour period shall be selected for calculation and reporting.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 189 of Clarification 02.
245	VI/B	G-07	6 of 8	51	Gland leakage coefficients	Such data requested in data sheets is proprietary in nature, hence cannot be furnished.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 190 of Clarification 02.
246	VI/B	A-07	7 of 25	1.18.01 Note	Any additional heat balances deemed necessary by the Employer shall be furnished. All the heat balances shall show turbine output, mechanical and electrical losses in turbine and generator and input to shaft driven auxiliaries, if any.	Mechanical losses, Generation Efficiency should be given in Guaranteed HBD's as per standard practice.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 191 of Clarification 02.
247	Sec. VI, PART-B	A-07	8 of 25	2.02.00/(C)	…vibration levels shall be Zone A of ISO 10816.	Applicable standard for Vibration for Vacuum pump shall be ISO-10816-1. Vibration shall be as per ISO-10816-1 Zone A/B. ISO 10816-3 is not applicable for LRVP.	ISO-10816-3 is also applicable for Vacuum pumps. Bidder to comply with the requirements of Technical Specification.
248	Sec. VI, PART-B	G-05	8 of 37	2.02.01	Applicable Codes and Standard: ASTM ISO 10816-3 (VIBRATION)		
249	Sec. VI, PART-B	G-06	7 of 14	3.03.04 (ii)(b)	Oxygen content in condensate, at hotwell outlet, shall not exceed 0.015 CC per litre over the entire load range and	In supercritical power plant, oxygen is intentionally dosed in the feedwater cycle for efficient working of boiler. This oxygen level in feedwater is also maintained through deaerator. Since, dosing is deliberately done in the condensate. Therefore it is not possible to demonstrate such a low ppb of dissolved oxygen in the condensate after condenser. This deliberate dosing is not done in sub critical set where it is possible to maintain 0.015cc/ltr of dissolved oxygen in condensate after condenser.	The dissolved oxygen limiting level is achievable in super critical power plant also. Bidder's proposal is not acceptable. Bidder to comply with the requirements of Technical Specification.
250	Sec. VI, PART-B	II-B-02 (MOTORS)	1 of 4	3.01.00 b).	Continuous duty LT motors upto 50KW Output rating (at 50 Deg. C ambient temperature), shall be super Premium Efficiency class-IE4, 50-200 KW shall be of Premium efficiency class-IE3 conforming to IS 12615 or IEC 60034-30.	Clause to be updated as "Continuous duty LT motors upto 200KW Output rating (at 50 Deg. C ambient temperature), shall be of Premium efficiency class-IE3 conforming to IS 12615 or IEC 60034-30."	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 950 of Clarification-02 of the same.
251	Sec. VI PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 34 OF 119	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).	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). For the items not appearing in the sub vendor list (Section-VI, Part-B , Indicative sub-vendor list.) final acceptance by NTPC shall be on the basis of certificate of conformance (COC) by main contractor. Item/component mounted on the skid of the main item or supplied as a integral part of the main item, to be supplied as per proven practice of the manufacturer meeting the Customer technical specification. No vendor approval will be sought from NTPC for such cases.	Bidder understanding is not right. a] In case sub vendor is not mentioned in the list , That will be tied up during detailed enginnering in post award.
252	SEC VI PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 34 OF 119	22.17.00	The contractor's proposal for any new sub vendor for any of the items identified in indicative sub-vendor list shall necessarily be furnished in the sub vendor questionnaire & main Contractor Evaluation report format attached as Annexure- VII with all relevant documents and main contractor's own physical assessment report assessed as per their quality management system for NTPC review and acceptance.	The contractor's proposal for any new sub vendor for any of the items identified in indicative sub-vendor list shall necessarily be furnished in the sub vendor questionnaire & main Contractor Evaluation report format attached as Annexure- VII with all relevant documents and main contractor's own physical assessment report /document review as applicable for domestic manufacturers and document review for foreign manufacturer) assessed as per their quality management system for NTPC review and acceptance. In case of physical assessment (for domestic vendor) is alreday done by main contractor then physical reassessment by main contractor is not required.	Bidder to comply technical specification requirement. Further, the same may be discussed during detailed engineering if required

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253	SEC VI, PART-B	SUB-SECTION- E28 GENERATOR AND AUXILIARIES REV- 13	PAGE 4 OF 9	PROCESS CHECK FOR ROTOR AND ASSEMBLY (GENERATOR/EXCITOR)	**Rotor wedges, damper Wedges.-** Ultrasonic test/RT (at suppliers work and after preliminary machining)	Ultrasonic test/RT is applicable for Rotor Slot wedges only.	Bidder to follow NTPC technical specification requirements.
254	SEC VI, PART-B	SUB-SECTION-E-8 STEAM TURBINE & INTEGRAL AUXILIARIE	PAGE 1 OF 26, 2 of 26	1.01.01 (1) a,b,c,d 1.01.03 (2) a,b,c,d 1.01.04 (b) 1.01.06 (a)I,ii,iii	Creep requirements: a) Steels chosen for design metal temperatures less than 400°C are exempt from creep /stress rupture testing. b) Steels chosen for design metal temperatures between 400°C to 540°C AND having less than 3% chromium, shall require 5 years performance feed back experience in the absence of which, creep rupture test will be required to be carried out for minimum test duration of 1000 hrs/mutually agreed parameters for NTPC approval. c) Steels chosen for design metal temperatures above 540°C AND/OR having more than 3% chromium, shall require 10 years performance feed back experience OR adequate stress rupture data, in the absence of which, creep rupture test will be required to be carried out for minimum test duration of 1000 hrs/mutually agreed parameters for NTPC approval. d) Unspecified alloying elements shall be controlled as per the applicable standard.	Bidder's understanding that the creep requirement is applicable for steel chosen for design metal temperatures above 400°C and not for vendor qualification. If the mentioned creep requirement is applicable for vendor qualification then the NTPC approved vendor's are exempted from the creep requirements.	Biider understanding is not correct. Bidder to follow NTPC technical specification requirements.
255	SEC VI PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 40 OF 119	25.03.00	The Contractor shall give the Project Manager/Inspector (15 days for domestic) / (45 days for foreign) 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 (15 days for domestic) / (45 days for foreign) of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.	The Contractor shall give the Project Manager/Inspector (~~15~~ 7 days for domestic) / (45 days for foreign) 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 (~~15~~ 7 days for domestic) / (45 days for foreign) of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.	Bidder consideration is not right : For doing the proper planning of Inspection activities , it is mentioned as 15 Days for Indian Origin Sub Vendors.
256	SEC VI PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 40 OF 119	25.04.00	The Project Manager or Inspector shall within 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 Project Manager or Inspector shall within ~~15~~ 7 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.	Bidder consideration is not right : For doing the proper planning of Inspection activities , it is mentioned as 15 Days for Indian Origin Sub Vendors.
257	SEC VI PART-C	GENERAL TECHNICAL REQUIREMENTS	PAGE 40 OF 119	25.05.00	When the factory tests have been completed at the Contractor's or subcontractor'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	When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this with immediate 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)~~ seven (7) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector	Bidder to follow NTPC technical specification requirements.
258	VI/B	D-1-8	10 of 20	8.06.00	All gratings shall be electroforged types. Minimum thickness of the grating shall be 40 mm.	As per Bidder's standard practice for Boiler and Auxiliaries Duct support structure area, Gratings thickness of 32 mm will be provided.	Specification requirement is clear in this regard. Bidder to comply technical specification requirement.
259	VI/B	D-1-9	1 OF 33	9.02.01 (a)	Minimum 1000 mm high (from floor/ roof level) hand railing shall be provided around all floor/roof openings, projections/balconies, walkways, platforms, steel stairs, etc., wherever the height of the building is more than 12m, railing height shall be 1.2m.	For all buildings, two hand rails with top rail at 1050 mm and bottom rail at 600 mm above platform level will be provided as per Bidder's regular practice being followed for all supercritical boiler design.	Specification requirement is clear in this regard. Bidder to comply technical specification requirement.
260	VI/B	D-1-9	1 OF 33	9.02.01 (b)	All stairs shall have a maximum riser height of 180 mm and a minimum tread width of 275 mm.	All steel stairs shall be provided with tread width of 250 mm as per our standard practice for all supercritical boiler design	Specification requirement is clear in this regard. Bidder to comply technical specification requirement.
261	VI/B	D-1-12(D)	2 OF 2	D1-12(D)	Basic wind speed 47 m/s, Risk coefficient K1=1.07 & Terrian category 2	Topography Factor (K3) & Importance factor (K4) shall be provided for wind pressure calculation	Bidder to follow technical specification & IS code 875.
262	VI/B	A-02	16 OF 67	8.02.00	(d) Supported by steam or water cooled hanger tubes forming part of Steam circuit with hanger tubes designed for a minimum of 2 times the calculated load so as not to cause any dislocation/damage to the tube banks/setting. Necessary calculations in support of this shall be furnished by the bidder. Structural type hanger support will not be acceptable.	Bidder has provided Mechanical type support for Economiser coil in many OTSC boilers which are running successfully now. Hence, Mechanical type hanger support may be accepted. Failure of even one tube calls for immediate correction. Hence this practically will not occur. The design of hanger tubes for two times the calculated load is unnecessary.	Reply to this query is already included in the section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Calrifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 966 of Clarifications 02.
263	VI/B	A-02	8 OF 67	3.06.00	Panel to panel welding in burner zone to be avoided to maximum possible extent. Profile shields/ erosion prevention measure to be provided on top and bottom burner panel bends.	Panel to panel welding in burner zone may be permitted.	Bidder's proposal is not accepted. Bidder to comply with tender requirements.

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264	VI/B	A-02	9 OF 87	1.05.05	(vi) Maximum depth of tube banks/sections in the direction of gas flow: 2 Meters or maximum soot blowing radius, whichever is lower.	Economiser bank depth may be allowed upto 2.5mtrs to include economizer future area addition with present for optimum design.	Reply to this query is already included in the section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Calrifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 216 of Clarifications 02.
265	VI/B	A-02	4 OF 67	1.11.05	Header to be provided with hand hole at end cover for ease of inspection and removal of foreign material.	Due to design & arrangement requirements, Hand hole pipes cannot be provided at ends. However, it will be provided radially.	Bidder to comply with the specification requirements as it eases header internal inspection process.
266	VI/B	A-02	9 OF 67	4.01.00 (b)	The casing/pent house and its supporting system shall be capable of taking additional loads due to accumulations of ash upto 300 mm height or actual expected (in between two overhauls of the units), whichever is higher. This additional load is over and above other loads considered for casing design. The ash density for the purpose of ash loading shall be at least 1300 kg/m³.	The roof panel for supercritical boilers is fin welded panel and hence the chance for ash ingress is very minimum. Hence casing/pent house supporting system shall be designed without considering ash load.	Bidder proposal is not accepted. Bidder to comply with the specification requirements.
267	VI/B	A-02	13 OF 67	7.01.01 (4)	All horizontal heat transfer surfaces shall be supported by steam or water cooled hanger tubes designed for a minimum of 2 times the calculated load so as not to cause any dislocation/damage to the tube banks/sections. Necessary calculations in support of this shall be furnished by the bidder. The stress in the hanger tubes under such condition also shall not exceed the maximum permissible limits as per IBR. One(1) mm erosion allowance shall be provided over and above the calculated thickness of hanger tubes.	Failure of even one tube calls for immediate correction. Hence this practically will not occur. The design of hanger tubes for two times the calculated load is unnecessary.	Bidder proposal is not accepted. Bidder to comply with the specification requirements.
268	VI/B	A-02	46 of 67	14.01.05 (c)	Temperature element on all drains lines, including soot blower drain line.	Temperature elements will be provided only for those drains which may be used during operation. Start-up and shut down drains will not be provided with temperature elements.	Bidder proposal is not accepted. Bidder to comply with the specification requirements.
269	VI/B	A-02	46 of 67	14.01.05 (d)	Motorized remote operated air release valves at locations, two in series, as required connected to a funnel, leading drains to drain trench.	One motorised isolation valve and one hand operated isolation valve in series shall be provided for all air release lines and drain lines which are not operated for regulation purpose during unit start-up and shut down.	Bidder proposal is not accepted. Bidder to comply with the specification requirements.
270	VI/B	A-02	47 of 67	14.01.07	Provide plugging/locking for each isolating drain valve such that to open the valve, the key has to be inserted and key can be withdrawn when the valve is closed	Chain and padlocking arrangement, which is simple and effective for the intended purpose, is envisaged for the furnace lower header drain valves only.	Bidder proposal is not accepted. Bidder to comply with the specification requirements.
271	VI/A	IIA-01	6 of 28	2.09.03	Manually operated isolation valves on steam supply line shall be provided at each stream of furnace blowers or as per standard proven practice of the bidder. These valves shall be designed for full flow and shall be tight shut off type.	For facilitate draining of the condensate, the soot blowers at various elevations are connected to steam line. This arrangement does not permit elevation wise isolation. Maintenance in LRSB can be done conveniently by closing the main isolating valve. Since the soot blowers are operated only once in a shift, no difficulty will be faced on account of closing the isolating valve for any maintenance work. This practice is followed in all boilers including NTPC units.	The specification requirement is clear. Bidder to comply with the same.
272	VI/A	IIA-01	4 of 28	2.07.01	The requirements indicated below for each leg of each stage of desuperheating spray system is for superheater spray system. Similar system shall be provided for reheater spray system also. (a) Two (2) nos. pneumatically operated spray control valves, each rated for full duty with two (2) nos. pneumatically/motor operated isolating valves upstream & two (2) nos. manually operated isolating valves down stream of the spray control valves	The superheater spray station will consist of one pneumatically operated spray control valve with one pneumatically/motor operated isolating valves up-stream & one manually operated isolating valve downstream of the spray con-trol valve for each of the 2 main lines and 2 bypass lines.	Bidder proposal is not accepted. Bidder to comply with the specification requirements.
273	VI/B	A-02	12 of 67	6.04.00	A CFD and FEM analysis to conform to specified cyclic requirements shall be carried out and furnished by the contractor along with the pump data sheet	The pump vendors are reputed and have supplied BCW pumps across the world including Bidder. The pumps supplied by them in the past, for NTPC/Non NTPC supercritical power stations, are running successfully without any issue. These vendors have already substantiated their pump quality and have proven the same in the past. Also vendors are not willing to carry the said analysis. In view of the above, CFD and FEM analysis of Pump requirement shall be exempted.	Bidder proposal is not accepted. Bidder to comply with the specification requirements. Reply to a similar query is already included in the section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Calrifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 220 of Clarifications 02.
274	Part_E_Mech_Civil	Flow Diagram - start up drain system	Tender Drawings START-UP DRAIN SYSTEM – DRG No: 001-POM-A-019		NRV downstream the boiler recirculation pump in the drawing (ZONE-B6)	NRV at discharge of start-up recirculation pump will reduce the warm –up flow thereby affecting the performance of the system. Hence Non-return valve (NRV)/Check Valve at discharge of start-up recirculation pumps is not envisaged.	Bidder to refer to the Cl. No. 2.06.00 (2) SUB SECTION-II A-01, Part A of Section VI for the scheme of valves at the discharge of startup drain recirculation pump.
275	VI/B	D-1-8	10 of 20	8.07.00	All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections.	For SG Bidder agrees to provide the type of bolts mentioned in this clause for field connections Field Structural Connections shall be as follows, 1) Main Columns : Fully Bolted Connections 2) Column to Beam : Connecting Cleat is welded with Column and bolted with Beams 3) Column to Vertical bracings : Gusset is Welded with Column and Bolted with Bracings. 4) Ceiling Structures : Connecting Cleat is bolted with girder and welded with beams 5) Horizontal truss and mid landings : Fully Welded Connections 6) Platforms : Fully Welded Connections 7) ID system structure : Fully Welded Connections	Bidder's Proposal is not acceptable. Bidder to comply with the Technical specification requirement.

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276	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 1 of 6.	Cl.No.-1.01.00 A.	Project Management Team: The team shall comprise of experience and qualified project professionals and shall be located at bidder's project management office as well as at site.	Location of Project Management team will be as per project requirement.	Specifications in Bidding document are clear. Provisions of Bidding Documents shall prevail.
277	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 1 of 6.	Cl.No.-1.01.00 A.	Training/familiarization of NTPC team with the project management tool. One nodal person to be identified for providing remote (Telephone/e-mail/Internet) or in-Person (wherever required) support.	Training module, will be available in the Project Management tool.	Specifications in Bidding document are clear. Provisions of Bidding Documents shall prevail.
278	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 1 of 6.	Cl.No.-1.01.00 A.	Any other information required for the project management purpose.	Offered project management system will be comprehensive. Any other information required, may please be elaborated.	Please refer Amendment in this regard
279	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 2 of 6.	Cl.No.-1.01.00 A.	Comply to the requirements of NTPC pertaining to statutory obligations and maintenance of Sequence of events/ Hindrance register.	Sequence of events/ Hindrance register will be uploaded on weekly basis in the system. Report of hinderance register should be made available to Bidder.	Specifications in Bidding document are clear. Provisions of Bidding Documents shall prevail.
280	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 2 of 6.	Cl.No.-1.01.00 B.	Should support integration with existing NTPC Systems viz C-Folder, Dreams, Pradip, Windsor, Team-up etc. with proposed software solution. (APIs will be provided by NTPC, subject to security authentication by NTPC IT team).	Bidder will maintain its drawing through it's PEDM system and the same will be integrated to offered project management system.	Specifications in Bidding document are clear. Provisions of Bidding Documents shall prevail.
281	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 2 of 6.	Cl.No.-1.01.00 B.	All the review meetings (Daily/Weekly/Monthly) shall be conducted on this platform and should support upload /generation of record notes. The format for the same should be customizable.	We are considering for manual uploading of record notes of review meetings in the system as per the format prescribed by NTPC.	Specifications in Bidding document are clear. Provisions of Bidding Documents shall prevail.
282	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 3 of 6.	Cl.No.-1.01.00 B.	Report Generation: Capital Budgeting, Bills submission & realization and Payment confirmation to sub-vendors.	We are considering for manual uploading of RA bill submission of Bidder & realization status in the system.	Provisions of Bidding Documents shall prevail.
283	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 3 of 6.	Cl.No.-1.01.00 B.	Any other custom reports as per the requirement and mutual agreement.	NTPC may please elaborate, which type of other reports required.	Since, Project progress is a dynamic process. Therefore, different kinds of reports needed at different intervals. In view of this Provisions of Bidding Documents shall prevail.
284	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 4 of 6.	Cl.No.-1.01.00 C.	Web-based output for visual monitoring on Project Management Tool.	We are considering for manual uploading of Drone based Project Monitoring reports in the system.	Provisions of Bidding Documents shall prevail.
285	SECTION– VI, PART-A	Annexure-A to subsection IIC (Project Management)	Page No. 4 of 6.	Cl.No.-1.01.00 C.	All the reports/Photographs/Videos are to be made available on Project management tool.	We are considering for achieving of all the reports/Photographs/Videos generated by Drone. The access link for the same may be provided in Project management tool.	Provisions of Bidding Documents shall prevail.
286	SECTION– VI, PART-D	Work & Safety Regulation	Page 27 of 64	44.22.00 (j)	Availability of Fire Tender shall be ensured by contractor before start of construction work	Availability of sufficient Fire extinguisher mechanism/Equipments shall be ensured. In any adverse eventuality, deployment of Fire Tender of Stage-I may be allowed.	Bidder's proposal reviewed but not accepted. Bidder to comply with tender requirements.

Sr. No.	Section / Part	Sub-section / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	NTPC's Clarification
287	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION- E-00 INTRODUCTION TO QUALITY ASSURANCE SPECIFICATION	-	PAGE 1 OF 1	Various standards referred in this document shall be the latest revisions.	Bidder request to follow clause "PART-C 5.00.00 CODES & STANDARDS of GENERAL TECHNICAL REQUIREMENTS 5.02.00 Unless covered otherwise in the specifications, the latest editions (as applicable as on the date of bid opening), of the codes and standards given below shall also apply: as there is different requirement in different sections of specification"	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 871. Bidder to comply
288	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-01 STEAM GENERATOR AND AUXILIARIES	PAGE 3 OF 13	(d)	(d) i) SHOP WELDS: Finished butt welds shall be subjected to RT or UT. Wherever the code/standard/process specifies random sampling, the same shall be minimum 20%. (ii) FIELD WELDS: a) Finished butt welds shall be subjected to RT or UT. Wherever the code/standard/process specifies random sampling, the same shall be minimum 20% b) Finished butt welds not covered under random sampling for RT/UT, referred above at point(a) shall be subjected to RT or UT or PAUT.	Bidder propose to perform extent of RT/UT at field welds shall be same as Shop welds Additionally PAUT /Recordable UT may be used in lieu of RT/UT Bidder understand, claue (ii) b) will be applicable to joints not part of clause a) (i.e. 20%)	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 872. Bidder to comply
289	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-4 FLUE GAS DESULPHURISATION SYSTEM	PAGE2 OF 5	1.05.02	Pressure vessels: 2) Butt welds of dished ends shall be stress relieved and subjected to 100% RT.	Dished ends stress relieving shall be done as per the applicable design and manufacutring code.	Bidder to follow the technical specification
290	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION –E-05 LP PIPING PACKAGE (MECHANICAL)	2 of 2	Note 1	100% Hydraulic test shall be carried out. Weld joints not subjected to hydraulic test due to some unavoidable reasons, shall be subjected to 100% RT/PAUT.	Bidder request to provide option for performing RT/PAUT in lieu of Hydraulic Test	"Bidder proposal is not acceptable. Hydrotest is carried out to validate the design & strength of the component. Bidder to follow the technical specification"
291	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-06 POWER CYCLE PIPING	Page 1 of 5	1.01.00	(f) All butt welds in alloy steel piping of P-91, X -20, X-22 & material P15E group & above shall be checked for RT/ UT/PAUT+TOFD & MPI after SR.	(f) All butt welds in alloy steel piping of P-91, X -20, X-22 & material P15E group & above shall be checked for RT/ UT/PAUT/TOFD & MPI after SR. Bidder has worked with similar NDT process and has successfully completed activity in past projects. Bidder request to kindly confirm	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 874 . Bidder to comply
292	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-6 POWER CYCLE PIPING	Page 1 of 5	1.01.00	Piping (b) All pipe lengths under this package, including piping where alloy steel is used shall be subjected to 100 % ultrasonic examination as per material specification standard with acceptable notch depth of 5% of the selected wall thickness (1.5mm maximum) except for the following piping system:	All pipe lengths shall be subjected to100% Ultrosonic Examination or 100% Hydrotest as per Material specification.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 1031. Bidder to comply
293	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-6 POWER CYCLE PIPING	Page 1 of 5	1.01.00	Piping (e) Non-destructive examination of welds shall be carried out after post weld heat treatment, if any. Piping: (i) Wherever SR/PWHT is envisaged for alloy steel, above NDTs shall be after SR/PWHT.	Bidder request, RT or UT of butt joints will be done before PWHT and MPI or DPT will be after PWHT	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 878. Bidder to comply

Sr. No.	Section / Part	Sub-section / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	NTPC's Clarification
294	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-06 POWER CYCLE PIPING	Page 2 of 6	2 3	Piping (h) Non-destructive examination of welds shall be carried out in accordance with the relevant design/manufacturing codes. However, as a minimum, the following requirements shall be met. Further statutory requirement, wherever applicable shall also be complied with. (1) Temperature > 400 Deg, C or pressure exceeding 71 bar. (i) 100% RT/UT on butt welds and full penetration branch welds. (ii) 100% MPE. (2) Temperature > 175 Deg, C upto 400 Deg. C or pressure exceeding 17 bar and upto 71 bar. (i) 100% RT/UT on butt welds and full penetration branch welds for pipe dia. more than 100 NB. (iii) 100% MPE.	Bidder request to provide option for performing Penetrant testing in lieu of MPE Where ever the vent pipes are used under these conditions will be 10% RT or UT tested as these are open to atmosphere. Also, alternative to RT, UT/Advanced NDT may be performed in line with bidder standard practice	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 875 . Bidder to comply
295	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-06 POWER CYCLE PIPING	3 of 5	1.05.00	(b) Hardened/stellitted valve disc and seat are to be subjected to LPI and hardness check.	Hardness testing on seat/disc may be performed on a sample test coupon (PTC) instead of actual seat. The Sample test coupon will undergo same process as that of actual seat material and the hardness of this test coupon will be measured. As the hardness test on actual seat creates indentation on seat, which may become a leak path in the feature during the valve operation. (inline with Sub section E-08 1.07.01). Different places of the specification Hardened/stellitted valve disc and seat differently (Ex: Sub section E-08 1.07.01). Kinldy clarify	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 876 . Bidder to comply
296	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-6 POWER CYCLE PIPING	5Page 2 of	1.02.00	Fittings: Raw material of all forged/formed fitting shall be ultrasonically tested. All mother pipes used for fitting shall be ultrasonically tested or hydraulic tested.	All the pipes used for formed fittings shall be UT or Hydrotested as per pipe material specification. (There is a contracdictory statement in the first and second sentence.)	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 879 . Bidder to comply
297	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-08 STEAM TURBINE & INTEGRAL AUXILIARIES	Page 25 of 26	1.10.02	(c) All welds between condenser neck and LP turbine shall be subjected to 100% radiographic and magnetic particle examination.	Bidder request to perform PT in lieu of Magnetic Particle Testing as there is very limited access available for performing NDT	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 881 . Bidder to comply
298	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-8 STEAM TURBINE & INTEGRAL AUXILIARIES	Page 13 of 26		(d) To ensure dimensional control of condenser, parts\sub assemblies shall be trial assembled at shop. BIDDER shall furnish his proposal in this regard, which will be subject to Employer's approval. The extent/need for trial Assembly of various parts of Condenser / sub assemblies like Water Box, Water Chamber, Hotwell, Main Tube plate and support plate, its alignment and trial insertion of few tubes etc. shall be as per Manufacturers standard established practices. Such established practices shall be furnished to NTPC during finalization of quality plan.	As per Bidder standard practice, all the Support plates and main tube sheets assembled one above the other for ensuring alignment through insertion of few tubes. As per Bidder standard, it is not envisaged to trial assemble water box, water chamber, hot well Main tube plate and support plate at the workshop.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 883 . Bidder to comply

Sr. No.	Section / Part	Sub-section / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	NTPC's Clarification
299	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-8 STEAM TURBINE & INTEGRAL AUXILIARIES	Page 16 of 26		1.04.02 Vacuum pump: The test should be conducted with the respective motors to be supplied.	The test shall be done either job motor or calibrated shop motor	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 882 . Bidder to comply
300	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-8 STEAM TURBINE & INTEGRAL AUXILIARIES	Page 18 of 26		1.06.02 Metallic Expansion Bellows (f) Life cycle test, meridional yield rupture test and squirm test to be carried out on a prototype/expansion bellow as per Sec.D clause 3.2 of standards of Expansion joint Manufacturer Association (EJMA). In case these tests have already been accepted by NTPC on a prototype expansion bellow, as defined in Sec.D Clause 3.2 of Expansion Joints Manufacturers Association (EJMA) test reports may be furnished by manufacturer for consideration and approval of Employer.	The type test reports witnessed by NTPC or other customers or thrid party agencies of Metallic Expansion bellow manufacturers may be submitted in-place of performing actual test	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 884 . Bidder to comply
301	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-8 STEAM TURBINE & INTEGRAL AUXILIARIES	Page 20 of 26		1.06.03 Rubber Expansion Joint (h) Life cycle test shall be carried out on bellows of each type, design and size. In case these tests have already been accepted by NTPC in earlier projects for the same type / size /design, test certificate for the same may be furnished for approval of Employer.	As pG17:H18cycle test is done then the lower sizes are automatically considered as approved. It is not envisaged to carryout life cycle test of each type, design and size of bellow.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 885 . Bidder to comply
302	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-8 STEAM TURBINE & INTEGRAL AUXILIARIES	Page 23 of 26		1.07.03 Butterfly valves: (h) After assembly, one valve of each size with respective actuator shall be shop operated over the full range of movement in both the directions, with the body subjected to the full hydrostatic pressure conditions, to demonstrate that the unit is in working order without any leakage through the joints and torque switches/clutches, limit switches are operating satisfactorily. During the test, hand wheel operation, opening/closing time and current drawn shall also be checked.	As per all the Butterfly valve manufacturer practice, after assembly of valve, the valve functional test will be done with respective actuator operated over the full range of movement in both the directions without subjectiing the body hydrostatic pressure conditions. Please note that the body is already hydrotested in assembled condition.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 880 . Bidder to comply
303	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-8 STEAM TURBINE & INTEGRAL AUXILIARIES	Page 25 of 26		(g) Condenser water boxes shall be tested hydraulically at a minimum test pressure of 1.3 times the design pressure.	Condenser water boxes shall be hydraulically tested at work shop. It is not envisaged to re-check again at site.	Bidder to follow the technical specification requirements.
304	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-10 CONDENSATE EXTRACTION PUMP SUB-SECTION-E-12 BOILER FEED PUMP	PAGE 2 OF 2 PAGE 3 OF 4	Note	Note: 1) Shop tests shall be conducted with soften Quality Water.	Water quality used for shop tests shall be as per approved manufacturer standard practice	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 857 . Bidder to comply

Sr. No.	Section / Part	Sub-section / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	NTPC's Clarification
305	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-10 CONDENSATE EXTRACTION PUMP SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE SUB-SECTION-E-12 BOILER FEED PUMP SUB SECTION- G-05 STANDARD TYPE TEST PROCEDURE	2 OF 2 Page 12 of 38 Page 2 OF 4 Page 2 of 37	Note 3.03.00 Note (2) 1.03.00	CEP: .NPSH (R) test shall be carried out on one Condensate Extraction Pump using cold water at pump flows of 25%, 50%, 80%, 100% and 125% of Design Flow at Design Speed. This shall be done at 3% head break by Suction Throttling Procedure / varying suction pressure. Plots will be made for NPSH vs head developed by 1st stage for all flows. From the plots NPSH values corresponding to 1% & 3% head drop will be determined for all the above % flows. Finally, Flow vs NPSH characteristic (1% & 3% head drop) will be drawn & value of NPSH at rated flow corresponding to "Design point" will be the requirement of the pump. BFP: ,NPSH (R) test shall be carried out on one Boiler Feed Pump and one booster pump using cold water at pump flows of 25%, 50%, 80%, 100% and 125% of Design Flow at Design Speed. This shall be done at 3% head break by Suction Throttling Procedure. Plots will be made for NPSH vs head developed by 1st stage for all flows. From the plots NPSH values corresponding to 1% & 3% head drop will be determined for all the above % flows. Finally, Flow vs NPSH characteristic (1% & 3% head drop) will be drawn & value of NPSH at rated flow corresponding to " Design point" will be the requirement of the pump.	.NPSH(R) test already done for the same model will be submitted for review and acceptance by Customer. If NPSH(R)already done for the same model, it is not envisaged to repeat the test. Bidder understand that, NPSH Test shall be performed at 3% head break by Suction Throttling Procedure. NPSH test at 1% head drop not envisaged	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 886 of Clarification 02.
306	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-10 CONDENSATE EXTRACTION PUMP	Page 2 OF 2		CEP: 1) Quantum of In-Process Checks/ Tests is 100% until & unless specified otherwise.	In process checks will be done 100% asper manufacturer standard practice and bidder will also witness the major tests, but the major inprocess checks will be offered to NTPC for 1 pump and and 100% final inspections will be offered to NTPC for witness.	Bidder to follow the technical specification requirements.Detailed test requirements shall be discussed during MQP finalisation.
307	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-12 BOILER FEED PUMP	Page 3 of 5	1	(a) Performance Tests on each Boiler Feed Pump to determine the characteristic curve (Head, Capacity, Efficiency & Power) at Design Speed and to ensure compliance with design requirements specified in the specification. Measurement shall be carried out at 10%, 25%, 50%, 65%,80%, 100% & 125% of Design Flow with loop water at design temperature. Performance Test at other specified Conditions shall be carried out on all Boiler Feed Pumps at their respective Speeds at design temperature.	Many manufacturers does not offers / recommend to conduct performance test below recommended flow, therefore performance tests at 10 % , 25 % flow will not be done. It's more like pump running in dry conditions which may damage the pump internals Performance test is performed at reduced speed and temperature meeting HIS guidelines and Note 5 of Sub Section E-12	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further, the similar query has been responded in Clarification 01B of Sipat-III EPC Package (under bulk tender) at SN 170 & 171. Bidder to comply.
308	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-12 BOILER FEED PUMP	Page 3 of 5		BFP; Type tests mentioned (NPSH, Pressure pulsation & Axial thrust measurement in the specification.	BFP; Type tests mentioned (NPSH, Pressure pulsation & Axial thrust measurement) already done for the same model then the reports will be submitted for review.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer SN 888 of Clarification 02.
309	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-E-13 RAW WATER SYSTEM (MECHANICAL)	Page 2 of 12 Page 7 of 12 Page 10 of 12	3) x xo vii ix	Hydraulic Test: 100%, 1.5 times the design pressure or 2 times the working pressure whichever is higher x. 5% RT/ 5% UT by TOFD/PAUT techniques on those butt weld joints which can be 100% hydro tested. xo. 100% RT / 100% UT by TOFD/PAUT technique of the butt weld joints of pipeline shall be carried out which cannot be Hydro tested. viii. 5% RT/ 5% UT by TOFD/PAUT techniques on those butt weld joints which can be 100% hydro tested. ix. 100% RT / 100% UT by TOFD/PAUT technique of the butt weld joints of pipeline shall be carried out which cannot be Hydro tested.	Bidder request to perform RT/UT/ PAUT/TOFD in lieu of Hydraulic Test	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 889 . Bidder to comply

Sr. No.	Section / Part	Sub-section / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	NTPC's Clarification
310	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-17 AC AND VENTILATION SYSTEM(MECH	Page 2 of 3	3.04.00	3.00.00 CENTRIFUGAL PUMP: 3.04.00 Standard Running Test i) All pumps shall be tested in the manufacturer's works preferably with contract motor (or as specified in Engg Tech spec) for capacity, efficiency, head and brake horse power.	As per standard Manufacturer practice, pumps will be tested either contract motor or Calibrated shop motor.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 891 . Bidder to comply
311	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-59 QA Civil Works	Page 5 of 6	A. Fabrication Works B. Erection Works at site	CW LINER/DUCT: NDT by RT in various Options	It is proposed to carryout UT instead of RT	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 890 . Bidder to comply
312	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION E-59 CIVIL WORKS	PAGE 4 OF 6	II	(II) CW Liner/ Pipes Fabricated using H.R. coils with spiral weld joints at DPT on root run: 100% DPT for pipes up to 1200mm diameter	Pipes fabricated using HR Coils with Spiral Weld Joints at factory is an automated process of welding and it is not possible to carryout DPT on root run.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 891 . Bidder to comply
313	TECHNICAL SPECIFICATION SECTION-VI, PART-D	Part D ERECTION CONDITIONS OF CONTRACT	PAGE 2 OF 71	4.01.00	Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of chartless recorder / IIOT sensors duly password protected with a connectivity to remote server /Cloud .	Presently IBR inspectors accept only physical/hardcopy chart Digital Recorders with chartless recorder / IIOT sensors may be used, however Director Boiler need to accept the digital form of recording and issue a directive to all IBR Inspectors to accept the same Hence bidder request to use digitalSmart PWHT - Pre-heating, post-heating and post-weld stress relief heat treatment for only P91/P91 materials, as with induction M/c digital data will be available However, if we work this initiative as part of digital joirney, 10% of FWS may be used with such system	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 893 . Bidder to comply
314	TECHNICAL SPECIFICATION SECTION-VI, PART-D	Part D ERECTION CONDITIONS OF CONTRACT	PAGE 42 OF 71	55.00.00	Computed RT shall be used as an advanced Engineering Practice. Main contractor to ensure minimum 10% computed radiography of weld joint to be performed in construction phase for scope agreed in FWS for boiler pressure parts. Main contractor to ensure the transfer & storage of these records in Server	Bidder would like to have exemption for the clause owing to following a) The acceptance from IBR at site for Computed RT shall be taken in to consideration from the boiler board b) In case of other alternative NDT method (such as UT/PAUT) adopted in past project same may also be permitted subject to statutory compliance.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 894 . Bidder to comply
315	TECHNICAL SPECIFICATION SECTION-VI, PART-D	Part D ERECTION CONDITIONS OF CONTRACT	PAGE 3 OF 71	3.05.00	Welding Equipment for high pressure (Boiler , PCP) - For GTAW process: HF Welding machines to be used. For SMAW process: Inverter based welding machine are to be used.	Welding equipment shall be used as per earlier practice of bidder as there were no imact of use of existing method welding while operation of plant.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 895 . Bidder to comply
316		SUB SECTION-A-08 Power Cycle Piping	(c)	PAGE 5 OF 19	2. Supplementary requirement S5: Certificate of conformity "COC" from pipe supplier for microstructure and delta ferrite (to be maintained within 3%max. when measured as per VD TUV 1272). Certificate of conformity "COC" from pipe supplier for microstructure and delta ferrite (to be maintained within 3%max. when measured as per VD TUV 1272).	Bidder would like to use VD TUV 1272/equivalent ASTM standard	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 896 of Clarification-02 of the same.

Sr. No.	Section / Part	Sub-section / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	NTPC's Clarification
317	GENERAL TECHNICAL REQUIREMENTS SECTION - VI	QA- Disclaimer of Indicative Vendor list	Page 1 of 2 Page 2 of 2	1.1 1.7	However, in case of error/omission, if any, and represented by the successful bidder this will be addressed during the execution of the contract based on the material evidence available with NTPC / Main Contractor. 1.7 The list of sub-vendors is periodically revised to include new sub-vendors. Such a revision may also see a deletion of certain sub-vendors who may have been disqualified on grounds of inadequate performance or banned in line with NTPC's banning policy. The then current list will be shared with the successful bidder immediately on award	Bidder understand that a) In case vendors who are already approved/have executed various items in NTPC project are not in the indicative vendor list, bidder may consider same b) Bidder request to share the banned vendors as on date, which will help bidder for taking in to consideration. This list shall be part of contract at the time of award or order. c) Bidder understand, Items specified in the specification of E-60 Sub Vendor list, additional vendor approval will be submitted to customer. Other items are purchased based on bidders vendor approval process, no separate approval from customer envisaged	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 897 . Bidder to comply
318	GENERAL TECHNICAL REQUIREMENTS SECTION - VI	QACP (QA Coordination Procedure)	Page 3 of 7		13 d) Inspection Calls d) Inspection Calls: Bidder shall give inspection call to the respective Employer QA&I RIO in Windsor-X system. For foreign inspection calls Main Contractor shall give inspection call to Employer QA&I (in Windsor-X system) Coordinators and through email as well, as per following schedule:- i. Supplier of Indian origin : 15 working days	Considering the Project cycle time, Bidder considers the follwing inspection notification time; i. Supplier of Indian origin : 7 working days	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Further the similar query has been responded in clarification 2 of sipat III EPC Pkg at Sl no 898 . Bidder to comply
319	SECTION – VI, PART-B	SUB-SECTION-D-1-5 CIVIL WORKS SALIENT FEATURES AND DESIGN CONCEPT	PAGE 29 OF 69	5.10.00	All roads shall be of rigid pavements unless otherwise specified. Rigid pavements shall be constructed with Geopolymer concrete. Concrete road/pavement or rigid pavement, mentioned in specification, shall mean road /pavement constructed with Geopolymer Concrete.	Bidder would like to clarify that, there is limited exposure in Geopolymer based concrete within India and experincing in quick setting within 30-40 min with crack developement afterwards. This concrete is still under developement and esatblishment stage for its usage in Permanent Road works. Bidder request to consider Cement based Pavement quality concrete road also.	Bidder to refer amendment no. D1B-01, D1B-2, D1B-03 In this regard
320	SECTION – VI, PART-B	SUB-SECTION-D-1-5 CIVIL WORKS SALIENT FEATURES AND DESIGN CONCEPT	PAGE 30 OF 69	5.10.00.01	The road construction including its shoulders, base, sub base and concrete pavement shall be as per MORTH. The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Laying /placing of Concrete DLC and PQC manually with hand-guided means or by semimechanized methods may be permitted around BTG area provided acceptance criteria as per MORT&H specification is achieved.	Bidder would like to clarify that, there is limited exposure in Geopolymer based concrete is having low workable period & quick setting within 30-40 min. It is quite dificult to do with fully mechanized pavers fitted with electronic sensors within such low time. Owner is requested to allow aying /placing of Concrete DLC and PQC manually with hand-guided means or by semimechanized methods In case of geo-polymer concrete.	Bidder to refer amendment no. D1B-01, D1B-2, D1B-03 In this regard
321	SECTION – VI, PART-B	SUB-SECTION-D-1-8 CIVIL WORKS GENERAL SPECIFICATION	PAGE 3 OF 20	8.01.02.29	Interlocking concrete block confirming to IS:15658, kerb blocks or concrete block specified for various uses shall be precast blocks made of alkali-activated concrete /Geopolymer concrete as per IS:17452-2020.	Owner is requested to allow cement concrete based interlocking concrete blocks/kerb blocks/Precast blocks confirming to respective standards.	Bidder to follow technical specification
322	SECTION-VI, PART-B	SUB-SECTION-D-1-8 CIVIL WORKS GENERAL SPECIFICATION	PAGE 4 OF 20	8.01.03	Acid/ Alkali Resistant Lining All structures receiving acid / alkali resistant lining shall be tested for water tightness and made leak proof before lining work. The acid / alkali resistant lining shall be provided broadly in the areas identified. The Bidder shall give a guarantee for satisfactory functioning of the lining for a period of 36 months from the date of completion of the work or date of handing over the site to the Engineer, whichever is later. The Bidder shall replace / rectify defects is any, observed in the lining to the satisfaction of the Engineer without any extra cost during this period.	Acid/ Alkali Resistant Lining All Liquid retaining concrete structures receiving acid / alkali resistant lining shall be tested for water tightness and made leak proof before lining work. The acid / alkali resistant lining shall be provided broadly in the areas identified. The Bidder shall give a guarantee for satisfactory functioning of the lining for a period of 36 months from the date of completion of the work or date of handing over the site to the Engineer, whichever is later. The Bidder shall replace / rectify defects if any **(free of visible physical damages)**, observed in the lining to the satisfaction of the Engineer without any extra cost during this period.	Bidder's proposal reviewed but not accepted. Bidder to comply with tender requirement.

Sr. No.	Section / Part	Sub-section / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	NTPC's Clarification
323	SECTION-VI, PART-B	SUB-SECTION-D-1-10 CIVIL WORKS MATERIAL SPECIFICATION	PAGE 3 OF 4	10.05.00	Bricks Only fly ash bricks shall be used in all construction, except for elevator shafts, which can be either of burnt clay bricks or RCC construction as per functional / codal provisions. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm2. Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS: 13757 and IS: 12894 respectively. Minimum fly ash content in fly ashbased bricks shall be 25%.	**Bricks** Only fly ash bricks shall be used in all construction, except for elevator shafts, which can be either of burnt clay bricks or RCC construction as per functional / codal provisions. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm2. Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS: 13757 and IS: 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%. **However, in case of fly ash bricks not available burnt clay bricks of compressive strength 75kg/cm2 and meeting requirement as per IS: 1077 shall be used.** **Owner is requested to confirm acceptance.**	Bidder's query is not clear. Bidder to follow technical specification.
324	SECTION – VI, PART-B	SUB-SECTION--E-59 QA CIVIL WORKS	PAGE 3 OF 4	2.00	2.0 LABORATORY AND FIELD TESTING The field laboratory for QA and QC activities …. The contractor shall establish the requisite laboratory equipment/set up and skilled QA&QC manpower within 30 days from the mobilization date of Main contractor at site.	Bidder would like to clarify that, Skilled QA& QC manpower will be mobilized at site as per discipline wise work progress,	Setting up of Site lab with skilled QA / QC manpower within 30days from mobilization date of main contractor at site is requred for minimizing delays in testing and adversely affecting site work progress. Also well equipped lab and manpower reduces non confirmity from approved quality plans. For discpline wise QA & QC manpower requirement, provision is already envisaged in indicative FQP. Hence Bidder has to follow the Technical Specification reqirements
325	SECTION-VI, PART-A	SUB-SECTION-D-1-7	PAGE 15 OF 25	8.07.01.4	All the welders to be employed for the job shall have to qualify the appropriate tests laid down in IS: 817 and IS: 1181 and ASME IX/AWS D1.1. All the necessary arrangements required for the testing of welders are to be provided by the Bidder.	In case of already qualified welders are available then those welders Qualification certificates will be shared with Customer and those will be deployed for welding without any re-qualification.	Bidder's proposal is not acceptable
326	SECTION-VI, PART-A	SUB-SECTION-D-1-7	Page 15 OF 25 Page 16 OF 25	8.07.01.5 8.07.01.6	b) Production Test Plate Test plates shall be incorporated on either side of at least one main butt welds of each flange plate and web plate of every main frame columns and crane girder. a) Fillet Welds ii. Macroetch examination on production test coupons for main fillet weld with minimum one joint per built up beam, column, and crane girder, etc. b) Butt Welds iii) Mechanical testing of production test coupons - minimum one joint/built up beam, column and crane girder.	Qualified WPS and PQR with Welder Qualification (WPQ) performed as per reference standard. Qualified WPS/PQR/WPQ will be used in lieu of performing PTC As Qualified WPS/PQR/WPQ along with NDT will provide integrity and strength of the material	Bidder's proposal is not acceptable
327	SECTION VI, PART- B	SUB SECTION-B-02 MOTORS	10.01.00	PAGE 3 OF 4	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 (b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.	Not Applicable for elastimold type terminations	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 910 of Clarification-02 of the same.
328	SECTION VI, PART- B	SUB-SECTION-B-03 VFD	28.02.00	PAGE 10 OF 11	Type test LIST OF TYPE TESTS TO BE CONDUCTED The following type tests shall be conducted under this contract for MV E8) Overall efficiency determination of VFD system including transformer/ Harmonic filters etc at motor full load	Bidder would like to clarify that test may be conducted with regenerative load	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 911 of Clarification-02 of the same.
329	SECTION VI, PART- B	SUB-SECTION B-04 TRANSFORMERS AND ASSOCIATED MAINTENANCE, MONITORING & TESTING EQUIPMENTS	1.11.02	PAGE 19 OF 36	Type tests criteria for Auxiliary oil filled transformers rated upto 16MVA, 11kV (only type test report has to be submitted) A) The Type Test reports should be of a transformer which is generally similar to the transformer being offered as per IEC 60076-5, Annexure-B and also identical to the offered transformer in the following aspects:...	Bidder would like to clarify that for similarity conditions IEC 600076-5, annexure B will be considered	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 912 of Clarification-02 of the same.

Sr. No.	Section / Part	Sub-section / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	NTPC's Clarification
330	SECTION VI, PART- B	SUB-SECTION B-04 TRANSFORMERS AND ASSOCIATED MAINTENANCE, MONITORING & TESTING EQUIPMENTS	1.11.04	PAGE 25 OF 36	ROUTINE / TYPE TESTS ON TRANSFORMERS: vi)**During Infra red thermography test of GT, the temperature of any part of tank shall be limited to 110 deg C.	We would like to clarify that Infra red thermography tests will be conducted for records only	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 913 of Clarification-02 of the same.
331	SECTION VI, PART- B	SUB-SECTION B-04 TRANSFORMERS AND ASSOCIATED MAINTENANCE, MONITORING & TESTING EQUIPMENTS	1.11.04 Sr. No 31	PAGE 23 OF 36	ROUTINE / TYPE TESTS ON TRANSFORMERS: Short duration heat run test (Not applicable for unit on which temperature rise test is performed)	Bidder would like to understand the procedure & acceptance criteria of this test. As this tests is not covered in generally used standards	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 914 of Clarification-02 of the same.
332	SECTION-VI, PART-A,	SUB-SECTION-I-A PROVENNESS / NUMERICAL RELAYS & NETWORKING	5.8.0	Page 31 OF 42	1.1 Bidder/ Sub Vendor should have manufactured and supplied and successfully configured at least one hundred (100) numbers of Numerical Relays with IEC 61850 used for application in Feeder Protections/Transformer Protections/Motor protections. These relays should have been in successful operation for at least two (2) years. 1.2 Bidder/ Sub Vendor should have manufactured/ integrated and successfully done Site Acceptance Test (SAT) for a network on IEC 61850 with at least one hundred (100) numbers of Communicable Numerical Relays.	Bidder would like to clarify under make in India Scheme , above qualificiaition for parent company to be considered	Bidder proposal is reviewed and not acceptable. Bidder to follow specification requirement.
333	SECTION-VI, PART-A,	AUXILIARY OIL FILLED TRANSFORMERS AND HT TRANSFORMERS	5.12.1	PAGE 31 OF 42	Bidder/Sub-Vendor should have his own facilities for conducting all routine and type tests as per IS: 2026 (except short circuit test).	Bidder would like to clarify : (Except Short circuit and Impulse test): Clarificaiton : Impulse test is a Type test and same can be done at Third Party lab	Bidder proposal is reviewed and not acceptable. Bidder to follow specification requirement.

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	Employer's response
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
334	SECTION – VI, PART-A	SUB-SECTION-I INTENT OF SPECIFICATION	6 of 8	4.03.00	All the first fills of consumables and one year's topping requirements of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases (excluding H2, CO2 and N2 for Generator) 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	First fill of consumables such as greases, oil, lubricants, servo fluids/control fluids, gases (excluding H2, CO2 and N2 for Generator) and essential chemicals shall be supplied by Bidder till Full Load/COD whichever is earlier.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 477 of Clarification-02 of the same.
335	SECTION – VI, PART-A	SUB-SECTION-D-1-5 CIVIL WORKS	6 of 8	2.01.00	Development of Bidders temporary staff colony and worker colony along with toilets & fencing etcFor safety of worker, bidder to provide separate approach road for their movement, as per site conditions, which shall be completely isolated from material movement road/path. No material movement shall be allowed on approach road meant for worker colony. Sole responsibility of development and maintenance of above facilities for construction workers hired by the Contractor or his sub-contractors shall rest with the Contractor. Land, water, electricity for the worker & staff colony shall be arranged by the Contractor as stipulated elsewhere in Technical Specification.	For construction of labor colony Land of 30,000 SqM may please be provided by customer within plat premises/in proximity of plant premises free of all charges. Apart from this ownner may kindly provide adequate water, electricity fuel supply, sanitation, fire prevention and fire-fighting equipment for contractor's staff and labour free of all charge	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 478 of Clarification-02 of the same.
336	SECTION – VI, PART-A	SUB-SECTION-D-1-5 CIVIL WORKS	6 of 8	2.02.00 (3)	Construction of following temporary facilities of bidder a) Construction office, b) Construction stores (covered) & open stores as per his requirement. c) Workshops for maintenance of construction plant and equipment. d) Material/field testing laboratory facilities and any other temporary building.	Owner may please provide land free of charge for temporary offices, fabrication yard, and storage facilities with in plant boundary. Temporary accommodation, including all fencing, water supply at two points (both for drinking and construction purposes), electricity, fuel, supply, sanitation, fire prevention and fire-fighting equipment for contractor's staff and labour free of charge.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 479 of Clarification-02 of the same.
337	SECTION – VI, PART-D	-	29 of 70	44.19.00	If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c shall have the right to regulate the payment in accordance with provisions of SCC. Further such defaulting worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor.	Owner is requested to delete the penalty clause. No penalty shall be imposed on contractor as mentioned in the clause.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 481 of Clarification-02 of the same.
338	SECTION – VI, PART-D	-	12 of 70	31.00.00	The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.	Watch and ward arrangement shall be taken care by contractor. However, the arrangement for a strong security set up to insulate complete project contours shall be costumer's responsibility.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 482 of Clarification-02 of the same.
339	SECTION – VI, PART-A	SUB-SECTION-IIB ELECTRICAL SYSTEM / EQUIPMENTS	11 OF 20	1.16.04.(Point l)	Dismantling of existing fencing roads, temporary sheds and building, foundations, re-routing of pipelines above the ground and below the ground available in present scope of bays is also in the scope of the bidder.	Since, the underground facilities are not visible, the underground facilities to be modified/ re-routed/ dismantled may please be taken care by the Owner. Hence, Scope of dismantling may please be deleted from bidder's scope. If above proposal not acceptable to customer,please share the details (drawing, quantity in nos., weight in tonnage etc.) for any existing above and below ground facilities which are to be dimolished/ rerouted/ reinstalled/dismantled.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 8 of the same.
340	SECTION VI, PART- B	SUB-SECTION E-59 QA CIVIL WORKS	2-3 of 6	4.0 (b)	Structural steel (plates and rolled sections i.e. channels, beams & angles) conforming to IS 2062 and Reinforcement steel conforming to IS 1786 supply if in the scope of the contractor shall be procured from Primary Steel Producers (Refer NOTE below).	Procurement from BIS APPROVED SOURCES HAVING VALID BIS LICENCE may kindly be allowed without any approval from NTPC after the award.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 177 of Clarification 01 the same.

341	SECTION VI, PART- B	SUB-SECTION E-59 QA CIVIL WORKS	2-3 of 6	4.0 (b)	In case of non-availability of certain steel section/s i.e. Angle smaller than 100x100x10 mm, MS flats, rounds, square bars and chequered plate from above acceptable primary steel producers, an option is given to the Main contractor to source these sections directly from SAIL Conversion/Wet Leasing agent subject to the conditions given at point no. A) below:-------	Procurement from BIS APPROVED SOURCES HAVING VALID BIS LICENCE may kindly be allowed without any approval from NTPC after the award.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 178 of Clarification 01 the same.
342	SECTION VI, PART- B	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL, SUB-SYSTEM:SG(MECH)	4 of 25	15	-	Procurement from BIS APPROVED SOURCES HAVING VALID BIS LICENCE may be allowed without any approval from NTPC after the award.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 179 of Clarification 01 the same.
343	SECTION-VI, PART-A	SUB-SECTION–I-A, Proveness	32 of 35	7.1	Bidder or its agency should have executed civil and steel structural works of 500 MW or higher capacity coal based/Lignite based power plant/Nuclear Power Plant, Earth work in filling involving mechanical compaction and cutting in rock, piling, Main power house building and Foundation for Turbo-generator..--- ---	For civil work proveness criteria - subagency through consortium to be allowed. For civil work proveness criteria work in any infrastructure project may kindly be considered.	Bidder's proposal is not acceptable
344	SECTION-VI, PART-A	SUB-SECTION–IA	32 of 35	7.1	Bidder or its agency should have executed civil and steel structural works of 500 MW or higher capacity coal based/Lignite based power plant/Nuclear Power Plant, Earth work in filling involving mechanical compaction and cutting in rock, piling, Main power house building and Foundation for Turbo-generator..--- ---	Civil & Structural works execution should not be linked with prior experience of TG/Bunker/other building. It should be modified in line with NTPC earlier tender enquiries / contract under execution. Therefore, bidder requests NTPC to amend the QR as follows: "In case Bidder or its agency do not meet the requirements at 7.1 and the Bidder proposes to engage agency (ies) for civil & structuralworks on work volume basis (except for Chimney works), Bidder or its agency (ies) should have executed such works in the past and the annual rate of execution in the reference works should not be less than eighty percent (80%) of the asking rate of such works, (structural steel fabrication & erection, RCC, and earthwork in filling involving mechanical compaction) for which it is being engaged	Bidder's proposal is not acceptable
345	SECTION – VI, PART-A	SUB-SECTION-IID CIVIL WORKS	8 OF 8	2.03.00	Bidder shall use a Lay down area as shown in tender GLP drawing. area marked in GLP totalling 50 acres (approx.) are identified as laydown /preassembly area. Fencing of the laydown area in the area marked for laydown is in bidder's scope.	Owner may please provide encumbrance free land (70-75 acre approx.) suitably marked in the plot plan free of charge for temporary offices, fabrication yard, and storage facilities within plant boundary. Incase any additional land is required to construction/erection facility like lay -down, pre asssembly,offices outside plant shall also be arranged by Owner . Kindly confirm	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no.709 of Clarification-02 of the same.
346	ERRATA TO SECTION VI TECHNICAL SPECIFICATIONS	Amendment 03 to Technical Specifications (Section VI)	611 of 700	D3-59	**No additional land** than what is mentioned in technical specifications, shall be pro vided by Owner for site fabrication. Bidder has to make all necessary arrangements of land, electricity, water, security, etc. on its own. No claim, whatsoever, regarding time extension and financial implication for site fabrication shall be entertained at any point of time.		
347	SECTION – VI, PART-A	SUB-SECTION–IIA-21 (SOLAR P.V.)	pdf pg 575 of 953	bullet point 3	Complete design, engineering, manufacture, inspection, supply, transportation, storage, insurance, civil work, erection, testing, commissioning and one year O&M of the grid connected rooftop Solar PV plants including all auxiliaries.	NTPC has one of the best O&M capabilities in India for power projects whereas Bidders do not have such competence. Even the system suppliers and equipment(s) supplier do not have such competency to operate the plant. Bidder requests NTPC to delete O&M services from EPC scope.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 492 of Clarification-02 of the same.
348	SECTION – VI, PART-A	SUB SECTION IIA-11 CW SYSTEM	3 of 4	1.04.0 (8)	Supply of all chemicals and O&M for complete CW Treatment System for one (1) year operation after PG test including first fill for all the units, etc. for the complete plant as per system requirement and as specified.	Owner is requested to delete the scope of O &M from the scope of the bidder.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 493 of Clarification-02 of the same.

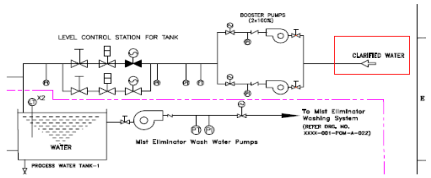
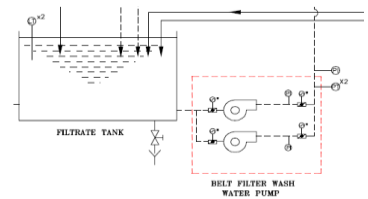
349	SECTION – VI, PART-A	SUB-SECTION-IIC CONTROL & INSTRUMENTATIO N SYSTEM	18 OF 19	25.00.00	Comprehensive Annual Maintenance Services (AMS) for three (03) years after warranty period shall be provided for the following system 1. Distributed Digital Control, Monitoring & Information System (DDCMIS) 2. Analyzer instruments of DM / PT, LET, Chlorination (ClO2), CWT and CPU plant. 3. CEMS and EQMS 4. Public address system (PA) 5. Wireless Instruments & System including fieldbus instruments 6. Closed circuit television system (CCTV)	Owner is requested to delete the scope of three years Annual Maintenance Services (AMS) from the scope of the bidder.	Bidder to refer to resolution against Sr. no. 494 of EMPLOYERS RESPONSE TO TYPICAL BIDDER'S QUERIES ON SECTION VI TECHNICAL SPECIFICATIONS (CLARIFICATIONS-02). Bidder's request is not acceptable as Comprehensive AMS for the indicated systems is required considering the Owner's perspective and is not a new stipulation. Bidder to comply to the Technical Specifications in toto.
350	SECTION – VI, PART-A	SUB-SECTION-IID CIVIL WORKS	1 OF 8	1.00.00	Site clearance including cutting of trees of girth less than 30 centimeters. Cutting of trees of girth more than 30 centimeters shall be done by the owner. However, removable and disposal of roots, trees of girth less than 30 centimeters and other vegetations in the bidder scope.	The land with approach for disposal shall be identified and arranged by the Owner within maximum leads upto 5 Km from Plant boundary free of all cost.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no.495 of Clarification-02 of the same.
351	ERRATA TO SECTION VI TECHNICAL SPECIFICATIONS	Amendment 01 to Technical Specifications (Section VI)	45 of 700		Site clearance including cutting of trees of girth less than 30 centimeters. Cutting of trees of girth more than 30cm shall be done by the Owner after finalization of GLP. However, removal and disposal of roots of trees of all girths (including trees of girth less than 30cm or more) and other vegetation is in Bidder's scope		
352	SECTION – VI, PART-A TECHNICAL SPECIFICATION SECTION-VI, PART-A	Annexure- C to subsection II C SUB-SECTION-I-A PROVENNESS	20 of 21 31 of 35	N(1) 6.6 (f)	Safety Control Room: 1) IP based PTZ dome camera (HD)(wired/wireless) Proveness Criteria: The combination of offered make of IP based camera and offered make of video management software, for CCTV system, should have been in successful operation for a period of not less than one (1) year in a large industrial setup viz power plant, cement plant, petroleum refinery, steel plants or coal mine, having installation of minimum forty (40) nos. cameras.	As per Bid condition readiness of safety control room is Criteria for processing of RA bill, in view of above it is proposed that Camera with same specificaton shall be installed for safety control room however Provenes shall shall not be established at that time. Bidder's RA bills shall be processed without establishment of Proveness Criteria. Further, Proveness shall be established at the time of installation of O &M cameras as both has to be interchangable and earlier cameras shall be taken back by bidder.	Bidder to refer to resolution against Sr. no. 497 of EMPLOYERS RESPONSE TO TYPICAL BIDDER'S QUERIES ON SECTION VI TECHNICAL SPECIFICATIONS (CLARIFICATIONS-02). Bidder's proposal is not accepted .Bidder to comply to the technical specifications.
353	SECTION – VI, PART-A	SUB-SECTION-I INTENT OF SPECIFICATION	5 of 8	4.02.00	Pre-commissioning and commissioning activities Commissioning Fuel	Calorific Value and other parameters of Fuel Oil and Coal should be specified and same may please be incorporated in the formula for arriving at corrected coal quantity to be issued free of cost.	Reply to this query is already included in the section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Calrifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 498 of Clarifications 02.
354	SECTION – VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	44 of 119	26.02.00	**Initial Operation:** …(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 contractor shall conduct the trial run as per clause 26.05.00 to demonstrate the compliance to the requirements as stipulated in the CERC (Indian Electricity Grid Code) Regulations, 2023. 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.	Operating parameters shall be within specified limits and at or near predicted performance provided necessary boundary conditions are met at the least. Hence, this portion of this clause may be modified as below. 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 **subject to the condition that specified boundary/battery limit conditions are met and fuel oil and coal with specified characteristics are fired.**	Reply to this query is already included in the section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Calrifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 499 of Clarifications 02.

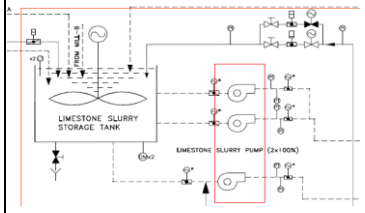
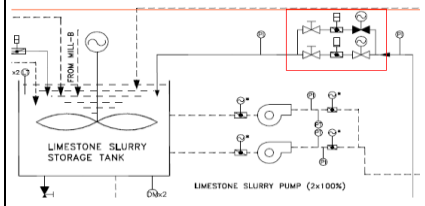
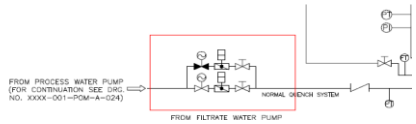
355	SECTION – VI, PART-A	SUB-SECTION-IV FUNCTIONAL GUARANTEES	11 of 73	1.01.03.02 (e)	Unless otherwise specified, the guarantees shall be based on design coal firing with coal/ ash analysis as given in the table at Annexure-IV-2, Sub-Section-I-B (Project Information) of Part-A of Technical Specification. The performance guarantee test will be carried out along with the Initial Operation of facilities or as per the time frame specified for a particular equipment/ plant/ system in the Technical specifications. Delay in conductance of the test beyond this period will not be normally permitted by the EMPLOYER. In the event of EMPLOYER agreeing to conductance of such tests after Initial Operations, for reasons not attributable to the EMPLOYER, as assessed by the Employer, no factor for ageing shall be considered for computing performance of the equipment.	This clause should specify a way out or suitable compensation if Employer is not able to fire design coal. Firing coal beyond specification may cause accelerated deterioration of equipment and same may be economically irreversible. This situation may lead to potential loss, both direct and indirect, to bidder. Owner is requested to delete the clause.	Reply to this query is already included in the section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Calrifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 500 of Clarifications 02.
356	General				Excavated earth disposal	NTPC to confirm the availablity of land for disposal along with approach road at the start of the project. Employer may also provide lead distance upto disposal site.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 504 of Clarification-02 of the same.
357	General				2 Nos. of material entry/exit gates requied	NTPC to confirm the exact location of entry gate and material gate in GLP. These should be provided near bidders identified storage yard. Further there should be no hinderance (viz. Overhead transmission line etc.) from Entry gate till Construction site/storage yad/Fabrication yard etc. Owner may kindly confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 505 of Clarification-02 of the same.
358	General					Start up power (Electrical Power) for charging the station transformer and onward testing, commissioning, Initial operation, Trail run, Full load , performance guarantee test and running the plant in any other condition shall be provided by Owner free of all charges.	Bidder's understanding is correct.
359	General					Raw Water for testing, commissioning, Initial operation, Trail run, Full load , performance guarantee test, and running the plant in any other condition shall be provided by Owner free of all charges.	Raw/Construction water may be supplied at one point on chargeable basis based on availability. Rate of the same shall be decided by NTPC based on the cost to NTPC, which shall be intimated during the execution stage.
360	TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-I INTENT OF SPECIFICATION	6 OF 8	4.03.00	All the consumables and one year topping requirement of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases (excluding H2, CO2 and N2 for Generator) 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 under stand **chemicals for BOP packages** (viz. ETP, STP, DM Plant, Pre Treatment Plant, CPU plant,CWTP etc.) is not part of this clause. Further, BOP Chemicals shall be supplied by Bidder till Full Load/COD whichever is earlier. Kindly confirm	Bidder to supply all essential chemicals to put the equipment covered under the scope of specifications into successful commissioning / initial operation and to establish completion of facilities. Bidder to comply with tender requirements.
361	SECTION-IV (GCC)	NTPC SAFETY RULES/Sect-I	22 (pdf pg 372 of 524)	26	Any Heavy equipment (crane, winch machine, etc.) manufactured less than 15 years from the current year shall be only allowed to be used at our project Site's. Pre-safety Inspection of the equipment by safety deptt. shall be done before mobilizing the equipment at our project site.	Owner is requested to delete the clause and allow the follwing criteria for deloyment of Heavy Equipment (Crane, winch, Machine etc.):- Any Heavy equipment (crane, winch machine, etc.) after Third Party inspection by competent authority shall be only allowed to be used at our project Site's. Pre-safety Inspection of the equipment by safety deptt. shall be done before mobilizing the equipment at our project site.	Bidder's proposal reviewed but not accepted. Bidder to comply with tender requirements.
362	TECHNICAL SPECIFICATION SECTION – VI, PART-D	ERECTION CONDITIONS OF CONTRACT	31	44.22.j)	Availability of Fire Tender shall be ensured by contractor before start of construction work	To cater emergency situation at construction activity, bidder shall ensure availability of sufficient no. of Fire extinguisher at working location at project site. However, if required bidder will tie up with local fire tender department viz. Fire department and/or available local agencies at project site to cater any eventuality. Hence, owner is requested to delete the clause.	Bidder's proposal reviewed but not accepted. Bidder to comply with tender requirements.

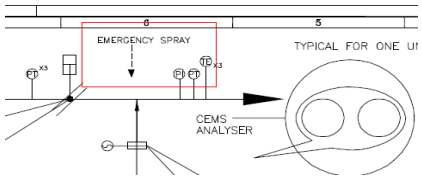
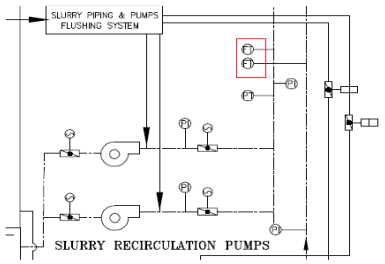
363	Site Visit					Bidder request NTPC for proper entry to site & Storage yard/lay down area. The complete land for Stage-III is in MGR bulb wherein only two entry points are available. One is underpass which is very low in height and material/T&P movement is not possible throuh it. Second access is above ground, howver, the MRG rail has to be crossed for that and we envisage following difficulties : 1) Each Consignment has to cross MGR Rail crossing with overhead transmission line as height of underpass is too low. Due to the Overhead transmission line each of the ODC may be stranded at the aforesaid rail crossing. It is most likely that the transmission line has to be removed for few of the ODC consignments. Due to retention of vehicles, contractor will have to pay huge demurrage charges also to its transporter as hydraulic trailers carrying ODC consignment have very high demurrage charges. 2) During Peak erection time, movement of vehicles will be hindered due to Railway crossing and this may lead to long queue of vehicles within existing plant. 3) 20 Acre of laydown area is outside MGR. Movement of erection material/equipment from that area to the erection site is difficult. This has safety issues also. NTPC is requested to provide clear access to the site/storage/laydown area. If hinderence free entry is not provided , Bidder request NTPC to arrange any type of clearance/ liasoning/ associated fees etc. with appropriate authority for shutting down the transmission line or removing and re-connecting the line (if required) by railway approved vendors for movement of /ODC Consignment/Plant/ Machinery etc. at their end. Any delay in arranging the permission shall not be attributable to bidder. Any cost incurred by bidder due to retention of vehicles/ demurrage charges etc. shall be reimbursed by Emoloyer. Owner may kindly confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 649 of Clarification-02 of the same. Further, for ODC consignment requiring removal of MGR overhead transmission line inside the plant, bidder may note that the employer shall make necessary arrangements for facilitating movement of the same.
364	TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-I INTENT OF SPECIFICATION	7 OF 8	4.09.00	The Contractor shall be responsible to undertake some activities related to its Corporate Social Responsibility (CSR) in the immediate vicinity of the project. The Contractor shall undertake such activities after prior consultations with the Employer to ensure that the efforts of the Employer and Contractor are complemented. The vendor / contractor is expected to carry out the CSR activities as per the provision (Rules) under section 135 of the companies Act 2013 relating to CSR and other circulars / instructions of various government departments viz MoEF etc. The share of CSR expenditure to be incurred by the vendor / contractor for this project in the total CSR expenditure incurred by the vendor/contractor as a company will be in the same proportion as the turnover of the project concerned to the total company turnover. This will be certified by the charted accountant once every fiscal year.Such activities will be undertaken by the contractor / vendor in consultation with the Employer	Bidder have their own CSR policy in conformance with extant requirements under the Companies Act 2013, the Companies (CSR Policy) Rules, 2014, as amended from time to time. All CSR activities are being carried by bidder as per the aforesaid CSR policy. **Hence , no certification is required .** **Hence, bidder request Owner to delete this clause .**	Bidder's proposal reviewed and not accepted. Bidder to comply with tender requirements.

365	TECHNICAL SPECIFICATION SECTION – VI, PART-A	SUB-SECTION-I INTENT OF SPECIFICATION	7 OF 8	4.10.00	The vendor / contractor shall visit the site to ascertain the position of land acquisition etc. and it is presumed that the contractor submitted his bid after considering the facts on the ground and that once vendor / contractor is successful in his bid, he will work in cooperation with the client for smooth execution of the project	Resolution of all land acquisition related issues shall be directly dealt by customer. Customer shall hand over clear encroachment free land with boundary / fencing to bidder for execution of project work at site. No responsibilities lies with the bidder in this regard. Hence, bidder request Owner to delete this clause .	Provisions of Bidding Documents shall prevail.
366	SECTION – VI, PART-C	GENERAL TECHNICAL REQUIREMENTS	46 of 119	26.05.00 (v)	v) Primary response through injecting a frequency test signal with a step change of ±0.1 Hz at 55%, 60%, 75% and 100% load. Provision of injecting external frequency test signal in control system for primary frequency response testing shall be in the contractor's scope.	Deputatio of CERC approved vendor shall be in owner's scope. However bidder shall provide all necessary assistance.	Bidder's understanding is correct. Bidder to further note that the Technical Specification requirements are clear and the same shall be followed.
367	SECTION - VII,BOOK 3 OF 3 (PART-1B)					As additional tender documents viz." EMPLOYERS RESPONSE TO TYPICAL BIDDER'S QUERIES ON ECTION VI TECHNICAL SPECIFICATIONS (CLARIFICATIONS 01 & 02" & ERRATA TO SECTION VI TECHNICAL SPECIFICATIONS (Amendments 1 to 11 has been provided with bid document. NTPC to indicate proper Order of precedence as the same clause of the specification has been revised at a number of clarification, amendment & errata. During bid preparation & contract execution it is not possible to locate the latest modified requirement under that clause.	Bidder to refer Sl. No. 91 of Clarification-1B issued for Sipat-III (1x800 MW) EPC Package (under bulk tender) in this regard.
368	General				Approach road to construction site shall be done by NTPC.	Bidder understands Owner will provide roads and approach roads upto the Main Plant for construction material, plant and equipments, ODCs etc upto main gate. NTPC may kindly confirm	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 503 of Clarification-02 of the same.
369	TECHNICAL SPECIFICATION SECTION -VI, PART-B	SUB SECTION E-24 FIRE PROTECTION SYSTEM	4 of 4	1.09.00.c(1),c(2)	(c.) Welding of Pipes:		Bidder to follow technical specifications.
					(1.) ERW Black / rolled welded:	(1.) ERW Black / rolled welded:	
					100% DPT on root of butt and finish weld of butt and fillet. RT on 10% randomly selected joints shall be carried out (for underground piping).	10% DPT on finish weld of butt.RT on 5% randomly selected joints shall be carried out (for underground piping)	
					(2.) GI Pipes	(2.) GI Pipes	
					Welding on GI Pipes in general shall not be done. Welding of GI Pipes, if permitted by design, (butt / socket / fillet weld) shall be done strictly as per approved drawing and procedure approved by NTPC Engineering. For all such welds 100% DP test and random 1% RT shall be done.	Welding on GI Pipes in general shall not be done. Welding of GI Pipes, if permitted by design, (butt / socket / fillet weld) shall be done strictly as per approved drawing and procedure approved by NTPC Engineering. For all such welds 10% DP test and random 1% RT shall be done.	
370	TECHNICAL SPECIFICATIONS SECTION – VI, PART-A BID DOC. NO.	SUB-SECTION-IIC CONTROL & INSTRUMENTATIO N SYSTEM	16 OF 19	11.03.00	All the chemicals and reagents required for initial commissioning and warranty period (18 months operation after successful commissioning) of SWAS is to be supplied in phased manner depending on shelf life, in addition to that indicated under mandatory spares. Contractor shall initially supply reagents for two months operation, further supply shall be based on commissioning schedule of Units and confirmation by site Engineer. Contractor to provide shelf life of all reagents during detail Engineering. All the reagents supplied to site shall have at least 90% of remaining useful life at the time of dispatch	All the chemicals and reagents for SWAS system shall supplied till I Full Load/COD whichever is earlier.	Bidder's proposal is not acceptable. Bidder to comply to the Technical Specifications.

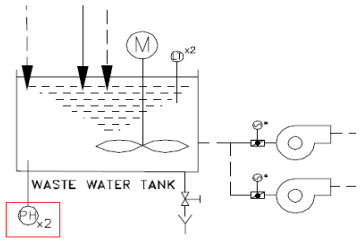
Sr. No.	Section / Part	Sub-section / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	NTPC's Clarification
371	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB-SECTION-E-6 POWER CYCLE PIPING	Page 2	1.01.00	(h) Non-destructive examination of welds shall be carried out in accordance with the relevant design/manufacturing codes. However, as a minimum, the following requirements shall be met. Further statutory requirement, wherever applicable shall also be complied with. (1) Temperature > 400 Deg, C or pressure exceeding 71 bar. (i) 100% RT/UT on butt welds and full penetration branch welds. (ii) 100% MPE. (2) Temperature > 175 Deg, C upto 400 Deg. C or pressure exceeding 17 bar and upto 71 bar. (i) 100% RT/UT on butt welds and full penetration branch welds for pipe dia. more than 100 NB. (ii) 10% RT/UT on butt welds and full penetration branch for pipe dia up to 100NB. (iii) 100% MPE.	If any of the piping falls under vent piping then the following NDT will be carrid out. (i) 10% RT /UT on butt welds and full penetration branch welds (ii) 100% MPE or DPT	Bidder's understanding is not correct. Technical specifications are clear in this regard, bidder to comply.

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	Employer's response
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
372	VI / A	Attachment 3K	63 of 361	1	1. If qualification sought as per clause 4.26.1 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 4.26.2, 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	We conduct open tender process with NTPC QR condition for procurement of FGD BOI. Therefore, Attachment 3K, which pertains to FGD BOI components such as Agitators, Slurry Recirculation Pumps, etc., will be submitted after the award of the contract. Please accept.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 96 of Clarification-01 of the same.
373	VI / A	IB	11 of 19	Annexure-IV-2	DOMESTIC COAL CHARACTERISTICS	Kindly provide chloride/fluoride value in coal or HCL/HF conc. in absorber inlet flue gas for FGD design.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 98 of Clarification-01 of the same.
374	VI / A	IB	3 of 19	13.02.00	**CW system blow down water shall be used for** plant service water requirement, dust suppression system of coal handling plant fire water tanks, **FGD (process water)** facilities, sealing of Vacuum pumps (if applicable) of Ash Handling plant. **Make-up to** AHS Cooling system, HVAC System & **FGD system** shall be met from PT plant of CW system (PT-CW). The waste service water collected from various areas and coal laden water from coal handling plant shall be treated as per requirement and reused. The quality of Raw water is given in this sub-section at Annexure-III-A, and III-B.	Source of FGD process water/make up water mentioned in two clauses are contradictory to each other. Kindly confirm whether source of FGD process water/make up water is from CW blowdown or from PT plant of CW system.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 99 of Clarification-01 of the same.
375	VI / B	A-05	24 of 29	13.01.00	Two (2) Process water Storage tanks (each tank catering to the requirements of 1 x 800 MW units) along with two numbers of 2x100 % Booster water pumps, if required, (Each pump catering to the process water requirements of 1 x 800 MW units) along with all necessary piping, valves, control & instrumentation **to feed the clarified water shall be provided by the Contractor**..... The **tank shall receive clarified water**	As per referred clause, FGD process water storage tank will receive clarified water. However, in another section of the tender specifications(VI/A-IB-13.02.00), source of FGD process water is indicated as CW blowdown water. Kindly clarify and confirm the source of FGD process water.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 100 of Clarification-01 of the same.
376	VI / E	Tender Drawing	34 of 91		Tender Drg. No. xxxx-001-POM-A-024 (zone E1) Scheme of Gypsum Dewatering System 	Source of FGD process water is indicated as clarified water in referred tender drawing. However, in another section of the tender specifications(VI/A-IB-13.02.00), Source of FGD process water is indicated as CW blowdown water. Kindly clarify and confirm the source of FGD process water.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 101 of Clarification-01 of the same.
377	VI / E	Tender Drawing	34 of 91	-	Tender Drg. No. xxxx-001-POM-A-024 (zone A7) Scheme of Gypsum Dewatering System 	In the tender drawing, it is observed that the belt filter wash water pump is drawing its suction from the filtrate tank. However, the filtrate tank contains slurry with solids, making the filtrate water unsuitable for belt filter washing. Hence, as per our proven practise, process water will be used for Belt filter washing. Please confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 102 of Clarification-01 of the same.

378	VI / E	Tender Drawing	33 of 91		Tender Drg. No. xxxx-001-POM-A-023 (zone G3) Scheme of FGD Milling System 	In the tender drawing, it is depicted that there are 3 nos. of limestone slurry pumps for each limestone slurry storage tank. However, under Sec VI-A, Sub Sec IIA-04, clause 3.01.04, the tender specification says total 2 nos. of limestone slurry pumps for 1x800 MW to be provided. Kindly confirm the correct number of pumps to be provided.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 103 of Clarification-01 of the same.
379	VI / E	Tender Drawing	33 of 91		Tender Drg. No. xxxx-001-POM-A-023 (zone H2) Scheme of FGD Milling System 	In the tender drawing, it is shown that process water is added to the limestone slurry tank via control station. Adding process water to limestone slurry tank will dilute the limestone slurry contained in the tank. Hence, it is not recommend to add process water to limestone slurry tank. Please accept.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 104 of Clarification-01 of the same.
380	VI / E	Tender Drawing	32 of 91		Tender Drg. No. xxxx-001-POM-A-022 (zone D8) Scheme of FGD Absorber System 	In tender drawing, normal quench system is shown. However, in tender specification, there is no mentioning of normal quench system. As per our collaborator proven FGD design also, normal quench system is not applicable. Kindly clarify what is the purpose of normal quench system and if it is mandatorily required, kindly provide the specification for the same.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 105 of Clarification-01 of the same.
381	VI / E	Tender Drawing	32 of 91		Scheme of FGD-Absorber system: Note 6- All instruments in slurry lines shall be provided isolation valves and diaphragm.	Bidder does not recommend valves in the impulse lines of slurry pipes in order to keep the stub length as minimum as possible and to prevent slurry settlement/blockage issues. Bidder request NTPC to review and confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 106 of Clarification-01 of the same.
382	VI / E	Tender Drawing	32 of 91 & 34 of 91		Scheme of FGD-Absorber system & Scheme of Gypsum Dewatering system	At the common discharge line of Filtrate water pumps, Valve station and instruments are repeatedly indicated in both the schemes of absorber system and Gypsum dewatering system. Bidder understand that one set of instruments and a valve station are only to be provided. Bidder request NTPC to review and confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 107 of Clarification-01 of the same.

383	VI / E	Tender Drawing	32 of 91		Tender Drg. No. xxxx-001-POM-A-022 (zone H6) Scheme of FGD Absorber System 	Emergency Spray is indicated in the FGD bypass duct to chimney in zone H6 of tender drawing. Kindly clarify whether this Emergency Spray is required since this is not called for elsewhere in the tender specification. Please note that, for other NTPC tenders also, NTPC clarified that Emergency spray is not required vide pre bid replies.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 108 of Clarification-01 of the same.
384	VI / E	Tender Drawing	32 of 91		Tender Drg. No. xxxx-001-POM-A-022 (zone E2) Scheme of FGD Absorber System 	In tender drawing, Flow Transmitter is shown on the RC pump discharge header. Magnetic type flow transmitter is applicable for slurry and magnetic flow transmitter required minimum 5D/2D straight distance upstream and downstream of flow meter. RC pump header size is typically around 1.8 m. ~13 m Straight distance required for magnetic flow meter. As per RC pump piping layout, it is not possible to provide this much straight distance and hence it is not technically possible to provide flow meter in RC pump discharge header. Hence, kindly delete flow meter.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 109 of Clarification-01 of the same.
385	VI / A	IB	15 of 19	4	The above represent limestone quality to be considered for basic sizing and guarantees. Further the bidder is required to collect limestone samples from site for analysing is characteristic including reactivity. Bidder shall indicate in its bid the quantity of limestone required for such testing.	Kindly clarify whether limestone reactivity test is to be carried out after award of contract or before award of contract.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 110 of Clarification-01 of the same.
386	VI / A	IIA-04	1 of 7	1.02.00	In case of higher pressure /flow requirements are envisaged for instrument & service air and water Contractor shall make its own arrangement.	As per this clause, we understand instrument air & service air will be provided by customer upto certain predefined limit. Kindly specify the ceiling limit for instrument & service air.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 112 of Clarification-01 of the same.
387	VI / A	IIA-04	2 of 7	2.06.00	The waste water from the system shall be collected and neutralized using lime and shall be pumped to the mixing tanks of HCSD System or in any other area with **suitable treatment** so as to suit/ not disturb the destination fluid quality.	Kindly specify a. type of treatment required for FGD waste water and b. quality of waste water required after treatment so as to bring uniformity among bidders	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 113 of Clarification-01 of the same.
388	VI / A	IIA-04	4 of 7	4.01.04	2x100 heaters for absorber outlet gate & **bypass gate**	We understand that FGD bypass gate is not applicable. The reference to the bypass gate in this clause is a typographical error. Please confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 114 of Clarification-01 of the same.
389	VI / A	IIA-04	4 of 7	4.01.09	Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and **control valves**	Control valve is not required in gypsum bleed pump line as per our proven practise. All valves (as per tender P&ID) will be provided for gypsum bleed pump line. Please accept. If control valve is mandatory in gypsum bleed pump line, please inform the purpose of control valve and type of control valve required.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 115 of Clarification-01 of the same.
390	VI / A	IIA-04	5 of 7	7.00.00	PROCESS WATER& COOLING WATER STORAGE & PUMPING SCHEME	This section does not stipulate any specific requirement for cooling water storage. Kindly confirm whether cooling water storage is required. If cooling water storage is required, provide specification for cooling water storage if required.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 116 of Clarification-01 of the same.

391	VI / A	IV	1 of 73	1.00.01	All CAT-1 Performance Guarantee tests shall be conducted along with initial operation except following a) Coal Pulveriser Wear Parts Warranty b) Particulate Emission/ESP Efficiency, **FGD.**	Kindly specify when FGD PG test is to be done. Is it after completion of initial operation?	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 117 of Clarification-01 of the same.
392	VI / A	IV	20 of 73	1.01.07.01 note 5	Guaranteed Unit Auxiliary Power Consumption of FGD system shall be taken by considering the additional pressure drop in the FGD system during FGD SO2 removal efficiency test at specified guarantee point conditions. For this purpose, difference of FGD system pressure drop during FGD SO2 removal efficiency test and that at Unit Auxiliary Power Consumption test shall be loaded as additional Auxiliary Power Consumption.	We understand that if booster fan is not provided, difference in ID fan power consumption measured during FGD SO2 removal efficiency test and that measured during Unit Auxiliary Power Consumption Test will be considered for FGD Power Consumption on account of FGD pressure loss. If booster fan is provided, booster fan power consumption only will be considered for FGD power consumption on account of FGD pressure loss. Kindly confirm our understanding is right.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 118 of Clarification-01 of the same.
393	VI / A	IV	22 of 73	1.01.07.02 c)	c) FGD System i. Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries ii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries iii. Booster water pump iv. Waste water pump v. Limestone Slurry Tank Agitators vi. Filtrate Pump(s) vii. Belt Filter Wash Water Pump viii. Hydro-cyclone Waste Water Sump Pump and Waste Water Pump	Wet Ball Mill System and Gypsum Dewatering System along with their associated equipment do not run continuously and are operated in batch mode. As per ASME PTC 40, Bidder calculates duty factors based on running time of equipment at guarantee point conditions and accordingly guaranteed auxiliary power will be furnished. Please accept. Otherwise NTPC is requested to specify duty factors for equipment indicated at sl. no. i to viii.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 119 of Clarification-01 of the same.
394	VI / A	IV	22 of 73	1.01.07.02 c)	c) FGD System viii. **Hydro-cyclone Waste Water Sump Pump** and Waste Water Pump	The name of this pump (Hydro-cyclone Waste Water Sump Pump) is ambiguous, and we are unable to understand its intended purpose or service. We kindly request clarification	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 120 of Clarification-01 of the same.
395	VI / A	IV	30 of 73	1.03.03 iv)	Pressure Drop across FGD The contractor shall demonstrate that the total pressure drop in the gas path across the FGD System shall not exceed the guaranteed values for the range of coal and loads specified in the Technical Specification	FGD pressure drop is directly related to power consumption of ID fan or booster fans the case may be. There is guarantee for Auxiliary Power Consumption envisaged in the tender. FGD pressure drop is already accounted in auxiliary power consumption guarantee. Hence, we request NTPC to remove FGD pressure drop guarantee for this project in line with other NTPC tenders.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 121 of Clarification-01 of the same.
396	VI / A	IV	30 of 73	1.03.03 vi)	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 the range of specified coal(s) and based on CaO content of 51% in limestone.	As per sub section IV, limestone purity to be considered for Gypsum purity guarantee is CaO 51% =>**CaCO3 91%** As per Sub section IB, limestone purity to be considered for Gypsum purity guarantee is **CaCO3 89%** Both clauses are contradictory. Kindly clarify.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 677 & 678 of Clarification-02 of the same.
397	VI / A	IB	14 of 19	Notes. 1	Guaranteed parameters (guarantee on limestone consumption, auxiliary power consumption & gypsum purity) shall be based on available (reactive) CaCO3 content of 89%.		
398	VI / A	IV	30 of 73	1.03.03 vii)	The Contractor guarantees that the maximum purge flow rate to **waste water treatment system** from FGD system for 1x800 MW unit shall be less than 10m3/h averaged over a 24 hour period for a the range of specified coal(s).	As per this clause, we understand that waste water from FGD system is sent to waste water treatment system. However, We could not find requirement of FGD waste water treatment system in other sections of tender specification. Kindly clarify the requirement or details of FGD waste water system.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 122 of Clarification-01 of the same.
399	VI / A	IV	30 of 73	1.03.03 vii)	The Contractor guarantees that the maximum purge flow rate to waste water treatment system from FGD system for 1x800 MW unit shall be less than **10m3/h** averaged over a 24 hour period for a the range of specified coal(s).	FGD waste water purge flow quantity is arrived to limit chloride content in absorber slurry < 20000 ppm. Source of chloride in absorber slurry is mainly from coal. Kindly provide coal chloride content to check adequacy of FGD waste water purge flow quantity.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 123 of Clarification-01 of the same.

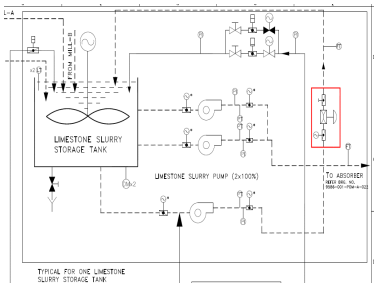
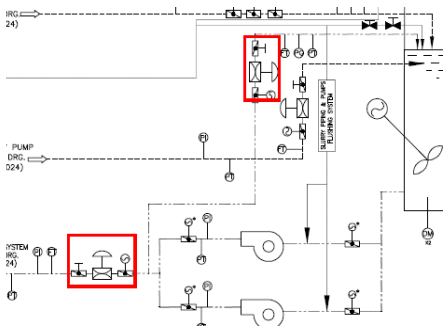
400	VI / A	IV	30 of 73	1.03.03 vii)	The Contractor guarantees that the maximum purge flow rate to waste water treatment system from FGD system for 1x800 MW unit shall be less than **10m3/h** averaged over a 24 hour period for a the range of specified coal(s).	FGD waste water purge flow of 10 m3/hr is too less for 1x800 MW unit. Bidder recommends that at least 15 m3/hr waste water purge flow per unit otherwise it will result in accumulation of high TDS/chloride content in the recirculated slurry which will impact FGD performance. NTPC is requested to review the clarification and provide necessary amendments.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 124 of Clarification-01 of the same.
401	VI / B	A-01	17 of 87	3 viii)	Pressure drop through FGD System 150mm WC or actual whichever is higher (Alternately, separate booster fans for FGD system may be provided. if pressure drop through FGD system exceeds 150 mm WC. In such case, specified pressure drop through FGD system shall not be considered for sizing of ID fan.)	We understand that separate booster is not mandatory even if FGD pressure drop is more than 150 mmwc. ID fan taking care of FGD pressure drop will be provided. Please confirm our understanding is correct.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 125 of Clarification-01 of the same.
402	VI / B	A-05	7 of 29	iv)	The slurry recirculation pumps shall have motor /pneumatic driven knife gate valve at pump suction.	Based on the proven practices of our collaborators, it is highly advisable to install a pneumatic butterfly valve at the suction point of the slurry recirculation pumps. Knife gate valves have a longer opening and closing time, approximately 5 minutes, in comparison to butterfly valves(15 sec). If a knife gate valve is used at the pump suction, it may cause delays in starting the recirculation pump, as one would have to wait until the suction gate valve is fully open. Please accept pneumatic butterfly valve at the suction point of the slurry recirculation pumps.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 126 of Clarification-01 of the same.
403	VI / B	A-05	9 of 29	5.04.00	Provision shall also be provide in the Gypsum Bleed Pumping system by provision of tap off, valves etc. for pumping the gypsum bleed to alternate source.	We understand that only provision for tap off with isolation valve will be provided in gypsum bleed pump discharge header pipe. Piping from tap off to alternate destination is not in bidder's scope. Please confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 127 of Clarification-01 of the same.
404	VI / B	A-05	4 of 29	2.00.00	The complete installation of liners shall be made under the supervision of the liner supplier as per their guidelines.	Since absorber is made of C276 clad plate, no liner is applicable. Hence, clause related to "supervision of the liner supplier" may be deleted.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 128 of Clarification-01 of the same.
405	VI / B	A-05	19 of 29	7.07.05	In case Bidder opts to provide additionally Lamella separator before the waste water tank and after the secondary hydro cyclone for removing impurities from the system, the solids con-centration in waste water up to max 10% can be acceptable.	Kindly clarify whether Lamella separator (before the waste water tank and after the secondary hydro cyclone) is mandatory or not.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 129 of Clarification-01 of the same.
406	VI / B	A-05	19 of 29	7.07.07	A pH monitor shall be provided at the discharge of the pumps for measurement and control.	As per Part B, pH analyser to be provided at discharge of the waste water pump. As per Tender drawing, ph analyser to be provided in waste water tank. Both clauses are contradictory. As per our proven practise, ph analyser will be provided in waste water tank. Please confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 130 & 131 of Clarification-01 of the same.
407	VI / E	Tender Drawing	34 of 91	-	Tender Drg. No. xxxx-001-POM-A-024 (zone F3) Scheme of Gypsum Dewatering System 		

408	VI / B	A-05	20 of 29	7.07.09	The lime storage silo shall be of minimum 24 hr capacity equivalent to the requirements of FGD system of **2x800 MW** at Design point and shall be complete with supporting steel structure, platforms, power operated outlet gates	2x800 MW mentioned in referred clause is typo error. It shall be 1x800 MW. Please confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 132 of Clarification-01 of the same.
409	VI / B	A-05	20 of 29	7.08.01	Bidder to provide the portable pumps of suitable capacity to drain the remaining slurry from the tank in max 2 hour into absorber area sump.	As per our proven practise, by opening drain valves in absorber, remaining slurry in absorber will flow automatically by gravity to absorber area sump via trench within 2hrs. Portable pumps to drain absorber tank is therefore not required. Please confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 133 of Clarification-01 of the same.
410	VI / B	A-05	21 of 29	8.04.00	All the slurry pumps shall be provided with motorized suction and discharge valves.	As per Part B, All the slurry pumps to be provided with motorized suction and discharge valves. However, the tender drawings allow for the provision of pneumatic valves based on the proven practices of the bidder for slurry pump suction/discharge. as per our proven practise, we will provide pneumatic valves for slurry pump suction/discharge. Please confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 134 of Clarification-01 of the same.
411	VI / B	A-05	22 of 29	9.01.00	Contractor shall make arrangements for pumping the drainage water back to the respective system with 2x100% vertical sump pumps.	As per referred clause, 2x100% sump pumps to be provided. However, in tender drawings, only one no. sump pump is shown for each of the respective sumps. Both are contradictory. Kindly clarify.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 135 of Clarification-01 of the same.
412	VI / B	A-05	22 of 29	10.01.00	Slurry tanks: Replaceable Chlorobutyl/Bromobutyl rubber lining of minimum 5 mm thickness	We interpret that the lining material and lining thickness for slurry tanks, such as the limestone slurry tank, wastewater tank, filtrate tank, and secondary hydrocyclone feed tank, should conform to the specifications provided in their respective sections or headings. The lining material and lining thickness details mentioned in this clause are intended for other slurry tanks for which such specifics are not explicitly stated.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 136 of Clarification-01 of the same.
413	VI / B	A-05	22 of 29	10.01.00	Coarse-screen(s) at suction-side of slurry recirculation pumps shall be provided	Both clauses are contradictory. As per our proven practise, Suction screens shall be installed inside the Absorber vessel to protect the Slurry recirculation pumps. Please confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 137 & 138 of Clarification-01 of the same.
414	VI / B	A-05	12 of 29	5.06.22	Suction screens shall be installed inside the Absorber vessel to protect the Slurry recirculation pumps.		
415	VI / B	A-05	25 of 29	14.03.00	An adequately sized manhole with platform (min. 2 sq. m) shall be provided above each spray level	Manhole size (min. 2 sq.m) asked in tender is very large and there is a risk of fall associated with larger manhole. As per our proven practise, manhole of size 600 x 900 mm is adequate and will be provided above spray level. Please accept.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 139 of Clarification-01 of the same.
416	VI / B	A-02	40 of 67	13.01.02 c	For flue gas ducts downstream of ESP, additional fly ash loading on the surface or for one tenth of duct full of ash or for maximum possible accumulation of ash in the ductwork, under	Kindly provide additional fly ash loading for absorber outlet duct upto bypass duct.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 140 of Clarification-01 of the same.
417	VI / B	A-01	20 of 87	1.05.14.01 a 3	Maximum Flue gas velocity from ESP out-let to chimney inlet shall be 15 m/sec.	We understand that maximum Flue gas Velocity for Absorber inlet duct and absorber outlet shall be 15 m/s. Please confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 141 of Clarification-01 of the same.
418	VI / A	IIA-04	2 of 7	3.01.05	On/Off type Diaphragm valves in Limestone circulation lines to be provided instead of pinch control valve.	Similar to limestone recirculation line, on/off type Diaphragm valves shall be provided in gypsum bleed pump recirculation line instead of pinch control valve. Please accept. Note. There is no requirement of control valve in recirculation line as per our proven design.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 142 of Clarification-01 of the same.

419	VI / B	A-05	4 of 29	3.01.00	5. Maximum flue gas velocity through the Absorber (M/sec) - Not more than 4 m/s at Design Point Conditions (not applicable for bubbling type absorber)	Gas Velocity inside the Absorber are design specific parameter and as per our DCFS FGD standard design practice, maximum flue gas velocity through the Absorber is maintained at 4.5m/s. Bidder request NTPC to review and kindly accept.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 143 of Clarification-01 of the same.
420	VI / B	A-01	26 of 87	1.05.21.01	7. SO2 Removal Efficiency **Guarantee Point** To be worked out by the Bidder to achieve SO2 emission in the chimney to less than 60 mg/nm3 (6% O2 dry basis) **Design Point** To be worked out by the Bidder to achieve SO2 emission in the chimney to less than 80 mg/Nm3 (6% O2 dry basis)	Bidder proposes the following Outlet SO2 limits 1.Guarantee Point : 80 mg/Nm3 (6% O2 dry basis) 2.Design Point : 90 mg/Nm3 (6% O2 dry basis) The above mentioned SO2 emission limits are below the Emission norms and it will ensure optimized FGD design. Bidder request NTPC to review and kindly accept the proposal.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 144 of Clarification-01 of the same.
421	VI / B	D-1-5	25 of 69	5.06.01	The civil works for FGD system shall comprise of civil, structural and architectural works below and above ground level of ball mill building, ball mill foundations, FGD control room building, **slurry re-circulating pumps & oxidation blowers building**	The referred clauses are contradictory. Bidder understands & considers that Slurry re-circulating slurry pumps & Oxidation blowers shall be installed in a shed only as per Section-VI, Part-A Sub-section-IIA-04 page 4 of 7 clause 4.01.12 and inline with all ongoing NTPC FGD contracts. Bidder request NTPC to review and confirm.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 145 & 146 of Clarification-01 of the same.
422	VI / A	IIA-04	4 of 7	4.01.12	All Slurry re-circulating slurry pumps & Oxidation blowers shall be installed in a shed provided with roof sheeting to be provided by the Contractor as per specifications specified elsewhere.		
423	VI / B	A-05	11 of 29	5.06.11	The complete absorber vessel (absorber oxidation tank, absorber tower & absorber outlet duct upto absorber outlet flange) shall be made of clad sheet of C276 / Alloy 59 (minimum 2 mm thickness) by explosion bonding or hot rolling, having minimum 7 mm thick carbon steel as base material.	Glass flake lining is the preferred material for FGD absorber linings worldwide owing to its inherent advantages. Our collaborator, MHI Japan, widely recommends the use of Glass Flake Resin Lining in absorber, citing its ease of application and maintenance. MHI Japan has successfully executed over 80% of their supplied absorbers with Resin Lined Carbon Steel globally. Glass Flake Resin Lining is a cost-effective alternative to alloy material, providing substantial savings in both material and installation costs. This alternative can significantly reduce the overall project budget. Glass Flake Resin Lining offers exceptional resistance to a wide range of corrosive chemicals and temperature conditions typically found in FGD systems. It can withstand the high corrosive/abrasive environment effectively, ensuring a longer service life for FGD. In view of the above, we request NTPC to review and accept 3 mm thickness vinyl ester based glass flake lining for absorber.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 147 of Clarification-01 of the same.
424	VI / B	A-05	5 of 29	3.02.04	Absorber outlet to bypass duct & duct after by pass damper/gate to chimney inlet shall be made of cladded sheet of minimum 2 mm thickness of either Titanium (Grade 2 as per ASME SB265) or C-276 over 7 mm thick (minimum) mild steel base metal	Glass Flake Resin Lining offers exceptional resistance to a wide range of corrosive chemicals and temperature conditions typically found in absorber outlet duct. It can withstand the high corrosive/abrasive environment effectively, ensuring a longer service life for FGD ducts. In view of the above, we request NTPC to review and accept 2 mm thickness vinyl ester based glass flake lining for absorber outlet duct in line with NTPC Dadri FGD.	Reply to this query is already included in the section 'Employer's response to typical Bidder's queries on Section VI' to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 148 of Clarification-01 of the same.

SN	Reference Specifications	Bidder's query	Employer's response
425	Errata to Section VI Technical Specifications (Amendment 11)	NTPC has changed the limiting values of Unit heat rates at 100% & 55% TMCR from earlier. Limiting value provided by NTPC at 100% TMCR is **2069 kcal/kWh**. As per latest CERC guidelines Unit Heat rate @ 100% TMCR works out to **2069.4 kcal/kWh** (1790 (TG HR) / 86.5% (Boiler eff)) • Request NTPC to increase the limiting values of Heat rate @ 100% TMCR inline with value derived from CERC guideline. • Based on the coal properties provided in the specifications it is not possible to achieve the Boiler efficiency of 86.5% as per CERC guidelines for Sipat project. Hence request NTPC to either modify the coal properties in order to achieve 86.5% Boiler efficiency values or increase the limiting values of Heat rate.	Bidder's proposal reviewed but not accepted. Bidder to comply with technical specification requirements.

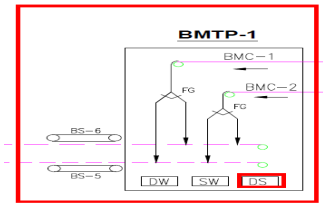
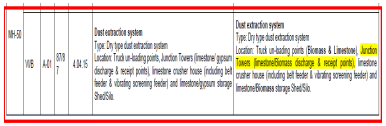
CLARIFICATION-02B FOR SIPAT-III (1X800 MW) EPC PACKAGE (UNDER BULK TENDER)

Sr. No.	Volume/ Section / Part	Chapter / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	Employer's Response
184	SECTION-VI, PART-A	SUB-SECTION-IIA-04	2 OF 7	3.01.05	Limestone slurry piping to each absorber, along with recirculation lines, all isolation and control valves. On/Off type Diaphragm valves in Limestone circulation lines to be provided instead of pinch control valve.	As per bidders past reference and proven practice, bidder proposes pneumatic control ceramic ball valve. Please confirm.	The requirement of the specification is clear. Bidder to comply with the specificaiton requirement.
185	SECTION – VI, Part-E	-Scheme of FGD Milling System	-	XXXX-001-POM-A-023			
186	Sipat_Errata_Technical_ Specs	Amendment 02 to Technical Specifications (Section VI)	473 of 700	SG.12	Limestone slurry piping to each absorber, along with recirculation lines, all isolation and control valves. ~~On/Off type Diaphragm valves in Limestone circulation lines to be provided instead of pinch control valve.~~ Pinch control valves shall be provided in the Limestone slurry recirculation lines. Alternatively, the bidder can also provide On/Off type Diaphragm valves as per its proven practice.		
187	SECTION-VI, PART-A	SUB-SECTION-IIA-04	4 OF 7	4.01.09	Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and control valves.	As per bidder's past reference and proven practice, bidder proposes pneumatic operated on/off Diaphragm / Butterfly valve. Please confirm.	The requirement of the specification is clear. Bidder to comply with the specificaiton requirement.
188	Sipat_Errata_Technical_ Specs	Amendment 02 to Technical Specifications (Section VI)	473 of 700	SG.14	Piping from gypsum bleed pumps to gypsum dewatering system, along with recirculation lines (if required) necessary isolation and control valves. **Pinch control valve shall be provided in the gypsum slurry recirculation lines. Alternatively, the bidder can also provide On/Off type Diaphragm valves as per its proven practice.**		
189	SECTION – VI, Part-E	SCHEME OF FGD - ABSORBER SYSTEM	-	1150-001-POM-A-022			
190	Sipat_Errata_Technical_ Specs	Amendment 02 to Technical Specifications (Section VI)	473 of 700	SG.15	2x100% cake washing pumps for each vacuum belt filter.	As only one VBF will be in operation and also a separate cake wash tank (1 No.) for storing shall be considered, hence, bidder proposes 2x100% Cake washing pumps common for both vacuum belt filters.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.
191	Sipat_Errata_Technical_ Specs	Amendment 02 to Technical Specifications (Section VI)	473 of 700	SG.16	2x100% cloth washing pumps for each vacuum belt filter.	As only one VBF will be in operation and also a separate cloth wash tank (1 No.) for storing shall be considered, bidder proposes 2x100% Cloth washing pumps common for both vacuum belt filters.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.

Sr. No.	Volume/ Section / Part	Chapter / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	Employer's Response
192	SECTION-VI, PART-B	SUB-SECTION-A-05	9 OF 27	5.06.02	The design of flue gas ducts and inlet and outlet hoods of the FGD as well as [guide vanes and baffle plates shall ensure a homogeneous flue gas flow with respect to the distributions of: (i) temperature (ii) velocity (iii) dust content (iv) slurry injection and distribution. The above shall be proven by two phase Computational Fluid Dynamics simulations (liquid and gas). The scope of modelling shall include flue gas path inside the absorber vessel including inlet and outlet duct.	Since JBR technology is a proven technology worldwide, Bidder will conduct CFD model of the FGD system gas path excluding absorber	Reply to this query is already included in section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Clarifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 1203 of Clarifications 02.
193	SECTION-VI, PART-B	SUB-SECTION-A-05	11 OF 27	5.06.10	The raw gas inlet duct of the absorber shall be equipped with a flushing device of the side walls and the ground, which shall operate continuously as well as intermittently.	Please note that, in the offered JBR type absorber, the gas cooling mechanism which is provided at raw gas inlet duct of the absorber will be continuously operated. Hence, no separate flushing devise is required and envisaged.	Reply to this query is already included in section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Clarifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 1207 of Clarifications 02.
194	SECTION-VI, PART-B	SUB-SECTION-A-05	15 OF 27	7.04.03	The complete frame of the filter and all parts in contact with gypsum shall be made of corrosion resistant material or shall be provided with corrosion resistant liners of proven design.	As the frame for vacuum belt filter shall never come in contact with gypsum slurry, hence shall be made of carbon steel painted with corrosion resistant paint. Bidder request owner to please agree and confirm the same.	Reply to this query is already included in section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Clarifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 1215 of Clarifications 02.
195	SECTION-VI, PART-B	SUB-SECTION-A-05	17 OF 27	7.07.06	2x100% horizontal centrifugal pumps shall be provided for pumping the waste water from waste water tank to the mixing tanks of HCSD system or in any other area with suitable treatment so as to suit/not to disturb the destination fluid quality. The material of Casing shall be rubber lined or Hi-chrome steel. The impeller shall be made of Hi-chrome steel. Shaft shall be of stainless steel 410 and shaft sleeve shall be stainless steel.	As shaft shall never come in contact with the medium of flow, hence, the shaft shall be of EN8 instead of stainless steel 410. Please confirm.	Reply to this query is already included in section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Clarifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 1219 of Clarifications 02.
196	SECTION-VI, PART-B	SUB-SECTION-A-05	18 OF 27	7.07.10	Bucket conveyors shall be provided by the contractor to feed lime to each of the lime storage silos from ground level. The Bucket conveyors shall be sized to completely feed each lime silo within 2hrs. Adequate storage and feeding system required for feeding the lime to the Bucket conveyors is also in the Contractor's scope	As the slacked lime quantity required for lime dosing is very less, hence bucket elevators are not required. For handling of lime a chain pulley arrangement shall be provided. Please confirm.	Reply to this query is already included in section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Clarifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 1220 of Clarifications 02.
197	SECTION-VI, PART-B	SUB-SECTION-A-05	21 OF 27	12.01.00	The contractor may provide a recirculation line with motorized isolation valve / restriction orifice made of erosion resistant material for the above purpose.	Bidder request owner to include the option of pneumatic operated valves as per proven practice.	Reply to this query is already included in section VI under "Employer's response to typical Bidder's queries on Section VI technical Specifications (Clarifications 01 & 02)" to clarify & avoid similar queries. Bidder is requested to refer Sl. no. 1225 of Clarifications 02.
198	SECTION-VI PART-A	SUB-SECTION-IV	31 of 77	1.03.03	(vii) Waste Water The Contractor guarantees that the maximum purge flow rate to waste water treatment system from FGD system for 1x800 MW unit shall be less than 10m3/h averaged over a 24 hour period for a the range of specified coal(s).	Bidder recommends that the guaranteed maximum purge flow rate to waste water treatment system from FGD system for 1X800 MW units shall not be restricted as the waste water bleed depends on the specified coal(s) and the quality of water used in the FGD system. If such scenario arises the accumulation of high TDS/chloride content will be recirculated in the gypsum slurry which will impact FGD performance. Bidder request owner to review the clarification and provide necessary amendments.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement. The Bidder to design the FGD system including the material of construction to meet the performance as specified in the Bidding documents.
199	SECTION-VI, PART-B ---------- Sipat_Errata_Technical_ Specs	SUB-SECTION-A-01 ---------- Amendment 02 to Technical Specifications (Section VI)	27 OF 87 ---------- 471 of 700	1.05.22.01 ---------- SG.2	EXISTING (As per Base Specification) A "wet Chimney" shall be installed ….without insulation for borosilicate lining. The stack shall be designed as per the latest guidelines of EPRI Wet Stack Design Guide. The design of wet ducts and stacks system shall consider the Stack liquid discharge (SLD), Corrosion/chemical attack, Condensate collection system and its drainage etc. A wet stack study shall……not be less than 8000mm. ---------- READ AS A "wet Chimney" shall be installed ….without insulation for borosilicate lining. The stack shall be designed as per the latest guidelines of EPRI Wet Stack Design Guide. The design of wet ducts and stacks system shall consider the Stack liquid discharge (SLD), Corrosion/chemical attack, Condensate collection system and its drainage etc. **To cater to the requirements of FGD running in bypass mode, the components of Condensate Drain collection system (such as ring collectors, gutters, condensate drain piping etc.) exposed to high temperature flue gas shall be made of Alloy C276 / Alloy 59 / Titanium Gr-II.** A wet stack study shall……not be less than 8000mm.	As the condensate drain pipe does not come in contact with flue gas inside the chimney, hence the MOC of drain pipe shall be FRP. Same is followed in our ongoing EPC project. Please accept.	Bidder's proposal is not acceptable. Bidder to comply with the specification requirement.

Sr. No.	Volume/ Section / Part	Chapter / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	Employer's Response
200	SECTION-VI, PART-B	SUB-SECTION-A-05	15 of 29	6.05.04	All parts of the mill including mill body, trunnion, integral pipes, mill circuit pumps and other parts in contact with limestone slurry shall be provided with replaceable rubber wear liners. ****	For limestone slurry pipes mentioned in clause no. 6.05.04 and 6.07.03 MOC shall be considered as per clause no. 12.02.00 SECTION-VI, PART-B SUB-SECTION-A-05 (FGD), Page 23 OF 29, i.e. "All the pipes handling slurry shall be provided slurry pipes size up to 400 NB made up of FRP material as per ASTM 2310 and testing as per ASTM B2583(silicon carbide coating on slurry exposed surface)." Please accept and confirm.	The specification requirement is clear with respect to the applicability of the FRP for pipes used for limestone slurry transport. Bidder to comply with the same.
201	SECTION-VI, PART-B	SUB-SECTION-A-05	16 of 29	6.07.03	The limestone slurry pipes shall be sized to minimize erosion and avoid settling of the limestone at part load operation. **The slurry pipes shall be lined with replaceable wear resistant natural rubber lining of minimum 6mm thickness. Additional thickness of 2 mm in rubber lining shall be provided at bends.**		
202	SECTION VI, PART-B	SUB-SECTION- A-9	4 of 20	2.03.05	5. Effluents from Neutralization pit - MSRL	As per bidder's standard practice, Carbon steel piping is considered for transferring waste oil from transformer sump pump.	Bidder's proposal is not acceptable. Bidder to comply the technical specificaiton requirements.
203	SECTION VI, PART-B	SUB-SECTION- A-9	7 of 20	2.07.02	For pipe size 350Nb and above mitre bends may be used for all pipes except rubber lined pipes. However, mitre bends are also acceptable for rubber lined pipes above 1200 NB. The bend radius shall be 1½ times the nominal pipe diameter. 90 deg. bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces 22½ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.	Bidder proposes, Pipe size 450Nb and above mitre bends may be used for all pipes.	Bidder's proposal is not acceptable. Bidder to comply the technical specificaiton requirements.
204	SECTION-VI PART-B	SUB SECTION-A-01	18 of 87 20 of 87	1.05.13.02 1.05.13.03	(x) Pressure required at chimney inlet: + 40 mm WC (In case separate booster fans for FGD system are provided, ID fans shall be sized for minimum +10 mm WC of pressure requirement at chimney inlet for any FGD bypass operation.)	Bidder understands that + 40 mm WC of Pressure required at chimney inlet is applicable only for sizing of ID and not for Booster fan. Booster fan shall be sized as per the actual calculated head required to overcome the pressure drop in absorber & ducts and maintain required stack inlet pressure. Please confirm.	Bidder's understanding is not correct. In case booster fan is envisaged by the bidder, the Pressure required at chimney inlet to be considered as + 40 mm WC
205	EMPLOYERS RESPONSE TO TYPICAL BIDDER'S QUERIES (CLARIFICATIONS 01 & 02)	Clarification no. 1233	141 of 147	--	Bidder to provide screw takeup arrangement for conveyor having length more than 25 m with travel of 4% of the total belt length.	Bidder requests owner to relook at the type of take up arrangement to be considered. Since the clause mentions to consider all conveyors with lengths more than 25m as screw takeup. Generally screw take-up can be considered for the conveyor lengths less than 60m as per IS 11592 with take up travel length of 1.5% of horizontal crs of conveyor length as per IS 4776. For all other conveyor lengths either VGTU or HGTU will be considered as per the conveyor profiles with take up lengths 2.5% of horizontal crs of conveyor length as per IS 4776. NTPC to confirm.	Bidder to provide screw take-up arrangement for conveyor having length up to 25 mts (Except the boom conveyor of stacker reclaimer) with take-up travel of 4% of horizontal of conveyor length(crs). For conveyor length more than 25 mts, HGTU or VGTU can be provided. The type of take-up and travel length adjustment shall be as per stipulation of standard technical specification & its amendment (For Detail Refer the earlier issued amendment no. 2 of section-VI/B, SN-MH-43).

Sr. No.	Volume/ Section / Part	Chapter / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	Employer's Response
206	SECTION – VI, PART-A	SUB-SECTION-A-14 LIMESTONE AND GYPSUM HANDLING PLANT	PAGE 4 OF 5	3.03.00	Minimum four (4) Nos. sump pumps in gypsum storage shed complete with motors, local control panel, level switches, individual discharge piping with fittings and valves up **to ash disposal slurry sump.**	There are discrepancies in mentioned clause regarding discharge of sump water in Gypsum storage area sump pumps. Sump Pump discharge lines shall be terminated up to nearest surface drain. Please confirm	Bidder to prefer the ash slurry disposal pump house sump or nearest plant drain (Except storm water drain) up to 50m distance from the gypsum storage shed, whichever is minimum.
	SECTION-VI, PART B	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	48 of 79	2.5.2	Sump pump Piping: **to nearest plant drain**		
	SECTION-VI, PART B	SUB-SECTION-A-20 Coal & Biomass and Limestone & Gypsum Handling Plant	Page 16 of 79	4.11.8	Sump pumps along with level switches & piping **upto nearest drain** (max upto 50.0 mtrs. From outside the building) shall be provided at all locations wherever natural drainage is not possible.		
207	SECTION – VI, PART-A	SUB-SECTION-IIC	PAGE 5 OF 19	2.02.00	**For CHP DDCMIS, necessary signal exchange with Employer's existing stage-I CHP DDCMIS system shall also be in Contractor's scope.** For this signal exchange, the number of I/Os shall be considered as DI: 32 DO: 16 AI:8 AO:8. The exact scheme shall be finalized during detail engineering. Employer's stage-I CHP DCS/RIO panel shall be the terminal point. All necessary hardware/ logic modifications/ upgradation, as required at Employer's existing system shall be in Employer's scope.	Bidder understands that these IO Counts are adequate to fulfil interface requirements with Existing Stage. Same shall not be exceeding during detailed Engineering . Please confirm.	Noted. However the final count can only be arrived at after detailed engineering by the EPC contractor.
208	SECTION – VI, PART-A	SUB-SECTION-IIA-15	PAGE 4 OF 6	2.08.00	Suitable temperature monitoring throughout the storage mass inside Silo/Hopper/Bin to be provided.	Bidder proposes to have Non-Contact Type Temperature Measurement arrangement to suit the biomass application. 1 No. Temperature monitoring unit along with required accessories shall provided for each silo. Please confirm.	Bidder to note that the Technical specifications indicated are functional and the bidder to consider the measurement system which shall be most suitable for biomass co-firing. The same shall be discussed and finalized during detailed engineering.
209	SECTION – VI, PART-A	ANNEXURE C TO IIC SUB-SECTION-IIA-04	PAGE 16 OF 21 PAGE 7 OF 7	1.03.00 11.02.00	SOx ANALYSERS FOR FGD SYSTEM: 1. SO2 Analyzer at FGD Outlet 2. SO2 Analyzer at FGD inlet Contractor shall provide air conditioning for the FGD control room and Analyser room (if separately provided) & ventilation for the FGD system buildings.	1. Bidder understands that SO2 Analyzer used for FGD application shall have inbuilt 6% O2 Correction features, no separate O2 Analyzers are required for FGD Application. 2. Bidder also understands that Technical Requirements Fumished under Clauses 6.02.00, 6.03.00 & 6.04.00 in SUB-SECTION-IIIC-04 ,SECTION-VI, PART-B for CONTINUOUS EMISSION MONITORING SYSTEM (CEMS) shall holds good for SO2 analyzers to be installed in Duct for FGD Application. 3. Bidder also understands that in case of In-situ type application ,analysers room are not required. Kindly confirm our understanding.	For point at Sr. No. 1, Bidder to refer note of clause no. 1.01.00, of Annexure-C to II-C, Part-A for the requirement of O2 measurement for correction of SO2 and shall further comply with the requirements of SO2 removal efficiency based on Sr. No. 7 of clause no. 1.05.21.01 of Sub-section-A-01, Section-VI, Part-B of the Technical Specifications. Bidder's understanding on the points at Sr. No. 2 & 3 is correct.
210	SECTION – VI, PART-A	SUB-SECTION-IIC	PAGE 2 OF 19	1.06.01	**Close Loop controls:** For close loop control of following applications of main plant SG/TG/BOP (Auxiliaries of SG and TG), conventional i.e. 4-20 mA / (HART) based actuators along with 4-20 mA(HART) based electronic transmitters (which are directly used in control of final control element), shall be provided. For balance measurements for even these areas/ applications fieldbus based PT/DPT/TT shall be provided. **FGD (a) Booster Fan Blade Pitch Control** For balance applications of main plant and for all applications of other areas including offsite areas fieldbus based control system, fieldbus based actuators and fieldbus based PT/DPT/TT shall be provided.	For FGD Application, addition to Booster Fan Control Loop bidder recommends to have conventional i.e. 4-20 mA / (HART) based actuators along with 4-20 mA(HART) based electronic transmitters considering the criticality of following loops; 1. Absorber Level Control 2. Absorber pH Control 3. Gypsum Bleed Control 4. Oxidation Air Flow Rate Control 5. Reclaim Water Return Control Kindly accept the same.	Bidder's proposal cannot be accepted. There are ready references of successful FGD implementations in NTPC in accordance with the stipulations in the Bid Specification indicated here and hence Bidder to comply to the Technical Specifications.
211	SECTION – VI, PART-A	SUB-SECTION-IIC	PAGE 3 OF 19	1.06.02	**Open loop controls:** For open loop control of complete main plant and offsite areas fieldbus based control system, fieldbus based actuators, Profibus DP based IMC in LV SWGR/MCC and fieldbus based PT/DPT/TT shall be provided excluding applications given in Note-A.	Bidder proposes to have 4-20 mA / (HART) based Conventional Actuators & HART Based Transmitters for certain specific applications of FGD ,where skid mounted Instruments & actuators are supplied or operation of system envisaged through OEM's supplied LCP i.e.; scoop coupling, Traveling tripper, Plough Feeder, Lime Sampling Unit , Dust Extraction etc.. Considering the above integration issues at package level , The control system and devices (Actuators, instruments) shall be conventional for above listed areas of FGD(offsite package). Kindly Accept the same.	For electrical actuators bidder to refer to reply at Sr. No. 416 of EMPLOYERS RESPONSE TO TYPICAL BIDDER'S QUERIES ON SECTION VI TECHNICAL SPECIFICATIONS (CLARIFICATIONS 01 & 02). However for PT / DPT / TT, Bidder shall comply with the stipulations of the Technical Specifications.
212	SECTION – VI, PART-A	ANNEXURE C TO IIC	PAGE 17 OF 21	26.00.00(K)	Contractor shall provide Phase marker sensor for ID, FD, PA, BFP, CEP, ACW, ECW as a minimum. Contractor shall provide compatible buffered phase marker and vibration signals required for integrated diagnostics and analysis of vibration of all the above equipment's **and for crushers as a minimum and other drives as per OEM recommendation for connectivity to the analysis system**.	1. For Limestone Crusher Vibration Sensors shall be provided at DE & NDE end. Phase Marker is only required for future diagnostic purposes. Hence, bidder shall provide Notch on the Rotor(NDE) of Limestone Crusher as a future provision for mounting Keyphasor. 2. Bidder understands that Key phasor requirements are not envisaged for FGD application ,the requirement is only for the mentioned main plants equipment. Kindly Clarify .	For Sr. No. 1, Bidder's understanding is correct. For Sr. No. 2, Bidder's understanding is not correct. Key phasor is envisaged for critical drives (mainly HT drives) in FGD application as well.

Sr. No.	Volume/ Section / Part	Chapter / Drawing No.	Page no.	Clause No.	Bid Specification Stipulation	Statement of Prebid Queries & Clarification	Employer's Response
213	SECTION – VI, PART-B	SUB-SECTION-IIIC-08	PAGE 4 OF 5	7.01.00	FGD Bypass Damper is very critical for the safe evacuation of flue gas when FGD is not in operation. Normally it shall be in CLOSED condition most of the times when FGD is in operation. But during emergency need, if it fails to OPEN, it can lead to high furnace pressure and subsequent MFT. Therefore, a PARTIAL STROKE TEST for the Bypass damper to be carried out in AUTO at regular intervals..... Contractor shall provide positioner with intrinsic Partial Stroke Test (PST) facility to achieve the above functionalities for the FGD Bypass Damper with all suitable pneumatic and electrical connections.	As per bidder standard practice, we are proposing Pneumatic Damper with inbuilt Fail Safe Operation. Such Partial Stroke Test disrupt boiler operation. When Booster Fans are in operation (Blade Pitch Actuators in Auto) in synchronous with Boiler Total air Flow Rate & Bypass Damper is in Closed Condition. It's not feasible to achieve the said functionality in Pneumatic Damper due to operational Philosophy as recommended by QFGDM. Kindly Consider the same.	Bidder to note that the Technical Specification requirements are clear and these requirements are meant for safe operation of the unit and therefore the same shall be complied to in totality.
214	TECHNICAL SPECIFICATIONS SECTION-VI, PART E(2)	COAL + BIOMASS FLOW DIAGRAM Drg. No.-XXXX-001-POM-A-040	PAGE 52 of 91	COAL + BIOMASS FLOW DIAGRAM Drg. No.-XXXX-001-POM-A-040	 	As per flow Diagram 'DS' system show in BMTP-1. but as per Clause no.4.04.15 (MH-50) - DE system is mentioned for Junction Tower (Biomass Discharge & Receipt Points). There are said discrepancy found between flow diagram & Amendment 02. Bidder understand that, Dry type Dust Extraction system to be provided instead of DS in BMTP-1. Bidder request Owner to confirm bidder's understanding is correct.	Bidders understanding is correct. DE to be provided in BMTP-1.

SL. NO	ENQUIRY SPECIFICATION				SPECIFICATION REQUIREMENT	COMMENTS / CLARIFICATIONS	EMPLOYER'S RESPONSE
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.			
215	VI/A	II-C	12 of 19	4.00.00 (d)	Temperature Transmitters: (i) In case of multiple measurements of temperature for any application, resulting in trip / protection, where logic implementation tolerates failure of one TE (e.g. 2v3, 2v4 etc.), for only one of the TE, dual TT is to be provided.	For temperature elements of PA/FD/ID fan bearings & HT motor bearings, as per Cl 4.00.00 (d)-Vol VI-Part A-Sec II-C-Page 12 of 19, one number of dual input TT & two numbers of single input TT are envisaged. M/s. NTPC is requested to confirm.	Bidder to refer Amendment Sl. No. C-01B, C-02B, C-03B and C-04B in this regard.
	VI/B	II-A-02	31 of 67	10.08.07	PRIMARY AIR FANS (d) Three nos. Duplex Pt-RTD (100 ohm at 0 deg.) with dual input temperature transmitters shall be provided for local and remote monitoring of each bearing metal temperature of fans.		
	VI/B	II-A-02	37 of 67	12.05.00	FD & ID FANS Fan Bearings (c) Three nos. Duplex Pt-RTD (100 ohm at 0 deg.) with dual input temperature transmitters shall be provided for local and remote monitoring of each bearing metal temperature of fans.		
	VI/B	II-B-02	3 of 4	7.07.00	Each bearing of HT motor shall be provided with 3 numbers duplex RTDs connected to three numbers dual input transmitters with display.		Bidder to comply with tender requirements.
216	Section-VI Part-A	Sub-Section-VI Chapter-01 List of Mandatory Spares for SG & Auxillaries	6 of 38	1.05.00.C.2- PA Fan	2. Fan Bearings including bearing housing-2 sets	We are offering spares against sub-clauses sl no: 2.1 (Fan bearing: 2 sets) & sl no: 2.2 (Fan bearing housing: 1 set) which are the overall constituents of spares against sl no: 2 (Fan Bearings including bearing housing). Owner to confirm our understanding.	Bidder to refer to Amendment Sl. No. SG-01B in this regard
217	Errata to Section VI Technical Specifications	Amendment No. 2	19	MH-27	SINGLE LINE FLOW DIAGRAM OF ASH CLASSIFIER SYSTEM (PRESSURE SYSTEM) - XXXX-001-POM-A-029-Rev B	Since the capacity of classifier silo for vacuum system is 60 MT capacity whereas the classifier silo of pressure system is mentioned as 150 MT. Please review and confirm the capacity	It is 100MT for both the cases. Bidder to refer amendment Sl. No. MH-03 B for the revised SLD for both the case.

Sl. No.	Section / Part / Chapter / Volume	Clause No.	Page no.	Bid Specification Stipulation	Bidder's Query	Employer's Response
218	SECTION-VI, PART-A, SUB-SECTION-I-A PROVENNESS	4.1.3 (b)	7 of 44	The Bidder/ Bidder's sub-vendor who fulfill the requirements at clause 4.1.3(a) above, shall also have an on-going Collaboration Agreement/Technology Licensing agreement prior to the date of submission of proposal for sub-vendor with such a manufacturer of Electrostatic Precipitators, who meets the requirements of clause 4.1.1 above.	We request you to delete the clause 4.1.3(b) for the regular ESP design/supply/Manufacturers of ESPs and meeting the requirement of clause 4.1.3(a).	Bidder's proposal reviewed but not accepted. The requirements specified are quite clear. Bidder to comply with the same
219	ATTACHMENT - 3K	2(a)	360 of 361	(a) We shall provide design, manufacturing and assembly drawings of……. (name of equipment/system*). ……. (name of equipment/system*) which shall be manufactured and supplied as per above design provided by us and the drawings approved by the Employer.	We request you to modify the clause as below; a) ~~We shall provide design, manufacturing and assembly drawings of……~~ (name of equipment/system*). ……. (name of equipment/system*) ~~which~~ shall be manufactured and supplied as per ~~above~~ design provided by us and the drawings approved by the Employer.	

Amendment-8B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

SN	Specification Reference				Existing	Read as
	Part	Sub Sec	Clause No	Page No		
TG-50B	B	A-07, Steam Turbine and Auxiliaries System	1.16.00(i)	5 of 25	LP Bypass stop and control valve main plug and pilot plug area shall be sized and selected in such a way that the pressure balancing of lower and upper chamber occurs in shortest possible time without transmitting any unbalance force to the stem/spindle. **Calculation for pressure balancing time and force being transmitted to the main plug stem during valve opening for each design cases of LP bypass shall be submitted by the Bidder/ LP Bypass valve supplier during detail engineering.**	LP Bypass stop and control valve main plug and pilot plug area shall be sized and selected in such a way that the pressure balancing of lower and upper chamber occurs in shortest possible time without transmitting any unbalance force to the stem/spindle. **During detail engineering confirmation shall be given that adequate design consideration regarding dynamic forces acting on valve trim has been considered enabling quick pressure balancing without transmitting any unbalance force to stem during transient operating condition.**

Amendment-6B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

<table>
<tr><th rowspan="2">SN</th><th colspan="4">Specification Reference</th><th>Existing</th><th>Read as</th></tr>
<tr><th>Part</th><th>Sub Sec</th><th>Page No</th><th>Clause No</th><th></th><th></th></tr>
<tr><td>GEN -03B</td><td>A</td><td>IV – FUNC-TIONAL GUARAN-TEES</td><td>5 of 73</td><td>1.02.01</td><td>
AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATEGORY-I GUARANTEES
If the performance guarantee(s) … the Contract Price:
<table>
<tr><th>S. No</th><th>Guarantee</th><th>Rate of Liqui-dated Damages (LD)</th><th>Limiting Value</th></tr>
<tr><td>…</td><td>…</td><td>…</td><td>…</td></tr>
<tr><td>(x)</td><td>For increase in the Unit Auxiliary power consumption in kW for unit auxiliaries re-quired for continuous unit operation at 100% TMCR i.e. 800 MW unit load.</td><td>US $ 5,025

(US Dollar Five Thousand Twenty Five only) per 1 kW increase in Unit Auxiliary Power Consumption.</td><td>Not more than 42000 KW</td></tr>
<tr><td>(xi)</td><td>For increase in Sta-tion auxiliary power consumption compris-ing of all station Auxil-iaries required for continuous station op-eration at 1x800 MW (i.e. 100% rated load of the unit).</td><td>US $ 5,025

(US Dollar Five Thousand Twenty Five only) per 1 kW increase in Sta-tion Auxiliary Power Con-sumption.</td><td>Not more than 14300 KW</td></tr>
<tr><td>…</td><td>…</td><td>…</td><td>…</td></tr>
</table>
</td><td>
AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATE-GORY-I GUARANTEES
If the performance guarantee(s) … the Contract Price:
<table>
<tr><th>S. No</th><th>Guarantee</th><th>Rate of Liqui-dated Dam-ages (LD)</th><th>Limiting Value</th></tr>
<tr><td>…</td><td>…</td><td>…</td><td>…</td></tr>
<tr><td>(x)</td><td>Deleted</td><td>Deleted</td><td>Deleted</td></tr>
<tr><td>(xi)</td><td>For increase in the Aux-iliary Power Consump-tion [Unit Auxiliary power consumption for unit auxiliaries required for continuous Unit oper-ation + Station auxiliary power consumption com-prising of all Station Aux-iliaries required for con-tinuous Station opera-tion] in kW at 1x800 MW i.e., 100% rated load of the Unit.</td><td>US $ 5,025

(US Dollar Five Thousand Twenty Five only) per 1 kW increase in Station Auxil-iary Power Consumption.</td><td>Not more than 52500 kW</td></tr>
<tr><td>…</td><td>…</td><td>…</td><td>…</td></tr>
</table>
</td></tr>
</table>

Amendment-6B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. NO.	SPECIFICATION REFERENCE				EXISTING	Read as
	SEC/ PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
PM-02B	VI/C	GTR	15 of 119	8.03.03.02	The Contractor shall submit a Project Completion Report at the time of handing over the plant.	**Project Completion Report** The Contractor shall submit a Project Completion Report at the time of handing over the plant. Completion report of works would in particular include but not limited to the following: a. As constructed drawings including details of new designs incorporated if any. b. Salient features of each work/project like peak rate of Earth work/ Concreting /Structural steel fabrication or erection, Pressure parts erection, Critical piping, Insulation, equipment erection etc. c. Resources deployed during peak of construction works in terms of manpower, construction equipment, T&Ps etc. d. Total executed value of important items like excavation, piling, concreting, Structure steel erection, cabling, piping etc. e. Major challenges faced and their mitigation strategies including tackling of unforeseen surprises like geological surprises etc. f. Time for completion of work as originally stipulated and as actually spent for its completion with dates of actual achievement of Milestones vis-à-vis Project schedule. g. Best Practices and new erection strategies adopted in the Project implementation. h. Surprises encountered during commissioning phase and action plan to deal with the surprises. i. Quality related issues faced during execution and measure to avoid future recurrence. j. Details of Safety incidents and measure to avoid future recurrence. Overall Safety Management System and its implementation /performance.

Amendment-5B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. NO.	SPECIFICATION REFERENCE				EXISTING	Read as
	SEC/ PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
PM-01B	VI/A	Annex-ure-A to subsec-tion IIC	6 of 6	1.01.00 (H)	----------	4D Model 4D modelling is the integration of a 3D model with con-struction schedule in order to visualise the sequence and progress of construction. Referring to clause 8.03.04 GTR part C section VI, Agency to represent actual site progress of construction activity with respect to planned progress based on Schedule in 4D model to NTPC every month.

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. NO.	SPECIFICATION REFERENCE				EXISTING	Read as
	SEC/ PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
WS-01B	VI/B	A-11	2 of 16	2.04.00	During start up conditions… ……. ……. ……. For design purposes, average crud loading shall be considered as 500 ppb. Under such…on their requirement.	During start up conditions… ……. ……. ……. For design purposes, average crud loading shall be considered as 500 ppb. Under such…on their requirement. **Useful service run under startup condition shall be min. 50 hours before regeneration.**

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. NO.	SPECIFICATION REFERENCE				EXISTING (As per Base Specification)	Read as
	SEC/ PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
SG-02B	VI/A	IV	20 of 73	1.01.07.01 ab)	ab) Electrostatic Precipitator with all TR sets , all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes working and rapping system in normal operation. During the test all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes will be kept in continuously ON condition at 100% duty condition and set point temperature shall be kept 5 degree Celsius above the flue gas temperature. (Refer Note 4 below)	ab) Electrostatic Precipitator with all TR sets , all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes working and rapping system in normal operation. During the test all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes will be kept in continuously ON condition **with the Set point temperature (cut in temperature) kept at least 5 deg. Celsius above the flue gas temperature corresponding to the ESP guarantee point or the operating flue gas temperature whichever is higher. (Refer Note 3 below).**
SG-03B	VI/A	IV	29 of 73	1.03.02 (v)	(a) Maximum tube to tube temperature differential between any two adjacent tubes.	(a) Maximum tube to tube temperature differential between any two adjacent tubes. **Water wall tube to tube temperature will be limited to 80 Deg. C. The same shall be further substantiated by the values as achieved by the Contractor in its similar reference steam generator which are operating successfully.**
SG-04B	VI/A	IV	29 of 73	1.03.02 (viii) (New clause added)	New clause added	**(viii) Rated Steam Generator Temperatures (Main steam/ HRH): The Contractor shall demonstrate the rated Steam Generator temperatures (Main Steam/HRH) at rated flow corresponding to 100% TMCR (800 MW Unit Load)) with design coal firing under stipulated ambient air condition i.e. 27 degree Celsius temperature , 60% RH and rated excess air not exceeding 20%.**

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. NO.	SPECIFICATION REFERENCE				EXISTING (As per Base Specification)	PROPOSED CHANGE
	SEC/ PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
SG-05B	VI-A	II-A-03	Page 2 of 2		**Scope for biomass…** …biomass co-firing with safety to be provided. Annexure-IV-7(A), (B) & (C) of Sub-Section-IB, Part-A, for '……in Government of India, Ministry of Power OM No F. No***. tL***/ 86/ 2017-Th.II (C.No 238797) dated 03.05.2023 placed at Annexure to this Sub Section.	**Scope for biomass…** …biomass co-firing with safety to be provided. Annexure-IV-7(A), (B) & (C) of Sub-Section-IB, Part-A, for '…..in Government of India, Ministry of Power Addendum, F. No. **11**/ 86/ 2017-Th.II (C.No 238797) dated 03.05.2023 placed at Annexure to this Sub Section.
SG-06B	VI-A	IIA-04	2 of 7	2.04.01	The FGD System shall be in operation… for the details of smart positioner. The design of the damper shall ***ensure 99.95%*** leak tightness, on flow basis, without seal air. The damper shall be 100% leak tight with seal air fans under the above conditions.	The FGD System shall be in operation… for the details of smart positioner. The design of the damper shall ***ensure 99.5%*** leak tightness, on flow basis, without seal air. The damper shall be 100% leak tight with seal air fans under the above conditions.
SG-07B	VI/B	G-06	9 of 14	3.03.09	**No fuel oil support shall be required above 40% TMCR** Contractor shall demonstrate that oil support for flame stabilization shall not be required beyond 40% of BMCR load when firing … the Steam Generator does not require any oil firing for stable and efficient boiler operation at and above 40% BMCR loads.	**No fuel oil support shall be required above 40% TMCR** Contractor shall demonstrate that oil support for flame stabilization shall not be required beyond 40% of TMCR load when firing … the Steam Generator does not require any oil firing for stable and efficient boiler operation at and above 40% TMCR loads.
SG-08B	VI/B	G-06 Annexure-IV	1 of 1		**Demonstration/Acceptance tests during Commissioning/Initial Operation** The following tests …. 4.Steam Temperature Imbalance 5. No fuel oil support shall be required above 40 % BMCR 6. …	**Demonstration/Acceptance tests during Commissioning/Initial Operation** The following tests …. 4.Steam Temperature Imbalance 5. No fuel oil support shall be required above **40 % TMCR**. 6. …
SG-09B	VI-B	A-02	Page 11 of 67	6.01.00 (iv)	(iv) Pressure transmitter to be installed downstream on control valves in the line connecting individual level control valves with flash tank for each unit (4 Nos.).	(iv) Control valves for controlling level of separator shall preferably be unbalanced type and designed to operate for minimum conditions equivalent to 50% TMCR (or higher value as per vendor practice) and for handling small debris parti-

S. NO.	SPECIFICATION REFERENCE				EXISTING (As per Base Specification)	PROPOSED CHANGE
	SEC/ PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
						cles. Further, valves shall also be designed as a system together with back pressure devices (dump tube ,orifice etc.), associated piping and shall be installed as close as possible to flash tank. Pressure transmitter to be installed downstream on control valves in the line connecting individual level control valves with flash tank for each unit (4 Nos.).
SG-10**B**	VI-B	A-02	54 of 66	17.01.11 (b)	(b) APH Baskets Platforms (minimum 100 Sq m of platforms) with proper approach near APH(s) for storage of APH Baskets. Weight of stored APH baskets shall be accounted in the structure and platform design.	(b) APH Baskets Platforms (minimum **500 Sq m** of platforms) with proper approach near APH(s) for storage of APH Baskets. Weight of stored APH baskets shall be accounted in the structure and platform design.
SG-11B	VI-B	A-02	60,61 of 66	3.02.00	Minimum 2.0M wide platforms… rain shall also be provided. Five (5) nos. of staircases (one each between the two ESP casings, ….. Further, the platforms between all the ESP casings shall be interconnected at least at one intermediate elevation.	Minimum 2.0M wide platforms… rain shall also be provided. Five (5) nos. of staircases (one each between the two ESP casings, ….. Further, the platforms between all the ESP casings shall be interconnected at least at one intermediate elevation. **Common platform of 1200 mm width for maintenance /access to ESP Inlet gate actuator to be provided. Similar platform for maintenance of ESP Outlet gates actuator to be provided.**
SG-12B	VI-A	IIA-01	3 of 28	2.07.00	**Superheater and Reheater Desuperheating Spray Systems** Desuperheating spray … Boiler Feed Pumps.	**Superheater and Reheater Desuperheating Spray Systems** Desuperheating spray … Boiler Feed Pumps. **Suitable Handling arrangement with hoist and monorail for spray station valves and actuators shall be provided.**
SG-13B	VI-B	A-05	7 of 29	5.01.00 A	vi) The slurry pumps shall also comply with the requirements stipulated in Clause 9.00.00 of this sub-section	vi) The slurry pumps shall also comply with the requirements stipulated in **Clause 8.00.00** of this sub-section.
SG-14B	VI-B	A-05	16 of 29	6.07.02	The limestone slurry pumps shall be designed to .... **Cl.No.9.00.00.** of this Sub-Section.	The limestone slurry pumps shall be designed to… **Cl.No.8.00.00.** of this Sub-Section.
SG-15B	VI-B	A-05	10 of 29	5.06.06	Three stage chevron …the third stage of mist eliminators. Wash water arrangement shall	Three stage chevron … the third stage of mist eliminators. Wash water arrangement shall also be provided at the back

S. NO.	SPECIFICATION REFERENCE				EXISTING (As per Base Specification)	PROPOSED CHANGE
	SEC/ PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
					also be provided at the back end of the **second** stage of mist eliminator. If the mist eliminator washing system is designed for cyclic washing of different sections, all the valves required for cycling shall be motorized or pneumatically operated. NA The ME system shall be equipped with … at Mist Eliminator casing only for the portion which is not exposed to slurry. Ease of replace ability….defined sequence of time.	end of the **third** stage of mist eliminator. If the mist eliminator washing system is designed for cyclic washing of different sections, all the valves required for cycling shall be motorized or pneumatically operated. **Blanking plates used in left out area after placement of ME shall be minimized and shall either be made of Alloy 59/ C276 or lined with minimum 2 mm Alloy 59/ C276.** The ME system shall be equipped with … at Mist Eliminator casing only for the portion which is not exposed to slurry. **ME wash pipe supporting arrangement shall either be made of Alloy 59/ C276 or lined with minimum 2 mm Alloy 59/ C276**. Ease of replace ability….defined sequence of time.
SG-16B	VI-B	A-05	11 of 29	5.06.17	The spray headers (if provided) and air supply headers (exposed to slurry in any form) shall be made of FRP or Carbon Steel with Chlorolobutyl/ Bromobutyl rubber lining **(minimum 10 mm natural rubber lining**), corrosions…	The spray headers (if provided) and air supply headers (exposed to slurry in any form) shall be made of FRP or Carbon Steel with Chlorolobutyl/ Bromobutyl rubber lining **(minimum 10 mm thick rubber lining**), corrosions…
SG-17B	VI/B	A-05	17 of 29	7.03.05	The hydro-cyclone shall … replaceable rubber lining. The feed chamber shall be provided with a minimum lining thickness of 12mm …	The hydro-cyclone shall … replaceable rubber lining. The feed chamber ***and overflow launder*** shall be provided with a minimum lining thickness of 12mm…
SG-18B	VI/B	A-13	5 of 8	2.02.00A New clause added		Refer Annexure-SG-18B to this amendment for the clause.
SG-19B	VI/B	A-13	7 of 8	2.03.00 9) IV	Air & Flue Gas ducts with external stiffeners shall have first layer of insulation between the stiffeners and a second layer of insulation over stiffeners so that stiffeners are also insulated and a level surface is achieved. Other requirements are same as given in as specified at clause no 21.10.00 of this chapter.	Air & Flue Gas ducts with external stiffeners shall have first layer of insulation between the stiffeners and a second layer of insulation over stiffeners so that stiffeners are also insulated and a level surface is achieved. Other requirements are same as given in as specified at clause no. **2.02.00 and 2.02.00A** of this chapter.
SG-20B	VI/B	A-05	28 of 29	17.01.00	Thermal Insulation along with aluminum cladding shall be provided for all the equipments/ surfaces having skin temperature more than	Thermal Insulation along with aluminium cladding shall be provided for all the equipments/surfaces having skin temper-

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. NO.	SPECIFICATION REFERENCE				EXISTING (As per Base Specification)	PROPOSED CHANGE
	SEC/ PART	SUB-SEC.	PAGE NO.	CLAUSE NO.		
					60degree Celsius. The specification of the insulation including type, density, thickness, heat conductivity and finish shall be as specified in Sub-Section A-13, Part B of the Technical Specification.	ature more than 60 degree Celsius except for absorber**. Further, Thermal insulation of min 75 mm shall be provided for absorber outlet flue gas duct irrespective of skin temperature**. The specification of the insulation including type, density, thickness, heat conductivity and finish shall be as specified in Sub-Section A-13, Part B of the Technical Specification.
SG-21B	VI/B	A-13	1 of 9	1.00.00 b) i)	The minimum insulation thickness, however, shall not be less than 75 mm for Steam Generator surfaces and 25 mm for other surfaces.	The minimum insulation thickness, however, shall not be less than 75 mm for Steam Generator / ESP / FGD surfaces and 25 mm for other surfaces.

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Sec/ Part	Sub Section	Page No.	Clause No.		
PU-01B	VIA	IIA-12	1 of 11	1.00.00 b)	**Centralized air-conditioning system for main plant TG building** There shall be one (1) ……. static excitation control rooms (if applicable), SWAS room, water analysis lab, etc.	**Centralized air-conditioning system for main plant TG building** There shall be one (1) ……. static excitation control rooms (if applicable), SWAS room, water analysis lab, **CEP VFD Room, office area in control tower,** etc.
PU-02B	VIA	IIA-12	1 of 11	1.00.00 f)	**Air-conditioning system for office area in control tower** Air cooled condensing units (D-X type) mainly comprising scroll compressor, drive unit, condenser, AHUs, interconnected refrigerant piping, controls, instruments, base frame, etc.	……**Deleted**……
PU-03B	VIA	IIA-12	6 of 11	4.00.00 e)	One (1) No. automatic total flooding inert gas fire extinguishing system ……..programmer/server rooms, **PC rooms**, panel room, ……associated civil works **like shed** for inert gas storage cylinders, etc. as per the detailed specifications in Part-B of technical specification.	One (1) No. automatic total flooding inert gas fire extinguishing system ……..programmer/server rooms, ~~**PC rooms**~~, panel room, ……associated civil works ~~**like shed**~~ for inert gas storage cylinders, etc. as per the detailed specifications in Part-B of technical specification.

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Sec/ Part	Sub Sec-tion	Page No.	Clause No.		
PU-04B	VIA	IIA-12	9 of 11	4.00.00 h)	**Power Supply System** The DC Power Supply system shall consists of the following system(s):- i)…….. ii)…… **Necessary redundant transformers shall be provided by the contractor to derive the power supply from 415V, 3 phase, 3 wire incomers for (i) & (ii) above.** For detailed specification of power supply system, please refer part B of technical Specification.	**Power Supply System** The DC Power Supply system shall consists of the following system(s):- i)…….. ii)……. ~~**Necessary redundant transformers shall be provided by the contractor to derive the power supply from 415V, 3 phase, 3 wire incomers for (i) & (ii) above.**~~ For detailed specification of power supply system, please refer part B of technical Specification.
PU-05B	VIA	IIA-12	6 of 11	4.00.00 d), 2)	Coal transfer points, coal conveyors (excluding open coal conveyors) and biomass conveyors & TPs.	Coal transfer points, coal conveyors (excluding open coal conveyors) and biomass conveyors & TPs **including take-up area**.
PU-06B	VIA	IIA-12	7 of 11	4.00.00 h), 4)	Infra-red detectors (IRD) shall be provided in all coal conveyors and all biomass conveyors **before TP** under bidder's scope for detection of moving fire.	Infra-red detectors (IRD) shall be provided in all coal conveyors and all biomass conveyors **(before TP, before Silo)** under bidder's scope for detection of moving fire.
PU-07B	VIA	IV	21 of 73	1.01.07.02, b)	Power consumption at motor input terminals of …… ……system of water system control building, **office area in control tower**. Power consumption at rated duty point for water cooled chillers & air cooled condensing units shall be based on site test and for other drives like chilled water pumps, Condenser water Pumps & AHU/centrifugal fans shall be based on shop test. **(Duty factor for power consumption of A/C equipments of office area in control tower shall be 0.5)**	Power consumption at motor input terminals of …… ……system of water system control building~~**, office area in control tower**~~. Power consumption at rated duty point for water cooled chillers & air cooled condensing units shall be based on site test and for other drives like chilled water pumps, Condenser water Pumps & AHU/centrifugal fans shall be based on shop test. ~~**(Duty factor for power consumption of A/C equipments of office area in control tower shall be 0.5)**~~
PU-08B	VIA	IV	31 of 73	1.03.04 B., 2)	Capacity (TR) of Air cooled condensing (D-X) unit for A/C system of water system control building, **office area in control tower**.	Capacity (TR) of Air cooled condensing (D-X) unit for A/C system of water system control building, ~~**office area in control tower**~~.

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Sec/ Part	Sub Sec-tion	Page No.	Clause No.		
PU-09B	VI/A	VI Ch-07	3 of 16	1.06.00	4. Dew Point meters - 1 No.	4. Dew Point meters with sensor - 1 No.
PU-10B	VI/A	VI Ch-07	9 of 16	3.00.00	2.9 Scrapper rings	2.9 Scrapper rings (if applicable)
PU-11B	VI/A	VI Ch-07	10 of 16	3.00.00	6.0 DELUGE VALVE ASSEMBLIES	6.0 DELUGE VALVE ASSEMBLIES (as applicable)
PU-12B	VI/B	G-06	10 of 14	3.03.19 a)	a) Following shall be demonstrated at Site: i)……. ii)…… iii) ……..	a) Following shall be demonstrated at Site: i)……. ii)…… iii) …….. **iv)Commissioning and performance test of all Deluge valves.**
PU-13B	VI/B	A-01	59 of 87	3.12.02 iii)	Coal/biomass conveyors at ground level shall be provided with external …… …… Further, fixed water monitors shall also be provided for coal conveyors / transfer points, etc. having elevation **20M** or more.	Coal/biomass/**limestone/gypsum** conveyors at ground level shall be provided with external …… …….. Further, fixed water monitors shall also be provided for coal/**biomass conveyors** / transfer points, etc. having elevation **15M** or more. **Combination of hydrant valves and Water monitor shall be provided alternately in coal stockpile.**
PU-14B	VI/B	A-01	59 of 87	3.12.02 iv)	All the landings of boiler staircases, turbine building, office area in control tower, crusher house (if applicable), track hopper/wagon tippler (if applicable), transfer points/junction house of CHP, bunker floors, etc. and other multi-storied structures of the entire plant shall be provided with hydrant landing valves.	All the landings of boiler staircases, turbine building, office area in control tower, crusher house (if applicable), track hopper/wagon tippler (if applicable), transfer points/junction house**/take-up belt area** of CHP/**Biomass**, bunker floors, etc. and other multi-storied structures of the entire plant shall be provided with hydrant landing valves.

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Sec/ Part	Sub Sec-tion	Page No.	Clause No.		
PU-15B	VI/B	A-01	60 of 87	3.12.02 v)	Each of the landing valves and external hydrant valves associated with the main plant (transformer yard, TG building, boiler and ESP area) areas shall be provided with a hose box. Each hose box shall contain two (2) numbers of 15M long hoses & coupling, branch pipes & nozzles, spanner etc as per TAC guidelines. For landing valves of various off-site buildings, the hose box shall have two (2) numbers 7.5 m long hoses, branch pipes, couplings, nozzles, spanners, etc. as per TAC guidelines.	Each of the landing valves and external hydrant valves associated with the main plant (transformer yard, TG building, boiler and ESP area) areas shall be provided with a hose box. Each hose box shall contain two (2) numbers of 15M long hoses & coupling, branch pipes & nozzles, spanner etc as per TAC guidelines. For landing valves of various off-site buildings, the hose box shall have two (2) numbers 7.5 m long hoses, branch pipes, couplings, nozzles, spanners, etc. as per TAC guidelines. **For offsite areas, 15M long hoses, branch pipes, couplings, nozzles, spanners, etc. in central hose stations of suitable quantity shall be provided for yard hydrants as per TAC guidelines.**
PU-16B	VI/B	A-01	64 of 87	3.12.06.01	**Pressure Venting:** Since huge quantity of ……..dampers, etc. shall be provided by the contractor. Required openings in the civil structure shall be provided by the owner. The contractor shall ……. engineering for approval.	**Pressure Venting:** Since huge quantity of ……..dampers, etc. shall be provided by the contractor. Required openings in the civil structure shall be provided ~~**by the owner**~~. The contractor shall ……. engineering for approval.
PU-17B	VI/B	A-01	67 of 87	3.13.01	21. As per ECBC codes minimum coefficient of performance (COP) for the chiller shall be as follows (based on AHRI conditions): A.COP of the water-cooled chiller: …….. …….. B.COP of the air-cooled chiller: …….. ……..	21. As per ECBC codes minimum coefficient of performance (COP) and star rating for the chillers shall be as per BEE. Minimum Star Rating/Co-efficient of performance (COP) of the Chillers shall be as per ECSBC/BEE regulations/guidelines.
PU-18B	VI/B	A-16	2 of 7	4.02.05	Any superior material & type (as per proven practice and relevant standard) of various components of **screw** compressor is also acceptable.	Any superior material & type (as per proven practice and relevant standard) of various components of **centrifugal** compressor is also acceptable.

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Sec/ Part	Sub Section	Page No.	Clause No.		
PU-19B	VI/B	A-17	1 of 30	2.02.00	Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.	Unless otherwise specified, equipment shall conform to the latest applicable **BEE, ECBC,** Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.
PU-20B	VI/B	A-17	1 of 30	3.01.00 a)	For Main Plant Areas [control room, control equipment room, UPS room, battery charger, static excitation control room (if applicable) SWAS room & water analysis lab]: i) Vapor compression type water chilling units: 2X100% ii) Chilled water pumps: 2X100% iii) Condenser water pumps: 2X100% iv) Cooling Towers: 2X100% v)AHUs: At least one (1) no. unit, capacity same as each working unit shall be provided as common standby.	For Main Plant Areas [control room, control equipment room, UPS room, battery charger, static excitation control room (if applicable) SWAS room & water analysis lab, CEP VFD Room, office area in control tower, etc.]: i) Vapor compression type water chilling units: 3X50% ii) Chilled water pumps: 3X50% iii) Condenser water pumps: 3X50% iv) Cooling Towers: 3X50% v)AHUs: At least one (1) no. unit, capacity same as each working unit shall be provided as common standby.
PU-21B	VI/B	A-17	1 of 30	3.01.00 c)	For office area in control tower: i) Air cooled (D-X Type) condensing units: 2X100% ii) AHUs: 2x100%	……**Deleted**……
PU-22B	VI/B	A-17	2 of 30	4.01.01	Each chilling unit shall …….. control. The screw compressor based chilling unit to be supplied shall be ARI /Eurovent/Equivalent standard certified (if applicable).	Each chilling unit shall …….. control. The screw compressor based chilling unit to be supplied shall be **BEE**, ARI /Eurovent/Equivalent standard certified (if applicable).
PU-23B	VI/B	A-17	5 of 30	4.05.01	Notes: (2) Split air conditioner shall conform to minimum three (3) star (***) rating and above of latest version of Bureau of Energy Efficiency (BEE) HVAC code issued by Ministry of Power, Govt of India.	Notes: (2) Air conditioners shall conform to minimum star rating as per latest code/standard/ guidelines issued by Bureau of Energy Efficiency (BEE), Ministry of Power, Govt of India.

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Sec/ Part	Sub Section	Page No.	Clause No.		
PU-24B	VI/B	A-17	13 of 30	6.05.04 i)	Where ever horizontal ducts …….. by the bidder. For vertical ducts running outside the building, bidder to take support from building columns and beams which is in Employer scope. However, all other auxiliary steel members, hooks, rods, etc. for supporting the duct work with **the employer's** beam & columns shall be provided by the bidder.	Where ever horizontal ducts …….. by the bidder. For vertical ducts running outside the building, bidder to take support from building columns and beams ~~**which is in Employer scope**~~. Further, all other auxiliary steel members, hooks, rods, etc. for supporting the duct work with ~~**the employer's**~~ beam & columns shall **also** be provided by the bidder.
PU-25B	VI/B	A-17	20 of 30	7.02.04	Air-Conditioning system for "Water system control room" shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS). **For Air Conditioning System of "office area in control tower" Contractor shall provide Microprocessor /PLC/ controller integrated GIU based Control System as per Manufacturer's standard & proven practice.**	Air-Conditioning system for "Water system control room" shall be controlled through microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS). ~~**For Air Conditioning System of "office area in control tower" Contractor shall provide Microprocessor /PLC/ controller integrated GIU based Control System as per Manufacturer's standard & proven practice.**~~

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Sec/ Part	Sub Section	Page No.	Clause No.		
PU-26B	VI/B	A-17	21 of 30	7.04.00	b) Humidity sensor and gyserstat located in the return air duct shall actuate the PAN humidifier to obtain the desired degree of humidification. d)Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (airstat - located in front of the each heater in the supply air duct) e) AHU shall be started either locally or from the main control room of AC system by means of Remote / Manual selection facility. g) Each AHU shall be provided with temperature indicators and pressure transmitter in the chilled water piping inlet and outlet to monitor the air-conditioning load of each area.	b) Humidity and temp. sensor shall actuate the PAN humidifier to obtain the desired degree of humidification. d)Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (airstat). e) AHU shall be started either locally or from the main control room of AC system by means of Remote / Local selection facility. g) Each AHU room shall be provided with temperature transmitters in the chilled water piping inlet & outlet and flow transmitter at chilled water outlet to calculate and display air-conditioning load of each area in control system.
PU-27B	VI/B	A-17	22 of 30	8.01.02	The Ventilation system for main Plant area, (excluding roof extraction fans, standalone Air supply and Air Exhaust fans) …… ……of operation, status indication, annunciation, interlock and protection of pumps/drives, etc.	The Ventilation system for main Plant area**, ESP/FGD control building area** (excluding roof extraction fans, standalone Air supply and Air Exhaust fans) …… ……of operation, status indication, annunciation, interlock and protection of pumps/drives, etc..
PU-28B	VI/B	A-18	2 of 14	3.03.00	**For Stacker-Reclaimer machines:** Water for spray system shall be tapped from hydrant header running along the stockyard. For this, combination of **butterfly valves** & quick cam couplings ……. flexible hose shall be permanently connected to deluge valve.	**For Stacker-Reclaimer machines:** Water for spray system shall be tapped from hydrant header running along the stockyard. For this, combination of **gate valves** & quick cam couplings ……. flexible hose shall be permanently connected to deluge valve.

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Sec/ Part	Sub Section	Page No.	Clause No.		
PU-29B	VI/B	A-18	2 of 14	3.02.00	Spray system shall mainly comprise of the following: • …… • …… • …… • …… • …… • …… • …… • …… • …… • ……	Spray system shall mainly comprise of the following: • …… • …… • …… • …… • …… • …… • …… • …… • …… • …… • **Additional pressure switch (wherever required) on wet-detection line (near respective protected area having high elevation) shall be provided for required interfacing and operations of solenoid valves to facilitate deluge valve operations.**
PU-30B	VI/B	A-18	14 of 14	Annexure-II	5. Water line Gate / Sluice Valve b) BS:5150 (for valves at other locations) - Pressure rating: PN1.6 (as per IS:14846) / PN16 (as per BS:5150) -Working Pr. :12Kg/cm2	5. Water line Gate / Sluice Valve b) BS:5150 (for valves at other locations)- **valves shall be of rising spindle type.** - Pressure rating: PN1.6 (as per IS:14846) / PN16 (as per BS:5150) -Working Pr. :12Kg/cm2
PU-31B	VI/E	Tender Drawing	-	-	Schematic Diagram for A/C system for Main Plant TG Building (0000-000-POM-A-054 Rev-A)	Schematic Diagram for A/C system for Main Plant TG Building (0000-000-POM-A-054 Rev-B)

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
D1B-4	E	Tender Drawing			WORKER'S ACCOMODATION FLOOR PLAN & ELEVATION tender draing no. 9551-XXX-POC-A-019	Deleted
D1B-5	VI/B	D-1-5	5.39.00		-	**HARD CRUSTING** Hard crusting in preassembly area and any other areas shall be done with 63mm to 45mm graded stone aggregate, watering and compacting each layer (not exceeding 200mm in thickness) to minimum of 85% of original volume of stone stack including filling the interstices of stone aggregate with moorum/locally available non-expansive soil. The minimum compacted thickness of stone aggregate layer shall be 200mm. The compacted subgrade below stone aggregate shall be 85% of standard proctor density
D1B-6	IID		1.00.00		7.m. Main Power House building.	7.m. Main Power House building. Air Conditioned Office of 250 sqm shall be provided in MPH building above CR in addition to other facilities specified.
D1B-7	IID		1.00.00			7. w. VFD Room in transformer Yard area, for CEP.
D1B-8	B	D-1-5	5.02.07		**ESP Control Building**	**ESP cum FGD electrical building**
D1B-9	B	D-1-5	5.02.11.01.10		2.0m wide walkway with M25 grad……	For **areas other than paved area**, 2.0m wide walkway with M25 grad……..
D1B-10	B	D-1-5	**5.23.02**		**Overhead / Ground Conveyor Galleries and Trestles** …….. …….. The steel structures using tubular	**Overhead / Ground Conveyor Galleries and Trestles** …… ……..

					sections shall be designed as per limit state method as per IS 800:2007. The properties and fabrication of tubular sections shall be as per IS 806 "Code of Practice for use of steel tubes in general building construction." and EN 1993-1-8:2005.	The steel structures using tubular sections shall be designed as per limit state method as per IS 800:2007. The properties and fabrication of tubular sections shall be as per IS:806 – "Code of Practice for use of steel tubes in general building construction." and EN 1993-1-8:2005.
D1B-11	B	D-1-5	**5.23.03**		For trestles…….. Encasement of the pedestal shall be done above the top of the stiffener plate.	For trestles ….. Encasement of the pedestal shall be done upto 75 mm(minimum) above the top of the stiffener plate.
D1B-12	B	D-1-5	5.23.17.01		Drainage System:- …… For Crusher House, pent house, transfer house each down comer shall lead the water / coal slurry/lime slurry into the peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / coal slurry to water / coal slurry to RCC pit (of 2 Cu.M capacity) to allow settling of coal. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally to the coal slurry settling pond. For Track hopper/Wagon Tippler & transfer houses peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / coal slurry to a local RCC pit (of 2 Cu. M. capacity) near each facility to allow settling of coal. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge to a coal slurry settling pit. Drainage of the complete biomass handling system facilities shall be discharged into coal settling pond after separation of biomass in biomass separation Pit. Drainage of the complete	Drainage System:- …… For Crusher House, pent house, transfer house each down comer shall lead the water / coal slurry/lime slurry into the peripheral drains which will lead the water / coal slurry to water / coal slurry to RCC pit (of 2 Cu.M capacity) to allow settling of coal. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally to the coal slurry settling pond. (a.) For **Track Hopper** & transfer houses peripheral drains shall lead the water / coal slurry to a local RCC pit (of 2 Cu. M. capacity) near each facility to allow settling of coal. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge to a coal slurry settling pit. In case of Control rooms and MCC buildings, Pump houses, etc water / coal slurry coming from down comers shall discharge into peripheral drains (which will lead the water / coal slurry into contractor's RCC drain, which will lead the discharge finally into coal slurry settling pond.

					Lime handling system facilities shall be discharged into bottom ash slurry sump after separation of lime in lime separation Pit. In case of Control rooms and MCC buildings, Pump houses, etc water / coal slurry coming from down comers shall discharge into peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / coal slurry into contractor's RCC drain, which will lead the discharge finally into coal slurry settling pond. …… Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / IRC standards and approval of Railway culverts from concern Railway authorities.	Drainage of the complete biomass handling system facilities shall be discharged into coal settling pond after separation of biomass in biomass separation Pit. …… Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / IRC standards and approval of Railway culverts from concern Railway authorities.
D1B-13	B	D-1-5	5.23.18		**Internal and external water supply, drainage etc.:-** The scope……. …… All buildings (including transfer houses, crusher house, MCC rooms, pump house etc.) shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth with removable steel gratings all around the periphery. All drains excepting the peripheral drains around the transfer points, crusher house, control / MCC. buildings, pumps house etc., shall be of RCC construction. Minimum 850 mm Width RCC drain shall be provided around crusher house area and its succeeding drains. All open RCC drains shall have removable steel gratings designed for loads as specified under loading clause. Minimum size of main bar of steel grating (Galvanised to 610 gm/m2) shall be 40 mm x 5mm and cross bars 6mm. At all entry or road/rail crossing point's RCC box/pipe culvert shall be provided. The opening size of	**Internal and external water supply, drainage etc.:-** The scope……. …… All buildings (including transfer houses, crusher house, MCC rooms, pump house etc.) shall be provided with open surface RCC drains of minimum size of 300 mm width and 300 mm depth with removable steel gratings all around the periphery. All drains shall be of RCC construction. Minimum 850 mm Width and 450 mm depth RCC drain shall be provided around stock pile area. Minimum 850 mm Width RCC drain shall be provided around crusher house area and its succeeding drains. All open RCC drains carrying coal/limestone/biomass slurry except in the stockpile area shall have removable steel gratings designed for loads as specified under loading clause. Moreover, all open drains around periphery of the CHP/LHP.GHP/BHP buildings shall have removable steel gratings designed for loads as specified under loading clause. All open RCC

					grating shall not be more than 90 mm x 35 mm. All drains as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. …… …….. For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.	drains shall have removable steel gratings designed for loads as specified under loading clause. Minimum size of main bar of steel grating (Galvanised to 610 gm/m^2) shall be 40 mm x 5mm and cross bars 6mm. At all entry or road/rail crossing point's RCC box/pipe culvert shall be provided. The opening size of grating shall not be more than 90 mm x 35 mm. All drains as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. …… …… For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.
D1B-14	B	D-1-5	5.02.24		**……..** Bidder **shall** integrate the boiler supporting structure with Mill & Bunker Building Structure. **……**	**……** Bidder **may** integrate the boiler supporting structure with Mill & Bunker Building Structure. **……..**
D1B-15	**VI/Part B**	D-1-10	10.05.00		Only fly ash bricks shall be used in all construction, except for elevator shafts, which can be either of burnt clay bricks or RCC construction as per functional / codal provisions. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm2. Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS: 13757 and IS: 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%	Only fly ash bricks shall be used in all construction, except for elevator shafts, which can be either of burnt clay bricks or RCC construction as per functional / codal provisions. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm2**. Burnt clay fly ash bricks conforming to IS: 13757, or Fly ash lime bricks conforming to IS: 12894 or Fly ash Cement Brick confirming to IS 16720 shall be used.** Minimum fly ash content in fly ash-based bricks shall be 25%."
D1B-16	**VI/Part B**	D-1-5	5.08.00		Complete storm water drainage system of Plant area is in bidder's scope. Storm water drain shall be designed taking into account the finished ground levels of the plant & surrounding area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years**.** These values shall be based on minimum rainfall intensity of 75mm/hr. All RCC drains shall be either RCC Cast-in-Situ or	Complete storm water drainage system of Plant area is in bidder's scope. Storm water drain shall be designed taking into account the finished ground levels of the plant & surrounding area, drainage pattern, intensity of rainfall, etc. with a return period of 50 years**.** These values shall be based on minimum rainfall intensity of 75mm/hr. All RCC drains shall be either RCC Cast-in-Situ

					RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains.The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The inside drain dimension at any point should not be less than 0 .45m (height) x 0.75m (breadth). …….	or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains.The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The inside drain dimension at any point should not be less than 0 .45m (height) x 0.75m (breadth). **The runoff coefficient of paved and unpaved area shall be 0.9 and 0.6 respectively.** **…….**
D1B-17	**VI/Part B**	D-1-8	8.09.00		**A) Ingredients**: Geo-Polymer Concrete is a special type of concrete where no cement is used unlike……. Fly ash produced by coal-based power stations of NTPC, if available, will be issued free of cost for the production of Geo-polymer concrete on 'as is where is' basis.	**A) Ingredients**: Geo-Polymer Concrete is a special type of concrete where no cement is used unlike……. Fly ash produced by coal-based power stations of NTPC, if available, will be issued **at a cost of Rs. 1/Ton** for the production of Geo-polymer concrete on 'as is where is' basis.
D1B-18	Section VI, Part B	D-1-5 D-1-8, Civil works	5.06.05 5.32.20.2 8.01.02.017 8.02.01		It consists of 50 mm thick **P.C.C. M-20 grade** It consists of 50 mm thick **P.C.C. M-25 grade** **PCC (M-15)** shall be provided around all buildings, pits / sumps, clarifiers, tanks, etc. PCC encasement of Pylon supports and CW Pipes; **Plinth protection - M20**	PCC for plinth protection shall be M20 grade of 100 mm thickness.
D1B-19	General					Thickness of Brick wall mentioned any where as 250 mm thick shall be read as minimum thickness of 230mm
D1B-20	General					Brand names mentioned any where in civil specification part B sub-section D shall be null & void.

Amendment-3B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

Sl. No.	Specification Reference				Existing	Read as
	Part	Sub Sec	Page No	Clause No		
C-05B	VI/B	VI Chapter-A-05	17 of 27	7.07.07	All piping, valves & instrumentation shall be in the contractor's scope. Provision…..**A pH monitor shall be provided at the discharge of the pumps for measurement and control.** Complete….room. Feeding of lime to bucket elevator can be manual.	All piping, valves & instrumentation shall be in the contractor's scope. Provision…..**A pH monitor shall be provided in the waste water tank for measurement and control.** Complete….room. Feeding of lime to bucket elevator can be manual.
C-06B	VI/A	VI Chapter-2	25 of 30	4.00.00	6. Fittings for HPBP, high pressure LPBP etc. - 1 complete set	6. Fittings for HPBP, ~~**high pressure**~~ LPBP etc. - 1 complete set
C-07B	VI/A	IIC	16 of 20	5.03.00	For Main Plant, UPS System has to be supplied on per unit basis as per Cl. No 1.05.00 (A), Part B, IIIC-05 of the Technical Specification. For other offsite common control locations Water System CER, AHP CER (s) and CHP Control Room (s), UPS Configuration shall be as per Cl. No 1.05.00 (B), Part B. For all other operator locations with OWS UPS with configuration as per Cl. No 1.05.00 (C), Part B to be provided. Manual discharge resistance bank of adequate capacity shall be provided for Main Plant UPS & offsite common areas (Max rating). UPS of minimum 5 KVA rating to be provided for powering UPS loads of Air Compressors". Accessories and devices required for maintenance and testing of batteries shall be supplied on as required basis.	For Main Plant, UPS System has to be supplied on per unit basis as per Cl. No 1.05.00 (A), Part B, IIIC-05 of the Technical Specification. For other offsite common control locations Water System CER, AHP CER (s) and CHP Control Room (s) **and FGD CER**, UPS Configuration shall be as per Cl. No 1.05.00 (B), Part B. **For all other operator locations (like FOPH, AWRS & Ash SILO etc.) with OWS/Servers UPS with configuration as per Cl. No 1.05.00 (C), Part B to be provided. UPS of minimum 5 KVA rating to be provided for powering UPS loads of Air Compressors.** Manual discharge resistance bank of adequate capacity shall be provided for Main Plant UPS & offsite common areas (Max rating). ~~**UPS of minimum 5 KVA rating to be provided for powering UPS loads of Air Compressors".**~~ Accessories and devices required for maintenance and testing of batteries shall be supplied on as required basis.
C-08B	VI/B	IIIC-05	2 of 10	1.03.00	**(B1)** DC power supply system for UNIT (BOP) Area: DC power supply system shall comprise of two sets. Each set shall……. **(B2)** DC power supply system for areas other than Unit (**BOP**): DC power supply system shall comprise of two sets. Each set shall…….	**(B1)** DC power supply system for UNIT (**SG, TG & BOP**) Area: DC power supply system shall comprise of two sets. Each set shall……. **(B2)** DC power supply system for areas other than Unit (**SG, TG & BOP**): DC power supply system shall comprise of two sets. Each set shall…….
C-09B	VI/B	IIIC-04	1 of 36	1.05.00	All instruments envisaged for sea water applications, shall be provided with wetted parts made of	All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C

					Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor). For Chlorine application: Instruments shall be provided with wetted parts (e.g., diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g., diaphragm seal, etc.) made of Tantalum.	or any other material (if provenness experience of the proposed material for such applications is established by contractor). For Chlorine application: Instruments shall be provided with wetted parts (e.g., diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g., diaphragm seal, etc.) made of Tantalum. **For limestone and gypsum slurry application instruments shall be provided with wetted parts MOC of Hastelloy or better.**
C-10B	VI/B	IIIC-04	10 of 36	6.00.00	**CONTINUOUS EMISSION MONITORING SYSTEM (CEMS): -** AS PER CONTRACTOR'S STANDARD AND PROVEN PRACTICE FOR MEETING SYSTEM AND LATEST CPCB REQUIREMENT. TOTAL NOX VALUES SHALL BE REPORTED AS NO2 I.E., NOX = NO + NO2 = NO X 1.53 + NO2 = NOX AS NO2.	**CONTINUOUS EMISSION MONITORING SYSTEM (CEMS): -** AS PER CONTRACTOR'S STANDARD AND PROVEN PRACTICE FOR MEETING SYSTEM AND LATEST CPCB REQUIREMENT. **Measurement for NO and NO2 shall be provided for correct reporting of NOx and NO2**. TOTAL NOX VALUES SHALL BE REPORTED AS NO2 I.E., NOX = NO + NO2 = NO X 1.53 + NO2 = NOX AS NO2.
C-11B	VI/A	VI Chapter-2	25 of 30	4.00.00	6. FITTINGS FOR HPBP, HIGH PRESSURE LPBP ETC. - 1 COMPLETE SET	6. FITTINGS FOR HPBP, ~~**HIGH PRESSURE**~~ LPBP ETC. - 1 COMPLETE SET
C-12B	VI/B	IIIC-02G	4 of 4	5.0	**Training**: 1. Developer/ Administrator level training: The Contractor…… 2. User level training: The Contractor shall…….. Training Material shall be…….	**Training**: 1. Developer/ Administrator level training: The Contractor…… 2. User level training: The Contractor shall…….. Training material shall be…….

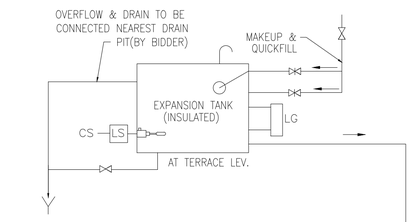
						Above Training period to be considered over and above Training man-months mentioned in PART-C of Technical Specification
C-13B	VI/A	IV	2 of 78	1.00.01 g)	Instruments for PG test…… Control system loop tuning required to limit the variation of parameters during performance guarantee testing shall be completed prior to **PG Test & during** initial operation.	Instruments for PG test…… Control system loop tuning required to limit the variation of parameters during performance guarantee testing shall be completed prior to **PG Test during** initial operation.
C-14B	VI/A	IIC	13 of 20	4.00.00 (d) i	These TTs shall be mounted as defined in subsection **IIC-04**, PART-B & tender drawing part-E of the specifications.	These TTs shall be mounted as defined in subsection **IIIC-04**, PART-B & tender drawing part-E of the specifications.
C-15B	VI/B	IIIC-02	11-17 of 17	22.00.00 to 32.00.00	24.00.00 System Software Requirements **22.00.00 Data Communication System** **23.00.00 Grounding** **24.00.00 System Cabinets / Panels** **25.00.00 Marshalling, Relays & Relay Cabinets** **26.00.00 HART System** **27.00.00 Requirement for SOE functionality (Refer Scope of Supply and Services for applicability)** **28.00.00 System Documentation** **29.00.00 Warranty** **30.00.00 Annual Maintenance Service (AMS)** **31.00.00 Remote Service Center** **32.00.00 Testing & Commissioning Tool**	24.00.00 System Software Requirements **25.00.00 Data Communication System** **26.00.00 Grounding** **27.00.00 System Cabinets / Panels** **28.00.00 Marshalling, Relays & Relay Cabinets** **29.00.00 HART System** **30.00.00 Requirement for SOE functionality (Refer Scope of Supply and Services for applicability)** **31.00.00 System Documentation** **32.00.00 Warranty** **33.00.00 Annual Maintenance Service (AMS)** **34.00.00 Remote Service Center** **35.00.00 Testing & Commissioning Tool**
C-16B	VI/B	IIIC-02C	3 of 6	1.01.11	Firewall: Next generation Firewall (NGFW) shall have features of Packet filtering, Stateful inspection and deep packet inspection, high availability and load balancing, data encryption support for AES 128-256 bit, support for NAT, PAT and policy based NAT/PAT with…….. min. firewall throughput of 4 Gbps, min. **3DES**/AES VPN throughput of 400 Mbps…	Firewall: Next generation Firewall (NGFW) shall have features of Packet filtering, Stateful inspection and deep packet inspection, high availability and load balancing, data encryption support for– AES 128-256 bit, support for NAT, PAT and policy based NAT/PAT with…….. min. firewall throughput of 4 Gbps, min. ~~**3DES**~~/AES VPN throughput of 400 Mbps…
C-17B	VI/B	IIIC-02C	4 of 6	1.01.14	Necessary KVM switches for controlling multiple operator workstations/LVS workstations (up to four nos.) from single keyboard/mouse/video placed at UCD in Control Room shall be supplied. **For quantity of switches refer Part A**. These switches are intended to be used only for keyboard multiplexing.	Necessary KVM switches for controlling multiple operator workstations/LVS workstations (up to four nos.) from single keyboard/mouse/video placed at UCD in Control Room shall be supplied. ~~**For quantity of switches refer Part A.**~~ These switches are intended to be used only for keyboard multiplexing.

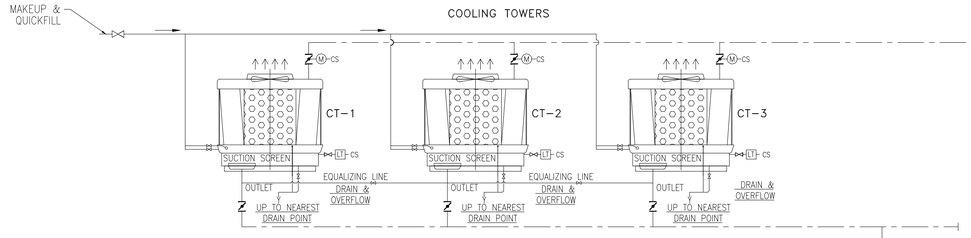
<table>
<tr><td>C-18B</td><td>VI/A</td><td>Attachment-3K</td><td>330 of 347</td><td>8.00.00</td><td>8.00.00 UPS system
8.01.00 We/our sub-vendor (M/s……) confirm that we meet the provenness requirements specified in Cl. No.6.6(c) of provenness requirements in the Sub-Section-IA, Part-A, Section-VI of Bidding Documents.</td><td>8.00.00 UPS system
8.01.00 We/our sub-vendor (M/s……) confirm that we meet the provenness requirements specified in Cl. No.6.6(d) of provenness requirements in the Sub-Section-IA, Part-A, Section-VI of Bidding Documents.</td></tr>
<tr><td>C-19B</td><td>VI/A</td><td>Attachment-3K</td><td>331 of 347</td><td>9.00.00</td><td>9.00.00 24 V DC Modular Charger
9.01.00 We/our sub-vendor (M/s……...) confirm that we meet the provenness requirements specified in Cl. No.6.6(d) of provenness requirements in the Sub- Section-IA, Part-A, Section-VI of Bidding Documents.</td><td>9.00.00 24 V DC Modular Charger
9.01.00 We/our sub-vendor (M/s……...) confirm that we meet the provenness requirements specified in Cl. No.6.6(e) of provenness requirements in the Sub- Section-IA, Part-A, Section-VI of Bidding Documents.</td></tr>
<tr><td>C-20B</td><td>VI/A</td><td>Attachment-3K</td><td>332 of 347</td><td>10.00.00</td><td>10.00.00 CCTV SYSTEM
10.01.00 We/our sub-vendor (M/s……) confirm that we meet the provenness requirements specified in Cl. No.6.6(e) of provenness requirements in the Sub-Section-IA, Part-A, Section-VI of Bidding Documents.</td><td>10.00.00 CCTV SYSTEM
10.01.00 We/our sub-vendor (M/s……) confirm that we meet the provenness requirements specified in Cl. No.6.6(f) of provenness requirements in the Sub-Section-IA, Part-A, Section-VI of Bidding Documents.</td></tr>
<tr><td>C-21B</td><td>VI/A</td><td>IV</td><td>48 of 78</td><td>1.03.26.02(IV)</td><td>All runback conditions listed below shall be proved by the Contractor without anyoil support.
-- FD/ID/PA fan trip
-- BFP/CEP/ trip
-- One mill and two mill trip
……...</td><td>All runback conditions listed below shall be proved by the Contractor without any oil support.
-- FD/ID fan trip
-- BFP/CEP trip
-- One mill and two mill trip.
……</td></tr>
<tr><td>C-22B</td><td>VI/A</td><td>VI
Ch-12</td><td>8 OF 9</td><td>7.00.00</td><td>
<table>
<tr><th>Sl No</th><th>Item</th><th>Quantity</th></tr>
<tr><td>(i)</td><td>PTZ camera</td><td>20 nos.</td></tr>
<tr><td>(ii)</td><td>Explosion proof camera</td><td>1 nos.</td></tr>
<tr><td>(iii)</td><td>Fixed Camera</td><td>2 nos.</td></tr>
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</table>
</td></tr>
</table>

C-23B	VI/A	IIA-01	25 of 28	3.01.06	Ash hoppers complete with curved panel heating elements, matching with curved surfaces of conical hopper, **level monitors and indicators,** outlet flanges, jointing material, poke holes, access doors and walkways beneath the hoppers.	Ash hoppers complete with curved panel heating elements, matching with curved surfaces of conical hopper, **level switches for Ash level high and low measurements in all ESP hoppers. Additionally, Acoustic 3D Level Scanner Based Level Monitoring System/ NOGS (Naturally Occuring Gamma Sensor) based level monitoring system for ESP hoppers of first three fields,** outlet flanges, jointing material, poke holes, access doors and walkways beneath the hoppers.

CLAUSE NO.	TECHNICAL REQUIREMENTS
2.02.00A	**Application of Metal Cladding** All metal cladding shall be fabricated and installed to ensure a neat appearance and no open-ended sections of cladding shall be left uncovered. The following provisions shall also be complied with: (a) Weatherproof flushing shall be installed where the panels intersect with columns and at other similar joints. (b) Removable insulated covers shall be provided over the manholes. (c) Cladding on top surface of Steam Generator/ESP/FGD system and ductwork and equipments shall be suitably reinforced to prevent damage by personnel walking thereon. (d) All cladding for outdoor application shall be with neoprene washers. (e) All openings and joints in outdoor cladding for piping connections, supports of access shall be suitably flashed and weatherproofed. Where such flushing or weatherproofing cannot effectively control the entry of moisture, then such openings and joints shall be weather proofed by application of aluminum pigmented sealer. (f) All insulation shall be protected by means of an outer covering of aluminum sheathing. All insulation/cladding joints shall be sealed and made effectively weather and waterproof. All flat surfaces shall be given suitable slope to prevent collection of pools of water on the cladding surface. (g) An asphalt and craft paper moisture barrier or PSMR (Polysurlin Moisture retardant) coating shall be provided to the aluminium cladding for ESP and the complete flue gas ducting downstream of the APH. Such moisture barriers shall be fixed to the inner surface of the cladding or shall be cemented to the outside surface of the insulation before application of cladding. (h) All longitudinal joints shall have a minimum overlap of 50 mm and shall be located at 45 degree or more below the horizontal for horizontal equipment. Joints shall be made with cheese headed self-tapping galvanized steel screws at 150 mm centers. (i) All circumferential joints shall have a minimum overlap of 100 mm and shall be held in position by stainless steel or anodized aluminum bands, stretched and clamped. (j) Removable box type cladding for valves and flanges shall be fitted on the connected pipe cladding, with bands. (k) Aluminum cladding shall not come directly into contact with either the equipment surface or with the supporting arrangement on the equipment surface. To this end, adequate layers of 3 mm thick ceramic board shall be provided between the cladding and any supporting arrangement equipment surface, and fitted with selftapping screws/metal bands, as applicable. (l) For bends, fittings etc. the cladding shall be provided in segments as to ensure a smooth finish of the cladding. (m) For cladding on vertical pipes/equipment, provision for load take up shall be made at every 2 to 4 meters along pipe/equipment axis. (n) All joints shall be sealed with acrylic emulsion weather barrier. Galvanic corrosion shall be prevented by carefully avoiding permanent contact of aluminium cladding with copper, copper alloys, tin, lead, nickel or nickel alloys including monel metal.

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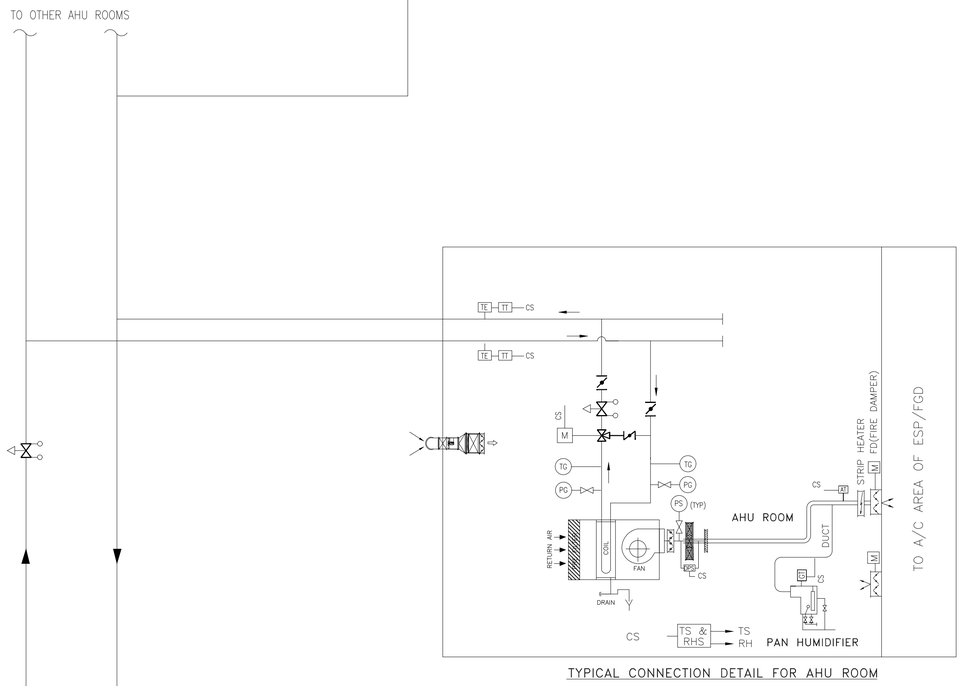




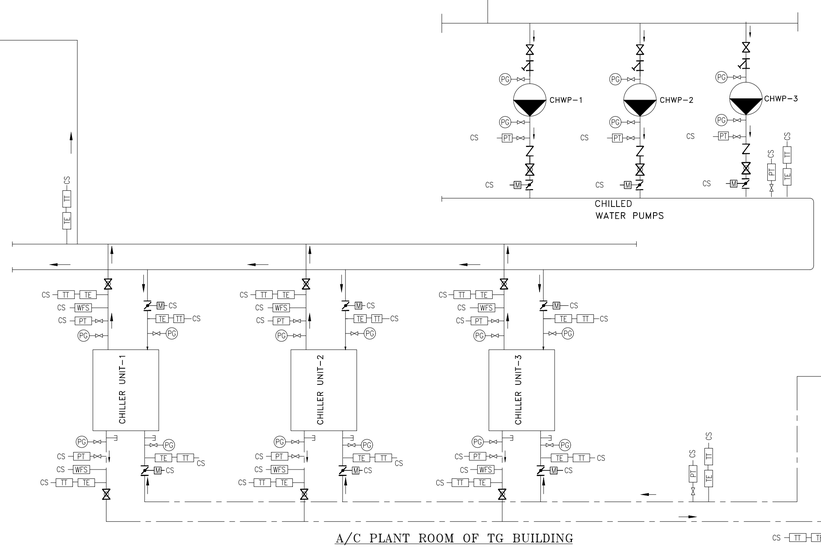
CHILLED WATER PUMP DETAIL	
NAME	QTY
CHWP-1,2 & 3	3 NOS(2W+1S/B)

CONDENSER WATER PUMP DETAIL	
NAME	QTY
COND.WP-1,2 & 3	3 NOS(2W+1S/B)

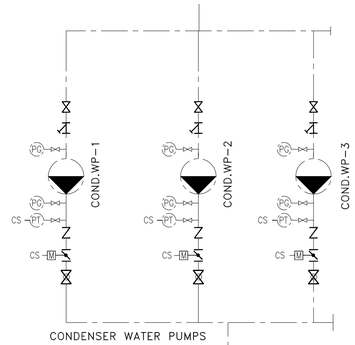
COOLING TOWER DETAILS	
NAME	QTY
CT-1,2 & 3	3 NOS(2W+1S/B)



TYPICAL CONNECTION DETAIL FOR AHU ROOM



A/C PLANT ROOM OF TG BUILDING



CS	CONTROL SYSTEM
TE	TEMPERATURE TRANSMITTER)
	CH.WATER SUPPLY & RETURN PIPE
	COND.WATER SUPPLY & RETURN PIPE
	OPEN DRAIN PIT
	ATMOSPHERIC VENT
	DESCALING CONNECTION
	STRIP HEATER
	FRESH AIR FAN WITH PRE FILTER & FINE FILTER
	CENTRIFUGAL FAN
	PUMP
	PAN HUMIDIFIER WITH 25NB GATE VAVE(3 NOS EACH),1 NO EACH FLOAT VALVE, M-UP/Q.FILL & DRAIN CON.
TG	TEMPARATURE GAUGE
LG	LEVEL GAUGE
LT-CS	LEVEL TRANSMITER
LS-CS	LEVEL SWITCH
GT-CS	GEYSER STAT
AT-CS	AIR STAT
DPS-CS	DIFFERENTIAL PRESSURE SWITCH
WFS-CS	WATER FLOW SWITCH
CS RS RHS TS RH	RH SENSOR &TEMP.SENSOR
TE-CS	TEMPARATURE ELEMENT(SENSOR)
PT-CS	PRESSURE TRANSMITTER
PG	PRESSORE GAUGE
	HEPA FILTER
	FINE FILTER
	PRE FILTER
FD M	ML TYPE FIRE DAMPER(MOTORISED)
VCD	VOLUME CONTROL DAMPER (ML TYPE)
NRD	NON RETURN DAMPER (ML TYPE)
	FLOW CONTROL VALVE
	GATE VALVE
	FLOAT VALVE
M	MOTORIZED GLOBE VALVE(INCHING TYPE)
	BALANCING VALVE
M	2 WAY VALVE (MODULATING WITH ACTUATOR)
	GLOBE VALVE
	CHECK VALVE
	'Y' STRAINER
M	BUTTERFLY VALVE(MOTORISED)
	BUTTERFLY VALVE
LEGEND	DESCRIPTION

NOTE:

1) CAPACITY OF ALL THE A/C EQUIPMENTS SHALL BE FINALIZED DURING DETAILED ENGINEERING BASED ON HEAT LOAD CALCULATION.
2) SIZE OF PIPES, VALVES ETC SHALL BE FINALIZED DURING DETAILED ENGINEERING
3) NUMBER OF AHU AND AHU CAPACITY SHALL BE FINALIZED DURING DETAILED ENGINEERING BASED ON THE FINALIZED ARCHITECTURAL DRAWINGS.
4) CHILLED WATER PUMPS, PIPING, VALVES,EXPANSION TANK, AHU-DRAIN ETC. SHALL BE INSULATED AS PER SPECIFICATION.
5) ALL PIPING & VALVES OF SIZE 40 NB & BELOW SHALL BE PROVIDED AS PER SYSTEM REQUIREMENT BY THE BIDDER.
6) FOR FLOW BALANCING, BALANCING VALVE AND ORIFICE PLATE SHALL BE PROVIDED BY BIDDER AS PER SYSTEM REQUIREMENT.
7) 1X100% CAPACITY FRESH AIR FAN SHALL BE PROVIDED IN EACH AHU ROOM
8) TEMPERATURE SENSOR (TS) & RELATIVE HUMIDITY SENSOR (RHS) SHALL BE PROVIDED IN EACH AHU ROOM.
9) AIR RELEASE VALVES AS PER SYSTEM REQUIREMENT SHALL BE PROVIDED AT SUITABLE LOCATIONS.
10) TENDER DRAWINGS SHALL BE READ IN CONJUNCTION WITH TECHNICAL SPECIFICATIONS.

FOR TENDER PURPOSE ONLY

REV.	DESCRIPTION	DRAWN	DESIGN	CHKD	L/O	TG	SG	LP	MH	WS	E	C	C&I	APPD	DATE
					CLEARED BY										
B	RELEASED FOR TENDER PURPOSE														

NTPC Limited
(A GOVT. OF INDIA ENTERPRISE)

PROJECT	SIPAT SUPER THERMAL POWER PROJECT **STAGE - III (1X800 MW)**
TITLE	SCHEMATIC DIAGRAM FOR A/C SYSTEM FOR TG BUILDING
SIZE A1 / SCALE	DRG.NO. **0000-000-POM-A-054** / REV. B

Amendment-2B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. NO.	SPECIFICATION REFERENCE				EXISTING	Read as
	SEC/ PART	SUBSEC.	PAGE NO.	CLAUSE NO.		
SG-01 B	VI/A	VI Chapter-01	1 to 38			The amended Chapter-01 is placed at **Annexure-SG-01B** to this amendment.

Amendment-2B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

Sl. No.	Specification Reference				Existing	Read as
	Section/Part	Sub Sec	Page No	Clause No		
TG-1 B.	VI/A	IIA-19	1 of 2	2.01.00 (a)	Feed water heaters & deaerator.	Feed water heaters & deaerator **(Applicable Hoists/Chain pully block for maintenance purpose shall be provided**).
TG-2 B.	VI/A	IIA-19 Elevators, Cranes and Hoist	2 of 2	2.01.00 (c)	Fans, motors, gear boxes etc., of Main Condenser, vacuum pumps, control fluid room etc.	~~Fans, motors, gear boxes etc., of Main Condenser, vacuum pumps, control fluid room etc.~~ **Condenser water boxes (Applicable If hinged type water box not envisaged) (front & rear), vacuum pumps, CW butterfly valves, control fluid system etc.**
TG-3 B.	VI/A	VI/Mandatory Spares Chapter-2	2 of 34	A.8	AC jacking oil pump complete assembly for Main Turbine along with complete coupling and Motor. — 1 No.	AC jacking oil pump complete assembly for Main Turbine along with complete coupling and Motor **(If applicable).** — 1 No.
TG-4 B.	VI/A	VI/Mandatory Spares Chapter-2	2 of 34	A.9	DC jacking oil pump assembly for Main Turbine along with complete coupling and Motor — 1 No.	DC jacking oil pump assembly for Main Turbine along with complete coupling and Motor **(If applicable)** — 1 No.
TG-5 B.	VI/A	VI/Mandatory Spares Chapter-2	12 of 34	C.1-xxi.	Duplex filter for Jacking oil system consisting of filter elements / cartridges, O-rings, gaskets except housing - 1 Sets	Duplex filter for Jacking oil system consisting of filter elements / cartridges, O-rings, gaskets except housing **(If applicable)** - 1 ~~Sets~~ **Set**
TG-6 B.	VI/A	VI/Mandatory Spares Chapter-2	15 of 34	11a-xi	Filters & Coolers for Mech. Seal Skid — 1 set (requirement for one pump)	Filters & Coolers for Mech. Seal Skid **(If applicable)** — 1 set (requirement for one pump)
TG-7 B.	VI/A	VI/Mandatory Spares Chapter-2	16 of 34	12-xi	Filters & Coolers for Mech. Seal Skid — 1 set (requirement for one pump)	

						Filters & Coolers for Mech. Seal Skid **(If applicable)** | 1 set (requirement for one pump)
TG-8 B.	VI/A	Sub-Section-VI Mandatory Spares Chapter-2	13 of 34	C.1-xxxi. **New clause**	-	**Hydraulic Power Pack complete assembly including all fittings & Hoses for Main Turbine Hydraulic coupling bolts (if applicable)** | **1 Set**
TG-9 B.	VI/A	I-A Provenness	11 of 35	4.18	**On-line Blade Vibration Monitoring System for Low Pressure (LP) Turbines (in case Free Standing Blades are offered)** The Bidder/sub-vendor ……. Detection of free standing blades of Low Pressure Turbine of Steam Turbine Generator set of 200 MW or above capacity. This integrated system* should have been in successful operation at each installation for at least 7000 operating hours prior to the date of techno-commercial bid opening. The Bidder should offer ……. meets the above requirement. OR The Bidder/sub-vendor ……. Detection of free standing blades of Compressor/Turbine of Gas Turbine Generator set** of 200 MW or above capacity. This integrated system* should have been in successful operation for at least 7000 operating hours prior to the date of techno-commercial bid opening. The Bidder should offer ……. meets the above requirement. * integrated system means ……. non-contact manner. ** In case of combined cycle …….Gas Turbine Generator set.	**On-line Blade Vibration Monitoring System for Low Pressure (LP) Turbines (in case Free Standing Blades are offered)** The Bidder/sub-vendor ……. Detection of free standing blades of Low Pressure Turbine of Steam Turbine Generator set of 200 MW or above capacity. This integrated system* should have been in successful operation at each installation for at least 7000 operating hours ~~prior to the date of techno-commercial bid opening~~. The Bidder should offer ……. meets the above requirement. OR The Bidder/sub-vendor ……. Detection of free standing blades of Compressor/Turbine of Gas Turbine Generator set** of 200 MW or above capacity. This integrated system* should have been in successful operation for at least 7000 operating hours ~~prior to the date of techno-commercial bid opening~~. The Bidder should offer ……. meets the above requirement. * integrated system means ……. non-contact manner. ** In case of combined cycle …….Gas Turbine Generator set.

TG-10 B.	VI/A	IIA-22	2 of 3	1.01.00 (g)	Submersible pumps shall be permanently fixed in the pits/sumps.	~~Submersible pumps shall be permanently fixed in the pits/sumps.~~
TG-11 B.	VI/A	Attachment 3K	87 of 361	1.02.09	**Details of manufacturer of equipment for units of atleast 500 MW rating as per clause 3.2 of Sub-Section-I-A, Section-VI, Part-A.** **……** Date of Commissioning of System/Package Whether the system/equipments are in successful operation prior to the date of techno-commercial bid opening Yes/No	**Details of manufacturer of equipment for units of atleast 500 MW rating as per clause 3.2 of Sub-Section-I-A, Section-VI, Part-A.** **……** Date of Commissioning of System/Package Whether the system/equipments are in successful operation ~~prior to the date of techno-commercial bid opening~~ **as on the date of LoA.** Yes/No
TG-12 B.	VI/A	Attachment 3K	87 of 361	1.02.13	**Details of manufacturer of equipment for units of at least 500 MW rating as per clause 3.2 of Sub-Section-I-A, Section-VI, Part-A** **……** Certificate from such Owner that aforesaid equipment has been supplied by the sub-vendor and is running satisfactorily prior to the date of techno-commercial bid opening is enclosed to this Attachment at Annexure..... Yes/No	**Details of manufacturer of equipment for units of at least 500 MW rating as per clause 3.2 of Sub-Section-I-A, Section-VI, Part-A** **……..** Certificate from such Owner that aforesaid equipment has been supplied by the sub-vendor and is running satisfactorily ~~prior to the date of techno-commercial bid opening~~ **as on the date of LoA** is enclosed to this Attachment at Annexure..... Yes/No
TG-13 B.	VI/A	Attachment 3K	111 of 361	1.12.00	**I. ONLINE BLADE VIBRATION MONITORING SYSTEM FOR LOW PRESSURE (LP) TURBINES (IN CASE FREE STANDING BLADES ARE OFFERED)** …… a) Whether the System/Equipments are in Successful Operation for at least 7000 operating hours prior to the date of techno commercial Bid opening b) End user certificate for successful	**I. ONLINE BLADE VIBRATION MONITORING SYSTEM FOR LOW PRESSURE (LP) TURBINES (IN CASE FREE STANDING BLADES ARE OFFERED)** …… a) Whether the System/Equipments are in Successful Operation for at least 7000 operating hours **as on the date of LoA** ~~prior to the date of techno-commercial Bid opening~~ b) End user certificate for successful operation is attached at Annexure_____

					operation is attached at Annexure_____ Yes*/No*	Yes*/No*
TG-14 B.	VI/A	Attachment-3K	85 of 361	3.	If the qualification sought…….such as, i)…….. ii)……. iii)…… Further, the details of collaborator or technology licenser or technology provider of the qualified equipment manufacturer who meets the requirement stipulated at 3.1, sub-section-IA, Part-A, Section-VI of Bidding Document shall be filled by the Bidder in the format A to F (format given at 1.00.00).	If the qualification sought…….such as, i)…….. ii)……. iii)…… Further, the details of collaborator or tech-nology licenser or technology provider of the qualified equipment manufacturer who meets the requirement stipulated at 3.1, sub-section-IA, Part-A, Section-VI of Bid-ding Document shall be filled by the Bidder in the format A to F (format given at ~~1.00.00~~ **3.00.00**).
TG-15 B.	VI/B	G-06	8 of 14	3.03.04 (ii) (g)	Condenser on load tube cleaning system shall be made ready before commercial operation of the plant. Life of sponge rubber balls & Number of balls lost during 336 hrs of plant operation shall be demonstrated by the bidder.	**Deleted**
TG-16 B.	VI/A	IV-FUNCTIONAL GUARANTEES	27 of 71	1.03.01	Not Used	Condenser on load tube cleaning system shall be made ready before commercial operation of the plant. Life of sponge rubber balls & Number of balls lost during 336 hours of continuous operation of COLTCS shall be demonstrated by the bidder.
TG-17 B.	VI/B	A-07	1 of 25	1.03.01	The turbine casing design shall have following features: (a) Adequate drainage …….. MSS SP61.	The turbine casing design shall have following features: (a) Adequate drainage …….. MSS SP61. **(b) Bearing inspection should be possible without necessity of dismantling the turbine casing.** **(c) Provide a completely self-contained exhaust hood spray system for L.P casing(s) to protect the turbine against excessive temperature due to windage at no load / low load and HP/LP bypass operations.**

TG-18 B.	VI/B	A-07	1 of 25	1.05.00	NOZZLES AND BLADES (a) …. (b) … (c) … (d) ….	NOZZLES AND BLADES (a) …. (b) … (c) … (d) …. **(e) Ensure quick & easy site replacement of blading.**
TG-19 B.	VI/B	A-07	2 of 25	1.06.00	**1.06.00 BEARINGS** (a) ….. (b) …… (c) …….	**1.06.00 BEARINGS** (a) ….. (b) …… (c) ……. **(d) Horizontally split with the ability to dismantle and replace lower half with minimum shaft lift.**
TG-20 B.	VI/B	A-07	7 of 25	1.18.01	----------	Additional HBD Added **v) 55% of rated load under turbine throttle main steam pressure of 150 Kg/cm^2 (abs) and rated main steam temperature / rated reheat steam temp. at turbine inlet at guaranteed condenser pressure with zero make-up with one TDBFP in operation.**
TG-21 B.	B	A-07	7 of 25	1.20.00	Type test(s) to be conducted: Life cycle test, meridional yield rupture test and squirm test on one each of following type of metallic expansion joints: (a) Condenser neck (if applicable) (b) Cross-over pipe (largest size) (c) LPH extraction line (highest pressure and temperature) (d) LPT Gland bellows (if applicable) (e) Hot-well interconnecting Bellows (If applicable)	Type test(s) to be conducted: ~~Life cycle test, meridional yield rupture test and squirm test on one each of following type of metallic expansion joints:~~ ~~(a) Condenser neck (if applicable)~~ ~~(b) Cross-over pipe (largest size)~~ ~~(c) LPH extraction line (highest pressure and temperature)~~ ~~(d) LPT Gland bellows (if applicable)~~ ~~(e) Hot-well interconnecting Bellows (If applicable)~~ **Following type tests are to be carried out:** **Life cycle test, meridional yield rupture test and squirm test on one metallic expansion joints of each type and size. For Life cycle test, minimum number of test cycles shall be 10,000.**

TG-22 B.	B	A-07	9 of 25	4.00.00	**CONDENSATE EXTRACTION PUMP** a) …… …….. b) …….. ……..	**CONDENSATE EXTRACTION PUMP** a) …… **a1) Shaft sealing** **Either mechanical seals or packed type with external water sealing designed to prevent air ingress to condenser even when the pump under shut down and exposed to condenser.** b)…… ……..
TG-23 B.	VI/B	G-01	2 of 4	1.03.00	The design…… specified elsewhere. The plant shall…… without affecting the design life of boiler and tur-bine-Generator systems. In addition to this, the plant shall also be capable of minimum N2 number of daily load cycles (N2 shall not be less than 1) from 55% to 40% of TMCR load (and vice versa) with a minimum ramp rate of 1% per minute. The main plant and its auxiliaries with their controls would be designed to permit operation of the units on house load without there being any necessity…….. system requirements (Refer clause 1.03.26.02 of Sub section IV, Part A, Section VI). To make unit capable…… requirements as defined above.	The design…… specified elsewhere. The plant shall…… without affecting the design life of boiler and tur-bine-Generator systems. In addition to this, the plant shall also be capable of minimum N2 number of daily load cycles (N2 shall not be less than 1) from 55% to 40% of ~~TMCR~~ **MCR** load (and vice versa) with a minimum ramp rate of 1% per minute. The main plant and its auxiliaries with their con-trols would be designed to permit opera-tion of the units on house load without there being any necessity…… system requirements (Refer clause 1.03.26.02 of Sub section IV, Part A, Section VI). To make unit capable…… requirements as defined above.
TG-24 B.	VI/B	G-04 Standard PG Test Procedure	9 of 227	3.3	**Test Method** The turbine generator performance test is carried out according to ASME PTC6-2004 or latest revision and technical specification. Uncertainty on the test results is not applicable on account of measuring instruments inaccuracy & Fluctuation of parameters during the conductance of test. Ageing correction is not applicable for TG Cycle Heat Rate &	**Test Method** The turbine generator performance test is carried out according to ASME PTC6-2004 or latest revision and technical specification. Uncertainty on the test results is not applicable on account of measuring instruments inaccuracy & Fluctuation of parameters during the conductance of test. Ageing correction is not applicable for TG Cycle Heat Rate & Output test. Test will be conducted ~~during~~

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>Output test. Test will be conducted during trial operations. No shutdown will be allowed on account of PG Test preparations.</td><td>~~trial~~ along with initial operations. No shutdown will be allowed on account of PG Test preparations.</td></tr>
<tr><td>TG-25 B.</td><td>VI/B</td><td>G-04 Standard PG Test Procedure</td><td>9 of 227</td><td>3.5</td><td>The acceptance test to be commenced during trial operations or during the period as defined in the contractual agreement.</td><td>The acceptance test to be commenced ~~during trial~~ along with initial operations or during the period as defined in the contractual agreement.</td></tr>
<tr><td>TG-26 B.</td><td>VI/B</td><td>G-04 Standard PG Test Procedure</td><td>28 of 227</td><td>5.7</td><td><u>Comparison with guarantees</u>
Comparison with guarantee should be made using corrected value of generator output and Heat Rate which are calculated in clause 5.4 and 5.6 as follows.
<u>Generator Output</u>
Generator…… (calculated in clause 5.6)
<u>Heat Rate</u>
Heat Rate guarantees are considered to be fulfilled when the following inequality is fulfilled.
HRa ≤ HRguar
Where,
HRguar: Value of Heat Rate according to the guarantee
HRa: Heat Rate which take into account the ageing allowance (calculated in clause 5.5).</td><td><u>Heat Rate</u>
Comparison with guarantee should be made using corrected value of generator output and Heat Rate which are calculated in clause 5.4 and 5.6 as follows.
<u>Generator Output</u>
Generator…… (calculated in clause 5.6)
Heat Rate guarantees are considered to be fulfilled when the following inequality is fulfilled.
~~HRa~~ HRc ≤ HRguar
Where,
HRguar: Value of Heat Rate according to the guarantee
~~HRa~~ HRc: Corrected Heat Rate on the specified condition ~~which take into account the ageing allowance~~ (calculated in clause ~~5.5~~ 5.4).</td></tr>
<tr><td>TG-27 B.</td><td>VI/B</td><td>G-04</td><td>93 of 227</td><td>PG Test Procedure for COLTCS

TEST RESULTS</td><td><table><tr><td colspan="2">TEST RESULTS</td></tr><tr><td>After expiry ..... condition (2.0 (A), Page 3)</td><td>336 hours of continuous operation of COLTCS
Test Results:</td></tr></table></td><td><table><tr><td colspan="2">TEST RESULTS</td></tr><tr><td>After expiry ..... condition (2.0 (A), Page 3)</td><td>336 hours of continuous operation of COLTCS Test Results:</td></tr></table></td></tr>
</table>

					Initial Balls Charged Qty. ' B ' =…….. ..... Healthy Balls observed ……against specified > 90% Initial Balls Charged Qty. ' B ' =…….. ..... % of Ball lost after 336 hours of continuous operation of COLTCS. = C X 100 / B Balls Lost observed ……..against specified within	Initial Balls Charged Qty. ' B ' =…….. ..... Healthy Balls observed ……against specified > 90% Initial Balls Charged Qty. ' B ' =…….. ..... % of Ball lost after 336 hours of continuous operation of COLTCS= C X 100 / B Balls Lost observed ……..against specified limit ~~within~~ ≤ **10 %.**
TG-28 B.	VI/B	G-06 PRE-COMMISSIONING & COMMISSIONING ACTIVITIES	7 of 14	3.03.04 (i)	**H.P./L.P. Bypass Capabilities** The HP & LP Bypass system should satisfy the following……and accepted by the EMPLOYER. The same shall be demonstrated. Bidder shall demonstrate the degree of superheat at upstream of HP Bypass valve during cold start-up as per approved Boiler Turbine combined start-up curve (The degree of superheat at upstream of HP bypass valve as derived from boiler turbine startup curve will be specified by bidder in HPBP sizing document). In case the degree of superheat is not achieved as per approved combined start-up curve and subsequently valve starts passing within defect liability period, Bidder shall reassess valve operating condition based on actual steam parameters during cold start-up. Accordingly necessary improvement	**H.P./L.P. Bypass Capabilities** The HP & LP Bypass system should satisfy the following……and accepted by the EMPLOYER. The same shall be demonstrated. Bidder shall demonstrate the degree of superheat at upstream of HP Bypass **& LP Bypass** valve during cold start-up as per approved Boiler Turbine combined start-up curve (The degree of superheat at upstream of HP bypass **& LP Bypass** valve as derived from boiler turbine start-up curve will be specified by bidder in HPBP **& LPBP** sizing document). In case the degree of superheat is not achieved as per approved combined start-up curve and subsequently valve starts passing within defect liability period, Bidder shall reassess valve operating condition based on actual steam parameters during cold start-up. Accordingly necessary improvement shall be done by the

					shall be done by the contractor to prevent further passing in the HP Bypass valves.	contractor to prevent further passing in the HP Bypass **& LP Bypass** valves.
TG-29 B.	VI/B	A-07	5 of 25	1.16.00 (k)	HP Bypass valves shall be designed as per degree of superheat based on Boiler- Turbine combined start-up curve i.e, degree of superheat based on Main steam pressure and Temperature at the time of HP Bypass valve opening during cold startup. For achieving degree of superheat as per approved combined start-up curve bidder shall make necessary arrangement for combination of drain lines with drain pots at the upstream of HP Bypass valves. Bidder shall provide necessary pressure and temperature measuring instruments near to HP Bypass valve for calculation of degree of superheat at upstream.	HP Bypass **and LP Bypass** valves shall be designed as per degree of superheat based on Boiler-Turbine combined start-up curve i.e, degree of superheat based on Main steam pressure & Temperature at the time of HP Bypass valve **and Reheater steam pressure & Temperature at the time of LP Bypass valve** opening during cold start-up. For achieving degree of superheat as per approved combined start-up curve bidder shall make necessary arrangement for combination of drain lines with drain pots at the upstream of HP Bypass **and LP** Bypass valves. Bidder shall provide necessary pressure and temperature measuring instruments near to HP Bypass **and LP Bypass valves** for calculation of degree of superheat at upstream.
TG-30 B.	VI/B	G-07 MDL Data Requirements	3 of 8	2.05.00 2. a.	6. Campbell diagrams (typical) for blading proposed, clearly indicating the resonant points and the operating frequency range (Ref. clause 1.05.00 (a), Sub-Section-A-07, Part-B, Section-VI.	6. Campbell diagrams (typical) for blading proposed, clearly indicating the resonant points and the operating frequency range (Ref. clause 1.05.00 (~~a~~ **b**), Sub-Section-A-07, Part-B, Section-VI.
TG-31 B.	VI/B	G-07 MDL Data Requirements	3 of 8	2.05.00 2. a.	9. Write up on criteria for back end loading of the turbine. Also furnish……back end loading etc. (Refer clause 1.06.00 (c), Sub-Section-A-07, Part- B, Section-VI).	9. Write up on criteria for back end loading of the turbine. Also furnish……back end loading etc. (Refer clause ~~1.06.00 (c)~~ **1.05.00 (d),** Sub-Section-A-07, Part- B, Section-VI).
TG-32 B.	VI/B	G-07 MDL Data Requirements	4 of 8	2.05.00 2. a.	11. furnish % over-pressure capability of the turbine generator under VWO condition and the corresponding continuous output and steam flow with rated steam temperature & 77 mm Hg Condenser pressure (Furnish Heat Balance Diagram) %	11. furnish % over-pressure capability of the turbine generator under VWO condition and the corresponding continuous output and steam flow with rated steam temperature & 77 mm Hg Condenser pressure (Furnish Heat Balance Diagram) ~~%~~
TG-33 B.	VI/B	G-07 MDL	43 of 43	Tentative Master Drawing List	----------	

						5119	**XXXX-001-110-PVM-P-xxx**	**Isometric for Extraction Steam Piping to all LPH's inside condenser**	
TG-34 B.	VI/B	G-07 MDL	43 of 43	Tentative Master Drawing List	-	**5120**	**XXXX-001-110-PVM-N-034**	**Design Ramp Rates of Steam Generator and Steam Turbine**	
TG-35 B.	VI/B	G-05 Standard Type Test Procedure	1 of 37	-	STANDARD TYPE TEST PROCEDURE …… ……			STANDARD TYPE TEST PROCEDURE **Standard type test procedure for the major equipment has been specified, however the Type test procedure not specified for equipment /system shall be submitted for approval by employer.** …… ……	
TG-36 B.	VI/B	G-05 Standard Type Test Procedure	2 of 37	1.03.00	**Acceptance Criteria:** 1. NPSH(R) (3% head drop) at --------- available. 2. NPSH(R) (3% head drop) at Design point shall not be less than the NPSH(R) determined by the suction specific of 10000 US unit and 9500 US unit for main pump and booster pump respectively calculated with the flow of Design point with Inter-stage closed.			**Acceptance Criteria:** 1. NPSH(R) (3% head drop) at ---------- available. 2. NPSH(R) (3% head drop) at Design point shall not be less than the NPSH(R) determined by the suction specific **speed** of 10000 US unit and 9500 US unit for main pump and booster pump respectively calculated with the flow of Design point with Inter-stage closed.	
TG-37 B.	VI/B	A-01 Equipment Sizing Criteria	31 of 87	2.01.01	**Type** The steam turbine shall be tandem compound, single reheat, regenerative, condensing, multi cylinder design with separate HP, separate IP & separate LP casings OR combined casings for HP - IP and separate casings for LP Turbine, directly coupled with generator, suitable for indoor installation.			**Type** The steam turbine shall be tandem compound, single reheat, regenerative, condensing, multi cylinder design with separate HP, separate IP & separate LP casings OR combined ~~casings~~ **casing** for HP - IP and separate casings for LP Turbine, directly coupled with generator, suitable for indoor installation.	
TG-38 B.	VI/B	A-01 Equipment Sizing Criteria	41 of 87	2.06.03	**2.06.03** NPSH Margin: (a) The ratio between NPSH (A) and NPSH (R) at 3% head drop for booster pump and main pump shall be not less than 2.5 at design point corresponding to Low-Low level of deaerator.			**2.06.03** ~~NPSH Margin~~ (a) **NPSH Margin**: The ratio between NPSH (A) and NPSH (R) at 3% head drop for booster pump and main pump shall be not less than 2.5 at design point corresponding to Low-Low level of deaerator.	

					(b) Trip speed of TDBFP: 10% above the design speed of the feed pump.	(b) Trip speed of TDBFP: 10% above the design speed of the feed pump.
TG-39 B.	VI/B	A-07	2 of 25	1.08.02 **New clause**	----------	**Bypass arrangements of Gland steam condenser from steam side, as per standard practice of turbine manufacturer, may be provided.**
TG-40 B.	VI/B	A-07	14 of 25	6.04.00	(2) **Material and other accessories** Complete with stainless steel impellers, bearings, …….. steel scoop tube, 1x100% lube oil cooler, 1x100% Working oil cooler, one portable type ……..be as specified in drive turbine section.	(2) **Material and other accessories** Complete with stainless steel impellers, bearings, …….. steel scoop tube, ~~1~~ **2**x100% lube oil cooler, ~~1~~ **2**x100% Working oil cooler, one portable type ……..be as specified in drive turbine section.
TG-41 B.	VI/B	A-07	2 of 25	1.10.0	**TURBINE GOVERNING SYSTEM** Provide adjustable steady state speed regulation between +3% to +8% of rated speed. Ensure dead band at rated speed and at any power output within rated output shall not exceed 0.06% of rated speed.	**TURBINE GOVERNING SYSTEM** Provide adjustable steady state speed regulation between +3% to ~~+8%~~ **+6%** of rated speed. Ensure dead band at rated speed and at any power output within rated output shall not exceed 0.06% of rated speed.
TG-42 B.	E	Tender Drawings (Mechanical)			**XXXX-999-POM-A-005 Rev A**	**XXXX-999-POM-A-005 Rev B** Refer Annexure TG-01B
TG-43 B.	E	Tender Drawings (Mechanical)			**XXXX-999-POM-A-006 Rev B**	**XXXX-999-POM-A-006 Rev C** Refer Annexure TG-01B
TG-44 B.	E	Tender Drawings (Mechanical)			**XXXX-999-POM-A-009 Rev A**	**XXXX-999-POM-A-009 Rev B** Refer Annexure TG-01B
TG-45 B.	E	Tender Drawings (Mechanical)			**XXXX-999-POM-A-010 Rev A**	**XXXX-999-POM-A-010 Rev B** Refer Annexure TG-01B
TG-46 B.	E	Tender Drawings (Mechanical)			**XXXX-999-POM-A-012 Rev A**	**XXXX-999-POM-A-012 Rev B** Refer Annexure TG-01B
TG-47 B.	E	Tender Drawings (Mechanical)			**XXXX-001-POM-A-015A Rev A**	**XXXX-001-POM-A-015A Rev B** Refer Annexure TG-01B
TG-48 B.	VI/A	I-A (Provenness)	1 of 35	1.0 (Provenness of Turbine set)	(a) The turbine set offered shall be built…….their provenness along with the techno commercial bid.	(a) The turbine set offered shall be built……. their provenness along with the techno commercial bid.

					(b) The turbine to be supplied under this……..Qualified Steam Turbine Generator Manufacturer.	(b) The turbine to be supplied under this……. Qualified Steam Turbine Generator Manufacturer. **Note:** In case bidder is seeking qualification through Route 1.8.0, the consortium partner meeting the qualification requirements for Steam Turbine Generator shall be required to meet the above turbine provenness requirements and shall furnish experience list of HP, IP (or Combined HP-IP) and LP turbine modules offered to substantiate their provenness along with the techno commercial bid.
TG-49 B.	VI/A	Attachment 3K	80 of 361		……Certificate(s) from Owner that the aforesaid Steam Turbine Modules are in successful operation for atleast one (1) year prior to the date of Techno- ommercial bid opening and caused no serious problem in past, are furnished alongwith techno-commercial Bid at **Annexure 1 to this Attachment-3K.** ---------- ---------- Date: Place: (Signature)..... (Printed Name) ..... (Designation)..... (Common Seal)	……..Certificate(s) from Owner that the aforesaid Steam Turbine Modules are in successful operation for atleast one (1) year prior to the date of Techno- ommercial bid opening and caused no serious problem in past, are furnished alongwith techno-commercial Bid at **Annexure 1 to this Attachment-3K.** ---------- ---------- Date: Place: (Signature)..... (Printed Name) ..... (Designation)..... (Common Seal) ..... Note: In case bidder is seeking qualification through Route 1.8.0, the consortium partner meeting the qualification requirements for Steam Turbine Generator shall be required to furnish the desired data/details of HP, IP (or Combined HP-IP) and LP turbine modules

Amendment-2B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

<table>
<tr><th rowspan="2">Sl. No.</th><th colspan="4">Specification References</th><th rowspan="2">Existing</th><th rowspan="2">Read As</th></tr>
<tr><th>Part</th><th>Sub section</th><th>Page no</th><th>Clause no</th></tr>
<tr><td>MH-03 B</td><td>VI/A</td><td>PART-E/ Errata to Section VI Technical Specifications (Amendment-2)</td><td></td><td></td><td>Tender Drawings:
SLD:
BOTTOM ASH HANDLING SYSTEM (JET PUMP SYSTEM)- XXXX-001-POM-A-025-RevA/ B.
XXXX-001-POM-A-028-Rev A XXXX-001-POM-A-028- (FLY ASH HANDLING PRESSURE SYSTEM –Rev A/B
XXXX-001-POM-A-029-Rev B CLASSIFIER SYSTEM (VACCUME SYSTEM) - XXXX-001-POM-A-029-Rev A/B
XXXX-001-POM-A-029-Rev B CLASSIFIER SYSTEM (PRESSURE SYSTEM) - XXXX-001-POM-A-029-Rev A/B</td><td>Updated Tender Drawings:
SLD:
BOTTOM ASH HANDLING SYSTEM (JET PUMP SYSTEM)-XXXX-001-POM-A-025-Rev C.
XXXX-001-POM-A-022-Rev A XXXX-001-POM-A-028-FLY ASH HANDLING PRESSURE SYSTEM –Rev C
XXXX-001-POM-A-029-Rev B CLASSIFIER SYSTEM (VACCUME SYSTEM) - XXXX-001-POM-A-029-Rev C
XXXX-001-POM-A-029-Rev B CLASSIFIER SYSTEM (PRESSURE SYSTEM) - XXXX-001-POM-A-029-Rev-C</td></tr>
<tr><td>MH-04 B</td><td colspan="4">Sn-MH-40,
Errata to Section VI Technical Specifications (Amendment-2)</td><td>Two numbers Semi-automatic Bagging machines with capacity of 200 bags/Hr/Nozzle having two Nozzles per Machines. The bagging plant shall have provision for mechanized bagging of this fine ash. Fine ash shall be bagged in 50 kg cement bags. The quantity of fine ash shall be 35 kg in cement bag of 50 kg.</td><td>Two numbers fully automatic Bagging machines with capacity of 200 bags/Hr/Nozzle having two Nozzles per Machines. The bagging plant shall have provision for mechanized bagging of this fine ash. Fine ash shall be bagged in 50 kg cement bags. The quantity of fine ash shall be 35 kg in cement bag of 50 kg. The intended bagging system shall be fully automatic with facility of automatic loading of filled bags to conveyors or nearby platform of fly ash silo, as applicable:
<table>
<tr><th>Requirements</th><th>Description/Details</th></tr>
<tr><td>Name of product</td><td>Automatic bagging machine</td></tr>
<tr><td>Target bags</td><td>Bags of 50 Kg (standard cement bags. Suitable correction for feed material may be considered)</td></tr>
<tr><td>Filling Capacity</td><td>400 bags/Hr /Machine</td></tr>
<tr><td>Number of spouts</td><td>Suitable to meet the Filling capacity</td></tr>
</table></td></tr>
</table>

			Bulk Density of fly ash	Compacted Density up to 1.3 MT/ Cubic meter. Loose bulk Density:0.8-0.9 MT/ Cubic meter.
			Particle Size Distribution	Minimum 5 micron to maximum 250 microns. Average: 50 microns
			Temperature of Material	Maximum- 100oC, Average: 50OC
			Working Conditions	Ambient up to 55 degrees Celsius, RH-100%, Environment- Dusty. The machine should be waterproof. Machine shall be designed to withstand against environment conditions like rainwater, and temperature variation from 0- 55degree Celsius. (if required, shed / canopy may also be provided by bidder)
			Is material / Dust being Flammable / Explosive	No
			Is material Hygroscopic	Yes. Moisture Contain: Up to 5%
			Is material hazardous	No
			Abrasive Material	Yes
			Stickiness	Non-sticky in dry and warm condition.
			Flow ability	Free Flowing (However, successful bidder may collect sample from NTPC site for testing &design purpose)
			Bag Filling	Self-Closing valve type filling (Other types like Open mouth type bag, etc. may also be accepted based on supporting data/details for suitability in fly ash applications)
			Accuracy	+/- 0.25% or better with digital scale bag filling machines.

			Input Requirement	Design Air flow/Pressure in kgf/sq.cm as per design requirement of OEM. Power Supply:415V AC (+-10%), 3 Phase,50+-5Hz AC.
			Other Requirements	The equipment should be waterproof. Equipment shall be designed to with-stand against environment conditions like rainwater, and temperature variation from 0- 55 degree Celsius. The equip-ment shall be provided with control panel and starter, voltmeter, ammeter, single phase preventer, overload protection, emergency push button and all other safety devices to protect the man and machine & other safety devices to pro-tect the man and machine.
			Type of packer:	Tentatively combination of gravity and auger packer. Bidder can opt for superior type of the two.
				Provision for installing suitable type de-dusting system shall be envisaged.
				Either common or individual conveying system along with truck loaders shall be provided below each bagging machine for automatic picking of filled ash bags and loading into trucks, considering the layout constraints below silo area (shall not affect movement of trucks/rail at silo area)
In case of Conveying of Ash Bags, all necessary instruments/devices required for safe and continuous operation of the Conveyors as per the standard and proven practice of the supplier and as specified shall be provided.				

Amendment-2B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Instead of	Read as
	Sec/ Part	Sub Section	Page No.	Clause No.		
LA-01B	VI/B	G-03	1 of 15	1.01.02	In case of rail track minimum **3m** horizontal clearance between face of adjacent structure to centre line of rail	In case of rail track minimum **3.5m** horizontal clearance between face of adjacent structure to centre line of rail

Amendment-2B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

Amendment no	Specification Reference				Existing	Read as
	Part	**Sub Sec**	**Page No**	**Clause No**		
C-01 B	VI/B	A-02	31 of 67	10.08.07 (d)	Three nos. Duplex Pt-RTD (100 ohm at 0 deg.) with **dual input temperature transmitters** shall be provided for local and remote monitoring of each bearing metal temperature of fans.	Three nos. Duplex Pt-RTD (100 ohm at 0 deg.) with **1 no of dual input TT and 2 nos of Single input TT** shall be provided for local and remote monitoring of each bearing metal temperature of fans.
C-02 B	VI/B	A-02	37 of 67	12.05.00 (c)	Three nos. Duplex Pt-RTD (100 ohm at 0 deg.) with **dual input temperature transmitters** shall be provided for local and remote monitoring of each bearing metal temperature of fans.	Three nos. Duplex Pt-RTD (100 ohm at 0 deg.) with **1 no of dual input TT and 2 nos of Single input TT** shall be provided for local and remote monitoring of each bearing metal temperature of fans.
C-03 B	VI/A	IIB	24 of 34	1.17.00	7) One set of "NO" & "NC" contacts (suitably wired up to field JBs) of High- and Low-level switches of each ESP ash hopper (except hoppers in First Field to third field) shall be provided for remote use. In First Field to third field of each ESP ash hopper, Radar based, or Acoustic Frequency Waves based 3D Level Scanner System shall be provided for continuous level monitoring.	7) One set of "NO" & "NC" contacts (suitably wired up to field JBs) of High- and Low-level switches of each ESP ash hopper ~~**(except hoppers in First Field to third field)**~~ shall be provided for remote use. **Additionally, in First Field to third field of each ESP ash hopper, Acoustic 3D Level Scanner Based Level Monitoring System/ NOGS (Naturally Occurring Gamma Sensor) based level monitoring system**, shall be provided for continuous level monitoring.
C-04 B	VI/B	IIB-02	3 of 5	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 3 numbers duplex RTDs connected to **three numbers dual input transmitters** with display. However for air compressor, being high speed drive, each motor bearing shall be provided with minimum two numbers of duplex RTDs connected to two numbers dual input transmitters with display unit.	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 3 numbers duplex RTDs connected to 1 no of dual input TT and 2 nos. of Single input TT with display. However, for air compressor, being high speed drive, each motor bearing shall be provided with minimum two numbers of duplex RTDs connected to two numbers dual input transmitters with display unit.

Amendment-2B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S. No.	SPECIFICATION REFERENCE				Existing	Read as
	Section / Part	Sub-Section	Clause No.	Page No.		
D1B-1	VI/B	D-1-5	5.10.00	29 of 69	All roads shall be of rigid pavements unless otherwise specified. Rigid pavements shall be constructed with Geopolymer concrete. Concrete road/pavement or rigid pavement, mentioned in specification, shall mean road /pavement constructed with Geopolymer Concrete. All concrete roads shall be unreinforced jointed plain concrete pavement having dowels in transverse joints and tie bars at longitudinal joints……..	All roads shall be of rigid pavements unless otherwise specified. Rigid pavements shall be constructed with **either conventional cement concrete or** with Geopolymer concrete. Concrete road/pavement or rigid pavement, mentioned in specification, shall mean road /pavement constructed with **either Cement Concrete (CC) or** Geopolymer Concrete. All concrete roads shall be unreinforced jointed plain concrete pavement having dowels in transverse joints and tie bars at longitudinal joints……
D1B-2	VI/B	D-1-5	5.10.00.01	29 of 69	For road to be constructed with Geopolymer Concrete	For road to be constructed with **Conventional Cement Concrete** or Geopolymer Concrete
D1B-3	VI/B	D-1-5	5.10.00.02	30 of 69	Geo-polymer concrete road…… is provided in Chapter D-1-8.	**Conventional Cement Concrete or** Geo-polymer concrete road…… is provided in Chapter D-1-8.

Amendment-2B to Technical Specifications (Section VI) of SIPAT-III (1X800 MW) EPC Package

S.No	Specification Reference				Existing	Read as
	Part	Sub Sec	Page No	Clause No		
EE- 01B	VI/A	SUB-SECTION-VI CHAPTER-02 STEAM TURBINE GENERATOR	20 of 34	19.3.J	Filter element of stator water cooling system -1 set	Deleted
EE-02B	VI/A	SUB-SECTION-VI CHAPTER-02 STEAM TURBINE GENERATOR	32 of 34	Mandatory spares for VFD for CEP S.No : 5	Power device (Thyristor, IGBT etc.): 1 Set of devices in one bridge leg	Power device (Thyristor, IGBT, Power cell etc.): 1 Set of devices in one bridge leg (complete quantity for one phase)
EE-03B	VI/A	SUB-SECTION-VI CHAPTER-03: **ASH HANDLING PLANT**	13 of 14	11.01.02 II-2	Complete Thyristor bridge leg: 1 set	Complete Thyristor bridge leg: 1 set (complete quantity for one phase)
EE-04B	VI/A	SUB-SECTION-VI CHAPTER-01: **SG & AUXILIARIES**	20 of 38	1.22.06 (2)	Thyristor bridge leg: 1 no. (Qty. for one ph.)	Thyristor bridge leg: 1 set (complete Qty. for one phase)
EE-05B	VI/A	SUB-SECTION-I-A	1/35	2.0 Provenness of Generator	a) The generator offered shall be……. to the date of techno commercial bid opening. b) The offered generator shall be similar……. Type of Excitation system. c) The generator to be supplied under……. along with the techno commercial bid.	a) The generator offered shall be……. to the date of techno commercial bid opening. b) The offered generator shall be similar……. Type of Excitation system. c) The generator to be supplied under……. along with the techno commercial bid. **Note:**

S.No	Specification Reference				Existing	Read as
	Part	Sub Sec	Page No	Clause No		
						In case bidder is seeking qualification through Route 1.8.0, the consortium partner/it's associate for generator, meeting the qualification requirements for Steam Turbine Generator in respect of generator, shall be required to meet the above generator provenness requirements and shall furnish experience list for offered Generator to substantiate it's provenness along with the techno commercial bid.
EE-06B	VI/A	Attachment-3K	208 of 361	2.0 (t)	List of above Generators (with date of supply) already manufactured, assembled & tested in the factory/works mentioned at S.No.(R1) above is enclosed at Annexure.... to this Attachment-3K ---------- Date : (Signature)..... Place : (Printed Name)..... (Designation)..... (Common seal).....	List of above Generators (with date of supply) already manufactured, assembled & tested in the factory/works mentioned at S.No.(R1) above is enclosed at Annexure.... to this Attachment-3K ---------- ---------- Date : (Signature)..... Place : (Printed Name)..... (Designation)..... (Common seal)..... **Note:** In case bidder is seeking qualification through Route 1.8.0, the consortium partner/it's associate for generator, meeting the qualification requirements for Steam Turbine Generator in respect of generator, shall be required to meet the above generator provenness requirements and shall furnish experience list for offered Generator to substantiate it's provenness along with the techno commercial bid.

Annexure- SG 01B

LIST OF MANDATORY SPARES FOR SG & AUXILIARIES

SI. NO.	PARTICULARS	QUANTITY
1.00.00	**STEAM GENERATOR & AUXILIARIES**	
1.01.00	**PRESSURE PARTS**	
	A. Economiser	
	1. Economiser coils*	10% of each size, type of coil of one unit
	* the coils and panels are to be fabricated and supplied in dismantled condition	
	2. Straight Tube	250 Mtr. of each size, type, thickness & material
	3. Coil end bends	30 Nos. of each size, type, thickness, radius & material.
	4. Coil Saddle Clamp/Alignment band / Male & Female sliding Spacers / Sliding Hooks /Straight Shields for boiler tubes & Profile Shields for Boiler tube bends/ Tube clamps	50 nos of each type, size, material 5% of population tube clamps of each type and size
	B. Water Wall / Evaporator	
	1. Straight tube/Spiral tube	750 m of each type, thickness, size and material.
	2. Bends for Burner elevation	25 Nos. for each size, type, thickness, radius and material
	3. Screen water wall tube (if applicable)	100 m of each size, type, thickness and material
	4. Screen water wall tube bends (if applicable)	5 Nos. for each size, type, thickness, radius and material
	5. Bends for S-panel Area	50 Nos. for each size, type, thickness, radius and material
	6. Forged Elbow and Other Forged item forming integral part of pressure parts	25 nos. for each type
	7. Swage tube (if applicable)	10 Nos. for each size, type, thickness, radius and material
	8. Profile Shield bends for Screen water wall tube bends	30 Nos. for each size, type and material
	C. Low Temperature Super Heater (LTSH) (As applicable)	
	1. Straight tube of 8-10 m length	300 mtr. of each size, thickness, types & material
	2. Bends	a) 100Nos. of each size, type, thickness, radius and material. b) 50 Nos supply tubes, bends/offset bends (not covered in above)
	3. Connection tube Bends/ Antlers in penthouse	5 Nos. of each type and size
	4. Coil Saddle Clamp/alignment band / Male & Female sliding Spacers / Male and Female connectors/ Sliding Hooks/ Shields for boiler tubes & Profile Shields for Boiler tube bends/	50 nos. of each type, size, material

SI. NO.	PARTICULARS	QUANTITY
	Swage tube/ Forged items forming integral part of pressure parts	
	D. Low Temperature Reheater (LTRH)	
	1. Straight tube of 8-10 m length	500 mtr. of each size, thickness, types & material
	2. Bends	a) 100 Nos. of each size, type, thickness, radius and material. b) 50 Nos for supply tubes, bends/offset bends (not covered in above)
	3. Coil saddle clamp/alignment Band / Male & Female sliding Spacers / Male and Female connectors/ Sliding Hooks/ Shields for boiler tubes & Profile Shields for Boiler tube bends/ Swage tube/ Forged items forming integral part of pressure parts/ Expansion bellow	100 nos. of each type, size, material
	E. Intermediate Temperature Superheater (ITSH) / Platen Super Heater	
	1. Straight tube of 8-10 m length	200 m of each size, thickness, type & material
	2. Straight tube above roof	100 m of each size, thickness, type & material
	3. Bends below roof	30 nos. of each size, thickness, radius, type and material
	4. Bends which are integral part of header (above roof)	25 Nos. of each size, thickness, radius, type and material
	5. Male & Female connectors, male female couplings spacers and alignment bands	25% of total population of each type and size in one boiler
	6. Dissimilar joint spot pcs.	25 Nos. of each size, thickness, type, radius & material
	7. Acromat Tube with acromat	10% of each type, size thickness and radius
	8. Spacer Tube for Superheaters	100 mtr each type and size.
	9 Spacer Tube connectors and stoppers	100% of population of one boiler
	10 Alignment Band / Male & Female sliding Spacers / Male and Female connectors/ Sliding Hooks/ Shields for boiler tubes & Profile Shields for Boiler tube bends/ Swage tube/ Forged items forming integral part of pressure parts/ Expansion Bellow	50 nos. of each type, size, material Expansion Bellow – 2 Nos. of each type/ size and material in one boiler
	F. High Temperature Superheater (HTSH)/ Final Superheater	

SI. NO.	PARTICULARS	QUANTITY
	1. Straight tube of 8-10 m length	100 mtr. of each size, thickness, type & material
	2. Straight tube above roof	50 m of each size, thickness, type & material
	3. Bends below roof	20 nos. of each size, thickness, type, radius & material
	4. Bends which are integral part of header (above roof)	50 Nos. of each size, thickness, radius, type and material
	5. Male & Female connectors, male female couplings spacers and alignment bands	50% of total population of each type and size in one boiler
	6. Dissimilar metal weld joint spot pcs.	50 Nos. of each size, thickness, type, radius & material
	7. Acromat tube with Acromat	10% of each type, size thickness and radius
	8. Spacer Tube for Superheaters	100 mtr each type and size
	9 Spacer Tube connectors and stoppers	200% of population of one boiler
	10 Alignment Band / Male & Female sliding Spacers / Male and Female connectors/ Sliding Hooks/ Shields for boiler tubes & Profile Shields for Boiler tube bends/ Swage tube/ Forged items forming integral part of pressure parts/ Expansion Bellow	50 nos. of each type, size, material Expansion Bellow – 2 Nos. of each type/ size and material in one boiler.
	G. Reheater (Other than LTRH given in D above)	
	1. Straight tube of 8-10 m length	200 mtr. of each size, thickness, type & material
	2. Straight tube above roof	50 m of each size, thickness, type & material
	3. Bends below roof	30 Nos. of each size, thickness, type, radius & material (including offset bend)
	4. Bends which are integral part of header (above roof)	30 Nos. of each size, thickness, radius, type and material
	5. Male & Female connectors, male female couplings spacers and alignment bands	50% of total population of each type and size in one boiler
	6. Dissimilar joint spot pcs.	50 Nos. of each size, thickness, type, radius & material
	7 Acromat tube with acomat	10% of each type, size, thickness and radius
	8. Spacer Tube for Superheaters	100 mtr each type and size
	9 Spacer Tube connectors and stoppers	200% of population of one boiler

SI. NO.	PARTICULARS	QUANTITY
	10 Alignment Band / Male & Female sliding Spacers / Male and Female connectors/ Sliding Hooks/ Shields for boiler tubes & Profile Shields for Boiler tube bends/ Swage tube/ Forged items forming integral part of pressure parts/ Expansion Bellow	50 nos. of each type, size, material
	H. Boiler roof and steam cooled wall	
	1. Straight tube of 8-10 m length	100 mtr. of each size, thickness, type & material
	2. Bends	40 Nos. of each size, thickness, type, radius & material (including offset bend)
1.02.00	**Spares for Header**	
	A. Water wall Header	
	1. Hand hole plate with cap / Inspection nozzle with end plate	2 nos. of each type
	2. Yoke plate with fasteners (if applicable)	2 sets* of each type
	B. Spares for Superheater Header	
	3. Hand hole plate with cap / Inspection nozzle with end plate	3 Nos. of each type
	4. Radiographic plug	4 nos. (wherever applicable)
	C. Spares for Reheater Header	
	5. Hand hole plate assembly / Inspection nozzle with end plate	3 nos. of each type
	6. Radiographic plug	4 nos. (wherever applicable)
*** One set means one complete replacement for one Unit**		
1.03.00	**Superheater / Reheater**	
	Attemperation System	
	1. Desuperheater liners	1 set* of each type
	2. Positioning screws for liners	1 set* of each type
*** One set means one complete replacement for one Unit**		
1.04.00 A	**Steam Generator startup re-circulation pump (for once through boiler)**	
	1. Complete Pump & Motor Assembly	1 Nos.
	2. Journal bearing	2 sets *
	3. Thrust bearing	3 sets *
	4. Casing wear rings	3 sets *
	5. Impeller wear rings (if applicable)	4 sets *
	6. Set of gaskets (All gaskets including heat exchanger)	4 sets*
	7. Set of 'O' rings	4 sets *

SI. NO.	PARTICULARS	QUANTITY
	8. Motor heat exchanger	2 sets*
	9. Strainers of BRP system	02 nos. of each type and size
	* One set means one complete replacement for one equipment.	
1.04.00 B	**Condensate Transfer Pumps and accessories**	
	a) Impeller of Pump	1 No.
	b) Impeller Wear Ring	2 Nos.
	c) Casing Wear Ring	2 Nos.
	d) Pump Gaskets and packings	3 sets*
	e) Pump Mechanical Seal	3 sets*
	f) Suction & Discharge expansion bellow	2 Nos. of each type, size
	* One set means one complete replacement for one equipment.	
1.05.00	**Fans**	
	A. ID Fans	
	1. Complete Fan rotor assembly (excluding fan body & Coupling) consisting of: -Rotor Hubs (drive & regulating end, as applicable) -Main Bearing Assy (Complete) -Hydraulic Actuating Device/Hydraulic Cylinder with Rotating Oil Seal Assy - Fan Blades with fixation parts (fastener, seals, clamp, pins etc.) Note: Complete Rotor assy to be supplied in assembled condition on a fixture/ transport stand. (Fan blades to be supplied in loose condition)	1 set
	2. ID fan motor complete	1 no.
	3. ID fan motor bearing	1 set
	4. Fan Main Bearing Assembly	
	4.1 Main bearing assembly (Complete assembled)	1 set
	4.2 Bearings for main bearing assembly	2 sets
	5. All internal Spares for blade bearing assembly (Excluding housing)	4 sets
	6. Lube Oil / Hydraulic Oil system	
	6.1 Pump assembly (excluding motor)	2 nos. of each type
	6.2 Motor	1 No of each type and rating
	6.3 Pressure regulator	3 nos. of each type and rating
	6.4 PRV	3 nos. of each type and rating
	6.5 Oil Filters	

SI. NO.	PARTICULARS	QUANTITY
	6.5.1 Filter housing Assembly (with changeover lever)	1 No of each type
	6.5.2 Filter Element	10 Nos of each type
	6.6 Coupling between oil pump & motor	4 nos. of each type
	6.7 Seals for pump	4 nos. of each type
	6.8 Lub Oil Cooler assembly (Complete)	1 set
	6.9 NRV of lub oil system	1 no. of each type
	7. Fan Blades with fixation parts (fastener, seals, clamp,pins etc.)	1 set
	8. Coupling between Fan & Motor (Including Intermediate shaft/ distance Piece)	2 sets
	9. Fan Blade Actuating Assembly	
	9.1 Hydraulic Actuating Device/Hydraulic Cylinder with rotating oil seal	4 Sets
	9.2 Regulating Linkage Assy	2 Sets
	9.3 Seal ring kit (complete)	10 Nos.
	10. Flexible oil hoses	4 sets
	B. FD Fans	
	1. Complete Fan rotor assembly (excluding fan body & Coupling) consisting of: -Rotor Hubs (drive & regulating end, as applicable) -Main Bearing Assy (Complete) -Hydraulic Actuating Device/Hydraulic Cylinder with Rotating Oil Seal Assy - Fan Blades with fixation parts (fastener, seals, clamp, pins etc.) Note: Complete Rotor assy to be supplied in assembled condition on a fixture/ transport stand. (Fan blades to be supplied in loose condition)	1 set
	2. Fan Main Bearing Assembly	
	2.1 Main bearing assembly (Complete assembled)	1 set
	2.2 Bearings for main bearing assembly	2 sets
	3. All internal Spares for blade bearing assembly (Excluding housing)	2 sets
	4. Lube Oil & Hydraulic Oil system	
	4.1 Pump assembly (excluding motor)	2 nos. of each type
	4.2 Motor assembly	1 no. of each type and rating
	4.3 Pressure regulator	4 nos. of each type
	4.4 PRV	4 nos. of each type
	4.5 Oil Filters	

SI. NO.	PARTICULARS	QUANTITY
	4.5.1 Filter housing Assembly (with changeover lever)	1 No.
	4.5.2 Filter Element	10 Nos.
	4.6 Coupling between oil pump & motor	4 nos.
	4.7 Seals of Pump	4 Nos. of each type
	4.8 Lub Oil Cooler assembly (Complete)	1 set
	4.9 NRV of lub oil system	1 No. of each type
	5. Fan Blades with fixation parts (fastener, seals, clamp,pins etc.)	1 set
	6. Coupling between Fan & Motor (Including Intermediate shaft/ distance Piece)	1 set
	7. Fan Blade Actuating Assembly	
	7.1 Hydraulic Actuating Device/Hydraulic Cylinder with rotating oil seal	1 set
	7.2 Regulating Linkage Assy	1 set
	7.3 Seal ring kit(complete)	10 Nos.
	8. Flexible Hoses	4 sets
	9. FD fan motor complete	1 No
	10. FD fan motor bearings	1 set
	C. PA Fan	
	1. Complete Fan rotor assembly (excluding fan body & Coupling) consisting of: -Rotor Hubs (drive & regulating end, as applicable) -Main Bearing Assy (Complete) -Hydraulic Actuating Device/Hydraulic Cylinder with Rotating Oil Seal Assy - Fan Blades with fixation parts (fastener, seals, clamp, pins etc.) Note: Complete Rotor assy to be supplied in assembled condition on a fixture/ transport stand. (Fan blades to be supplied in loose condition)	1 set
	2. Fan Main Bearing Assembly	
	2.1 Main bearing assembly (Complete assembled)	1 set
	2.2 Bearings for main bearing assembly	2 sets
	3. Coupling between fan & motor (Including Intermediate shaft/ distance Piece)	2 sets
	4. Fan Blades with fixation parts (fastener, seals, clamp, pins, Blade hub seals etc.)	1 set
	5. All internal Spares for blade bearing assembly (Excluding housing)	4 sets
	6. Lube Oil & Hydraulic Oil system	
	6.1 Pump assembly (excluding motor)	2 nos. of each type

SI. NO.	PARTICULARS	QUANTITY
	6.2 Motor	1 no. of each type and rating
	6.3 Pressure regulator	4 nos. of each type
	6.4 PRV	4 nos. of each type
	6.5 Oil Filters	
	6.5.1 Filter housing Assembly (with changeover lever)	1 no.
	6.5.2 Filter Element	10 nos.
	6.6 Coupling between oil pump & motor	4 nos.
	6.7 Seals for pump	4 Nos. of each type
	6.8 Lub Oil Cooler assembly (Complete)	1 set
	6.9 NRV of lub oil system	1 no. of each type
	7. Fan Blade Actuating Assembly	
	7.1 Hydraulic Actuating Device/Hydraulic Cylinder with rotating oil seal	4 sets
	7.2 Regulating Linkage Assy	1 set
	7.3 Seal ring kit(complete)	10 nos.
	8 Flexible Oil Hoses	4 Sets
	9. PA fan motor complete	01 no
	10. PA fan motor bearing	1set
	Note : In Clause 1.05.00 (A), (B) & (C) above, one set means one complete replacement for one fan	
	D. Scanner Air Fan	
	1. Fan assembly (excluding fan body)	1 no. of each type
	2. Motor for AC scanner air fan	1 no
	3. Motor for DC scanner air fan	1 no
1.06.00	**Coal Pulverizers**	
	1. Grinding elements	
	1.1 Rollers/tyres/grinding balls / roller liners (as applicable)	3 sets*
	1.2 Bull ring segments/ bowl / rings / Table liners (as applicable)	3 sets*
	Note: One set of grinding element at (1.1) & (1.2) above is defined as under :	
	1 Set = (Grinding elements needed for complete replacement of one mill) X A	
	Where	
	A= [8000 x N)/GWL, rounded off to nearest higher whole number.]	
	GWL = Guaranteed wear life of grinding element (1.1) & (1.2) as offered by the bidder.	
	N = Number of mills installed for one Steam generator unit.	
	2. Gear box all internals including input shaft (except bearings & seals)	1 set *
	3. Complete Gear Box	2 sets *
	4. Bearings for mills	5 sets *

SI. NO.	PARTICULARS	QUANTITY
	5. Seals & rings for gear box	4 sets *
	6. Seals & rings for mills	4 sets *
	7. Liners with brackets & fasteners for Mill internal and body	4 sets*
	8. Discharge valve assembly	2 sets *
	9. Multiport outlet with liners	4 sets *
	10. Mill main shaft/yoke for worm gear-worm shaft type mill (if applicable)	2 nos.
	11. Spring Assy (as applicable)	4 nos.
	12. Hydraulic loading cylinder(as applicable)	2 nos.
	13. Roller Journal Assembly (without grinding roll)	3 sets*
	14. Oil system Components for Hydraulic loading cylinder (if applicable)	
	14.1 Oil Filter	
	14.1.1 Filter assembly	2 nos.
	14.1.2 Filter Element	10 nos.
	14.2 Pump & Motor coupling	2 nos.
	14.3 Pump assembly (excluding motor)	2 nos.
	14.4 Motor	2 nos.
	14.5 Oil cooler assembly	1 no.
	14.6 Oil Cooler 3-way valve	2 nos.
	14.7 Oil block	1 no.
	14.8 Accumulator & Bladder with air fill valve	1 set*
	14.9 Pressure regulator	2 nos. each type
	14.10 PRV	2 nos. each type
	14.11 NRV of oil system	2 nos. each type
	14.12 Solenoid Valve	2 nos. each type
	14.13 Seal Set of Hydraulic cylinder	4 sets*
	15. Mill Bottom (if applicable)	2 no.
	16. Bowl hub assembly/Ring seat	1 no.
	17. Lube Oil System for Mill	
	17.1 Pump & Motor coupling	2 nos.
	17.2 Pump assembly (excluding motor)	2 nos.
	17.3 Oil Filter	
	17.3.1 Filter assembly	2 nos.
	17.3.2 Filter element	12 nos.
	17.4 Pressure regulator	4 nos. each type
	17.5 PRV	4 nos. each type
	17.6 Oil cooler assembly for coal mills	2 nos.
	17.7 Mill lube oil motor	2 nos.

SI. NO.	PARTICULARS	QUANTITY
	17.8 NRV of lub oil system	2 nos. each type
	18. Bearings for gear box	
	18.1 Anti-friction bearings	4 sets *
	18.2 Thrust pad and bush bearings	4 sets*
	19. Coupling between mill gearbox and motor	4 Nos.
	20. Mill motor complete	1 no
	21. Mill motor bearing	2 sets*
	22. VFD assembly for dynamic classifier	4 sets*
	23. Mill lower skirt/Lower air seal ring with gasket & fasteners (as applicable)	2 sets*
	24. Labyrinth seal assembly/Gland rope follower/Upper air seal ring with gasket & fasteners (as applicable)	5 sets*
	25. Classifier blades AND Rotor & rotor support assembly (as applicable)	1 set*
	26. Spares for Dynamic classifiers	
	26.1 Gearbox	1 no
	26.2 Belt & Pulley	2 sets*
	26.3 Bearing	1 set*
	27. Mill Scrapper assembly	2 sets*
	* One set means one complete replacement of one mill	
1.07.00	**Feeders**	
	1. Belt	8 sets *
	2. Belt drive reducer	3 nos.
	3. Clean out conveyor (COC) reducer	2 nos.
	4. Counter assembly (complete)/Belt takeup assembly (Complete) (as applicable)	2 nos.
	5. Head pulley assembly (complete)	2 nos.
	6. Weight sensing system	
	6.1 Weighing roll	2 nos.
	6.2 Weighing spare roller assembly	2 nos.
	6.3 Drag link assembly	2 nos.
	7. Tension roll/ Belt take-up pulley (as applicable)	2 nos.
	8. Gearbox all internals	2 nos.
	9. Feeder Inlet and outlet gate (complete assembly)	2 nos. of each type
	10. Mill feeder motor	2 nos. of each type
	11. Mill feeder COC motor (if applicable)	2 nos.
1.08.00 A)	**Coal Burners/ Coal Pipe Bends(for tangential firing)**	

SI. NO.	PARTICULARS	QUANTITY
	1. Coal compartment assembly	1 set**
	2. Inter air compartments	1/2 set**
	3. Oil compartments/oil nozzle tips	1/2 set**
	4. End air compartment	1/2 set**
	5. Coal nozzle castings	1 set**
	6. Adjustable coal nozzle tips	1 set**
	7. Coal pipe bends with liners	20% of population for each type size, thickness & radius for one unit.
	8. Coal pipe couplings	30 nos. of each type & size
	9. Coal pipe coupling gasket	30 nos. of each type & size
	** One set means one complete replacement for a unit	
1.08.00 B)	**Coal Burners/ Coal Pipe Bends (for front / rear wall firing)**	
	1. Complete Coal compartment assembly	1 set**
	2. Adjustable coal nozzle tips	1 set**
	3. Coal pipe bends with liners	20% of population for each type size, thickness & radius for one unit.
	4. Coal pipe couplings	30 nos. of each type & size
	5. Coal pipe coupling gasket	30 nos. of each type & size
1.08.00C	COFA/SOFA/AA Air nozzle assembly	
	1. COFA/SOFA/AA assembly	25% of total quantity of one unit
	** One set means one complete replacement for a unit	
1.09.00	**Seal Air Fan**	
	1. Fan assembly (excluding fan body)	2 nos.
	2. Bearings & seals	
	2.1 Bearing	2 sets*
	2.2 Bearing Housing	2 sets *
	2.3 Shaft Seal	2 sets*
	3. Seal air fan motor	1 no.
	4. Seal air fan motor bearing	1 set*
	5. Fan suction filters	2 nos.
	* One set means complete replacement of one fan	
1.10.00 A)	**Regenerative Air Preheater (Primary & Secondary APH)**	
	1. Support Bearing	Half of the total population
	2. Guide Bearing	Half of the total population
	3. Lubricating system of support & Guide Brg	
	3.1 Pump assembly (except motor)	2 nos. each for PAPH & SAPH
	3.2 Pump Motor	2 nos. each type & rating for PAPH & SAPH

SI. NO.	PARTICULARS	QUANTITY
	3.3 Pressure regulator	2 nos. each for PAPH & SAPH
	3.4 PRV	2 nos. each for PAPH & SAPH
	3.5 Oil Filters	
	3.5.1 Filter housing Assembly (with changeover lever)	1 no. each for PAPH & SAPH
	3.5.2 Filter Element	6 nos. each for PAPH & SAPH
	3.6 Pump Motor coupling	3 nos. each for PAPH & SAPH
	3.7 Lub Oil Cooler assembly (Complete)	2 nos. each for PAPH & SAPH
	3.8 NRV of lub oil system	1 no. each type and ratings for PAPH & SAPH
	4. Radial seals	4 sets* each for PAPH & SAPH
	5. Axial Seals	2 sets* each for PAPH & SAPH
	6. Circumferential or bypass seals	2 sets* each for PAPH & SAPH
	7. Rotor post seals	2 sets* each for PAPH & SAPH
	8. Air Motor	2 nos. each for PAPH & SAPH
	8.1 Air motor (Complete assembly)	2 nos. each for PAPH & SAPH
	8.2 Bearings	4 sets* each for PAPH & SAPH
	8.3 Seals for air motor	4 sets* each for PAPH & SAPH
	9. Main drive speed reducer	
	9.1 Speed reducer (Complete Assembly)	2 sets* each for PAPH & SAPH
	9.2 Speed reducer Gears, pinions & shaft	2 sets* each for PAPH & SAPH
	9.3 Speed reducer Bearings	2 sets * for PAPH & SAPH
	9.4 Speed reducer Seals & gaskets	4 sets* each for PAPH & SAPH
	9.5 Speed reducer Clutch assembly	4 nos. each for PAPH & SAPH
	10. Fluid coupling (if applicable)	4 nos. each for PAPH & SAPH
	11. Other couplings with inserts & fasteners (if applicable)	2 nos. each for PAPH & SAPH
	12. Spare for cleaning device for Hot end & Cold end (Corresponding equivalent item shall be considered for any non-applicable part)	
	12.1 Worm & worm wheel for gear reducer	1 set* each for PAPH & SAPH
	12.2 Coupling	1 set* each for PAPH & SAPH
	12.3 Bearing & seals for speed reducer	1 set* each for PAPH & SAPH
	12.4 Bearing for cleaning device	1 set* each for PAPH & SAPH
	12.5 Poppet valve assembly	1 No
	12.6 Carriage assembly	1No
	12.7 Rotary Chain Box Assembly	1No
	12.8 Lance and feed pipe	1 No
	13. Spare Kit for rotor stoppage (rotation sensor) alarm	2 sets*
	14. Spare kit for fire sensing device with fire fighting nozzle	2 sets*

SI. NO.	PARTICULARS	QUANTITY
	15. Bushings for all worm gear reducer (if applicable)	2 sets*
	16. Cold, intermediate & hot end baskets	1 set* each type and size
	17. Rack & pinion assembly (if applicable)	1 set* each for PAPH & SAPH
	18. Motor Bearing for all motors in APH	1 set* each type for PAPH & SAPH
	19. Air pre heater motor	1 no. of each type and rating for PAPH and SAPH
	20. Air pre heater soot blower motor	1 no. of each type and rating for PAPH and SAPH
	21. VFD system	1 no. of each type and rating for PAPH and SAPH
	22. Support bearing Housing	1 no. of each type and rating for PAPH and SAPH
	23. Guide bearing Housing	1 no. of each type and rating for PAPH and SAPH
	24. Seal Tube for Guide bearing	1 no. of each type and rating for PAPH and SAPH
	25. Sleeve for guide bearing	1 no. of each type and rating for PAPH and SAPH
	26. Sector Plate Actuators	1 set* each for PAPH & SAPH
	* One set means one complete replacement each for Primary & Secondary APH.	
	OR	
1.10.00 (B)	**Regenerative Air Preheater –Trisector type**	
	1. Support Bearing	2 nos.
	2. Guide Bearing	2 nos.
	3. Lubricating system of support & Guide Brg.	
	3.1 Pump assembly(except motor)	2 nos.
	3.2 Pump Motor	2 nos.
	3.3 Pressure regulator	2 nos.
	3.4 PRV	2 nos. of each type
	3.5 Oil Filters	
	3.5.1 Filter housing Assembly (with changeover lever)	1 no.
	3.5.2 Filter Element	4 nos.
	3.6 Pump Motor coupling	2 nos.
	3.7 Lub Oil Cooler assembly (Complete)	2 nos.
	3.8 NRV of lub oil system	1 no. each type
	4. Radial seals	4 sets*
	5. Axial Seals	2 sets*
	6. Circumferential or bypass seals	2 sets*
	7. Rotor post seals	2 sets*

SI. NO.	PARTICULARS	QUANTITY
	8. Air Motor	
	8.1 Air motor (Complete assembly)	2 nos.
	8.2 Bearings	2 sets*
	8.3 Seals for air motor	2 sets*
	9. Main drive speed reducer	
	9.1 Speed reducer (Complete Assembly)	2 sets*
	9.2 Speed reducer Gears, pinions & shaft	2 sets*
	9.3 Speed reducer Bearings	2 sets*
	9.4 Speed reducer Seals & gaskets	2 sets*
	9.5 Speed reducer Clutch assembly	2 nos.
	10. Fluid coupling (if applicable)	3 nos.
	11 Other couplings with inserts & fasteners (if applicable)	3 nos.
	12 Spare for cleaning device for Hot end & Cold end (Corresponding equivalent item shall be considered for any non-applicable part)	
	12.1 Worm & worm wheel for gear reducer	2 sets*
	12.2 Coupling	2 sets*
	12.3 Bearing & seals for speed reducer	2 sets*
	12.4 Bearing for cleaning device	2 sets*
	12.5 Poppet valve assembly	1 no.
	12.6 Carriage assembly	1 no.
	12.7 Rotary Chain Box Assembly	1 no.
	12.8 Lance and feed pipe	2 nos.
	13. Spare Kit for rotor stoppage (speed sensor) alarm	2 sets*
	14. Spare kit for fire sensing device with firefighting nozzle	2 sets*
	15. Bushings for worm gear reducer (if applicable)	3 sets*
	16. Cold, intermediate & hot end baskets	1 set each type and size*
	17. Rack & pinion assy (if applicable)	1 set*
	18. APH Main drive Motor (complete)	1 no. of each type and rating
	19. VFD system	1 no. of each type and rating
	20. Air preheater soot blower motor	1 no. of each type
	21. Support bearing Housing	1 no. of each type and rating for APH
	22. Guide bearing Housing	1 no. of each type and rating for APH
	23. Seal Tube for Guide bearing	1 no. of each type and rating for APH
	24. Sleeve for guide bearing	1 no. of each type and rating for APH

SI. NO.	PARTICULARS	QUANTITY
	25. Sector Plate Actuators	1 set*
	* One set means one complete replacement of one APH.	
1.11.00	**Fuel Oil System**	
	Light Fuel Oil System	
	1. Light Oil gun	1 Set **
	2. Oil gun nozzle (with back plate, mixing plate & cap nut)	2 sets**
	3. Oil gun flexible hoses (including for guide pipe, air line)	4 sets**
	4. Complete Pump & Motor Assembly	2 nos.
	5. Light Oil pump	
	5.1 Complete cartridge assembly	2 sets*
	5.2 Bearings including that of motor	2 sets*
	5.3 Mech. Seals	2 sets*
	5.4 Set of 'O' rings & seals	4 sets*
	5.5 Set of all types of bushes & sleeves	2 sets*
	5.6 Set of gaskets	4 sets*
	6. LDO pump relief valve complete accessories	2 nos.
	7. Spares for LDO pump relief valve	
	7.1 Valve spindle & disc	2 nos.
	7.2 Set of gaskets	4 sets*
	7.3 Sealing ring	2 sets*
	7.4 Springs	2 sets*
	8. Burner isolation valve	24 nos. or 20% which is less
	8.1 Gaskets for above valves	4 sets**
	8.2 Gland packing for above valves	4 sets**
	9. Light oil pressure control valve	1 no.
	10. Light oil main trip valve	1 no.
	11. Valves (each type & size)	(a) 1 no. where total quantity of particular type and size of valve is less than or equal to 10. (b) 2 Nos. where total quantity of a particular type & size of valve is less than 40 but more than 10
	12. Strainers of LDO System	02 of each type & Size
	* One set means one complete replacement of one pump	
	** One set means one complete replacement of one Unit	
1.12.00	**HEA Ignitors**	
	1. HEA retractor assembly (including power cylinder, HEA spark rod tip, solenoid valve, limit switches etc.	6 nos.
	2. HEA spark rod (including special cables from exciter)	12 nos.
	3. HEA spark tip	12 nos.
	4. HEA exciter	12 nos.

SI. NO.	PARTICULARS	QUANTITY
1.13.00	**Soot Blowers**	
	1. Complete assembly of water wall deslagger with motor	4 nos.
	2. Motor for water wall deslagger	01 (one no. of each type)
	3. Complete valve assembly for water wall deslagger.	4 nos.
	4. Long retractable soot blower assemblies complete with motor	2 nos. of each type
	5. Motor for long retractable soot blower	1 no.
	6. Complete valve assembly for long retractable soot blower.	2 nos.
	7. Reduction gear box & motor for air preheater soot blower oscillation	2 nos. of each type (If separate type & rating of SB are envisaged for primary & secondary APH, then 2 Nos. of each type.)
	8. Complete valve assembly for air preheater soot blower	4 nos. of each type (If separate type & rating of SB are envisaged for primary & secondary APH, then 2 Nos. of each type.)
	9. Bearings for	
	9.1 Long retractable soot blower	3 sets*
	9.2 Water wall deslagger	3 sets*
	10. Oil seal/other seals (as applicable) for	
	10.1 Long retractable soot blower	3 sets*
	10.2 Water wall deslagger	3 sets*
	11. Complete steam safety valve assembly	1 no.
	12. Steam control valve assembly	2 nos. of each type
	13. Sweep action/ swing arm/ Long retractable/ Semi retractable non-rotating/ Multimedia type blower for Air Preheater	3 nos. each for PAPH and SAPH or 3 nos. for Tri-sector APH
	14. Limit switches	4 nos. of each type & ratings.
	15. Complete power pack assembly for Long Retractable soot blower	(Two no. for rotary + Two no. for transverse)
	16. Spare set of rotary & transverse chain for long retractable soot blowers	2 nos. of each type and size
	17. Spares for rack gear assembly	
	17.1 Set of Gears & shaft	2 sets*
	17.2 Rack & pinion	2 sets*
	16. LRSB lance tube (SS)	02 nos.
	* One set means one complete replacement of one valve/Equipment.	

SI. NO.	PARTICULARS	QUANTITY
1.14.00	**VALVES**	
	A. Spares for Steam Separator / Separator outlet/ Primary Superheater Safety valves	
	1. Complete separator/ Separator outlet/ Primary Superheater safety valve assy.	1 no. of each type
	2. Upper adjusting ring	2 nos. of each type
	3. Lower adjusting ring	4 nos. of each type
	4. Locking pin set (Adjusting ring pin)	4 nos. of each type
	5. Safety valve Disc	8 nos. of each type
	6. Safety Valve Spindle	2 nos. of each type
	7. Disc Holder	4 nos. of each type
	8. Guide	2 nos. of each type
	9. Cotter Pins (If applicable)	10 nos. of each type
	10. Set of Washer	1 no. of each Type
	B. Spares for SH Safety Valves	
	1. Complete Superheater safety valve assy	2 nos. of each type
	2. Upper adjusting ring	4 nos. of each type
	3. Lower adjusting ring	4 nos. of each type
	4. Locking pin set (Adjusting ring pin)	4 nos. of each type
	5. Safety valve Disc	8 nos. of each type
	6. Safety Valve Spindle	4 nos. of each type
	7. Disc Holder	4 nos. of each type
	8. Guide	2 nos. of each type
	9. Cotter Pins (If applicable)	10 nos. of each type
	10. Set of Washer	4 nos. of each Type
	C. Spares for Hot RH safety Valves	
	1. Complete Hot Reheater safety valve assy	1 no. of each type
	2. Upper adjusting ring	2 nos. of each type
	3. Lower adjusting ring	2 nos. of each type
	4. Locking pin set (Adjusting ring pin)	4 nos. of each type
	5. Safety valve Disc	2 nos. of each type
	6. Safety Valve Spindle	1 no. of each type
	7. Disc Holder	2 nos. of each type
	8. Guide	2 nos. of each type
	9. Cotter Pins (If applicable)	10 nos. of each type
	10. Set of Washer	1 no. of each Type
	D. Spares for Cold RH safety Valves	
	1. Complete Cold Reheat safety valve assy	1 no. of each type
	2. Upper adjusting ring	2 nos. of each type
	3. Lower adjusting ring	2 nos. of each type
	4. Locking pin set (Adjusting ring pin)	2 nos. of each type
	5. Safety valve Disc	4 nos. of each type
	6. Safety Valve Spindle	2 nos. of each type
	7. Disc Holder	2 nos. of each type

SI. NO.	PARTICULARS	QUANTITY
	8. Guide	2 nos. of each type
	9. Cotter Pins (If applicable)	10 nos. of each type
	10. Set of Washer	1 no. of each Type
	E-1. Spares for Electromatic Relief Valves (If applicable)	
	1. Complete Electromatic relief valve	1 no. of each type
	2. Spares for above:	
	2.1 Disc for main valve	2 nos. of each type
	2.2 Spring for main valve	2 nos. of each type
	2.3 Seal rings for main valve	4 nos. of each type
	2.4 Seal bushing for main valve	4 nos. of each type
	2.5 Disc and stem assembly for pilot valve	2 Nos. of each type
	2.6 Bushing for pilot valve	4 nos. of each type
	2.7 Spring for pilot valve	4 nos. of each type
	2.8 Seal ring	4 nos. of each type
	3. Isolation valve for ERV	2 nos. of each type
	E-2. Spares for Electromatic Ball Valves (If applicable)	
	1. Complete Electromatic ball valve	2 nos. of each type
	2. Spares for above:	
	2.1 Ball and seat assembly	2 nos. of each type
	2.2 Gasket	4 nos. of each type
	2.3 Packing Gland Flange	2 nos. of each type
	2.4 Packing ring	4 nos. of each type
	F. Spares for Superheater spray control Valves	
	1. Complete superheater spray control valve	2 nos. of each type
	2. Spares for above:	
	2.1 Gland packing set	10 sets of each type*
	2.2 Pressure seal gasket	2 nos. of each type
	2.3 Stem	4 nos. of each type
	2.4 Control Valve Plug	4 nos. of each type
	G. Spares for Reheater spray control Valves	
	1. Complete Reheater spray control valve	2 nos. of each type
	2. Spares for above:	
	2.1 Gland packing set	10 sets of each type*
	2.2 Pressure seal gasket	10 nos. of each type
	2.3 Stem	4 nos. of each type
	2.4 Control Valve Plug	4 nos. of each type
1.15.00	**Superheater Spray Block Valve Spares**	
	1. Gland packing set	10 sets of each type*
	2. Pressure seal gasket	10 nos. of each type
	3. Stem	2 nos. of each type
	4. Block Valve plug	2 nos. of each type

SI. NO.	PARTICULARS	QUANTITY
	***Note:** one set means complete replacement for one valve	
1.16.00	**Reheater Spray Block Valve Spares**	
	1. Gland packing set	10 sets of each type*
	2. Pressure seal gasket	10 nos. of each type
	3. Stem	2 nos. of each type
	4. Block Valve plug	2 nos. of each type
	***Note:** one set means complete replacement for one valve	
1.17.00	**Spares for boiler main steam stop valve**	
	1. Boiler main stop valve(complete assy)	1 no.
	2. Set of gland packings	4 sets*
	3. Pressure seal gaskets	4 sets*
	4. Stem	1 no. of each type for main valve & 2 nos. of each type for integral bypass valve.
	5. Disc	2 sets*
	6. Seat rings (if applicable)	4 sets*
	7. Fasteners	2 sets*
	***Note:** one set means complete replacement for one valve including integral bypass valves.	
1.18.00	**Boiler Feed Check Valve**	
	1. Body seat rings	2 nos.
	2. Flap	1 no.
	3. Pressure seal ring for main body and Hinge Pin	4 nos. for each type
	4. Gland packings (if applicable)	4 sets* for each type
	5. Fasteners	2 sets*
	***Note:** one set means complete replacement for one valve	
1.19.00	**Start up vent valve**	
	1. Stem	1 no.
	2. Disc	2 nos.
	3. Body seat rings	4 sets*
	4. Gland packings	6 sets*
	5. Pressure seal rings	4 nos.
	6. Fasteners	3 sets*
	***Note:** one set means complete replacement for one valve	
1.20.00	**Auxiliary Steam Pressure Reducing & Desuperheating System**	
	I. High Capacity PRDS System (MS)	
	1. Steam pressure reducing cum desuperheating valves	1 no.
	1.1 Stem	1 no.

SI. NO.	PARTICULARS	QUANTITY
	1.2 Disc	1 no.
	1.3 Body seat rings	4 nos. for each type, size and rating of valves
	1.4 Gland packings	4 nos. for each type, size and rating of valves
	1.5 Pressure seal ring	4 nos.
	1.6 Gasket	4 nos.
	II. Low Capacity PRDS System (CRH)	
	1. Steam pressure reducing valve	1 no.
	1.1 Stem	1 no.
	1.2 Disc	1 no.
	1.3 Body seat rings	4 nos. for each type/size
	1.4 Gland packings	4 nos. for each size, type & rating of valves
	1.5 Pressure seal ring	4 nos.
	1.6 Gaskets	2 nos.
1.20.00 A	**Valve trim set for all control valves supplied under this package (except for SH/RH spray, HCPRDS & LCPRDS CV for which spares are covered under separate clause)**	
	Valve trim (including cage, plug, stem, seat rings, guide bushings, gland packing, gaskets etc.)	1 set for each type, class, size of control valve. 5 Sets* each for gland packing and gaskets for all control valves.
	Note: 1 set means complete replacement for one valve	
1.20.00 B	**Valves (Manual valves, Motor operated valves, Plug valves and any other valves type except control valves as under 1.20.00 A) supplied under this SG package and is not covered under separate clause**	
	Valve Stem, Disc and Seat	1 Set for each size,class and type of valve
	Gland Packings, Gaskets	5 Sets* each for gland packing and gaskets for each size, type of valves.
	Pressure seal rings	5 sets * for each size, type of valves
	Actuator nut for Motor operated valve	2 sets* for each type, size and class of valve
	Needle Bearings/ Plain bearing of actuator nut	2 sets* for each type, size and class of valve
	Complete Manual valves upto 50 NB	10% of population of each type, size and class of valve
	Complete Motor Operated valves upto 50 NB	10% of population of each type, size and class of valve
	Complete Plug Valve	10% of each type, size and class of valve

SI. NO.	PARTICULARS	QUANTITY
	*Note: 1 set means complete replacement for one valve	
1.20.00 C	**Gear Box of Valves, Gates (Gear Box of valve actuator and valve of motor operated valve and Gear Box of manual valve, plug valve etc., Gear box of Gates)**	
	1. Complete Gear Box	1 no. of each type, size
	2. Bearings for Gear Box	2 sets* of each type, size of gear box.
	3. Gaskets for Gear Box	4 sets* of each type, size of gear box.
	4. Oil seal and any other applicable packings for gear box	4 sets* of each type, size of gear box.
	Note: 1 set means complete replacement for one valve	
1.21.00	**Auxiliary Boiler (NOT USED)**	
1.22.00	**FGD System**	
1.22.01	**Booster Fans (if applicable)**	
	1. Complete Fan rotor assembly (excluding fan body & Coupling) consisting of: - Rotor Hubs (drive & regulating end as applicable) - Main Bearing Assy(Complete) - Hydraulic Actuating Device/Hydraulic Cylinder with Rotating Oil Seal Assy - Fan Blades with fixation parts (fastener, seals, clamp, pins etc.) Note: Complete Rotor assy to be supplied in assembled condition on a fixture/ transport stand. (Fan blades to be supplied in loose condition)	1 set*
	2. Booster fan motor complete	1 no.
	3. Booster fan motor bearing	1 set*
	4. Main bearing assembly	
	4.1 Main bearing assembly (Complete assembled)	1 set*
	4.2 Bearings for main bearing assembly	2 sets*
	5. All internal Spares for blade bearing assembly (Excluding housing)	4 sets*
	6. Lube Oil / Hydraulic Oil system	
	6.1 Pump assembly (excluding motor)	2 nos. of each type
	6.2 Motor	1 no. of each type and rating
	6.3 Pressure regulator	4 nos.
	6.4 PRV	3 nos. of each type
	6.5 Oil Filter	

SI. NO.	PARTICULARS	QUANTITY
	6.5.1 Filter housing Assembly (with changeover lever)	1 no
	6.5.2 Filter Element	6 nos.
	6.6 Coupling between oil pump & motor	2 nos.
	6.7 Seals for pump	4 Nos.
	6.8 Lub Oil Cooler assembly (Complete)	1 set*
	6.9 NRV of lub oil system	1 no of each type
	7. Fan Blades with fixation parts (fastener, seals, clamp,pins etc.)	1 set*
	8. Coupling between Fan & Motor (Including Intermediate shaft/ distance Piece)	2 sets*
	9. Fan Blade Actuating Assembly	
	9.1 Hydraulic Actuating Device/Hydraulic Cylinder with rotating oil seal	2 sets*
	9.2 Regulating Linkage Assy	1 set*
	9.3 Seal Ring Kit (complete)	10 nos
	10. Flexible Oil Hoses	4 sets
1.22.02	**Not Used**	
1.22.03	**Absorber**	
	1. Liner Material	5% coverage of each material and thickness for one Unit/Absorber
	2. Absorber Spray/Oxidation nozzles	10% of each type
	3. Absorber Mist Eliminator Washing Nozzles	10% of each type
	4. Absorber Mist Eliminator	5% of each type
1.22.04	**Oxidation Air Compressor**	
	1. Impeller Assembly	1 no.
	2. Bearings	1 no. of each type
	3. Motor	1 no. of each type and rating
1.22.05	**Agitators** (For Absorber Oxidation Tank, Mill Separator Tank, Limestone Slurry Preparation Tank and any other tank provided with agitators)	
	1. Impeller Assembly	1 no. of each type
	2. Bearing Assembly	2 nos. of each type
	3. Motor*	1 no. of each type and rating
	4. Belt and Pulley (If applicable)	2 nos. of each type
	5. Gear Box Assembly (If Applicable) *	1 no. of each type
	6. Agitator shaft assembly	1 no. of each type and rating

SI. NO.	PARTICULARS	QUANTITY
	7. Shaft Seal (If applicable)	2 nos. of each type
	8. Complete Agitator Assembly	1 no. of each type
	*In case of Geared Motor/ Motor with integrated Gear where separate Gear Box is not applicable, twice the quantity specified for Motor to be supplied by the contractor.	
1.22.06	**Slurry Pumps** (Absorber Slurry Recirculation Pump, Gypsum Bleed Pumps, Mill Circuit Pump, Limestone Supply Pumps and any other slurry pumps)	
	1. Impeller Assembly	1 no. of each type
	2. Casing Liners (Where replaceable liners are applicable)	2 nos. of each type
	2A. Complete Casing (For the Absorber Slurry Recirculation/Gas Cooling Pump/Recycle Pump/All Slurry Pumps)	1 set* of each type and size
	3. Seals	3 sets* of each type
	4. Bearings	2 nos. of each type
	5. Motor	1 no. of each type and rating
	6. Motor-Pump Coupling	1 no. of each type
1.22.06 A	**VFD TRANSFORMER (If applicable)**	
	a) VFD Transformer, one of each type and rating	1 set*
	b) Primary Bushings with metal parts and gaskets (if applicable)	1 no. each rating
	c) Secondary Bushings with metal parts and gaskets	1 no. each rating
	d) Winding temperature indicator with alarm & trip contacts	1 no.
	e) Oil temperature indicator with alarm & trip contacts	1 no.
	f) Magnetic oil level gauge	1 no.
	g) Pressure relief device	1 no.
	h) Diaphragm for explosion vent	1 no.
	i) Buchholz relay/sudden pressure relay	1 no.
	j) Silca gel charge	1 no.
	k) Pressure gauge (applicable for sealed tank)	1 no. each type
1	Electronic cards	
	(a) Control modules	1 no. of each type & rating
	(b) I/O module	1 no. of each type & rating
	(c) Power supply modules	1 no. of each type & rating

SI. NO.	PARTICULARS	QUANTITY
	(d) Thyristor gate module including gate transformer	100% of one channel
	(e) Exciter module	1 no.
2	Thyristor bridge leg	1 no. (Qty. for one ph.)
3	Over voltage limiter and surge suppressor network	1 set *
4	Semi conductor fuses for thyristor	1 set*
5	Power & Control fuse	25% of installed quantity
6	Control Transformer	1 no. of each type & rating
7	Contactor/Breaker	1 no.
8	CT/VT	1 no. of each type & rating
9	Indicating lamps	100% of each type & rating
10	Auxiliary contactors & relays	1 no. of each type & rating
11	Panel mounted printer	1 no.
12	Indicating lamp holder full set	15% of each type and colour
13	Panel mounted meters	1 no. of each type & rating
14	Current Sensor	1 no. of each type & rating
15	Ground fault sensing card	1 no. of each type & rating
16	Fiber cable with connectors	1 set *
1.22.07	**Hydro-cyclones** (Mill, Gypsum Primary Dewatering, Secondary Waste Water and any other Hydrocyclone)	
	1. Hydro-cyclone Isolation Valve	10% of each type OR 1 no. whichever is higher
	2. Hydro-Cyclone	10% of each type OR 1 no. whichever is higher
	3. Hydro-Cyclone rubber lining	10% of each type OR 1 no. whichever is higher
1.22.08	**Feeders**	
	1. Belt	3 sets*
	2. Belt drive motor	1 no. of each type and rating
	3. Belt drive reducer	2 nos.
	4. Speed Reducer Assembly	1 set*
	5. Weighing Instruments	1 set*
	6. Feeder weighing roll	1 no.
	7. Gravimetric feeder gate actuator assembly	1 no.
	8. Counter assembly of feeder complete	1 no.

SI. NO.	PARTICULARS	QUANTITY
	9. Feeder head pulley assembly	1 no.
	10. Inlet span roller assembly	4 nos.
1.22.09	**Limestone Mills**	
	1. Mill Wear Parts (Liners) & Grinding element	1 set*
	Note : One set of Mill Wear Parts (Liners) above is defined as under :	
	1 Set = (Grinding elements needed for complete replacement of one mill) X (8000 x 1) / GWL, rounded off to nearest higher whole number. Where : GWL = Guaranteed wear life of Mill Wear Parts as offered by the bidder.	
	2. Mill Motor	1 no. of each type and rating
	3. Auxiliary Motor	1 no. of each type and rating
	4. Gear box internals (including Bearings and Seals)	2 sets*
	5. Complete Gear Box	1 set*
	6. Mill motor Bearings	1 set*
	7. Lube Oil / Grease System	
	7.1 Pump assembly	2 nos. of each type
	7.2 Motor	1 no. of each type and rating
	7.3 Pressure regulator	1 no. of each type
	7.4 Filters	2 nos. of each type
	7.5 Pump & Motor coupling	1 no. of each type
1.22.10	**Slurry Valves**	2 nos. of each type and size
1.22.11	**Slurry Line Bends**	2 nos. of each type and size
1.22.12	**Vacuum Belt Filter**	
	1. Filter Cloth	2 sets*
	2. Belt (if applicable)	1 set*

SI. NO.	PARTICULARS	QUANTITY
	3. Vacuum Box Seals	2 sets*
	4. Drive Motor (if applicable)	1 no.
1.22.12 A	**Vacuum Pump**	
	1. Pump Impeller Assembly	1 no
	2. Pump Bearing	1 set*
	3. Seals	1 set*
	4. Motor	1 no
1.22.13	**Vacuum Breaker Valves**	
	1. Valve Assembly	1 no.
	2. Actuator	1 no.
1.22.14	**Sump Pumps**	
	1. Complete Impeller Assembly	1 no. of each type
	2. Casing Liners	1 set* of each type
	3. Bearing	2 sets*
	4. Motor	1 no. of each type and rating
	5. Pump discharge valve assembly	1 no. of each type
1.22.15	**Horizontal Centrifugal Pumps**	
	1. Complete Impeller Assembly	1 no. of each type
	2. Casing Liners	1 set of each type
	3. Bearing	2 sets*
	4. Motor	1 no. of each type and rating
	5. Pump discharge valve assembly	1 no. of each type
1.23.00	**Goods cum passenger elevator for FGD (if applicable)**	
23.1	Over current relay	2 Nos. of each type and rating
23.2	Auxiliary relays	3 Nos. of each type
23.3	Friction block	2 Nos. of each type
23.4	Guide roller of each type	20% of total population or 3 nos. of each type whichever is high
23.5	Contactors of each type and rating	2 nos.
23.6	Control transformer	1 no. of each type and rating
23.7	Time device	2 nos. of each type and rating
23.8	Rectifiers	2 nos. of each type and rating
23.9	Resistor	3 nos. of each type and rating

SI. NO.	PARTICULARS	QUANTITY
23.10	Fuses of each rating	20 % of the total population
23.11	Limit switches of each type and rating	3 nos.
23.12	Push button	3 nos. of each type and rating
23.13	Contact device (if applicable)	3 nos. of each type and rating
23.14	Brake motor	2 nos. of each type and rating
23.15	Transmitters (if applicable)	2 nos. of each type and rating
23.16	Switches of each type and rating (if applicable)	3 nos.
23.17	Receiver	2 nos. of each type and rating
23.18	Bearings of each type & size	2 nos.
23.19	Roller of each type	3 nos.
23.20	Worm gear spares	
	a) 'O' rings	3 sets*
	b) Sealing ring of each type	3 sets*
23.21	Spares for brake	
	a) Fan	2 nos. of each type and rating
	b) Magnetic coil	3 nos. of each type and rating
	c) Brake disc	2 sets*
	d) Brake pad	2 sets*
23.22	Bushing (for door front)	2 sets*
23.23	Pinion	2 nos. of each type
23.24	Lift main Drive motor	1 no. of each type & rating
23.25	Door Operating Motor	1 no. of each type & rating
23.26	Landing Door complete	1 set. of each type & rating
23.27	Car Door Complete	1 set. of each type & rating
23.28	VFD drive	1 no. of each type
1.24.00	**Gates in Air and Flue gas path/ducts of boiler including FGD**	
	Seals	1 set of each type and size (Set means complete replacement for one gate)
	Actuator	1 no. of each type
1.25.00	**CC (BCW) pump motor assembly complete with cooler (if applicable)**	1 no. of each type and rating
2.00.00	**CONTROL AND INSTRUMENTATION** (APPLICABLE FOR STEAM GENERATOR AND AUXILIARIES INCLUDING FUEL OIL PRESSURISATION AND HEATING SYSTEM, DOZING System, ECW, FGD, De-NOx, Aux Boiler)	
2.01.00	**OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS / EQUIPMENTS**	
	Other SG related sub-systems	
	1. Flame Monitoring System	
	1.1 Complete Flame Scanner Assembly including scanner head assembly, scanner housing, and fiber optic cables.	20 % or 4 nos., whichever is more