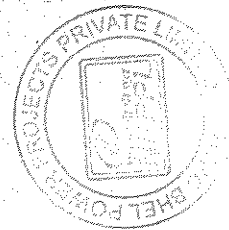


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PART- B

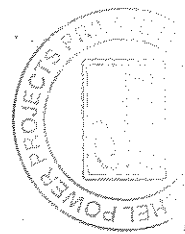
CIVIL WORKS



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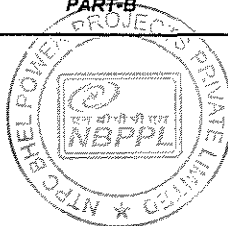
SUB-SECTION – D-01

CIVIL WORKS



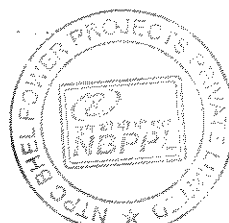
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
1.00.00 1.01.00	GENERAL This specification is to cover design, preparation of general arrangement drawings, construction and fabrication drawings, supply of labour, materials and construction of all civil, structural and architectural works. Description of various items of work under this specification and nature of work in detail are given hereinafter. The complete work under this scope is referred to as civil works. Various buildings, structures, plant and systems, facilities, etc., covered under the scope is given in Vol. - II, Part A and herein. The work to be performed under this specification consists of design, engineering 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 reasonably implied or necessary for the completion and proper functioning of the plant, all in strict accordance with the specifications including revisions and amendments thereto as may be required during the execution of work. All materials including cement, reinforcement steel and structural steel, etc., shall be arranged by 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. 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 bench mark or other acceptable bench mark of Govt. deptt. 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 1 OF 245



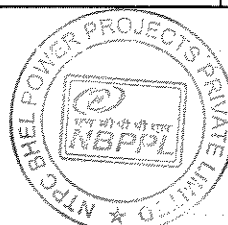
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CLAUSE NO.	CIVIL WORKS			
	The Bidder shall fully appraise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site specific parameters and shall include for 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.			
2.00.00	SUBMISSIONS			
2.01.00	Commencement of fabrication and erection and construction shall be done after approval of the relevant documents and drawings. All drawings shall be of standard sizes (Metric System) and shall be made on AutoCAD. All documents shall be made using MS office. Bidder shall submit all documents and drawings as per the followings: Drawings: 6 paper prints and soft copy via email 2 sets of paper prints of all final approved drawings on A3 size in bound form along with 2 CD's Design/Document: 3 paper prints and soft copy via email 1 sets of paper print of all final approved design/document on 2 CD's As Built Drgs: 1 paper print along with 2 CD's In general 3D modeling and structural frame analysis and design for the plant structures shall be submitted by the bidder for Employer's review and approval. All construction drawings shall include total quantity of concrete (grade wise), reinforcement (diameter wise) and structural steel (section wise). 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) Plant 'General Layout Plan' drawing with coordinates of roads, boundary wall, buildings and facilities, piping/cable corridors, railway lines, green belt, etc.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 2 OF 245



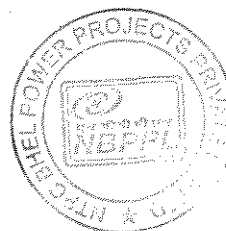
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
	b) Drawings showing underground facilities with co-ordinates and invert levels of the facilities like buried pipes, buried cables, trenches, ducts, sewers, drains, sumps, pits, culverts, manholes, etc. c) Architectural floor plans, including conceptual interior/equipment and furniture arrangement, elevations and cross-sections of all buildings. For main plant building, the Bidder shall submit two different schemes (with perspective view in colour) along with a report elaborating the underlying philosophy of the proposed architectural concepts. d) Survey drawings indicating spot levels for the area under the scope of work and L-section along pipe corridors outside plant boundary. e) Project design intent document giving the basis of design, which shall cover all the aspects, parameters, assumptions, references, structural idealisation/mathematical model, loading cases, load combinations, basis of analysis and design of all buildings, facilities, systems and structures etc. shall be furnished and got approved before commencement of detailed engineering. f) Structural analysis, design calculations and drawings of substructure and super structures for all buildings, structures, facilities, and systems including cooling water ducts/pipes. g) Analysis, design calculations and drawings for all services like roads, culverts, bridges, road/rail crossings, drainage pump houses (if required), drains, sewers, sewage pump house, water supply, water tank, coal conveyor galleries, trestles, transfer points, trenches, ducts, etc. h) All architectural drawings required for execution of construction work such as detail floor plans, detail elevations, detail sections and other miscellaneous architectural details such as finish schedule, colour scheme (both internal and external), doors and windows, flooring including provision of north/sky light in the roof of turbine bay, false flooring, false ceiling, etc., architectural facia and projections, miscellaneous architectural details, coping, flashing, khurras, water proofing, fillet, roof decking, wall cladding, surface drains, rain water down comers, sanitary, plumbing, etc. i) Design calculations including dynamic analysis and drawings for all foundations subjected to dynamic loads like foundation for TG, BFP, Mills, Fans (PA, FD, ID), Crusher etc. j) Write-up on various statutory requirements and their compliance for various buildings, facilities, structures and systems, etc.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 3 OF 245



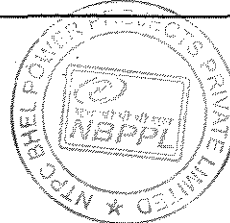
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CLAUSE NO.	CIVIL WORKS		
	k) Shop drawings/fabrication drawings of all structural steel works (only for reference) and design calculations for important joints/ connections. l) Construction and erection procedure for all major structures such as Main Plant building including Control tower, Mill and Bunker building including coal bunkers, Transfer Points, Conveyor Galleries, Boiler/ ESP structures, Chimney, C.W.PH, Cooling Towers, Switchyard Structures, Ash Slurry PH, Ash Water PH, TG foundation and other machine foundations, C.W. Clarifiers, etc. covered under the Bidder's scope. m) In case of piling, scheme for initial pile load tests in vertical, lateral and uplift modes along with supporting design calculations, and methodology for installation of working piles. n) In case of piling, the design of piles in terms of type, rated capacity, length, diameter and termination criteria to locate the founding level. o) Marking scheme identifying the equipment lay-down areas, with distinctive colour scheme. p) Material test certificates. q) Design criteria and drawings for Boiler/ESP supporting structures. r) As built drawings with quantities of various items of work system wise, building wise, structure wise, etc. duly certified by Site after execution of work for information/record. s) Details of corrosion protection measures for all structures. t) One complete set of applicable standards, references, specifications, code of practice along with soft copy (wherever required with minimum 2 years license fee) to the Engineer for use at site. u) Analysis of proportioning of major foundations to minimise differential settlement. v) Wherever applicable, scheme for dewatering, shoring, strutting/sheet piling and scheme for blasting (including controlled blasting) of hard rock. w) Bunker/Hopper Flowability study report. x) All other design details/drawings or any other submission as indicated elsewhere in this specification and as required by the Employer.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 4 OF 245



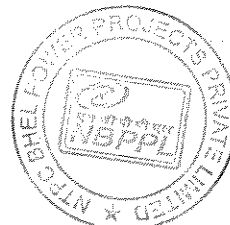
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CLAUSE NO.	CIVIL WORKS	एन.टी.पी.सी. NTPC	
3.00.00	DESIGN CRITERIA		
3.01.00	General		
3.01.01	The design criteria given herein is applicable for all structures and buildings including Main Plant buildings, Control building, office/service building, Mill and Bunker building, Coal Conveyor Galleries/Trestles, Transfer Points, Track hopper, Tunnel, Pent house, Stacker-reclaimer supporting structure, Crusher house, Chimney, Cooling towers, Fuel Oil Handling Plant, Light Diesel Oil Handling System, Pump Houses, C.W. ducts, Compressor house, D.G. Set building, switch gear and other miscellaneous buildings, Culverts, Bridges, Water retaining/carrying structures, Boiler/ESP supporting structures, Switchyard structures, Ash Silos, Roads, Drains, Sewers, Cables and pipe trestles and various other works included in the scope of the bidder.		
3.01.02	Structures shall be designed for the most critical combinations of dead loads, imposed loads, equipment loads, crane loads, piping loads (static, friction and dynamic), wind loads, seismic loads and temperature loads. In addition, Erection loads, loads and forces developed due to differential settlement shall also be considered.		
3.01.03	i) All the buildings shall have framed super structure. Type of building framework (steel or RCC), type of cladding (masonry or metal cladding) shall be as specified under Structural Design Concept. ii) The Main Plant building, Bunker building, transfer towers, conveyor galleries and trestles, crusher house, boiler and ESP supporting structures including inlet and exhaust duct support structures 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 200 mm.) on exterior face. v) All buildings, having structural steel frame work shall have non insulated metal cladding on exterior face above the masonry work and RCC roof over permanent metal deck shuttering, except in areas subjected to heavy loads where RCC roofing without metal deck shall be provided. For Mill & bunker buildings and TPs, insulated metal sheeting roof shall be provided.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 5 OF 245



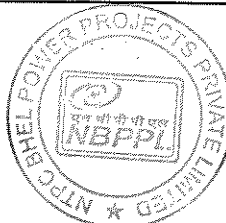
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CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC	
3.02.00	Loading			
3.02.01	Dead loads			
	Dead loads shall include the weight of structure complete with finishes, fixtures and partitions and shall be taken as per IS: 875 (Part-I)			
3.02.02	Imposed loads			
	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)	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	3.00	
		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	
	vii)	Roof (where equipment are located)	0.50	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 6 OF 245



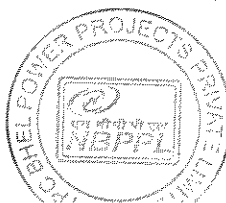
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	B) Deaerator and Heater Bay i) H.P/L.P. heater floor 1.00 ii) Deaerator floor 1.00 iii) Cable gallery 0.50 (In addition to this, actual cable load shall be considered) iv) MCC, switchgear and Control building floors 1.00 v) Roof 0.15 (Where no equipment are located) 0.5 (Where equipment are located) vi) A.H.U Room, Battery Room, Air Washer Room 1.0 C) 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) D) Pump Houses Operating floor 1.50 E) Maintenance bay (CWPH & RWPH) 3.0 F) Underground Structures such as Channels, Sumps, Underground Pump House, Tanks, Trenches, Reservoirs, C.W. ducts etc.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 7 OF 245



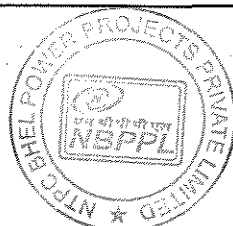
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CLAUSE NO.	CIVIL WORKS		
	In addition to earth pressure and ground water pressure, the surcharge load of 2T/sq.m. shall also be considered for design of all underground structures.		
G)	Road Culverts/Bridges and its allied structures including RCC 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.		
H)	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)	
I)	Railway Supporting Structures, Rail Culverts	As per Railway 'Bridge Rules'	
J)	Boiler/ ESP Support Structures	0.50	
K)	Conveyor Galleries	In addition to the live loads, loads due to cable trays, fire fighting / 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 fire fighting pipes/ Service water pipes. Tentative locations and diameter for pipes	
L)	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	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 8 OF 245



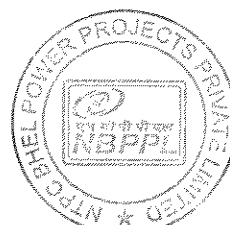
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CLAUSE NO.	CIVIL WORKS	NTPC	
	b) Flat Roofs (where equipment 0.50 are located) c) Inaccessible roof 0.075 vi) Inclined Roofs As per IS : 875 (Part-II) vii) Dust load on roof Equivalent to 0.30 M of ash deposit viii) Walkways (General) 0.50 ix) Walkways 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 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. 3.02.03 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. 3.02.04 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 9 OF 245



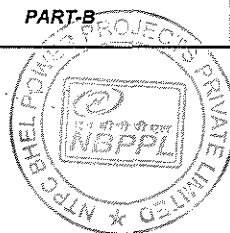
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CLAUSE NO.	CIVIL WORKS			
3.02.05	Seismic load For design of all structures, the site specific seismic spectrum as attached in Annexure-EQ shall be followed.			
3.02.06	Wind load For design of all structures, the wind loads shall be taken as per the following criteria.			
3.02.06.01	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 below. 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, ovaling 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.			
3.02.06.02	Site specific design parameters The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows: a) The basic wind speed " V_b " at ten metres above the mean ground level : 47 metres/second			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 10 OF 245



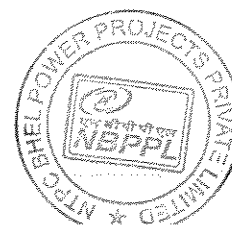
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CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC
3.02.07	b)	The risk coefficient "K ₁ " : 1.07	
	c)	Category of terrain : Category-2	
	Note: Notwithstanding the values of the above mentioned parameters, the design wind pressure so computed at any point shall not be taken less than 1500 N/Sq. metre for all classes of structures, i.e. A, B and C, as defined in IS: 875 (Part-3).		
	Damping in Structures		
3.02.08	The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below:		
	Type of Structure	Wind load	Seismic load
	a) Welded steel structure	1%	2%
	b) Bolted steel structure	2%	2%
	c) R.C.C. structure	1.6%	5%
	d) Steel stacks	As per IS:6533 and CICIND Model Code whichever is more critical	
3.02.09	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.		
3.02.09	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.		
	Differential settlement Loads		
3.02.09	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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 11 OF 245



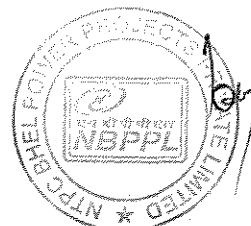
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CLAUSE NO.	CIVIL WORKS			
3.02.10	Additional Loads Following Minimum additional Loads shall be considered in the design of Steam generator structures, Mill & bunker buildings, Coal handling Transfer points and Trestles. (a) Cantilever Loads of not 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			
3.03.00	Civil Design Concepts			
3.03.01	Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.,			
3.03.02	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.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 12 OF 245



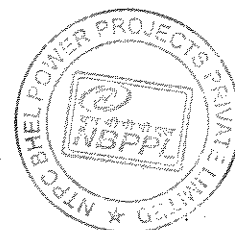
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CLAUSE NO.	CIVIL WORKS 		
3.03.03	c) 'Lifted load' of crane shall not be considered during seismic condition. d) In case two cranes are provided and tandem operation is not envisaged, the load shall be taken as one crane fully loaded and second crane without lifted load but standing idle adjacent to first crane. e) In case two cranes are provided and tandem operation is envisaged for some bays, then the load shall be taken as both the cranes fully loaded and standing side by side for these bays. For other bays, load shall be taken as one crane fully loaded and second crane without lifted load but standing idle adjacent to first crane. 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 upto 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, grating walkway with handrails shall be provided for entire column sectional depth for full length of the building. In addition, it shall be ensured that on B-row columns, through walkway (without hindrance) of minimum 600 mm clear width is available to the nearest part of the crane structure from the face of the column. On A-row and on both gable ends, a continuous covered walkway of minimum clear width of 1000 mm shall be provided. k) For checking against uplift / tension case, 75% of Dead Loads with no Imposed Loads shall be considered along with other Loads l) In all Loading Combinations, the Loads that have reduction effect on design condition shall not be taken into account in the Combination concerned. m) Where Wind is the main Load acting on the Structure, no increase in Stresses is to be considered for Design of Structures and Foundation Bolts. Design of steel structures shall be done by the working stress method. Design shall be as per provisions of IS:800 and other relevant IS standards. For design of coal bins and loading hopper IS:9178 (part I to III) shall be followed.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 13 OF 245

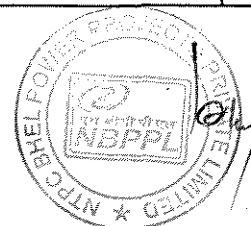


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CLAUSE NO.	CIVIL WORKS		
3.03.04	Shop connections will be all welded type and field connections will generally be bolted unless otherwise specified. Field bolts wherever provided will be high tensile friction grip bolts of 20 mm dia or higher and of property class 8.8(min) as per 1367 for all major connections. The bolted joints will be designed for friction type connection and H.T. bolts will be tightened to develop the required pretension during their installation. 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-1363. Following connections will be provided during erection 1. Welded connection a) connection of secondary beam to main beam b) connection of bracing to column c) connection of bracing to the longitudinal beam d) connection of longitudinal tie beam to column e) connection of spandrel beam to column f) connection of their secondary structures 2. HSFG connection a) splicing of column/transverse frame beam/longitudinal tie beam b) connection of frame beam to column c) connection of crane girder to column d) connection between crane girders e) connection of brackets from columns f) connection of members where tension will be in the fasteners g) other major connections		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 14 OF 245

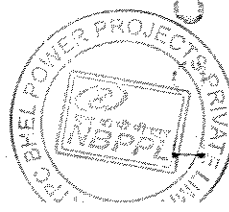


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3.03.05	3. Bearing Type connection (H.T. bolts grade 8.8) All removable type connections.												
	4. M.S. bolts (Grade 4.6) shall be used for purlins, stairs, wall beams etc. For HSS bolt connection, IS: 4000, IS: 3757, IS: 6623 and IS: 6649 shall be followed. IS: 814, IS: 816, IS: 1024, IS: 4353 and IS: 9595 shall be followed for welding of structures.												
3.03.05	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 1.6 x (rated capacity of conveyor system) 1200 x Conveyor speed 800												
3.03.06	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.												
3.03.07	Horizontal Deflection criteria The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following: <table><tr><th>Sl. No.</th><th>Description</th><th>Maximum value of</th></tr><tr><td>1.</td><td>For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)</td><td>Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)</td></tr><tr><td>2.</td><td>For Mill & Bunker Building</td><td>Height/500 (For wind load by Gust Factor Method / Seismic Load)</td></tr></table>				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 Mill & Bunker Building	Height/500 (For wind load by Gust Factor Method / Seismic Load)
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 Mill & Bunker Building	Height/500 (For wind load by Gust Factor Method / Seismic Load)											
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 15 OF 245									



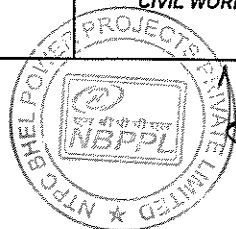
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
3.03.08	a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part). b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.		
3.03.09	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 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 t capacity : span/750 2) over 50 t capacity : span/1000 d) 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.		
3.03.10	Transverse coal pressure on Bunker/Silo/Hopper walls shall be calculated using Walker's theory and 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.		
3.03.11	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		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 16 OF 245



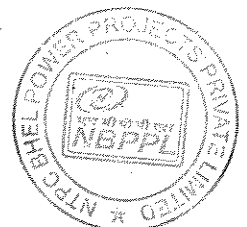
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CLAUSE NO.	CIVIL WORKS 
	and (b) pressure determined as per Walker's formula for static as well as dynamic conditions. The silo shall be designed for the following conditions: (a) The silo is full up to its full height / capacity (b) The silo is partially 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./cu.m. b) Density of bottom ash to be considered for load calculation shall be 1600 kg/cu.m. c) Density of fly ash to be considered for volume calculation shall be 750 kg/cu.m. d) Density of fly ash to be considered for load calculation shall be 1600 kg./cu.m. 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) Silos shall be covered at the top with the Hot Rolled M.S. Steel plate of minimum 3.15mm thickness welded to the supporting structure and silo with a provision of maintenance hatch. c) The joint between the wall and roof of the silo shall be properly sealed by welding or by any other approved means. d) Maintenance floors made out of the grating, covering the total plan area, shall be provided at least 250mm above the silo roof. e) Operating platform covering total plan areawise in silo structure made of grating shall be provided below the hopper outlet.
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B SUB-SECTION-D-01 CIVIL WORKS PAGE 17 OF 245



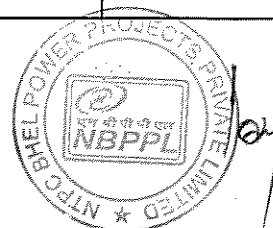
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CLAUSE NO.	CIVIL WORKS 		
3.03.12	f) The minimum clear distance between the bottom of the hopper and the top of the ground floor paving of the silo area shall be 6.0m. g) Top level platform and operating platform for two silos shall be connected to ground with a common open steel staircase. h) The silo supporting structure shall also support all the equipments, instruments, fittings and attachments associated with silos, such as aeration system, dust separators, hoists, ventilation filter, all valves including the valves below silos, vibration feeders with measuring arrangement, hydromix conditioners alongwith associated water piping and valves, dry fly ash unloaders, loads due to railway locomotive and ash wagons. i) The silos shall be supported at top and at bottom of cylindrical portion. The silo outlets provided at the bottom of silos shall have adequate lateral restraint to prevent vibrations. j) 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. k) The conical portion of the silos shall be lined. l) Independent access for trucks shall be provided below each silo. The trucks / tankers should be able to leave in forward direction without reversing. m) The columns of supporting structure shall have bracings in longitudinal as well in transverse directions. 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 IS:9178 considering structure exposed to atmosphere. The corrosion allowance shall be provided in addition to the requirement of minimum thickness of steel plate as per IS:9178. A comprehensive flowability study shall be conducted by the Bidder, for the coal bunker hopper to ensure smooth flow of coal in all seasons with different moisture contents and different percentage of fines. The geometric parameters of hopper		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 18 OF 245



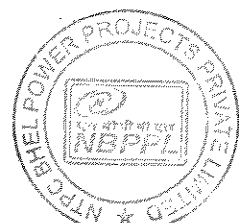
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	shall be decided considering the findings of the flowability study. Bunker shall be of MS while the hopper shall be of MS with stainless steel (grade SS 304) lining. The minimum thickness of MS plate and SS lining in hopper portion shall be 8 mm and 4 mm respectively. Samples of the coal to be actually fired in the power station shall be used for the flowability study. The effect of storage shall also be studied. The samples of the coal shall be collected by the Bidder from the source as indicated by the Employer. 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 nuisance. The bellow strap shall be of minimum 200 mm wide under un-stretched condition and shall be of minimum 2mm thick.		
3.03.13	The live storage capacity of each bunker shall be greater of the following: - Total 14 hours 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. - Total 14 hours 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. - Total 14 hours 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.		
3.03.14	For all capacity (volume) calculation and structural design (load calculation) unit weight of coal shall be assumed as 800 Kg/cu.m. and 1100 Kg/cu.m respectively.		
3.03.15	Design pressure on coal bunker/hopper walls shall take into account all possible flow regimes (core flow, mass flow, etc.), and different aeration regimes (radial, diametrical, radial and core, impulsive, etc).		
3.03.16	- 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. - For design and construction of steel-concrete composite members, IS: 11384 shall be followed. - For reinforcement detailing, IS: 5525 and SP: 34 shall be followed. - Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 19 OF 245

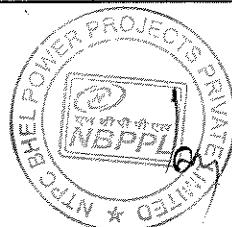


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CLAUSE NO.	CIVIL WORKS 		
3.03.17	a) All RCC liquid retaining/conveying structure (except water storage tanks) shall be designed in accordance with IS: 3370 (Part 1 to 4) by the working stress method, using limited steel stress. However, water storage tanks shall be designed as an uncracked section as per IS:3370 (Part 1 to 4) by working stress method. b) Water proofing treatment shall be provided for liquid retaining/ carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser /super-plasticiser cum water proofing compound shall be added to the concrete. All the construction/expansion joints shall be properly treated with PVC water bar and/or chemical injection grouting as per IS:6494. As applicable internal/external surface of such structures shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For liquid carrying/retaining structures, minimum two coats of such coating shall be applied. For external application wherever the surface is in contact with the earth, fine silica/quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non critical structures minimum two coats of bitumen grade 85/25 as per IS:702, mixed with 1% of anti-stripping compound meeting the requirement of IS:6241, shall be applied. The total application of bitumen shall not be less than 1.7 kg/sq.m. Bidder shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Employer's approval prior to commencement of work. c) All liquid retaining/carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.		
3.03.18	For design of all underground structures, foundations, C.W. ducts, etc. ground water table shall be assumed at the finished ground level unless specified otherwise.		
3.03.19	Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest or co-efficient of active earth pressure, whichever is applicable, depending upon the structural configuration. However, for the design of substructure of pump houses, earth pressure at rest shall be considered. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.		
3.03.20	a) Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid-		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 20 OF 245

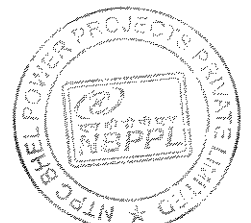


CLAUSE NO.	CIVIL WORKS			
3.03.21	i) Water pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.) ii) Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside. iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves/flap valves, etc., shall not be permitted to counter the buoyancy. iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level. b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance. c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads.			
	a) For the foundations of Turbo-generator, Boiler feed pumps, Fans (ID, FD and PA), Mills, etc. detailed static and dynamic analysis shall be done. The static analysis shall include all operating conditions, load cases and abnormal loads like short circuit, loss of blade, unbalance and seismic forces. Unbalanced loads for normal operating condition as given by machine manufacturer and/or VDI 2060 whichever is more conservative shall be used for calculating dynamic response. The dynamic analysis shall consist of free vibration analysis and forced vibration analysis. Transient analysis shall be carried out for the short circuit condition with an appropriate force function. Frequency separation criteria and amplitude criteria as laid down in IS:2974 and/or DIN 4024 and/or VDI 2056 and/or as required by the machine manufacturer, whichever is more stringent shall be satisfied. RCC design shall be done by the working stress method for all machine foundations. A fatigue factor of 2.0 shall be considered for dynamic forces. Minimum reinforcement shall be governed by IS:2974 as well as IS:456. However minimum reinforcement in bottom face of the foundation raft resting on soil or pile shall not be less than 0.2% of effective cross sectional area of the raft.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 21 OF 245



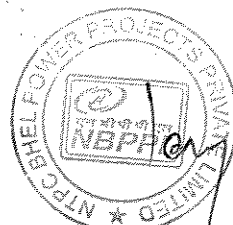
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CLAUSE NO.	CIVIL WORKS	एन टी पी सी NTPC	
	The special requirements for concreting including grade, type of aggregate, use of admixture, temperature control, ultrasonic testing, etc., shall be as mentioned elsewhere in this specification. b) All block foundations supporting rotating equipment resting on soil or piles shall be designed using the elastic half space theory. The mass of the RCC block shall not be less than three times the mass of the machine. Dynamic analysis shall be carried out to calculate natural frequencies in all the modes including coupled modes and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down in the relevant codes and/or by machine manufacturer whichever is more stringent shall be satisfied. Minimum reinforcement shall be governed by IS:2974 and IS:456. Minimum Reinforcement in base raft in either direction shall be as follows: - i) At bottom face - 0.2% of gross cross-sectional area ii) At top face - 0.12% of gross cross-sectional area c) For the foundations supporting minor rotating equipment weighing less than one tonne 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. d) Steam turbo-generators, Fans (ID, FD and PA), Boiler feed pumps shall be supported on vibration isolation system. The vibration isolation system shall consist of steel helical spring units and viscous dampers supporting the RCC deck, which would support the machine. The spring units shall conform to DIN 2089 and DIN 2096. e) The vibration isolation system supplied shall be of proven make and shall be in successful operation supporting machines like steam turbo-generators, ID/PA/FD Fans, BFP, etc., f) Isolation efficiency of at least 90% shall be provided for the Turbo-generator, BFP and ID/PA/FD Fan foundations. The nominal spring capacity shall be at least 25% higher than the actual spring-supported weight for the TG, BFP, and ID/PA/FD fan. Viscous dampers shall be designed for 3% to 5% of critical damping for TG, BFP, and ID/PA/FD fan foundations. g) Springs and dampers of the vibration isolation system shall be located above the finished floor level for ID/PA/FD fans. Basements/pits/trenches shall not be provided for these machine foundations.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 22 OF 245



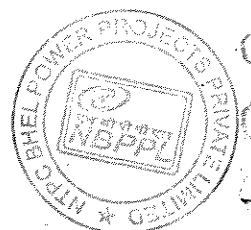
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CLAUSE NO.	CIVIL WORKS			
3.03.22	If RCC floor/roof is assumed to act as diaphragm, transmitting lateral loads to braced bays, it shall be provided with shear connectors. However, whenever large / more number of cut-outs are provided in the floor slab, horizontal floor bracings shall be provided below slab to transfer horizontal force to columns without considering diaphragm action from slab.			
3.03.23	All roads shall be of flexible pavements unless otherwise specified design of flexible pavement shall be carried out as per IRC-37. The minimum requirements as specified in table under figure-2 of IRC-37 w.r.t. surfacing base and sub base shall be followed. The design traffic load shall be a minimum 4 million cumulative standard axle. In case of concrete pavement the design shall be carried out as per IRC-58.			
3.03.24	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 8 m 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 750mm 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, etc. where the floor shall be of RCC. Oil equipment room shall also have RCC floor below the grating floor.			
3.03.25	The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. These values shall be based on the recommendations of the Indian Meteorological Department (IMD). 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.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 23 OF 245



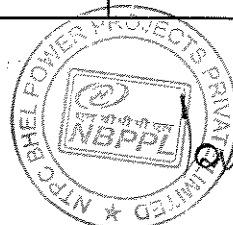
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CLAUSE NO.	CIVIL WORKS	एनडीपीसी NTPC	
3.03.26	Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec.		
	Manual on sewerage and sewage treatment (published by Central Public Health Environment Engineering Organisation, Government of India) shall be followed for design purpose.		
3.03.27	Roof decking sheets shall be designed as per IS: 801 to carry the self load, dead load due to RCC slab and finishes and imposed load. The deflection of metal deck shall be limited as per BS: 5950. In case composite action is considered in the design, suitable shear studs shall be provided as per BS: 5950.		
3.03.28	Foundations for all tanks shall be designed for as per IS: 803.		
3.03.29	Footings shall be so proportioned to as to minimise the differential settlement.		
3.03.30	Boiler/ ESP support structures shall be designed for: i) Live/Imposed loads. ii) Dead load iii) Static and dynamic loads of piping, movable equipment and maintenance parts. iv) Loads from cable trays and walkways supported on columns. v) Ash water piping supported on the outermost row of boiler columns. vi) 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 upto the inlet duct bottom level at a natural repose angle (not less than 30 degree to horizontal in any case). vii) Ash load at bottom ash hopper and pent house of the boiler shall be as mentioned in the mechanical chapter of the specifications. viii) Seismic and wind loads as specified elsewhere in the specifications. ix) Temperature variation of +/-25°C for atmospheric temperature variations. x) Temperature variations under ESP operating condition. xi) The loads listed above indicate the minimum requirements.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 24 OF 245

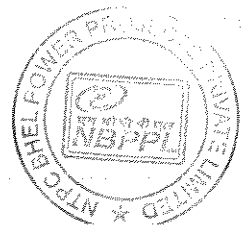


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CLAUSE NO.	CIVIL WORKS		
3.03.31	Boiler supporting structures shall be so configured that the temperature of steel does not exceed 60 °C unless specified otherwise. Brackets shall be provided on both sides of the outermost row of columns of both the 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.		
3.03.32	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.		
3.03.33	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.		
3.03.34	Design Criteria for foundations and some other facilities/areas are covered separately in this specification.		
3.03.35	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.		
3.03.36	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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 25 OF 245

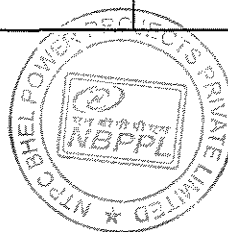


CLAUSE NO.	CIVIL WORKS 		
3.03.37	c) Shear connections shall be designed for 60% of section strength for rolled sections and 80% of section strength for built up section or rolled section with cover plates. However, if load is more than above, the connection shall be designed for actual load. d) Moment connections between beam and column shall be designed for 100% of moment capacity of the beam section. This can be achieved either by direct butt welding of the top flange of beam with column flange or by providing top moment plate with suitable notch for additional weld length. 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. In exceptional cases, the field splicing shall be designed for 50% of load carried by the cover plates and remaining 50% load through full penetration butt weld. 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.		
	Pipe Pedestals, pipe supports and other structures for Ash handling/ash water recirculation 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 C_o - 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 26 OF 245



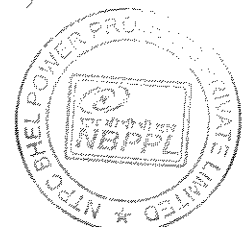
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CLAUSE NO.	CIVIL WORKS			
3.03.38	c) The design and construction of RCC structures shall be carried out as per IS: 456. In general, limit state theory shall be followed for the design of RCC structures, however, working stress method shall be adopted 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.			
	Coal Handling Plant structures a) The loads for all railway load bearing structures e. g. track hopper including machinery hatches, tunnel, culverts and under ground transfer houses etc. and the analysis and the design of these structures shall be made strictly in accordance with the provisions of Indian Railway Bridge rules (latest edition), and Indian Railway Codes of practice (latest edition) with all amendments up to the date of opening of bids. However, the axle load for analysis and design shall be considered as 30 MT. Coal heap of 1.2m height shall be considered above hopper top for design of coal tray, hopper and supporting elements of track hopper. The analysis, design and detailed drawing for the structure coming below the railway track shall be got approved by the Bidder from the concerned railway authorities before taking up construction. All necessary payment for the above work shall be made by the bidder to the railway authority. b) The crusher and 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. c) Design of Hopper walls shall be done for both Static & Dynamic flow condition using Walker's theory d) 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. e) The buildings shall conform to local bye - laws, rules and regulations for industrial buildings and also B. I. S. publications, SP 32 and 41. f) Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports. g) Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 27 OF 245

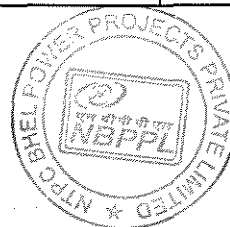


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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
3.04.00	h) For design of R. C. C. pipes for culverts, latest editions of IS : 458, IS : 783 should be followed. i) Design of masonry walls shall be made as per IS : 1905. j) Minimum reinforcement shall be provided at the top face of the footing, even if, no reinforcement is required as per design.		
	Architectural Concepts and Design (a) Layout of the plant area shall have definite hierarchy of road network depending upon its usage, aesthetic, visual sensibilities for creating road vistas, focal road vistas, focal points, building back drops, building frames. General layout shall be evolved considering the landform & local climate and due consideration shall be given to orientation and wind direction. The resulting built mass shall present a definite image with in distinct vocabulary in the form of landmarks, nodes and skyline and at the same time, merge harmoniously with the existing buildings. (b) Main Plant building shall be architecturally treated in such a way that it retains a monumental scale, yet presents a pleasing composition of mass and void with suitable and functionally designed projections and recesses. The overall impact of the building shall be one of aesthetically unified architectural composition having a comprehensible scale, blending tonal values with the surroundings and taking full consideration of the climatic conditions, the building orientation and the existing structures of stage I&II. (c) All other buildings and structures shall be architecturally treated in such a way so as to be in complete harmony with the main plant, surrounding structures and environment. Local architectural characters and materials may be judiciously imbibed. The building shall be designed initiating an architectural control common to all buildings. (d) Overall colour scheme of the plant and other 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. (e) Natural light shall be used to the maximum extent, especially in the form of North Light/sky light. For adequate light and ventilation, National Building Code recommendations shall be followed. (f) Entrance canopies chajjas (projections, recesses) over open able windows and door openings on exterior facades shall be provided.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 28 OF 245

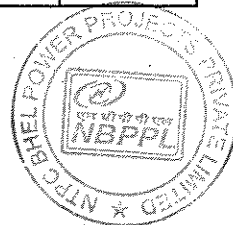


CLAUSE NO.	CIVIL WORKS 		
	(g) All the buildings shall be architecturally designed to meet the National Building Code. (h) During design stage, Technical specification as prepared shall govern the finishes as well as quantity. (i) Human safety factors shall form firm basis of design criteria. (j) Service building and Canteen building shall be designed as ECBC (Energy Conservation Building Code) compliant building achieving energy efficiency. In addition Green Building concept shall be incorporated in the design of Service Building. (k) All public buildings shall be designed on the principles of providing barrier free environment for physically disabled persons. (l) Overall emphasis shall be on developing eco-friendly architecture, merging with the nature with its own sustainable energy management systems. Buildings Main Power house Building External cladding for the building will be of brick wall upto a height of 3M except the wall adjacent to the generator transformer, which will be of RCC upto 10M height for fire protection purpose and single skin metal panel will be provided for remaining height of the building. On B-row, the wall will be from roof level upto Deaerator floor with single skin metal cladding finish. Double skin metal panel cladding shall be provided above TG hall level for A row & Gable end. Glazing for A Row & Gable end shall be Reflective toughened glass with Al.frame. Hermetically sealed double glazing shall be provided between A/C areas & non-A/C areas. On C-row brick wall shall be upto Deaerator floor with single skin sheeting covering and full height of brick wall with single sheet cladding in UPS battery room area and control equipment room area. Existing predominant building elements, colour, window levels etc would be strong design guidelines. Harmony in internal ambience and external appearance is to be achieved to match with the surroundings. Functionally the very heart of Power House Building is its Control Room. Special attention shall be given for conceptualisation of interior design of the Control Room.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 29 OF 245

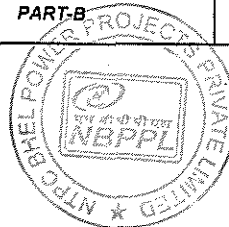


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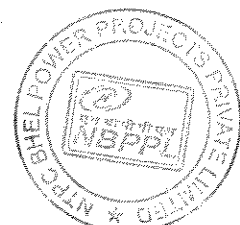
CLAUSE NO.	CIVIL WORKS 		
	ARCW Pump House / Air Washer Building This building shall be steel framed structure with 230mm thk. brick wall & single skin metal cladding of sizes as per mechanical general arrangement drawing. Roof of the building shall be metal sheeting on steel roof truss. Steel columns and beams shall be encased with brick and concrete, wherever applicable. Metal side cladding shall be composed of different colour shades to match with the existing surroundings. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. Provision of different rooms and staff facilities within this building shall be kept as per mechanical general arrangement drawings. Safety norms shall be followed as applicable. Facilities for the staff shall be provided as applicable. Air Compressor Building This building shall be steel framed structure with 230mm thk. brick wall & single skin metal cladding of sizes as per mechanical general arrangement drawing. Roof of the building shall be metal sheeting on steel roof truss. Steel columns and beams shall be encased with brick and concrete, wherever applicable. Metal side cladding shall be composed of different colour shades to match with the existing surroundings. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. Provision of different rooms and staff facilities within this building shall be kept as per mechanical general arrangement drawings. Safety norms shall be followed as applicable. Facilities for the staff shall be provided as applicable. D.G. Building This building shall be steel framed structure with 230mm thk. brick wall & single skin metal cladding of sizes as per mechanical general arrangement drawing. Roof of the building shall be metal sheeting on steel roof truss. Steel columns and beams shall be encased with brick and concrete, wherever applicable. Metal side cladding shall be composed of different colour shades to match with the existing surroundings. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 30 OF 245



CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC
	Provision of different rooms and staff facilities within this building shall be kept as per mechanical general arrangement drawings. Safety norms shall be followed as applicable. Facilities for the staff shall be provided as applicable. Mill & Bunker Building The Mill & Bunker Building shall be a structural steel framed structure having RCC floors and insulated metal sheet sloped roof at required levels. The tripper floor shall be clad with single skin metal cladding. ESP Control Building This building shall be steel framed structure with 230mm thk. brick wall as per mechanical general arrangement drawing with RCC floor and roof at required level as per the drawing. Steel columns and beam encased with brick / RCC, wherever applicable. External finish shall be combination of Acrylic Co-polymer resin bonded paint and textured granular paint. 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. Side cladding shall be of brick wall with wall in front of transformer yard made sufficiently thick to satisfy fire rating as per TAC regulations. EC control room and VFD room shall be air-conditioned and shall have steel false ceiling. Safety norms shall be followed as applicable. Facilities for the staff shall be provided as applicable. Service Building This building shall be 230mm thk. brick masonry (G + 4 storied) having RCC frame with RCC floors and roof. Size of the building shall be 28m X 28m having floor-to-floor height 4.25m as per architectural layout. A connecting corridor with MPH building shall be provided at operating floor level. This is one of the most prestigious buildings within the plant area, both location wise and function wise, which calls for an identity of its own. External finishing shall be coloured granular textured paint, Coloured Aluminium Composite panels shall also be considered to accentuate the appearance of this building. The	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 31 OF 245



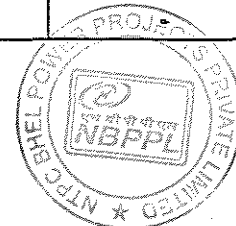
CLAUSE NO.	CIVIL WORKS		
	building design shall be based on achieving ECBC compliance. Structural glazing with hermetically sealed double glass to be provided for external glazing. This building shall house offices for Operation staff, Conference room, C & I Laboratory, etc. This will be fully air-conditioned building with adequate provision of toilets, pantry etc. 2nos. capsule lift shall be housed within the central atrium. The atrium shall have polycarbonate sheet dome cover of suitable shape at roof level. Fuel Oil Handling Buildings These buildings shall be 230mm thick brick masonry having RCC frame with RCC floors and roof. The size of the building shall be as per mechanical general arrangement drawing. External finish shall be combination of Acrylic Co-polymer resin bonded paint and textured granular paint. Safety norms shall be followed as applicable. Facilities for the staff shall be provided as applicable. Fuel oil pressurisation pump house will house fuel oil pumps, heaters and MCC's. The pumps will be located in an R.C.C basement. Protective handrail shall be provided all round the basement. MCC shall be located at plinth level. Proper access shall be given to the basement. Basement shall be given proper drainage facility. O&M Store This building shall be 230mm thk. brick masonry having RCC framed with RCC floors and roof, with covered area of 1500 SqM. The roof shall be flat with gentle slope of about 1:100 in one direction. Heavy material store area a 3-tier bay will be RCC slab over trough metal sheet decking resting on steel purling supported on steel girders. Light material store and office area will be RCC flat roof supported on RCC beams. Heavy material store shall be single storey building and Light material store shall be double storey building. Heavy material store shall have column free space for easy movement of materials. A part of light material store shall have facility for storing electronic equipment / instruments. This particular area shall be air-conditioned for dust proof environment. A central office shall be provided for management and monitoring the stored materials. Adequate space shall be kept for loading unloading of materials. Office shall space for Supervisor/In-Charge room, general office cum record-documentation area, toilets, pantry, etc.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 32 OF 245



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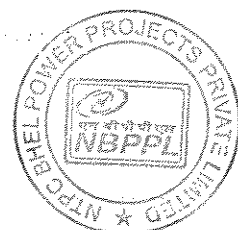
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CLAUSE NO.	CIVIL WORKS	एनडीपीसी NTPC	
	External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. Dozer Shed This building shall be steel structure with brick masonry / metal cladding with RCC slab/metal roofing, with covered area of 500 SqM. The roof shall be flat with gentle slope of about 1:100 in one direction. Metal side cladding shall be composed of different colour shades to match with the existing surroundings. External finish for brick walls shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. CHP Maintenance Building This building shall be 2 storeyed, RCC frame with brick masonry. Total covered area of the building shall be 900 SqM. The roof shall be flat with gentle slope of about 1:100 in one direction. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. Hydrogen Generation Plant Building This building shall be RCC frame with brick masonry. Total covered area of the building shall be 625 SqM. The size of the building shall be as per Mechanical General Arrangement drawing. This building falls under hazardous building category. The entire building campus shall be properly fenced to prevent unauthorised ingress or egress. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. Safety norms shall be followed as applicable. Facilities for the staff shall be provided as applicable. Canteen This building shall be single storied RCC frame structure with RCC roof with covered area of 1000 SqM.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 33 OF 245



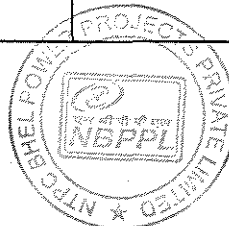
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC
	The building shall have entrance lobby, dining hall for staff, dining room for executives, pantry, kitchen, office, stores, wash areas, rest room for kitchen staff, toilets, etc. The building shall have its own identity and shall be achieved by inviting built form within pleasing landscaped surroundings. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. Internal finish -floor and walls upto lintel level- shall be suitable for washing and cleaning regularly. There shall be separate service road and entrance for supply of cooking materials and garbage disposal. CW Pump House This building shall be steel framed structure with 230mm thk. brick wall & single skin metal cladding of sizes as per mechanical general arrangement drawing. Roof of the building shall be metal sheeting on steel roof truss. Steel columns and beams shall be encased with brick and concrete, wherever applicable. Metal side cladding shall be composed of different colour shades to match with the existing surroundings. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. Provision of different rooms and staff facilities within this building shall be kept as per mechanical general arrangement drawings. Safety norms shall be followed as applicable. Facilities for the staff shall be provided as applicable. Fire Water Pump House This shall be RCC framed structured building with RCC roof and brick masonry. The size of the building shall be as per mechanical general arrangement drawing. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. Safety norms shall be followed as applicable. The building shall house pumps, MCCs, etc. Facilities for the staff shall be provided as applicable.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
		PAGE 34 OF 245



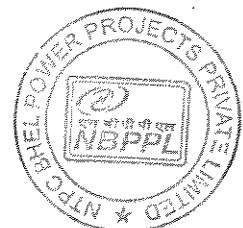
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CLAUSE NO.	CIVIL WORKS 		
	Cooling Tower Switch Gear Room/Control Room This shall be single storeyed building, framed RCC structure with beams, columns, floor and roof. It shall have non-load bearing brick wall cladding. It shall house the switch gear and MCC of cooling tower & associated cable trenches. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. DM & PT plant structure All buildings shall have framed super structure. Buildings with sheds shall not have brick cladding. 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. Roof of the building shall be metal sheeting on steel roof truss / metal deck roofing. Unless specified, the wall cladding shall be with minimum one brick thick on exterior face. Metal side cladding shall be composed of different colour shades to match with the existing surroundings. External finish shall be combination of Acrylic co-polymer resin bonded paint and textured granular paint. The building shall have toilets, pantries / kitchen, office rooms, laboratories, control rooms, MCC rooms, etc. Switchyard Control Room building This buildings shall have framed super structure The Control Room building shall have RCC framed super structure with brick wall cladding on exterior face. The Control room building shall consist of rooms/facilities/ equipments/ 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. Unless specified, the wall cladding shall be with minimum one brick thick on exterior face.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 35 OF 245

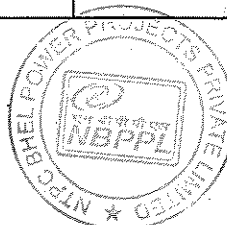


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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
3.05.00	Corrosion Protection		
3.05.01	General		
	(a) All equipments, pipes, etc. shall be painted as per the requirements specified in the relevant section of the specification.		
	(b) All Steel structures (except those embedded in Concrete) shall be provided with Painting as given below which is designed for a minimum maintenance free life of Ten (10) years (expected life, long range Ten (10) to Twenty (20) years, as per BS : 5493.		
	(c) All Paints shall be of high build constitution.		
	(d) All Painting shall be done as per approved Painting scheme of the Vendors / Manufacturers, which shall be submitted by the Bidder and as approved by the Employer. Painting scheme shall also include Item codification / Description of all Coats of Paints for manufacturer's, from whom the Paint is intended to be procured.		
3.05.02	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.		
3.05.03	Painting of Steel Surfaces (other than those embedded in Concrete)		
	(a) All Steel surfaces shall be provided with self curing Inorganic Zinc Silicate Primer Coat (Solid by Volume Minimum 60%) of Minimum 75 Micron Dry Film Thickness (DFT) applied over blast cleaned surface to near white metal conforming to Sa 2 ½ finish of Swedish standard SIS-05-5900. The Primer Coat shall be applied in Shop immediately after blast cleaning by Airless spray technique.		
	(b) Primer Coat shall be followed with the application of Intermediate Coat of Polyamide Cured pigmented Titanium Dioxide (TiO2) or Micaceous Iron Oxide (MIO) Epoxy based Paint (Solid by Volume Minimum 60%) of		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 36 OF 245

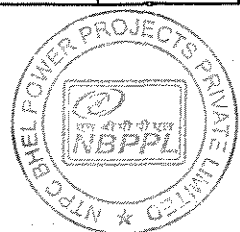


CLAUSE NO.	CIVIL WORKS			
3.05.04	Minimum 75 Micron DFT. This Coat shall be applied in Shop after an interval of Minimum overnight (from the application of Primer Coat) by Airless spray technique.			
	(c) - Intermediate Coat shall be followed with the application of Finish Coat of Polyamide Cured colour pigmented Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied after an interval of Minimum overnight and maximum indefinite (from the application of Intermediate Coat) either before Erection by Airless spray technique or after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Employer. The Finish Coat thickness of 75 Micron can be built up either in Single application at Shop or in two applications one at Shop and the other at Site. (d) Finish Coat shall be followed with the application of Final Finish Coat of Polyurethane based colour pigmented Paint (Solid by Volume Minimum 40%) of Minimum 25 Micron DFT. This Coat shall be applied within Seven (7) days (from the completion of Finish Coat), after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Employer.			
3.05.04	Touch-up Painting on damaged areas			
	(a) For Coatings damaged up to metal surface Surface preparation shall be carried out by Manual Cleaning. Minimum 6 inches adjoining area with existing Coating shall be roughened by Wire brushing, emery paper rubbing etc., for best adhesion of patch Primer. Over this Primer Coat, Intermediate Coat, Finish Coat and Final Finish Coat shall be applied as covered above by brush with Intermediate Coat applied within maximum seven (7) days of application of touch up Primer. (b) For Coatings damaged upto Intermediate Coatings (i.e. where Primer Coat is intact). Damaged area including Minimum 6 inches adjoining area with existing Coating should be roughened by wire brushing, emery paper rubbing etc., for best adhesion of patch Primer without damaging the Primer Coat. Touch-up Primer, Intermediate, Finish and Final Finish Coats shall be applied as specified above for Coatings damaged up to metal surface.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 37 OF 245

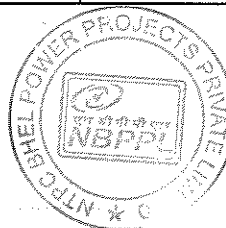


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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
3.05.05	Painting of Welded areas / Painting of areas exposed after removal of temporary supports / Touch-up Painting on damaged areas Structures, where inter-connection, Welding / modification etc. has been carried out by the Bidder. (a) Clean the surface to remove flux spatters and loose rust, loose Coatings in the adjoining areas of Weld seams by wire brush and emery paper. (b) Painting procedure to be followed as mentioned above for Touch-up Painting on damaged areas.			
3.05.06	Dry film thickness of each coat shall be checked and measured as per the procedure specified in paint application standard no. 2 by SSPC: The Society for Protective Coating. The thickness as measured shall not be less than the minimum thickness specified for the coat of paint under relevant clauses of technical specification.			
3.05.07	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 Gms / 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.			
3.05.08	Gratings All gratings shall be blast cleaned to Sa 2 ½ finish of Swedish standard SIS-05-5900 and shall be hot dip galvanised at the rate of 610 Gms / Sq. M.			
3.05.09	Hand Railings and Ladders All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS : 4736.			
3.05.10	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.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 38 OF 245

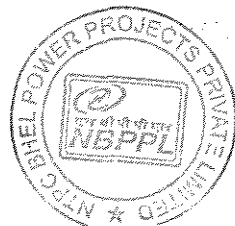


CLAUSE NO.	CIVIL WORKS		
3.05.11	All structural steel members in switchyard (excluding fencing and gate) shall be hot dip galvanised as specified elsewhere.		
3.05.12	For reinforced concrete work. i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical 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.		
4.00.00	FOUNDATION SYSTEM AND GEOTECHNICAL DATA		
4.01.00	SOIL DATA AND FOUNDATION SYSTEM		
	Bearing capacity and pile capacities for design of foundations and Borelogs data are given at Annexure - I of this specification.		
4.02.00	Soil Data		
4.02.01	Employer is carrying out detailed geotechnical investigation in the main plant area and balance of plant area. The detailed geotechnical investigation report comprising of Boreholes, Laboratory tests, Chemical analysis, etc. in respect of the sub-strata prevailing at site will be made available for the Bidder's study at the Employer's office, if required. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder.		
4.03.00	Foundation System		
	The requirements for the foundation system to be adopted are as given in subsequent clauses.		
4.03.01	General Requirements		
	(a.) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or on pile foundations.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 39 OF 245



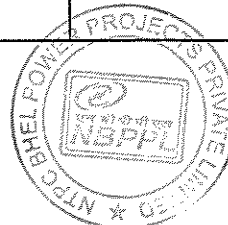
08712

CLAUSE NO.	CIVIL WORKS 		
4.03.02	(b.) The roads, ground floor slabs, trenches, channels/drains and staircase foundation with foundation loading intensity less than 5 T / M² may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. (c.) No other foundation 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. The water table for design purpose shall be considered at Finished Ground Level. (e.) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building. 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.) The minimum depth of foundation shall be 1.0 m below natural ground level. (c.) Minimum founding level, bearing capacity and permissible settlements shall be as given in the Annexure - 1 to this specification. In case pile foundations are to be adopted the requirements under para "pile foundations" shall be adhered to.		
	4.03.03 Pile Foundations In case piles are adopted, following shall be adhered to : i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using self erecting Rotary Hydraulic Rigs. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 40 OF 245



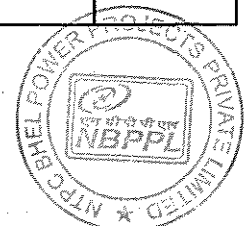
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CLAUSE NO.	CIVIL WORKS			एन टी सी NTPC				
	ii) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in vertical compression shall be limited to the values given at Annexure - I. The uplift and lateral load capacity shall be respectively restricted to 30% and 5% of the allowable load capacity in vertical compression. However, the pile capacities to be adopted shall be the least of the estimated design values and that obtained from the initial pile load tests. iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m. iv) The bidder shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, locations of initial test piles etc.) for Engineer's approval. v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Bidder for Engineer's approval. vi) Number of initial load tests to be performed for each diameter & length and rated capacity of pile shall be subject to minimum as under. <table><tr><td>Vertical</td><td rowspan="3">Minimum of 3 Nos. in each mode in BTG area and 2 Nos. in Balance of Plant (BOP) area.</td></tr><tr><td>Lateral</td></tr><tr><td>Uplift</td></tr></table> vii) The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. In case of compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part). viii) Load test shall be conducted at pile cut of level (COL). If the water table is above the COL the test pit shall be kept dry through out the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter. ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under :				Vertical	Minimum of 3 Nos. in each mode in BTG area and 2 Nos. in Balance of Plant (BOP) area.	Lateral	Uplift
Vertical	Minimum of 3 Nos. in each mode in BTG area and 2 Nos. in Balance of Plant (BOP) area.							
Lateral								
Uplift								
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 41 OF 245				



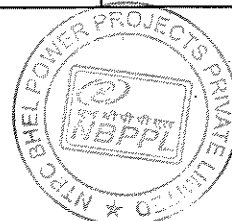
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC
	i) Vertical : 0.5% of the total number of piles provided. ii) Lateral : 0.5% of the total number of piles provided. x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer. xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Bidder shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required. xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Bidder shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm. xiii) The test load on initial test piles shall be applied by means of reaction from anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge. xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM. xv) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles.	
4.04.00	Special Requirements	
4.04.01	Details of treatment for foundations / underground structures required to counteract soil / water chemical environment, cement type, grade of concrete, type of reinforcement, cover to reinforcement and protective coating to foundations, etc. shall be as mentioned in Annexure-1 of this specification.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
		PAGE 42 OF 245

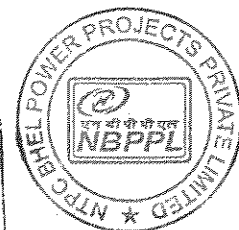


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CLAUSE NO.	CIVIL WORKS 		
4.05.00	Excavation, Filling and Dewatering		
4.05.01	For excavation works, comprehensive dewatering with well point or deep wells arrangement wherever required shall be adopted. Scheme for dewatering and design with all computations and back data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.		
4.05.02	Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M 7.5. 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.		
4.05.03	Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 75% of relative density for non cohesive soils.		
4.05.04	The 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.		
4.05.05	CBR tests for pavement/road design shall be carried out by the Bidder after earth filling (if applicable) has been completed upto the formation level.		
4.05.06	Following details shall be submitted by the Bidder before start of work at site. Scheme for initial pile load tests in vertical, lateral and uplift modes along with supporting design calculations and methodology for installation of working piles and the complete piles installation data for individual pile including the pile test result for all piles (for reference only).		
4.06.00	Sheeting & Shoring The Bidder shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation, executing the work. Sheet Piling, Cofferdams, sheeting and shoring, bracing and maintaining suitable slopes, draining etc. shall be provided and installed by the Bidder, to the satisfaction of the Engineer.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 43 OF 245

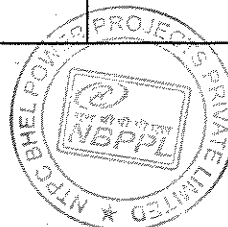


CLAUSE NO.	CIVIL WORKS	एन टी पी सी NTPC						
	ANNEXURE-I SOIL DATA AND FOUNDATION SYSTEM a) Logs of representative boreholes from this area are enclosed with this Annexure. b) The foundation system to be adopted for different structures shall be as given in Table – 1 below Table – 1: Net Allowable Bearing Pressure <table><tr><th>STRUCTURE</th><th>TYPE OF FOUNDATION TO BE ADOPTED</th></tr><tr><td>Boiler and Mills, Bunker buildings, Power House building, TG's, Chimneys, TP's, Crusher House, Conveyor Trestle (in BTG area)</td><td>Piles</td></tr><tr><td>ESP & ESP Control Room, ID Duct support columns, Transformer yard, Cooling Tower, Stacker Reclaimer, DM PH, DM Tanks, CST PH, CWPH, Air Compressor House, Control room/service building, FW tanks, FWPH, SW tanks, SWPH, FO Tanks, FO PH, Ash silos, TACH, ASPH, BAST, AWPB, Settling Tank, Clarified water Pump House & Storage Tank, Switchyard, Track hopper, Chlorination Building, H2 Plant, PT Plant, AC & MCC, Conveyor Trestle (other than BTG area), Pipe and Cable Trestles, O&M Store, Dozer Maintenance Shed, Fire Station Building, CHP Office & Maintenance Building, Ash Dyke Area, Canteen</td><td>Open</td></tr></table>	STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED	Boiler and Mills, Bunker buildings, Power House building, TG's, Chimneys, TP's, Crusher House, Conveyor Trestle (in BTG area)	Piles	ESP & ESP Control Room, ID Duct support columns, Transformer yard, Cooling Tower, Stacker Reclaimer, DM PH, DM Tanks, CST PH, CWPH, Air Compressor House, Control room/service building, FW tanks, FWPH, SW tanks, SWPH, FO Tanks, FO PH, Ash silos, TACH, ASPH, BAST, AWPB, Settling Tank, Clarified water Pump House & Storage Tank, Switchyard, Track hopper, Chlorination Building, H2 Plant, PT Plant, AC & MCC, Conveyor Trestle (other than BTG area), Pipe and Cable Trestles, O&M Store, Dozer Maintenance Shed, Fire Station Building, CHP Office & Maintenance Building, Ash Dyke Area, Canteen	Open	
STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED							
Boiler and Mills, Bunker buildings, Power House building, TG's, Chimneys, TP's, Crusher House, Conveyor Trestle (in BTG area)	Piles							
ESP & ESP Control Room, ID Duct support columns, Transformer yard, Cooling Tower, Stacker Reclaimer, DM PH, DM Tanks, CST PH, CWPH, Air Compressor House, Control room/service building, FW tanks, FWPH, SW tanks, SWPH, FO Tanks, FO PH, Ash silos, TACH, ASPH, BAST, AWPB, Settling Tank, Clarified water Pump House & Storage Tank, Switchyard, Track hopper, Chlorination Building, H2 Plant, PT Plant, AC & MCC, Conveyor Trestle (other than BTG area), Pipe and Cable Trestles, O&M Store, Dozer Maintenance Shed, Fire Station Building, CHP Office & Maintenance Building, Ash Dyke Area, Canteen	Open							
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS						
		PAGE 44 OF 245						



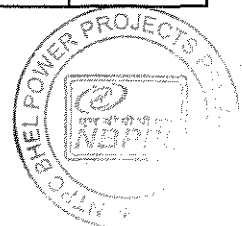
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CLAUSE NO.	CIVIL WORKS				एन टी पी सी NTPC																													
	c) The minimum founding level and the corresponding net allowable bearing pressure shall be as given in Table – 2 below.																																	
	Table – 2: Net Allowable Bearing Pressure																																	
	<table><tr><th rowspan="2">Facility</th><th rowspan="2">Type of Foundation System</th><th rowspan="2">Depth of Foundation below NGL (m)</th><th colspan="2">Net Allowable bearing pressure (T/m²)</th></tr><tr><th>Width (1-6m)</th><th>Width > 6m (Raft)</th></tr><tr><td rowspan="4">ESP & ESP Control Room, ID Duct support columns, Transformer yard, Cooling Tower, Stack Reclaimer, DM PH, DM Tanks, CST PH, CWP, Air Compressor House, Control room/service building, FW tanks, FWPH, SW tanks, SWPH, FO Tanks, FO PH, Ash silos, TACH, ASPH, BAST, Wagon Tripper, Track hopper, Chlorination Building, H2 Plant, Conveyor Trestle (other than BTG area), AC & MCC, AWP, Settling Tank, CHP Office & Maintenance Building, DM treatment plant, CW chemical treatment, WSPH, Effluent treatment area, Clarifier</td><td rowspan="4">Open</td><td>2 m</td><td>12</td><td>14</td></tr><tr><td>3 m</td><td>15</td><td>18</td></tr><tr><td>4 m</td><td>16</td><td>20</td></tr><tr><td>5 m</td><td>20</td><td>24</td></tr><tr><td rowspan="2">Switchyard</td><td rowspan="2">Open</td><td>2 m</td><td>6</td><td>8</td></tr><tr><td>3 m</td><td>8</td><td>10</td></tr></table>					Facility	Type of Foundation System	Depth of Foundation below NGL (m)	Net Allowable bearing pressure (T/m ²)		Width (1-6m)	Width > 6m (Raft)	ESP & ESP Control Room, ID Duct support columns, Transformer yard, Cooling Tower, Stack Reclaimer, DM PH, DM Tanks, CST PH, CWP, Air Compressor House, Control room/service building, FW tanks, FWPH, SW tanks, SWPH, FO Tanks, FO PH, Ash silos, TACH, ASPH, BAST, Wagon Tripper, Track hopper, Chlorination Building, H2 Plant, Conveyor Trestle (other than BTG area), AC & MCC, AWP, Settling Tank, CHP Office & Maintenance Building, DM treatment plant, CW chemical treatment, WSPH, Effluent treatment area, Clarifier	Open	2 m	12	14	3 m	15	18	4 m	16	20	5 m	20	24	Switchyard	Open	2 m	6	8	3 m	8	10
Facility	Type of Foundation System	Depth of Foundation below NGL (m)	Net Allowable bearing pressure (T/m ²)																															
			Width (1-6m)	Width > 6m (Raft)																														
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		3 m	15	18																														
		4 m	16	20																														
		5 m	20	24																														
Switchyard	Open	2 m	6	8																														
		3 m	8	10																														
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS		PAGE 45 OF 245																													

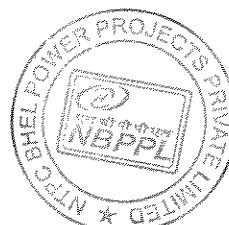


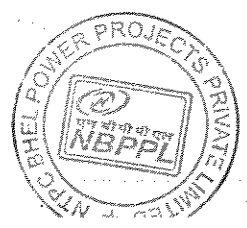
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CLAUSE NO.	CIVIL WORKS					एनटीपीसी NTPC																					
	<table><tr><td rowspan="4">Pipe and Cable Trestles, O&M Store, Dozer Maintenance Shed, Fire Station Building, Clarified water pump house & Storage tank, chemical house, sludge sump/PH, Canteen</td><td>Open</td><td>2 m</td><td>8</td><td>10</td></tr><tr><td></td><td>3 m</td><td>10</td><td>12</td></tr><tr><td></td><td>4 m</td><td>12</td><td>15</td></tr><tr><td></td><td>5 m</td><td>15</td><td>18</td></tr><tr><td>Ash Dyke Area</td><td>Open</td><td>-</td><td>-</td><td>-</td></tr></table>					Pipe and Cable Trestles, O&M Store, Dozer Maintenance Shed, Fire Station Building, Clarified water pump house & Storage tank, chemical house, sludge sump/PH, Canteen	Open	2 m	8	10		3 m	10	12		4 m	12	15		5 m	15	18	Ash Dyke Area	Open	-	-	-
Pipe and Cable Trestles, O&M Store, Dozer Maintenance Shed, Fire Station Building, Clarified water pump house & Storage tank, chemical house, sludge sump/PH, Canteen	Open	2 m	8	10																							
		3 m	10	12																							
		4 m	12	15																							
		5 m	15	18																							
Ash Dyke Area	Open	-	-	-																							
NGL - Natural Ground Level 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. d) Permissible Settlement of Foundations: For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following: <table><tr><td>Isolated & Strip</td><td>40 mm</td></tr><tr><td>Raft (widths greater than 6 m)</td><td>75 mm</td></tr><tr><td>Foundations on weathered rock</td><td>12 mm</td></tr></table> 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.						Isolated & Strip	40 mm	Raft (widths greater than 6 m)	75 mm	Foundations on weathered rock	12 mm																
Isolated & Strip	40 mm																										
Raft (widths greater than 6 m)	75 mm																										
Foundations on weathered rock	12 mm																										
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS		PAGE 46 OF 245																					



CLAUSE NO.	CIVIL WORKS				एन टी पी सी NTPC															
	e)	The diameter of pile, minimum length and maximum allowable capacity of piles shall be as given below:																		
		<table><tr><th rowspan="2">Pile Diameter (mm)</th><th rowspan="2">Minimum Length of Bored Pile Below Cut-off Level (m)</th><th colspan="3">Safe Load Capacity in</th></tr><tr><th>Vertical Comp.(MT)</th><th>Pullout (MT)</th><th>Lateral (MT)</th></tr><tr><td>600</td><td>15.0</td><td>140</td><td>42.0</td><td>7.0</td></tr><tr><td>760</td><td>16.0</td><td>250</td><td>75.0</td><td>12.5</td></tr></table>	Pile Diameter (mm)	Minimum Length of Bored Pile Below Cut-off Level (m)	Safe Load Capacity in			Vertical Comp.(MT)	Pullout (MT)	Lateral (MT)	600	15.0	140	42.0	7.0	760	16.0	250	75.0	12.5
	Pile Diameter (mm)	Minimum Length of Bored Pile Below Cut-off Level (m)			Safe Load Capacity in															
			Vertical Comp.(MT)	Pullout (MT)	Lateral (MT)															
	600	15.0	140	42.0	7.0															
	760	16.0	250	75.0	12.5															
		- Cut off Level (COL) is assumed at 3.0 m below Finished Ground Level.																		
	f)	The criteria for Pile Termination (founding level) shall be as given below:																		
		The termination level of the pile shall be decided based on the following criterion																		
		i)	Minimum length of the pile below COL (cut off level) shall be as specified above																	
	ii)	The socketing horizon and the minimum pile length for each group of piles shall be determined based on the nearest borelog. A minimum socketing length of 3 times the diameter of the pile into the rock with core recovery greater than 10% as observed in such borelog shall be ensured, while deciding the minimum length of pile.																		
	iii)	However, in no case the length of pile shall be less than the minimum length determined as in (II) above, for that group.																		
g)	Special Requirements:																			
	Cement Type	As specified elsewhere in the specifications																		
	Concrete Grade	As specified elsewhere in the specifications																		
	Type of Reinforcement	As specified elsewhere in the specifications																		
	Cover to Reinforcement	As specified elsewhere in the specifications																		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS	PAGE 47 OF 245															





CLAUSE NO.

CIVIL WORKS

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NTPC

BORELOG DATA SHEETS (SHEET 2/26)

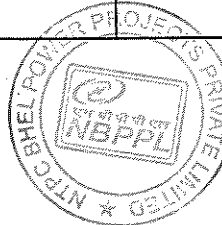
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**SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE**

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
49 OF 245



08722

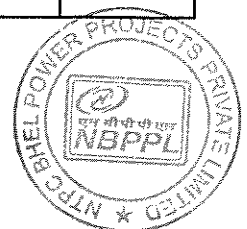
CLAUSE NO.		CIVIL WORKS		NTPC			
BORELOG DATA SHEETS (SHEET 3/26)							
GEO TEST HOUSE							
BORE LOG SHEET							
CLIENT: NTPC Limited LOCATION: Singrauli, Madhya Pradesh CO-ORDINATES: N 84° 75' E 78° 74' R.L.: 526.00 DEPTH OF GROUND WATER: 3.71 m		BORE HOLE NO.: 07 DATE FROM: 6/05/09 TO: 12/5/09 DEPTH OF TERMINATION: 25 m		TYPE OF DRILLING: Rotary Drilling BIT TYPE: SIZE 150 mm EPCV: TO: 150 mm FROM: TO: 150 mm			
DRILLER: Reem (Rajendra Singh)							
SAMPLE RECORD				REMARKS			
DRILL RUN IN METER	DEPTH OF SAMPLING		TYPE OF SAMPLE	SPT	CORE RECOVERY %	PENETRATION RATE MHR	VISUAL DESCRIPTION OF SUB SOIL
	FROM	TO					
0.0	0.0	1.50	U.S.	A 10 16 22 28			Filling soil
	1.50	3.00	U.S.	10 16 22 28			Yellowish red clayey sand
	3.00	4.50	U.S.	12 22 32 54			do
	4.50	6.00	U.S.	10 16 22 28			do
	6.00	7.50	U.S.	10 16 22 28			do
	7.50	9.00	U.S.	10 16 22 28			do
	9.00	10.50	SPT	30 3/50			do
	10.50	12.00	SPT	30 5/50			do
	12.00	13.50	SPT	14 1/40			do
	13.50	15.00	SPT	12 1/4			do
	15.00	16.50	SPT	25 1/2			do
	16.50	18.00	SPT	22 1/2			do
	18.00	19.50	SPT	16 1/2			do
	19.50	21.00	SPT	14 1/2			do
	21.00	22.50	SPT	30 1/2			do
22.50	24.00	SPT	35 1/2			do	
24.00	25.00	SPT	41 1/2			do	
25.00	26.00	SPT	55 1/2			do	
26.00	27.00	SPT	55 1/2			do	
27.00	28.00	SPT	55 1/2			do	
28.00	29.00	SPT	55 1/2			do	
29.00	30.00	SPT	55 1/2			do	
30.00	31.00	SPT	55 1/2			do	
31.00	32.00	SPT	55 1/2			do	
32.00	33.00	SPT	55 1/2			do	
33.00	34.00	SPT	55 1/2			do	
34.00	35.00	SPT	55 1/2			do	
35.00	36.00	SPT	55 1/2			do	
36.00	37.00	SPT	55 1/2			do	
37.00	38.00	SPT	55 1/2			do	
38.00	39.00	SPT	55 1/2			do	
39.00	40.00	SPT	55 1/2			do	
40.00	41.00	SPT	55 1/2			do	
41.00	42.00	SPT	55 1/2			do	
42.00	43.00	SPT	55 1/2			do	
43.00	44.00	SPT	55 1/2			do	
44.00	45.00	SPT	55 1/2			do	
45.00	46.00	SPT	55 1/2			do	
46.00	47.00	SPT	55 1/2			do	
47.00	48.00	SPT	55 1/2			do	
48.00	49.00	SPT	55 1/2			do	
49.00	50.00	SPT	55 1/2			do	
50.00	51.00	SPT	55 1/2			do	
51.00	52.00	SPT	55 1/2			do	
52.00	53.00	SPT	55 1/2			do	
53.00	54.00	SPT	55 1/2			do	
54.00	55.00	SPT	55 1/2			do	
55.00	56.00	SPT	55 1/2			do	
56.00	57.00	SPT	55 1/2			do	
57.00	58.00	SPT	55 1/2			do	
58.00	59.00	SPT	55 1/2			do	
59.00	60.00	SPT	55 1/2			do	
60.00	61.00	SPT	55 1/2			do	
61.00	62.00	SPT	55 1/2			do	
62.00	63.00	SPT	55 1/2			do	
63.00	64.00	SPT	55 1/2			do	
64.00	65.00	SPT	55 1/2			do	
65.00	66.00	SPT	55 1/2			do	
66.00	67.00	SPT	55 1/2			do	
67.00	68.00	SPT	55 1/2			do	
68.00	69.00	SPT	55 1/2			do	
69.00	70.00	SPT	55 1/2			do	
70.00	71.00	SPT	55 1/2			do	
71.00	72.00	SPT	55 1/2			do	
72.00	73.00	SPT	55 1/2			do	
73.00	74.00	SPT	55 1/2			do	
74.00	75.00	SPT	55 1/2			do	
75.00	76.00	SPT	55 1/2			do	
76.00	77.00	SPT	55 1/2			do	
77.00	78.00	SPT	55 1/2			do	
78.00	79.00	SPT	55 1/2			do	
79.00	80.00	SPT	55 1/2			do	
80.00	81.00	SPT	55 1/2			do	
81.00	82.00	SPT	55 1/2			do	
82.00	83.00	SPT	55 1/2			do	
83.00	84.00	SPT	55 1/2			do	
84.00	85.00	SPT	55 1/2			do	
85.00	86.00	SPT	55 1/2			do	
86.00	87.00	SPT	55 1/2			do	
87.00	88.00	SPT	55 1/2			do	
88.00	89.00	SPT	55 1/2			do	
89.00	90.00	SPT	55 1/2			do	
90.00	91.00	SPT	55 1/2			do	
91.00	92.00	SPT	55 1/2			do	
92.00	93.00	SPT	55 1/2			do	
93.00	94.00	SPT	55 1/2			do	
94.00	95.00	SPT	55 1/2			do	
95.00	96.00	SPT	55 1/2			do	
96.00	97.00	SPT	55 1/2			do	
97.00	98.00	SPT	55 1/2			do	
98.00	99.00	SPT	55 1/2			do	
99.00	100.00	SPT	55 1/2			do	

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
50 OF 245



CLAUSE NO.

CIVIL WORKS

**एनटीपीसी
NTPC**

BORELOG DATA SHEETS (SHEET 4/26)

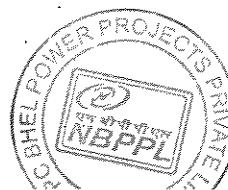
GEO TEST HOUSE				GEO TEST HOUSE											
BORE LOG SHEET				BORE LOG SHEET											
CLIENT :- NTPC, Limited. LOCATION :- Stage - III GEO COORDINATES :- N 24+27 E 98+44 RL :- 271.204 DEPTH OF GROUND WATER :- 4.84m				BORE HOLE NO :- 20 DATE FROM :- 25/10/9 TO :- 31/10/9. DEPTH OF TERMINATION :- 25.0m											
TYPE OF DRILLING :- Hydraulic Drilling. BIT TYPE :- TLE BFL SIZE 150mm TO 150mm FROM 0 TO 3.0m CRUISE :- Unmesh				TYPE OF DRILLING :- Hydraulic Drilling. BIT TYPE :- TLE BFL SIZE 150mm TO 150mm FROM 0 TO 3.0m CRUISE :- Unmesh											
DRILL RUN IN METER		DEPTH OF SAMPLING		TYPE OF SAMPLE		SAMPLE RECORD		CORE RECOVERY		PENETRATION RATE MHR		VISUAL DESCRIPTION OF SUB SOIL		REMARKS	
FROM	TO	FROM	TO	A	B	C	IN-BTC	%	%						
0.0	3.0m	0.5m	0.5m	18	11	50	R								
3.0m	4.5m	1.5m	1.5m	3	3	4	4								
4.5m	6.0m	3.0m	3.0m	5	5	18	17								
6.0m	7.5m	4.5m	4.5m	5	4	13	32								
7.5m	9.0m	6.0m	6.0m	6	9	13	32								
9.0m	10.5m	7.5m	7.5m	23	51	42	R								
10.5m	12.0m	9.0m	9.0m	36	50	16	R								
12.0m	13.5m	10.5m	10.5m	30	50	16	R								
13.5m	15.0m	12.0m	12.0m	36	100	16	R								
15.0m	16.5m	13.5m	13.5m	20	22	30	44								
16.5m	18.0m	15.0m	15.0m	35	11	11	R								
18.0m	19.5m	16.5m	16.5m	30	11	11	R								
19.5m	21.0m	18.0m	18.0m	28	11	11	R								
21.0m	22.5m	19.5m	19.5m	28	11	11	R								
22.5m	24.0m	21.0m	21.0m	28	11	11	R								
24.0m	25.0m	23.0m	23.0m	28	11	11	R								
25.0m	26.0m	24.0m	24.0m	28	11	11	R								
26.0m	27.0m	25.0m	25.0m	28	11	11	R								
27.0m	28.0m	26.0m	26.0m	28	11	11	R								
28.0m	29.0m	27.0m	27.0m	28	11	11	R								
29.0m	30.0m	28.0m	28.0m	28	11	11	R								
30.0m	31.0m	29.0m	29.0m	28	11	11	R								
31.0m	32.0m	30.0m	30.0m	28	11	11	R								
32.0m	33.0m	31.0m	31.0m	28	11	11	R								
33.0m	34.0m	32.0m	32.0m	28	11	11	R								
34.0m	35.0m	33.0m	33.0m	28	11	11	R								
35.0m	36.0m	34.0m	34.0m	28	11	11	R								
36.0m	37.0m	35.0m	35.0m	28	11	11	R								
37.0m	38.0m	36.0m	36.0m	28	11	11	R								

**SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE**

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

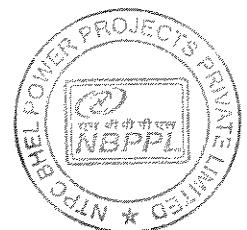
SUB-SECTION-D-01
CIVIL WORKS

PAGE
51 OF 245



08724

CLAUSE NO.		CIVIL WORKS											
BORELOG DATA SHEETS (SHEET 5/26)													
CLIENT: NTPC Ltd Singrauli (U.P.) LOCATION: Boiler Area COORDINATES: N 98° 40' 5" E 88° 3' 57" R.L.: 245.741 DEPTH OF GROUND WATER: TYPE OF DRILLING: Rotary drilling SIZE: 6 inch FROM TO: 0.0 12.0 SIZE: 6 inch FROM TO: 0.0 1.5 m DRILLER: K. K. K.													
BORE HOLE NO.: 27 DATE FROM: 14/5/09 TO 18/5/09 DEPTH OF TERMINATION: 255.5 TYPE OF DRILLING: Rotary drilling SIZE: 6 inch FROM TO: 0.0 12.0 SIZE: 6 inch FROM TO: 0.0 1.5 m DRILLER: K. K. K.													
SAMPLE RECORD													
DRILL RUN IN METER		DEPTH OF SAMPLING		TYPE OF SAMPLE		SPT		CORE RECOVERY		PENETRATION RATE		REMARKS	
FROM	TO	FROM	TO	A	B	C	N-B+C	%	%	ROD	MIN	DESCRIPTION OF SUB SOIL	REMARKS
0.0	0.0	0.0	0.0									Filed up 30%	
		0.5	0.5									Light yellow silty sand	
		1.5	1.5									Yellow silty sand	
		3.0	3.0									Mediumish yellow silty sand	
		4.5	4.5									Yellowish crushed sand	
		6.0	6.0									Yellow sand stone	
		7.5	7.5										
		9.0	9.0										
		10.5	10.5										
		12.0	12.0										
		13.0	13.0										
		14.0	14.0										
		15.0	15.0										
		16.0	16.0										
		17.0	17.0										
		18.0	18.0										
		19.0	19.0										
		20.0	20.0										
		21.0	21.0										
		22.0	22.0										
21.0	22.0											Orange-yellow sand stone	
												Orange over consolidated clay	



SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
52 OF 245

CLAUSE NO.

CIVIL WORKS

एनटीपीसी
NTPC

BORELOG DATA SHEETS (SHEET 6/26)

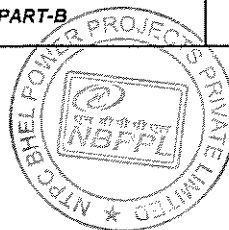
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**SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE**

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
53 OF 245



08726

CLAUSE NO.

CIVIL WORKS

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BORELOG DATA SHEETS (SHEET 7/26)

GEO TEST HOUSE

BORE LOG SHEET

BORE HOLE NO.- 40

DATE FROM: 16/5/09 TO: 22/5/09

DEPTH OF TERMINATION:- 30.0 m

CLIENT:- NTPC Ltd, Singrauli (C.P.)

LOCATION:- Chikment

COORDINATES:- N 8A + 78 E 7B + 10

R.L.: 275.379

R.L.: 276.055

DEPTH OF GROUND WATER:-

TYPE OF DRILLING:- Rotary Drilling m/c

BIT TYPE:- CASING:-

SIZE FROM TO SIZE FROM TO

6 inch 0.0 m 12.0 m 6 inch 0.0 m 1.5 m

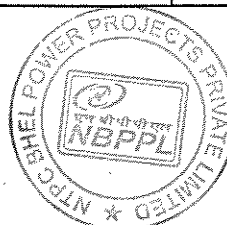
N/A 12.0 m

DRILLER:- Sushil Kumar

DRILL RUN IN METER			DEPTH OF SAMPLING		TYPE OF SAMPLE		SPT			CORE RECOVERY		PENETRATION RATE/MHR		VISUAL DESCRIPTION OF SUB SOIL	
FROM	TO						A	B	C	N+B+C	%	FC	2	1	
0.0	0.0		0.0		DS										Filled up soil with boulder 0.0m to 1.5 m
1.5	1.5		0.5		DS										Yellow silty sand 1.5m to 4.5m
4.5	4.5		1.5		DS/SPT		6	8	8	16					Reddish yellow clayey sand 4.5m to 7.5m
7.5	7.5		3.0		DS/SPT		12	9	7	16					Yellow clayey sand 7.5m to 9.0m
9.0	9.0		4.5		DS/SPT		10	13	15	28					Yellow sand stone 9.0m to 13.0m
13.0	13.0		4.0		DS/SPT		13	24	39	63					Yellowish grey over consolidated clay / soft rock 13.0m to 17.0m
17.0	17.0		4.0		SPT		15	84	200	219					Reddish yellow sand stone 17.0m to 21.0m
21.0	21.0		4.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	Reddish over consolidated clay / soft rock 21.0m to 23.0m
23.0	23.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	Yellowish grey over consolidated clay / soft rock 23.0m to 25.0m
25.0	25.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
27.0	27.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
29.0	29.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
31.0	31.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
33.0	33.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
35.0	35.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
37.0	37.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
39.0	39.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
41.0	41.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
43.0	43.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
45.0	45.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
47.0	47.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
49.0	49.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
51.0	51.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
53.0	53.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
55.0	55.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
57.0	57.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
59.0	59.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
61.0	61.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
63.0	63.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
65.0	65.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
67.0	67.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
69.0	69.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
71.0	71.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
73.0	73.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
75.0	75.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
77.0	77.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
79.0	79.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
81.0	81.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
83.0	83.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
85.0	85.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
87.0	87.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
89.0	89.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
91.0	91.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
93.0	93.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
95.0	95.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
97.0	97.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
99.0	99.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
101.0	101.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
103.0	103.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
105.0	105.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
107.0	107.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
109.0	109.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
111.0	111.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
113.0	113.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
115.0	115.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
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119.0	119.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
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131.0	131.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
133.0	133.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
135.0	135.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
137.0	137.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
139.0	139.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
141.0	141.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
143.0	143.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
145.0	145.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
147.0	147.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
149.0	149.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
151.0	151.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
153.0	153.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
155.0	155.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
157.0	157.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
159.0	159.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
161.0	161.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
163.0	163.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
165.0	165.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
167.0	167.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
169.0	169.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
171.0	171.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
173.0	173.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
175.0	175.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
177.0	177.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
179.0	179.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	
181.0	181.0		2.0		CORE		20	10	10	40	13.3	Nil	Nil	0.120	

08727

CLAUSE NO.	CIVIL WORKS																																																																																																																																																	
BORELOG DATA SHEETS (SHEET 8/26)																																																																																																																																																		
GEO TEST HOUSE BORELOG SHEET BH-40	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="text-align: center;"> TYPE OF DRILLING: <i>Rotary drilling</i> </td> </tr> <tr> <td style="width: 50%;"> BIT TYPE: <i>6 inch</i> </td> <td style="width: 50%;"> CASING: <i>12.0m</i> </td> </tr> <tr> <td style="width: 50%;"> SIZE: <i>6 inch</i> </td> <td style="width: 50%;"> FROM: <i>0.0m</i> </td> </tr> <tr> <td style="width: 50%;"> TO: <i>12.0m</i> </td> <td style="width: 50%;"> TO: <i>12.0m</i> </td> </tr> <tr> <td colspan="2" style="text-align: center;"> DRILLER: <i>Subur Purnak</i> </td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="text-align: center;"> BORE HOLE NO: 40 </td> </tr> <tr> <td style="width: 50%;"> DATE FROM: 16/5/09 </td> <td style="width: 50%;"> DATE TO: 22/5/09 </td> </tr> <tr> <td colspan="2" style="text-align: center;"> DEPTH OF TERMINATION: 30.0 m </td> </tr> <tr> <td colspan="2" style="text-align: center;"> COORDINATES: N 84° 59' E 78° 10' </td> </tr> <tr> <td colspan="2" style="text-align: center;"> R.L.: 275.397 </td> </tr> <tr> <td colspan="2" style="text-align: center;"> DEPTH OF GROUND WATER: 275.455 </td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" rowspan="2">DRILL RUN IN METER</th> <th rowspan="2">DEPTH OF SAMPLING</th> <th rowspan="2">TYPE OF SAMPLE</th> <th colspan="3">SPT</th> <th rowspan="2">CORE RECOVERY %</th> <th rowspan="2">ROD%</th> <th rowspan="2">PENETRATION RATE MHR</th> <th rowspan="2">VISUAL DESCRIPTION OF SUB SOIL</th> <th rowspan="2">REMARKS</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>21.0</td> <td>23.0</td> <td>23.0</td> <td>CORE</td> <td>70%</td> <td>10%</td> <td>18%</td> <td>10%</td> <td>10%</td> <td>2.23</td> <td>Yellow sand stone</td> <td>Layer 23.0m to 25.0m</td> </tr> <tr> <td>23.0</td> <td>25.0</td> <td>24.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td>21%</td> <td>11%</td> <td>2.32</td> <td>Gravelly yellow sand stone</td> <td>25.0m to 26.0m</td> </tr> <tr> <td>25.0</td> <td>26.0</td> <td>25.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td>23%</td> <td>11%</td> <td>2.45</td> <td>Gravelly sand stone</td> <td>26.0m to 27.0m</td> </tr> <tr> <td></td> <td></td> <td>26.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td>62%</td> <td>53%</td> <td>2.58</td> <td></td> <td>27.0m to 28.0m</td> </tr> <tr> <td></td> <td></td> <td>27.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td>74%</td> <td>58%</td> <td>3.27</td> <td></td> <td>28.0m to 29.0m</td> </tr> <tr> <td></td> <td></td> <td>28.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td>50%</td> <td>61%</td> <td>3.48</td> <td></td> <td>29.0m to 30.0m</td> </tr> <tr> <td></td> <td></td> <td>29.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td>59%</td> <td>61%</td> <td>4.10</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>30.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td>93%</td> <td>70%</td> <td>4.23</td> <td></td> <td></td> </tr> <tr> <td>26.0</td> <td>30.0</td> <td>31.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Gravelly sand stone broken at T.C. BIT & Line is in broken state bore hole hence sample could not be obtained.</td> <td></td> </tr> </tbody> </table> <i>[Signature]</i> 22/5/09	TYPE OF DRILLING: <i>Rotary drilling</i>		BIT TYPE: <i>6 inch</i>	CASING: <i>12.0m</i>	SIZE: <i>6 inch</i>	FROM: <i>0.0m</i>	TO: <i>12.0m</i>	TO: <i>12.0m</i>	DRILLER: <i>Subur Purnak</i>		BORE HOLE NO: 40		DATE FROM: 16/5/09	DATE TO: 22/5/09	DEPTH OF TERMINATION: 30.0 m		COORDINATES: N 84° 59' E 78° 10'		R.L.: 275.397		DEPTH OF GROUND WATER: 275.455		DRILL RUN IN METER		DEPTH OF SAMPLING	TYPE OF SAMPLE	SPT			CORE RECOVERY %	ROD%	PENETRATION RATE MHR	VISUAL DESCRIPTION OF SUB SOIL	REMARKS	A	B	C	21.0	23.0	23.0	CORE	70%	10%	18%	10%	10%	2.23	Yellow sand stone	Layer 23.0m to 25.0m	23.0	25.0	24.0	CORE				21%	11%	2.32	Gravelly yellow sand stone	25.0m to 26.0m	25.0	26.0	25.0	CORE				23%	11%	2.45	Gravelly sand stone	26.0m to 27.0m			26.0	CORE				62%	53%	2.58		27.0m to 28.0m			27.0	CORE				74%	58%	3.27		28.0m to 29.0m			28.0	CORE				50%	61%	3.48		29.0m to 30.0m			29.0	CORE				59%	61%	4.10					30.0	CORE				93%	70%	4.23			26.0	30.0	31.0	CORE							Gravelly sand stone broken at T.C. BIT & Line is in broken state bore hole hence sample could not be obtained.	
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SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 55 OF 245																																																																																																																																															



CLAUSE NO.

CIVIL WORKS

एनटीपीसी
NTPC

BORELOG DATA SHEETS (SHEET 9/26)

GEO TEST HOUSE																
BORE LOG SHEET																
CLIENT :- NTPC LTD., Sagwadi LOCATION :- CO ORDINATES :- N 84° 11' E 684.92 RL :- 236.2771 DEPTH OF GROUND WATER :- 4.65 m.					BOREHOLE NO: 42 DATE FROM: 9/5/07 TO: 13/5/07 DEPTH OF TERMINATION: 30 mt											
TYPE OF DRILLING:- Rotary Drilling.																
BIT TYPE:- CASING:-																
SIZE		FROM:		TO:		SIZE		FROM:		TO:						
DRILLER:-																
SAMPLE RECORD																
DRILL RUN IN METER		DEPTH OF SAMPLING		TYPE OF SAMPLE		SPT			CORE RECOVERY		PENETRATION RATE		VISUAL DESCRIPTION OF SUB SOIL		REMARKS	
FROM	TO			A	B	C	N	B+C	%	Q	RQD %	mm/hr				
		0.0														
		1.5		11	20	24	44						Filled up soil			
		3.0											Yellowish silty sand			
		4.5		12	16	24	42									
		6.0		8	12	18	30						Yellowish stiff clay with some sand			
		7.5														
		9.0		14	20	26	46									
		10.5		10/52				R								
		12.0		6/59				>100	13%	Nil			Brownish yellow clayey sand with some gravel			
		13.5							15%	Nil			Brownish grey sandstone			
		14.5							14%	Nil						
		15.5							12%	Nil						
		16.5							10%	10%						
		17.5							14%	Nil						
		18.5							13%	Nil						
		19.5							14%	Nil						
		20.5							11.5%	Nil			Laterite soil rock			
		21.5							12.5%	10.5%						
		22.5							13%	15.5%						
		23.5							15%	14%			Brownish sand stone			
		24.5							15%	14%						

TESTED BY:

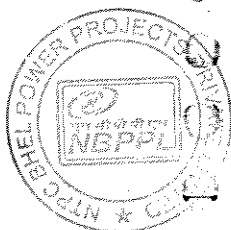
CHECKED BY: (

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
56 OF 245



08730

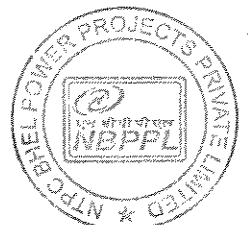
CLAUSE NO.		CIVIL WORKS		एनटीपीसी NTPC							
BORELOG DATA SHEETS (SHEET 11/26)											
GEO TEST HOUSE											
CLIENT: NTPC LTD., Singrauli. LOCATION: Singrauli COORDINATES: N 24° 05' E 81° 45' S R.L.: 274.926 DEPTH OF GROUND WATER: 3.2-5.1 M											
BORE HOLE NO.: G-0 DATE FROM: 14/5/07 TO: 15/5/07 DEPTH OF TERMINATION: 20.0 M											
TYPE OF DRILLING: Hydraulic BIT TYPE: SIZE FROM: TO: SIZE FROM: TO: CASING: DRILLER: Umesh K. Kathode											
GEO TEST HOUSE											
BORE LOG SHEET											
SAMPLE RECORD											
DRILL RUN IN METER		DEPTH OF SAMPLING		TYPE OF SAMPLE		SPT		CORE RECOVERY %	PENETRATION RATE M/HR	VISUAL DESCRIPTION OF SUB SOIL	REMARKS
FROM	TO	FROM	TO	A	B	C	N-BHC				
		0.0	1.5	DS							
		1.5	3.0	SPT	9	16	21	37			
		3.0	4.5	SPT	5	14	21	35			
		4.5	6.0	SPT	3	3	4	7			
		6.0	7.5	SPT	3	2	3	5			
		7.5	9.0	SPT	4	4	6	10			
		9.0	10.5	SPT	5	5	10	15			
		10.5	12.0	SPT	5	11	16	21			
		12.0	13.5	SPT	3	10	12	21			
		13.5	15.0	SPT	3	5	5	12			
		15.0	16.5	SPT	3	3	3	12			
		16.5	17.5	CORE	3/41	-	-	>100	11%	Nil	
		17.5	18.5	CORE	2/48	-	-	>100	38%	10%	
		18.5	19.5	CORE	2/100	-	-	>100	10%	14%	
		19.5	20.0	CORE	2/100	-	-	>100	43%	17%	
		20.0		CORE	2/100	-	-	>100	42%	15%	
TESTED BY: <i>Umesh K. Kathode</i>											

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
58 OF 245



08731

CLAUSE NO.

CIVIL WORKS

एनटीपीसी
NTPC

BORELOG DATA SHEETS (SHEET 12/26)

BORELOG SHEET

TEST HOUSE: **TEST HOUSE**

BORE HOLE NO.: **69**

DATE FROM: **13/5/07** TO: **15/5/07**

DEPTH OF TERMINATION: **26.0m**

LOCATION: **CHANDER HOUSE**

COORDINATES: **N 14° 52' E 8 B + 23**

L: **276.215**

DEPTH OF GROUND WATER: **2.57 m**

TYPE OF DRILLING: **Hydraulic**

SILETYPE: **T.C. R.T.T.**

SIZE: **6 inch**

FROM: **0.0m** TO: **20.0m** SIZE: **6 inch** FROM: **0.0m** TO: **1.5m**

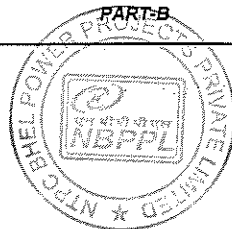
DRILLER: **N.A.**

DRILL RUN IN METER		DEPTH OF SAMPLING	TYPE OF SAMPLE	SPT			CORE RECOVERY %	PENETRATION RATE/MHR	VISUAL DESCRIPTION OF SUB SOIL	MARKS
FROM	TO			A	B	C				
0.0	1.5	0.0	DS						Earth Filling	0.0 to 1.5
		0.5	DS						Brownish yellow stiff silty clay with some sand & gravels	1.5 to 4.5
		1.5	DS/SPT	8	5	9	17			
		3.0	DS/SPT	9	11	14	25		Yellowish clayey sand	4.5 to 6.0
		4.5	DS						Yellowish grey silty clay with some sand & gravels	6.0 to 9.0m
		6.0	SPT	7	9	10	19		Light yellowish crumbled sand stone	9.0m to 15.0
		7.5	SPT	11	23	39	62			
		9.0	DS/SPT	14	27	42	59			
		10.5	DS/SPT	100	150					
		12.0	DS/SPT	100	150					
		13.5	DS/SPT	100	150					
		15.0	DS							
		16.5	SPT	100	150					
		18.0	DS/SPT	100	150					
		19.5	DS/SPT	100	150					

Checked By: **27/5/07**

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGETECHNICAL SPECIFICATION
SECTION - VI

PART-B

SUB-SECTION-D-01
CIVIL WORKSPAGE
59 OF 245

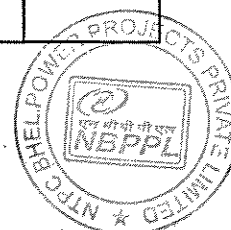
08732

CLAUSE NO.	CIVIL WORKS		
BORELOG DATA SHEETS (SHEET 13/26)			
BORE LOG SHEET			
BH-69 Coughaz House		GEO TEST HOUSE	
CLIENT :- NTPC Ltd. Singrauli (D.P.) LOCATION :- Coughaz House COORDINATES :- N 14° 42' E 88° 23' ELEVATION :- 276.215 DEPTH OF GROUND WATER :-		BOREHOLE NO. :- 69 DATE FROM 13/5/01 TO 15/5/01 DEPTH OF TERMINATION :- 26.0m	
TYPE OF DRILLING :- Hydraulic BIT TYPE :- SIZE : FROM TO : DRILLER :-		VISUAL DESCRIPTION OF SUB SOIL :- 23.3 23.5 23.8 24.0 24.2 24.5 25.0 25.5 26.0	
SAMPLE RECORD SPT A B C N=2+0 DEPTH OF TYPE OF SAMPLING SAMPLE FROM TO 20.0 D.S. 21.0 CORE 22.0 CORE 23.0 CORE 24.0 CORE 25.0 CORE 26.0 CORE		CORE RECOVERY % Nil 55% 28% 38% 68% 70% 42% 11.98	
PENETRATION RATE MHR 0.31 0.38 1.15 1.23 1.29 1.48		VISUAL DESCRIPTION OF SUB SOIL :- Whiteish grey sand stone Blackish sand stone with pieces of lignite & mica Blackish white sand stone	

 SINGRAULI STPP STAGE-III
 (1X500 MW)
 EPC PACKAGE

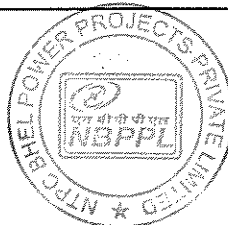
 TECHNICAL SPECIFICATION
 SECTION - VI
 PART-B

 SUB-SECTION-D-01
 CIVIL WORKS

 PAGE
 60 OF 245


08733

CLAUSE NO.	CIVIL WORKS																																																																																																																																																																															
BORELOG DATA SHEETS (SHEET 14/26)																																																																																																																																																																																
BH-83 (Cooling Tower Area) CLIENT :- NTPC Ltd, Singrauli LOCATION :- Cooling Tower Area COORDINATES :- N 11A 58 E 58 + 44 R.L. :- 276.407 DEPTH OF GROUND WATER :- GEO TEST HOUSE BORE LOG SHEET BORE HOLE NO. :- 83 DATE FROM 18/5/09 TO 23/5/09 DEPTH OF TERMINATION :- 30.0 m TYPE OF DRILL :- Rotary Dr. Hydraulic m/c BIT TYPE :- 7.625" 6 inch SIZE FROM 0.0m TO 30.0m FROM 0.0m TO 1.5m TO 1.5m TO 30.0m DRILLER :- Umesh																																																																																																																																																																																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" rowspan="2">DRILL RUN IN METER</th> <th rowspan="2">DEPTH OF SAMPLING</th> <th rowspan="2">TYPE OF SAMPLE</th> <th colspan="4">SPT</th> <th rowspan="2">CORE RECOVERY %</th> <th rowspan="2">ROD %</th> <th rowspan="2">PENETRATION RATE MHR</th> <th rowspan="2">VEGETAL DISPOSITION OF SUB SOIL</th> <th rowspan="2">REMARKS</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> <th>N-B+C</th> </tr> </thead> <tbody> <tr> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Filled up soil</td> <td></td> </tr> <tr> <td></td> <td>1.5</td> <td>0.5</td> <td>DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Yellowish clayey sand</td> <td></td> </tr> <tr> <td></td> <td></td> <td>1.5</td> <td>SPT/DS</td> <td>8</td> <td>8</td> <td>11</td> <td>19</td> <td></td> <td></td> <td></td> <td>Yellowish yellow clayey silty sand</td> <td></td> </tr> <tr> <td>1.5</td> <td>4.5</td> <td>4.5</td> <td>DS/SPT</td> <td>5</td> <td>13</td> <td>18</td> <td>31</td> <td></td> <td></td> <td></td> <td>Yellowish clayey silty sand</td> <td></td> </tr> <tr> <td>4.5</td> <td>7.5</td> <td>7.5</td> <td>DS/SPT</td> <td>10</td> <td>16</td> <td>24</td> <td>40</td> <td></td> <td></td> <td></td> <td>Yellow silty sand</td> <td></td> </tr> <tr> <td>7.5</td> <td>10.5</td> <td>10.5</td> <td>SPT</td> <td>100</td> <td>100</td> <td>100</td> <td>100</td> <td></td> <td></td> <td></td> <td>Reddish yellow clayey sand</td> <td></td> </tr> <tr> <td></td> <td></td> <td>12.0</td> <td>SPT/DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Sand stone</td> <td></td> </tr> <tr> <td>10.5</td> <td>15.0</td> <td>15.0</td> <td>SPT/DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Yellowish clayey silty sand</td> <td></td> </tr> <tr> <td>15.0</td> <td>18.0</td> <td>18.0</td> <td>SPT/DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Yellowish white sand stone</td> <td></td> </tr> <tr> <td>18.0</td> <td>22.0</td> <td>22.0</td> <td>SPT/DS</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Yellow sand stone</td> <td></td> </tr> <tr> <td>22.0</td> <td>25.0</td> <td>25.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>25.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				DRILL RUN IN METER		DEPTH OF SAMPLING	TYPE OF SAMPLE	SPT				CORE RECOVERY %	ROD %	PENETRATION RATE MHR	VEGETAL DISPOSITION OF SUB SOIL	REMARKS	A	B	C	N-B+C	0.0	0.0	0.0	DS								Filled up soil			1.5	0.5	DS								Yellowish clayey sand				1.5	SPT/DS	8	8	11	19				Yellowish yellow clayey silty sand		1.5	4.5	4.5	DS/SPT	5	13	18	31				Yellowish clayey silty sand		4.5	7.5	7.5	DS/SPT	10	16	24	40				Yellow silty sand		7.5	10.5	10.5	SPT	100	100	100	100				Reddish yellow clayey sand				12.0	SPT/DS								Sand stone		10.5	15.0	15.0	SPT/DS								Yellowish clayey silty sand		15.0	18.0	18.0	SPT/DS								Yellowish white sand stone		18.0	22.0	22.0	SPT/DS								Yellow sand stone		22.0	25.0	25.0	CORE												25.0	CORE									
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SUB-SECTION-D-01 CIVIL WORKS PAGE 61 OF 245																																																																																																																																																																																



08734

CLAUSE NO.

CIVIL WORKS

एनटीपीसी
NTPC

BORELOG DATA SHEETS (SHEET 15/26)

TYPE OF DRILL : G. Hydraulic m/c

BIT TYPE - CASING -

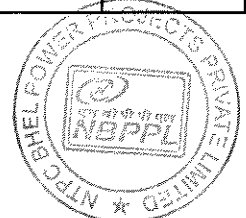
SIZE	FROM	TO	SIZE	FROM	TO
6 inch	0.0m	21.0	6 inch	0.0m	1.5m
1X	21.0m	30.0			

DRILLER:-

SAMPLE RECORD

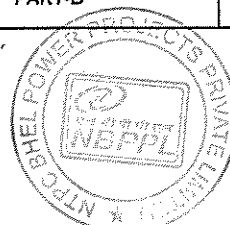
DEPTH OF GROUND WATER :-	DRILL RUN IN METER		DEPTH OF SAMPLING	TYPE OF SAMPLE	SPT			CORE RECOVERY %	CORE ROD %	PENETRATION RATE MHR	VISUAL DESCRIPTION OF SUB SOIL	REMARKS
	FROM	TO			A	B	C					
23.0	23.0	26.0	26.0	CORE				22%	Nil	1.25	Whiteish grey sand stone	
26.0	26.0	28.0	27.0	CORE				29%	Nil	1.38	greyish over consolidated clay / soft rocks	
28.0	28.0	29.0	28.0	CORE				40%	42%	2.40	Blackish grey sand stone	
29.0	29.0	30.0	30.0	CORE				36%	36%	2.58		

Checked By: *[Signature]*

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGETECHNICAL SPECIFICATION
SECTION - VI
PART-BSUB-SECTION-D-01
CIVIL WORKSPAGE
62 OF 245

08735

CLAUSE NO.	CIVIL WORKS																																																																															
BORELOG DATA SHEETS (SHEET 16/26)																																																																																
3H-96 CDM Plant Area CLIENT :- NTPC Ltd. Singrauli (C.P.) LOCATION :- DM Plant Area COORDINATES :- N 8A+41 E 20B+77 RL :- 276.332 DEPTH OF GROUND WATER :- BORE LOG SHEET BORE HOLE NO. :- 96 DATE FROM :- 18/09 TO 20/09 DEPTH OF TERMINATION :- 20 m																																																																																
TYPE OF DRILL :- Rotary Drilling BIT TYPE :- SIZE :- 6 inch FROM TO :- 0.0 to 20.0 m SIZE :- 6 inch FROM TO :- 0.0 to 1.5 m DRILLER :- REMARKS																																																																																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="4" style="text-align: center;">SAMPLE RECORD</th> <th rowspan="2">CORE RECOVERY %</th> <th rowspan="2">PENETRATION RATE MHR</th> <th rowspan="2">DESCRIPTION OF SUB SOIL</th> <th rowspan="2">REMARKS</th> </tr> <tr> <th colspan="2">DEPTH OF TYPE OF SAMPLING</th> <th colspan="2">SPT</th> </tr> <tr> <th>FROM</th> <th>TO</th> <th>A</th> <th>B</th> <th>C</th> <th>N</th> <th>Q</th> <th>REMARKS</th> </tr> </thead> <tbody> <tr> <td>0.0 m</td> <td>0.0 m</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Yellowish clayey sand</td> </tr> <tr> <td>3.0 m</td> <td>3.0 m</td> <td>5</td> <td>11</td> <td>16</td> <td></td> <td></td> <td>Reddish yellow clayey sand</td> </tr> <tr> <td>6.0 m</td> <td>6.0 m</td> <td>5</td> <td>11</td> <td>16</td> <td></td> <td></td> <td>Reddish yellow silty sand</td> </tr> <tr> <td>7.5 m</td> <td>7.5 m</td> <td>5</td> <td>11</td> <td>16</td> <td></td> <td></td> <td>Reddish yellow consolidated sand stone</td> </tr> <tr> <td>13.0 m</td> <td>13.0 m</td> <td>5</td> <td>11</td> <td>16</td> <td></td> <td></td> <td>Reddish yellow sand stone</td> </tr> <tr> <td>19.0 m</td> <td>19.0 m</td> <td>5</td> <td>11</td> <td>16</td> <td></td> <td></td> <td>Yellow Sand stone</td> </tr> <tr> <td>20.0 m</td> <td>20.0 m</td> <td>5</td> <td>11</td> <td>16</td> <td></td> <td></td> <td>Yellow Sand stone</td> </tr> </tbody> </table>					SAMPLE RECORD				CORE RECOVERY %	PENETRATION RATE MHR	DESCRIPTION OF SUB SOIL	REMARKS	DEPTH OF TYPE OF SAMPLING		SPT		FROM	TO	A	B	C	N	Q	REMARKS	0.0 m	0.0 m						Yellowish clayey sand	3.0 m	3.0 m	5	11	16			Reddish yellow clayey sand	6.0 m	6.0 m	5	11	16			Reddish yellow silty sand	7.5 m	7.5 m	5	11	16			Reddish yellow consolidated sand stone	13.0 m	13.0 m	5	11	16			Reddish yellow sand stone	19.0 m	19.0 m	5	11	16			Yellow Sand stone	20.0 m	20.0 m	5	11	16			Yellow Sand stone
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SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE TECHNICAL SPECIFICATION SECTION - VI PART-B SUB-SECTION-D-01 CIVIL WORKS PAGE 63 OF 245																																																																																



[illegible]

CLAUSE NO.

CIVIL WORKS

एनटीपीसी
NTPC

BORELOG DATA SHEETS (SHEET 17/26)

Geo Test MC 13

ESNOH ISEL O3GO

BORE LOG SHEET

CLIENT :- NTPC Ltd, Singrauli. (U.P.) BOREHOLE NO. 24

CLIENT :- NTPC Ltd, Singuradi. (U.P.) BOREHOLE NO. 24

DATE FROM: 27/5/09 TO:

COORDINATES: N 8A + 77 E 8B + 82 DEPTH OF TERMINATION: 30.0 M

COORDINATES: N 08
26° 00' 00"
27° 00' 00"

TYPE OF DRILLING- Rotary drilling

BIT TYPE: 128 BIT CASINO

SIZE	FROM	TO	SIZE	FROM	TO
10	10	10	10	10	10
11	11	11	11	11	11
12	12	12	12	12	12
13	13	13	13	13	13
14	14	14	14	14	14
15	15	15	15	15	15
16	16	16	16	16	16
17	17	17	17	17	17
18	18	18	18	18	18
19	19	19	19	19	19
20	20	20	20	20	20
21	21	21	21	21	21
22	22	22	22	22	22
23	23	23	23	23	23
24	24	24	24	24	24
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30	30	30	30	30	30
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32	32	32	32	32	32
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35	35	35	35	35	35
36	36	36	36	36	36
37	37	37	37	37	37
38	38	38	38	38	38
39	39	39	39	39	39
40	40	40	40	40	40
41	41	41	41	41	41
42	42	42	42	42	42
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76	76	76	76	76	76
77	77	77	77	77	77
78	78	78	78	78	78
79	79	79	79	79	79
80	80	80	80	80	80
81	81	81	81	81	81
82	82	82	82	82	82
83	83</				

6.7mch	0.0m	9.0m	0.0m	9.0m

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

DRILLER: SUBSIP DUMMERY

SAMPLE RECORD

19

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19

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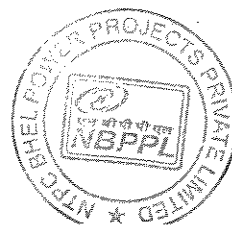
19

**SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE**

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
64 OF 245



08737

CLAUSE NO.

CIVIL WORKS



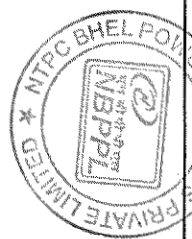
BORELOG DATA SHEETS (SHEET 18/26)

GEO TEST HOUSE												
BORE LOG SHEET												
BH-24												
CLIENT - NTPC Ltd, Singrauli (MP)					BORE HOLE NO- 24							
LOCATION -					DATE FROM: 27/5/09 TO:							
CO-ORDINATES - N 84+77 E 88+82					DEPTH OF TERMINATION - 30.0m							
R.L. - 275.895												
DEPTH OF GROUND WATER - 2.85m												
TYPE OF DRILL & G- Rotocut Drilling												
BIT TYPE-												
SIZE		FROM		TO		SIZE		FROM		TO		
6 inch		0.0m		9.0m		6 inch		0.0m		9.0m		
NX		9.0m										
DRILLER- S. K. Sharma												
SAMPLE RECORD												
DRILL RUN IN METER		DEPTH OF SAMPLING (m)	TYPE OF SAMPLE	SPT				CORE RECOVERY %	RQD %	PENETRATION RATE MHR	VISUAL DISCRIPTION OF SUB SOIL	REMARKS
FROM	TO			A	B	C	N=B+C					
20.0m	21.0m	21.0	CORE SPT	10	0	0	10	8%	Nil	2.10	Reddish yellow sand stone with some Boulder	
21.0m	22.0m	22.0	CORE					30%	Nil	2.18	Grey yellowish grey - over consolidated clay	
		23.0	CORE					26%	Nil	2.56		
		24.0	CORE					26%	11%	3.10	Soft ROCK	
24.0m	25.0m	25.0	CORE					26%	18%	3.15		
25.0m	26.0m	26.0	CORE					24%	24%	3.28	Yellow sand stone	
		27.0	CORE					31%	31%	3.42	Greyish Black sand stone	
		28.0	CORE					35%	35%	3.61	Greyish Black sand stone	
28.0m	29.0m	29.0	CORE					36%	27%	3.83	Greyish Black sand stone	
29.0m	30.0m	30.0	CORE					74%	70%	4.03		

Tested By: [Signature]

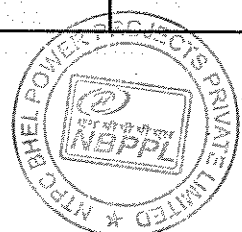
Checked By: [Signature]

SINGRAULI STPP STAGE-III
 (1X500 MW)
 EPC PACKAGE
 SECTION - VI
 PART-B OBJECTS
 SUB-SECTION-D-01
 CIVIL WORKS
 PAGE 65 OF 245



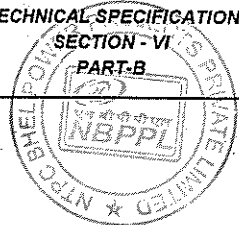
08738

CLAUSE NO.	CIVIL WORKS																																																																																																																																																																																																	
BORELOG DATA SHEETS (SHEET 19/26)																																																																																																																																																																																																		
BH-61 (Switch yard) CLIENT :- NTPC Ltd, Singrauli (U.P.) LOCATION :- Switch yard COORDINATES :- N49+43 E 11B+73 R.L. :- 274.772 DEPTH OF GROUND WATER :- 3.86 M	GEO TEST HOUSE BORE LOG SHEET BORE HOLE NO. :- 61 DATE FROM :- 25/10/2015 TO :- 25/10/15 DEPTH OF TERMINATION :- 25.0 m TYPE OF DRILLING :- Hydraulic BIT TYPE :- <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>SIZE</th> <th>FROM</th> <th>TO</th> <th>SIZE</th> <th>FROM</th> <th>TO</th> </tr> <tr> <td>6 inch</td> <td>0.0 m</td> <td>16.5 m</td> <td>6 inch</td> <td>0.0 m</td> <td>16.5 m</td> </tr> <tr> <td>NX</td> <td>16.5 m</td> <td>25.0 m</td> <td></td> <td></td> <td></td> </tr> </table> DRILLER :- Litesh Kumar	SIZE	FROM	TO	SIZE	FROM	TO	6 inch	0.0 m	16.5 m	6 inch	0.0 m	16.5 m	NX	16.5 m	25.0 m																																																																																																																																																																																		
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SUB-SECTION-D-01 CIVIL WORKS	PAGE 66 OF 245																																																																																																																																																																																																	



08739

CLAUSE NO.	CIVIL WORKS																																																																							
BORELOG DATA SHEETS (SHEET 20/26)																																																																								
BH-61 (Switch yard) CLIENT :- NTPC Ltd. Singrauli (U.P.) LOCATION :- Switch yard COORDINATES :- N 4A + 43 E 11 B + 73 R.L. :- 274.972 DEPTH OF GROUND WATER :- 3.86 M BORE LOG SHEET BORE HOLE NO. :- 61 DATE FROM :- 25/5/09 TO :- 27/5/09 DEPTH OF TERMINATION :- 25.0 M																																																																								
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Checked By: <i>[Signature]</i> Tested By: <i>[Signature]</i>																																																																								



08740

CLAUSE NO.

CIVIL WORKS



BORELOG DATA SHEETS (SHEET 21/26)

GEO TEST HOUSE

GEO TEST HOUSE

BORE LOG SHEET

TYPE OF DRILLING:- *Rotary Drilling*

BIT TYPE:-			CASING:-		
SIZE	FROM	TO	SIZE	FROM	TO
6 inch	0.0m	14.0m	6 inch	0.0m	14.0m
NX	14.0m	30.0m			

DRILLER:- *Mund*

BORE HOLE NO:- 73
 DATE FROM: *28/5/09*
 DEPTH OF TERMINATION:- *30.0m*

CLIENT :- *NTPC Ltd, Singrauli*
 LOCATION :- *Torack hopper*
 COORDINATES :- *N 14+50 E 98+07*
 R.L. :- *281.421*
 DEPTH OF GROUND WATER :-

SAMPLE RECORD

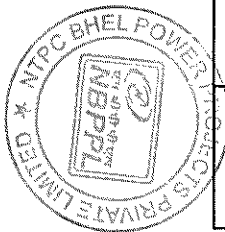
DRILL RUN IN METER (Cased in m)		DEPTH OF SAMPLING	TYPE OF SAMPLE	SPT				CORE RECOVERY %	RQD%	PENETRATION RATE MHR	VISUAL DISCRIPTION OF SUB SOIL	REMARKS
FROM	TO			A	B	C	N=B+C					
0.0	0.0	0.0	DS								Yellow silty sand	
0.0	0.5	0.5	UDS/DS								Yellowish Red clayey sand	
		1.5	DS/SPT	4	4	8	12					
		3.0	DS/UDS									
		4.5	DS/SPT	10	13	19	32					
		6.0	DS/UDS									
		7.5	DS/SPT	12	21	34	55					
		9.0	DS/UDS									
		10.5	DS/SPT	24	48	51	99				Yellow crushed sand	
0.5	12.0	12.0	DS/SPT	>100	-	-	R				stone	
		13.5	DS/SPT	>100	-	-	R				Redish yellow to whitish	
12.0	14.5	14.5	CORE	>100	-	-	R	15%	15%	0:30	Yellow sand stone	
		15.5	CORE	>100	-	-	R	18%	11%	1:20		
		16.5	CORE	>100	-	-	R	16%	10%	2:35		
		17.5	CORE	>100	-	-	R	21%	15%	2:50		
		18.5	CORE	>100	-	-	R	13%	13%	2:58	Whitish coarse sand stone	
14.5	19.5	19.5	CORE	>100	-	-	R	15%	15%	3:20		
		20.5	CORE	>100	-	-	R	19%	19%	3:40		
		21.5	CORE	>100	-	-	R	32%	32%	3:50		
		22.5	CORE	>100	-	-	R	30%	19%	4:35		
		23.5	CORE									

Checked By:-

SINGRAULI STPP STAGE-III

(1X500 MM)
EPC PACKAGE

TECHNICAL SPECIFICATION

SECTION - VI
PART-BSUB-SECTION-D-01
CIVIL WORKSPAGE
68 OF 245

08741

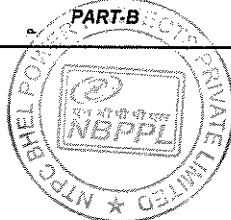
CLAUSE NO.		CIVIL WORKS																																																																																									
BORELOG DATA SHEETS (SHEET 22/26)																																																																																											
BORE LOG SHEET BORE HOLE NO: 73 DATE FROM: 28/10/09 TO: 28/10/09 DEPTH OF TERMINATION: 30.0m CLIENT: NTPC Ltd, Singrauli LOCATION: Toruck hopper COORDINATES: N 14 A + 50 E 98 + 07 R.L.: 281.421 DEPTH OF GROUND WATER: - TYPE OF DRILL NO.: Rotary drilling BIT TYPE: 6 inch FROM: 0.0m TO: 14.0m SIZE: 6 inch FROM: 0.0m TO: 30.0m DRILLER: Manoj																																																																																											
SAMPLE RECORD <table border="1"> <thead> <tr> <th rowspan="2">DRILL RUN IN METER (10m or 20m)</th> <th colspan="2">DEPTH OF SAMPLING (m)</th> <th rowspan="2">TYPE OF SAMPLE</th> <th colspan="4">SPT</th> <th rowspan="2">CORE RECOVERY %</th> <th rowspan="2">RODM</th> <th rowspan="2">PENETRATION RATE MMHR</th> <th rowspan="2">REMARKS</th> </tr> <tr> <th>FROM</th> <th>TO</th> <th>A</th> <th>B</th> <th>C</th> <th>N+B+C</th> </tr> </thead> <tbody> <tr> <td>19.5</td> <td>24.5</td> <td>25.5</td> <td>CORE</td> <td></td> <td></td> <td></td> <td></td> <td>53%</td> <td>53%</td> <td>5:35</td> <td rowspan="5">Whitish grey sand stone</td> </tr> <tr> <td></td> <td>25.5</td> <td>26.5</td> <td>CORE</td> <td></td> <td></td> <td></td> <td></td> <td>26%</td> <td>26%</td> <td>5:15</td> </tr> <tr> <td></td> <td>26.5</td> <td>27.5</td> <td>CORE</td> <td></td> <td></td> <td></td> <td></td> <td>27%</td> <td>27%</td> <td>4:20</td> </tr> <tr> <td></td> <td>27.5</td> <td>28.5</td> <td>CORE</td> <td></td> <td></td> <td></td> <td></td> <td>27%</td> <td>27%</td> <td>4:35</td> </tr> <tr> <td></td> <td>28.5</td> <td>29.5</td> <td>CORE</td> <td></td> <td></td> <td></td> <td></td> <td>34%</td> <td>34%</td> <td>5:15</td> </tr> <tr> <td></td> <td>29.5</td> <td>30.0</td> <td>CORE</td> <td></td> <td></td> <td></td> <td></td> <td>38%</td> <td>38%</td> <td>5:25</td> <td></td> </tr> </tbody> </table>			DRILL RUN IN METER (10m or 20m)	DEPTH OF SAMPLING (m)		TYPE OF SAMPLE	SPT				CORE RECOVERY %	RODM	PENETRATION RATE MMHR	REMARKS	FROM	TO	A	B	C	N+B+C	19.5	24.5	25.5	CORE					53%	53%	5:35	Whitish grey sand stone		25.5	26.5	CORE					26%	26%	5:15		26.5	27.5	CORE					27%	27%	4:20		27.5	28.5	CORE					27%	27%	4:35		28.5	29.5	CORE					34%	34%	5:15		29.5	30.0	CORE					38%	38%	5:25		Checked By: 		
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SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
69 OF 245



08742

CLAUSE NO.

CIVIL WORKS



BORELOG DATA SHEETS (SHEET 23/26)

BH- 86 (Cooling Tower Area)

BORE LOG SHEET

CLIENT :- NTPC Ltd, Singrauli (U.P.)
 LOCATION :- Cooling Tower Area
 CO-ORDINATES :- N 11A+65 E 78+87
 RL :- 276.281
 DEPTH OF GROUND WATER :-

BORE HOLE NO:- 86
 DATE FROM:- 19/5/09 TO:- 23/5/09
 DEPTH OF TERMINATION:- 25.0m

TYPE OF DRILLING:- Rotary Drilling					
BIT TYPE:-			CASING:-		
SIZE	FROM	TO	SIZE	FROM	TO
6 Inch	0.0m	10.5m	6 Inch	0.0m	1.5m
NX	10.5m	25.0m			
DRILLER:- Rakesh					

DEPTH OF GROUND WATER												SAMPLE RECORD					
DRILL RUN IN METER (CLAYEY)		DEPTH OF SAMPLING	TYPE OF SAMPLE	SPT				CORE RECOVERY %	ROD%	PENETRATION RATE M/HR	VISUAL DISCRPTION OF SUB SOL	REMARKS					
FROM	TO			A	B	C	N=B+C										
0.0	0.0	0.0	D.S.								Filled up Soil with Boulder greyish yellow clayey sand.						
		0.5	DS														
0.0	1.5	1.5	DS/SPT	3	7	7	14										
		3.0	DS/UDS														
		4.5	DS/SPT	3	13	14	27										
		6.0	DS/UDS														
		7.5	DS/SPT	8	14	18	32										
1.5	10.5	9.0	DS/UDS								yellow sand stone						
		10.5	DS/SPT				R										
		11.0	CORE					21%	21%	0.47							
		12.0	CORE					22.3%	15%	0.35							
		13.0	CORE					21.0%	13.5%	0.42							
		14.0	CORE					26.0%	26%	1.15							
		15.0	CORE					29.0%	29%	1.48							
		16.0	CORE					30.0%	30%	1.52							
		17.0	CORE					26.0%	Nil	1.10							
10.5	18.0	18.0	CORE					23.0%	Nil	2.08		greyish yellow sand stone					
		19.0	CORE					20.0%	Nil	2.15							
		20.0	CORE					22.0%	Nil	2.19							
		21.0	CORE					61.0%	53%	2.35							
18.0	22.0	22.0	CORE					64.0%	60%	2.40	yellow sand stone						

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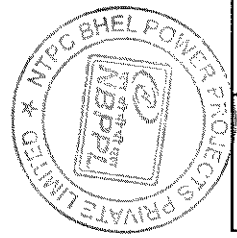
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SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
70 OF 245



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08714

CLAUSE NO.

CIVIL WORKS

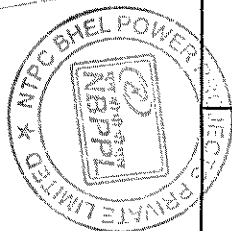


BORELOG DATA SHEETS (SHEET 25/26)

GEO TEST HOUSE										GEO TEST HOUSE			
BORE LOG SHEET													
BH-97 (D.M. Plant Area)													
CLIENT :- <i>97 NTPC Ltd, Singareni (U.P.)</i>										BORE HOLE NO:- 97			
LOCATION :- <i>D.M. Plant Area</i>										DATE FROM <i>21/5/07</i> TO: <i>24/5/07</i>			
CO-ORDINATES :- <i>N 8A + 40 E 218 + 04</i>										DEPTH OF TERMINATION:- <i>25.0m</i>			
R.L. :- <i>276.283</i>													
DEPTH OF GROUND WATER :- <i>2.57 m</i>													
TYPE OF DRILL :- <i>G-Rotary drilling</i>													
BIT TYPE:-										CASING:-			
SIZE		FROM		TO		SIZE		FROM		TO			
6 inch		0.0m		7.5m		6 inch		0.0m		1.5m			
NX		7.5m		25.0m									
DRILLER:- <i>M.M.M.</i>													
SAMPLE RECORD													
DRILL RUN IN METER (Log/feet)		DEPTH OF SAMPLING	TYPE OF SAMPLE	SPT				CORE RECOVERY %	RQD%	PENETRATION RATE M/HR	VISUAL DESCRIPTION OF SUB SOIL	REMARKS	
FROM	TO			A	B	C	N=B+C						
0.0	0.0	0.0	D.S.								Redish yellow silty sand with little gravels.		
		0.5	D.S.										
		1.5	DS/SPT	6	11	16	27						
		3.0	DS/UDS								Greyish yellow silty sand		
0.0	4.5	4.5	DS/SPT	6	14	19	33						
		6.0	DS/UDS										
4.5	7.5	7.5	DS/SPT								Greyish yellow clayey silty sand with little gravels. Yellow sand stone		
		9.0	DS/SPT	>100			R						
7.5	10.0	10.0	CORE	>100			R	18%	Nil	0.48			
		11.0	CORE	>100			R	19%	Nil	0.53			
		12.0	CORE	>100			R	18%	10%	1.24	Greyish yellow sand stone		
10.0	13.0	13.0	CORE					26%	10%	1.25			
		14.0	CORE					29%	Nil	1.32			
		15.0	CORE					28%	22%	1.50			
		16.0	CORE					32%	Nil	1.54			
		17.0	CORE	>100			R	19%	10%	2.25			
		18.0	CORE					35%	Nil	2.35	Redish yellow sand stone		
13.0	19.0	19.0	CORE					25%	Nil	2.40			
		20.0	CORE	>100			R	18%	Nil	2.08			
		21.0	CORE					23%	10%	3.05	Whitish grey sand stone		
19.0	21.0	22.0	CORE					20%	15%	3.20			

Tested By:-

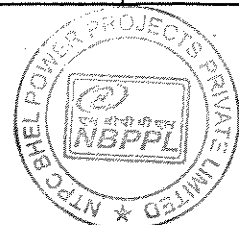
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SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGETECHNICAL SPECIFICATION
SECTION - VI
PART-BSUB-SECTION-D-01
CIVIL WORKSPAGE
72 OF 245



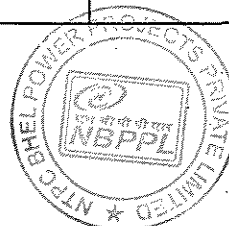
08746

CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
5.00.00	GENERAL LAYOUT PLAN			
5.01.00	The general layout plan proposed for the project is shown in tender drawing. It shall form the basis for further elaboration by the Bidder for the plant facilities, which are in his scope.			
5.02.00	While preparing the detailed general layout, planning the facilities in the Bidder's scope and deciding upon the transportation and construction / erection strategy, and functional requirements the Bidder 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 be located in such a way so as to have an offset of minimum 25m with respect to centre line of double lane road and 20 metre with respect to centre line of single lane road. c) The interface requirements with the plant construction/erection activities of other contracting agencies engaged by the Employer. These agencies engaged will be working parallelly with the Bidder within the plant premises. d) The area for construction/erection facilities like lay-down, pre-assembly, offices and stores is to be managed by the Bidder within the areas identified for the Project on General Layout Plan. Bidder shall have to share these areas with other contracting agencies engaged by the Employer. The final location and extent of area allocated to each Bidder shall be as directed by the Project Manager. e) No permanent facility shall be located within the safety zone limit around the fuel Oil storage tanks, Hydrogen plant complex, etc., except those permitted by Employer f) Transportation of all equipment and materials shall be by road as envisaged. Any other mode envisaged by the bidder may be proposed. However the same may be adopted subject to approval of the Employer. g) All the buildings and facilities shall be approachable by fire tenders.			
5.03.00	SITE LEVELLING			
	A bore-hole investigation has been carried out and bore-log details are enclosed with this specification. However, these are solely for the guidance of the bidder and the Owner does not take any responsibility about the accuracy of these results and			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 74 OF 245

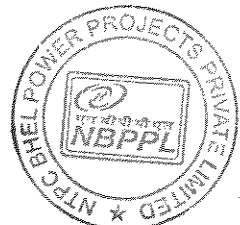


08747

CLAUSE NO.	CIVIL WORKS		
	any variation of the said details shall not constitute a valid reason for changing the terms and conditions of the contract The Bidder shall satisfy himself about the actual nature of soil/rock present at site. A grid system of co-ordinates has been established at site by the Owner. Permanent reference pillars have been established. It shall be the responsibility of the Bidder to protect the reference pillars at respective locations and levels until the site is finally handed over to the Owner. Any reference pillar disturbed or lost during this period for any reason whatsoever shall be replaced and re-established at the original location and level . It shall be the responsibility of the Bidder that no air borne and water borne pollution should occur during all stages of his operations such as in cutting areas, during transportation of excavated materials, during placement of fill materials, etc. It shall be the responsibility of the Bidder to undertake all measures such as water sprinkling, covering the fill/disposable materials in open trucks with tarpaulins etc. to take care of the above, if necessary. The high grounds within the levelling boundary shall be cut to proposed formation level(s). Suitable excavated material shall be used for filling up the low grounds to proposed formation level(s) by controlled filling. Site levelling work will involve the following operations: - Excavation in soil/rock. - Loading, transportation and unloading of suitable material to the filling site. - Spreading of earth/rock in layers and compaction. - Finishing of surfaces. - Sampling & testing. - Setting out and making profiles. The following types of materials shall not be used for filling: - Material from swamps, marshes and bogs, - Peat, logs, stumps, sod and perishable materials, - Materials susceptible to combustion, - Any natural material or industrial and domestic produce which will adversely affect other materials in the work.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 75 OF 245

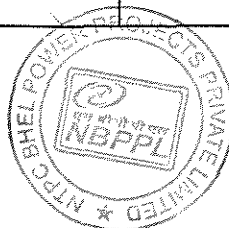


CLAUSE NO.	CIVIL WORKS	एन टी पी सी NTPC	
	Before commencement of filling, it shall be ensured that the area to be filled is clear of any vegetation, water, organic matter, slush etc. Original ground shall be compacted by rolling as directed by the Engineer subject to a minimum of six passes of 8 to 10 tonnes roller. The earth shall then be spread in horizontal layers of 500mm thickness. Each layer shall be watered and compacted with proper moisture content and with such equipment as may be required to obtain a compaction/density of 95% of Standard Proctor's Maximum Dry Density. The combined excavation and placing operations shall be such that the materials when compacted in the fill will be blended sufficiently to produce specified degree of compaction. Before start of filling, the Bidder shall submit to the Engineer his proposal for methodology to be adopted for compaction of fill material. The Bidder shall also carry out compaction trials to establish the proposed methodology. The Bidder shall finalise a detailed Field Quality Assurance Programme according to the requirements of this specification. This shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan etc. The fill material shall be tested for determining optimum moisture content and maximum dry density by Standard Proctor Test as per IS:2720 (Part-II) and (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 10000 cu.m. of fill material shall be tested. Additional samples shall be tested, whenever there is a change in the type of fill material. The compacted earth shall be tested for its in-situ dry density as per the procedure outlined in IS:2720 (Part-XXIX or Part-XXVIII). Sample 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. Masonry pillars shall be erected at suitable places in the area to serve as bench marks for the execution of the work. These bench marks shall be connected with GTS or any other permanent bench mark.		
6.00.00	MAIN PLANT, AUXILIARY BUILDINGS AND STRUCTURES		
6.01.00	Main plant shall comprise of:		
	a) Main plant building shall consist of TG bay, Deaerator bay, service building / Control room and all the auxiliary structures/facilities located therein.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 75 OF 245



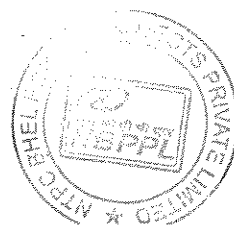
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CLAUSE NO.	CIVIL WORKS NTPC		
6.02.00	b) Mill and Bunker building All floors of buildings covered under a) and b) above shall generally be provided with cast-in-situ RCC slab. However, steel grating, chequered flooring as well as precast RCC covers with matching finish shall be provided as per the functional requirements. RCC canopy shall be provided over the deaerator. The bunker shall be circular in plan and shall be provided with conical hopper unless otherwise approved by Employer. The profile of bunker shall be based on flowability study as approved by Engineer. The MS hopper shall be lined with stainless steel grade-SS: 304 (as manufactured by SAIL) or any other approved grade. No guniting is envisaged for the bunker. Wherever it is intended not to transfer the horizontal load to the adjacent structures, then the same shall be achieved only through Poly Tetra Fluro Ethylene (PTFE) bearings. Auxiliary Buildings/Structures Auxiliary (plant) buildings shall generally consist of the following in addition to any other buildings that would be required as per the system requirements. a) D. G. set building b) Air compressor house building c) Air washer building d) CPU regeneration building e) Ash water pump house. f) Fire water tanks and pump house g) Ash slurry pump house. h) Condensate transfer pump house. i) AC plant equipment room. j) Air handling units room. k) ESP control/VFD building (with air-conditioning for control rooms of ESP and VFD, ventilation, etc.). Adequate space provision shall also be kept for seating of O&M staff in the above buildings including main plant building.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 77 OF 245



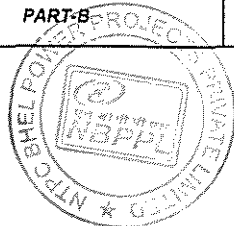
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CLAUSE NO.	CIVIL WORKS			
6.03.00	Structural arrangement, foundation system, cladding, interior and exterior finishes, etc. for above buildings shall be as specified elsewhere in this specification.			
6.04.00	Service Building / Control Room Service building shall be provided for housing the O&M staff and laboratories for relay testing, electrical testing, C&I repairs and transmitter. This building shall be located closer to main powerhouse and shall be inter-connected to the main plant building at least at the operating floor level. The total covered floor area for the building shall not be less than 5000 sq. m out of which minimum 3000 sq. m shall be air-conditioned. Additionally covered parking area at least for 20 cars and 40 scooters with RCC canopy shall be provided. Building shall be provided with porch at the entrance. The building shall have provision of attached toilet with the cabin of senior executives and conference rooms. In addition, one pantry and one storeroom shall also be provided in the building. The building shall be provided with minimum two elevators of adequate capacity (at least 13 persons). The internal partitions of the building shall be done using prelaminated particle board and clear glass fixed in electro colour coated (anodised) aluminium frame work as per approved layout. False ceiling shall be provided as specified elsewhere in this specification. Inter-connecting galleries wherever provided shall be covered on top and with appropriate glazing on sides in electro colour coated aluminium framework. Structural arrangement, foundation, cladding, interior and exterior finishes etc. for the building shall be as specified elsewhere in this specification.			
7.00.00	POTABLE WATER OVERHEAD TANK This shall be of RCC with twin compartments. Total storage capacity of the tank shall be 25 cubic metres and the height of the tank shall be suitably decided.			
8.00.00	CHIMNEY			
8.01.00	General Arrangement One single flue steel lined reinforced concrete chimney shall be provided catering to one unit of Stage-III of the project. There will be one flue (liner) for each unit. The flue gas emission point shall be minimum 275 meters above the plant grade level. The chimney shell (windshield) shall be constructed using slip form shuttering. Liner shall be of structural steel and of hung type (with multiple point liner support) with resin bonded wool type thermal insulation. The liner portion above roof top shall be constructed from acid & heat resistant bricks. Internal platforms of structural steel			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 78 OF 245



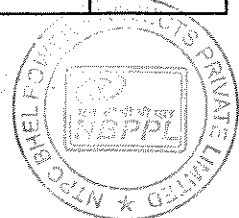
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CLAUSE NO.	CIVIL WORKS 
	shall be provided for enabling access to various elevations of the stack and to support the steel liners. Platforms shall be spaced at a minimum spacing of 45.0 M (approx.). The platform beams shall rest on bearing blocks made of mild steel plate with lead/stainless steel bearing strip, supported on concrete shell in the recesses provided for the purpose. Openings in the concrete shell for flue duct entry, access doors at platform levels, access door & truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around the external platforms, internal staircase & around the ventilation voids in the internal platform using min. 32 mm galvanized pipes medium grade of IS:1239/ IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1000 mm. Minimum two middle horizontal pipe of 32mm galvanized pipes medium grade of IS:1239/IS:1161 shall be provided. At top of platforms concrete curb/kick plate shall be provided all around the platform. The rectangular flue duct outside the chimney shall be connected to the flue liner inside the chimney through a thermally insulated transition duct. The transition duct shall be bottom supported and shall be profiled into a circular shape to connect to the flue liner. The interface between the flue liner and the transition ducting shall be provided with non-metallic fluoroelastomeric fabric expansion joint. External platforms shall be of RCC with pipe handrail. 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 handrails of tubular section shall be provided for full height of the chimney and internal ladder for a small height, over last staircase landing, to access the chimney roof through a roof access hatch. The inside surface of the chimney shell above roof, horizontal surface of the shell at top, underside of roof slab, inside and outside surfaces of mini-shell, top exposed surface of external platforms etc shall be painted with acid & heat resistant black bituminous paint conforming to IS:158 (not less than four coats). Total dry film shall not be less than 150 micron. The entire outside surface of chimney shell shall be painted with alternate bands of signal red and bright white colours, out of which top 50 M shall be painted with acid & heat resistant polyurethane paint and rest of the outside surface shall be painted with synthetic enamel paint. The other components of the chimney include cast iron caps, liner test ports (for continuous pollution monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, a large electrically operated grill type roll-up door (8mx8m) at grade level and personnel access metallic doors at all floors, roof drain basin, rain water down comer pipe (150 mm dia galvanized pipe), connection to plant drains, louvers with bird screens for ventilation openings and all gaps in the wind shield, galvanized mild steel discrete stake embedments, painting of balance chimney shell
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B SUB-SECTION-D-01 CIVIL WORKS PAGE 79 OF 245



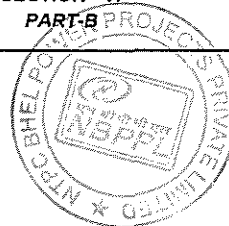
08752

CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	surfaces and painting/coating of all structural steel works and miscellaneous ferrous components (for a maintenance free life of at least ten years), all finishing works, electrical power distribution boards, lighting panels, power and control cabling and wiring systems, stair and platforms lighting, socket outlet, lightening protection and grounding system, aviation obstruction lighting, communication system, a rack and pinion elevator and other items of work, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects.		
8.02.00	Design Requirements		
8.02.01	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 IS, 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. Additional 25% of liner load shall be taken as impact loading for liner erection. The min. thickness of web for plate girders shall be kept as 12 mm. Seismic forces on the chimney system shall be as per site specific seismic information & IS : 1893. Wind forces on the chimney system shall be determined in accordance with IS:875 (Part-III). The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings. Design of all chimney components shall be based on working stress method.		
8.02.02	Wind Shield The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients. The various loading 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 (e.g. corbel) loadings, insulations effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 80 OF 245

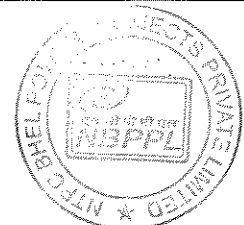


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CLAUSE NO.	CIVIL WORKS 		
8.02.03	Seismic response of the chimney shall be computed by the response spectrum method. At least, the first five modes of vibrations shall be used for this analysis. The cross wind analysis of the chimney shall be carried out irrespective of the value of the Scruton Number for the chimney and other empirical considerations which suggest structural immunity to cross wind oscillations. The effect of the openings/cut-outs in the shell wall shall be duly considered in the design of the windsheid. 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 circumferential reinforcement in the top 3 meters of the windshield shall be twice that required from design forces. The maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The clear cover to reinforcement shall be 50 mm. Grade of concrete for chimney shell, and other super structure shall be minimum M 30. Only OPC cement shall be used for Chimney shell and other super structure. The final design will be checked & verified by 'Wind Tunnel Test' and shall be conducted at a reputed institution. Dynamic interference effects due to additional chimney(s) located in the area or in the future expansion shall be determined along with the other topographical features of the local area through model test. Steel Liners The flue diameter shall be so sized to ensure that the flue gas exit velocity is of the order of 20-25 metres/second at the normal continuous operating load. It should be ensured that the flue gas exit velocity at the lowest continuous unit load is high enough (of the order of 15 metres/second) to enable adequate dispersion of the flue gases. For the purpose, 100 percent turbine MCR condition with design coal firing shall be considered as normal continuous operating condition, and 60 percent turbine MCR condition with design coal/ worst coal firing (whichever yields lesser flue gas quantity) shall be considered as the lowest continuous load condition. However, minimum flue diameter shall not be less than 6750mm. Two manholes placed diametrically opposite shall also be provided in each flue at all platform levels. The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 81 OF 245

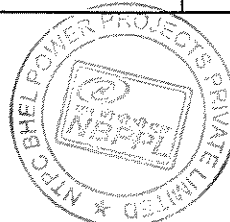


CLAUSE NO.	CIVIL WORKS		
8.03.04	The liner thickness shall be determined from structural and corrosion potential considerations. However, the minimum thickness of the liner, determined from structural conditions alone, shall not be less than 6 mm and the corrosion allowance adopted shall not be less than 4mm. Therefore, minimum installed thickness of the mild steel liners shall not be less than 10 mm in any case. Transition Ducting The duct work profile and the guide vanes shall be so configured and sized to achieve the desired flue gas flow characteristics and to minimise flue gas pressure losses. The duct work and its supporting structures shall be designed for the most onerous of the possible combinations of gravity loading (accounting for ash accumulation), seismic loading, flue gas pressure loading and thermal loading. Like in the case of steel liners, the minimum thickness of duct plates shall not be less than 10 mm in any case from structural condition and corrosion allowance point of view. Clean-out door shall be provided below the flue for the removal of ash.		
8.03.05	Brick Liners AR Brick liners shall be provided above the roof top. The brickwork shall be 115 mm thick and shall be laid with acid resistant mortar of potassium silicate type.		
8.03.06	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/or 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.		
8.03.07	External Platforms External Platforms, with a clear walking space of not less than1000 mm, shall also be provided along the chimney height to match the levels of the internal platforms. Suitable provisions shall be made in the shell for enabling access to the external platform for inspection and maintenance of external surface of the chimney. 32 mm dia GI drainage spouts shall be provided in external platforms for drainage of rain water.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 82 OF 245



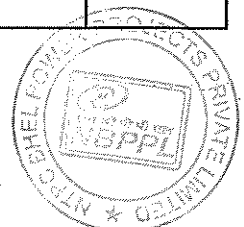
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CLAUSE NO.	CIVIL WORKS 		
8.03.08	Internal Staircase The staircase shall have clear a passage way width of not less than 800 mm. The risers more than 175 mm and treads shall not be less than 225 mm respectively.		
8.03.09	Foundation The chimney foundation shall be designed 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 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 wind loading. No allowance shall be made in the stresses for design of foundation in seismic loading. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. Grade of concrete for foundation shall be minimum M 25.		
8.03.10	Thermal Insulation 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 insulation thickness shall be determined based on the maximum ambient temperature, surface air velocity worked out based on the draught of ventilation air in the annular space between the flue liner and chimney shell, insulation surface emissivity of 0.3 and the insulation cold face maximum temperature not exceeding 55 deg.C. The draught of air in the annular space shall be the natural draught created by the heating of air by the flue liner and the air being vented out through the openings in the chimney shell. The increase in the annulus air temperature due to the rising heated air shall be taken into account while calculating the insulation thickness. 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 83 OF 245



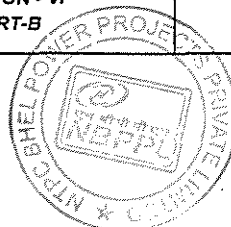
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
8.03.11	Electrical System 415V, normal and emergency AC power supply for chimney shall be derived from main plant power supply system. Emergency supply shall feed 20% of platform lighting, 50% of staircase lighting, aviation obstruction lighting and elevator load. All other loads shall be connected on normal power supply. Ambient temperature for design of all equipment shall be considered as 55 deg. C which is likely to be encountered inside the chimney. The distribution boards of chimney shall comprise switchfuse units of appropriate ratings. Emergency board shall have two incomers, one from emergency supply and other from normal AC distribution board itself. Autochangeover scheme shall be provided in emergency board to enable changeover to healthy source on failure of any source. Dry type isolating transformer of Dyn connection shall be provided in emergency board to obtain neutral lead, in case 3 phase 3 wire emergency supply is derived from main plant. Various platforms shall be illuminated by 70/150W HPSV well glass lighting fixtures. Staircase lighting shall be with 70W HPSV well glass fixtures. Average illuminations level of 150 lux shall be maintained on equipment and 50 lux on platforms/staircases. Lighting system shall be controlled through MCB provided in lighting panel. A lighting and power panel each shall be located at grade level and at other in between levels as required. All distribution boards, aviation lighting controls, etc. shall be located at grade level only. At each platform, 1 No. 63A, 415V welding receptacle and 1 No. 15A, 240V receptacle shall be provided and shall be fed from power panel. Wiring installation for lighting fixture shall be of PVC insulated copper/aluminium wires through galvanised steel conduits. Aviations obstruction lighting system shall conform to the requirements of the latest rules and regulations of the International Civil Aviation Organisation (ICAO), National Airports Authority (NAA) and Directorate of Air Routes and Aerodromes (DARA). The type of aviation obstruction lighting system shall be of high intensity aviation obstruction lights having an effective intensity of 4000 to 2,00,000 cd depending upon back ground illuminance. The aviation obstruction lighting system shall be of type FTB 205 and FTC 110N of Flash Technology Corporation of USA or equivalent. A minimum of three levels will be provided with aviation obstruction lights and there will be four light units per level. The lowest level should not be lower than 75 meters above the ground and vertical spacing of the intermediate levels could vary between			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 84 OF 245



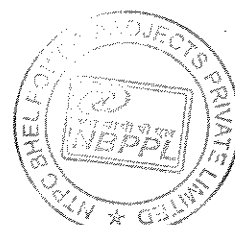
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CLAUSE NO.	CIVIL WORKS 		
8.03.12	75 and 105 meters. Aviation obstruction lighting shall be complete with lights, photo cell, controller, special cables, etc. A temporary aviation obstruction lighting system shall be provided during construction of the chimney. Cables from distribution board to lighting panels/power panels/receptacles shall be 1100V grade, HR-PVC/XLPE insulated armoured aluminium conductor FRLS PVC sheathed with a minimum size of 4 sq.mm. cables shall be laid on galvanised sheet steel cable trays. Cables shall be terminated using double compression type cable glands and solderless crimping type tinned copper cable lugs. Lightning protection system shall comprise minimum 3 vertical air terminations for each flue liner, horizontal air terminations and minimum 4 Nos. of down conductors spaced 90 degrees apart routed all along chimney height on external surface and connected to the earthing system. Above ground level earthing and lightning protection system shall comprise galvanised steel strips. These materials provided at top 12 meters shall have additional coating of 2 mm thick seamless lead cover and the accessories like nuts, bolts, washers etc. shall be of stainless steel to take care of corrosion. Chimney earthing system shall be interconnected to main plant earthing system. A temporary lightning protection system shall be provided during construction of the chimney till a permanent lightning protection system is installed. Communication system comprising of telephone socket at every internal platform level and at grade level, necessary wiring installation, a telephone hand set, junction boxes etc. shall also be provided. For various equipment, the technical requirements and practices shall conform to the relevant clauses of the main plant electrical specification.		
	Rack and Pinion Elevator A rack and pinion elevator, with a load carrying capacity of 400 kg (min) , 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.).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 80 starts per hour. The motor shall be provided with internal 220 V AC space heaters or an alternate heating system The elevator shall be supplied, installed, painted,		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 85 OF 245



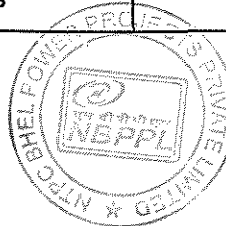
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CLAUSE NO.	CIVIL WORKS		
	tested, commissioned etc. complete with all mandatory spares and operation maintenance manual.		
9.00.00	INDUCED DRAUGHT COOLING TOWERS		
	The civil works for cooling towers are related mainly to following areas, but not limited to:		
9.01.00	Cooling Tower		
	a) Cooling Tower Basin, Sump and Duct		
	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 either screed concrete of 1: 2: 4 having minimum thickness at edge as 25 mm or by suitably adjusting base/floor raft. Drainage arrangement of basin shall be as specified elsewhere in the Technical Specifications. Galvanized handrail (32 NB medium class) 1000 mm high shall be provided all around the cooling tower basin and sludge sump pit. The bottom 500 mm of this railing shall also have galvanized wire mesh with opening size of 50mm grid to avoid ingress of leaves, vegetation, debris into the basin. The Bidder's scope includes construction of one outlet channel, stoplog gate for the cooling tower as indicated elsewhere in the Technical Specification. 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 uncracked section. The end of the outlet channel shall be provided with 230 mm wide and 6 mm thick PVC water stop all round the cross section of channel at the terminal point of bidder to enable further extension by the Employer. The outlet channel shall be covered on top with removable precast concrete slabs with G. I. handrail on both sides of the channel. Hot water duct around cooling towers shall be below ground.		
	b) Foundation of Cooling Tower		
	The foundation of the Cooling Tower shall be as detailed out elsewhere in the specifications.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 86 OF 245



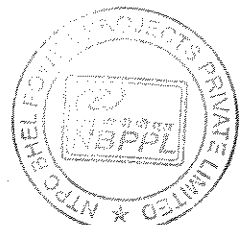
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	c) Super Structure of Cooling Tower beams and other structures like tie beams, slabs etc. shall be of reinforced cement concrete of grade M - 30 (minimum) as per IS : 456. Uniform concrete grade shall be used 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 (1 : 3 : 6). Deck slab and all other overground platforms shall be provided with galvanized 32 mm. dia. Medium class GI hand rails (vertical post as well as horizontal pipes) and with galvanised toe guard all around. Suitable arrangement for drainage of rain water to be provided. However, there is no specific requirement of Rain Water down comers. d) Cells, Distribution System and Stack Cooling tower cells shall consist of RCC columns, beams and walls. Hot water distribution channel shall also be of RCC. Cell division partition walls may be of Cast - in - Situ RCC or precast concrete blocks. 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. e) Stairs Two (2) numbers RCC staircase for approach to fan deck for each cooling tower. The stairs shall have 1000 mm clear width and 32 NB Medium class, GI handrailing. The steps shall be finished with IPS Flooring. The riser shall be maximum 175 mm & treads 250 mm (minimum). f) Steel Structures All mild steel parts of structures used in cooling towers shall be hot double dip galvanized. The minimum coating shall be 610 gm/sq.m and shall comply with relevant IS Codes. Galvanizing shall be checked and tested in accordance with IS: 2629. All welding shall be done before galvanizing. Any site joints required to be carried out after galvanizing shall be either flanged or screwed joints. Nails, nuts, bolts and all components coming in direct contact with water shall be of stainless steel of AISI 304 or equivalent.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 87 OF 245



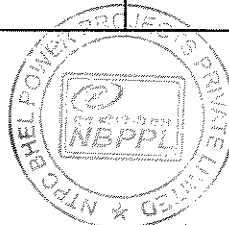
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CLAUSE NO.	CIVIL WORKS		
	g) Water proofing of structures and construction joints For water proofing of underground structures including basin slab and hot water distribution channel, water proofing cum plasticizer compound shall be mixed with the concrete. In addition Chemical injection treatment shall be provided for the construction joints of all underground structures. h) Expansion Joints PVC sealing strips shall be used for all expansion joints where water is retained. The minimum thickness of PVC sealing strip will be 6 mm and minimum width 230 mm. The expansion joint shall be as per IS : 3370. At expansion joints, joints filler material with sealing compound on both sides shall be provided throughout the height of the cooling tower. i) Grade of concrete All RCC work to be done under this specification, unless specified otherwise, shall be design mix (controlled) concrete of grade M 30 of IS : 456. Water - cement ratio shall not exceed 0.45. Minimum 75 mm thick lean concrete of proportion 1 : 3 : 6 shall be provided as mud mat below foundation unless specified otherwise. The lean concrete shall extend 75 mm beyond the outer edge of structural concrete. For water retaining structure minimum 100 mm thick lean concrete of proportion 1 : 3 : 6 shall be provided as mud mat below the bottom slab / raft. The lean concrete shall extend 100 mm beyond the outer edge of the structural concrete. A layer of bitumen paper or craft paper shall be provided over the blinding layer (lean concrete) to destroy the bond between structural concrete and blinding layer. j) All other Civil works required to make installation of cooling tower complete, including the connection of hot water duct . k) Degree of compaction Filling in trenches, plinth, sides of foundations and other underground structures, pipes shall be done so as to achieve the 90% of Standard Proctor's density. Filling for paving below ground floor shall be done to achieve 95% of Standard Proctor's density.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 88 OF 245



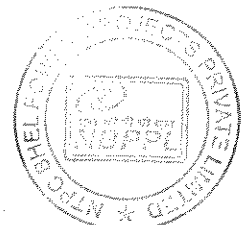
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	l) Form-Work Form-work for basin, basin walls, outlet channel shall be of ordinary quality. For super structures plywood form work shall be used. m) Doors Single sheet steel door of 18 G mild steel with suitable stiffeners hot dip galvanised or FRP door shall be provided in each fan stack at fan deck level. Door height & width as per requirement for equipment movement (clear) shall be provided. However, door size shall be minimum 2100 mm high (clear) & 1200 mm wide (clear). The galvanisation shall not be less than 610 gm / sq.m as per IS : 4759. Door shall have locking facility. n) Coating All concrete surfaces in direct contact with water/ water spray shall be applied with tar extended two component coating system or its equivalent as specified in Annexure-A. All concrete surfaces subject to water/ water spray upto and including Drift eliminator level including basin slab, walls, etc, except exterior surfaces of columns/beams/slab wall and air inlet louvers 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-A o) Paving Paving shall be provided for a minimum clear width of 5.0 m from the outer face of the HW risers all around the cooling tower basin. Paving shall also be provided in between the hot water risers and space available between HW risers and CT basin wall spray catcher. The total width of paving around CT basin shall be atleast 8.5 m from outer edge of the spray catcher basin wall. Paving shall consist of reinforced concrete base slab laid over 75 mm thick 1 : 4 : 8 PCC 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 95% of Standard Proctor's Maximum Dry density. The thickness of the RCC base slab of grade M - 25 shall be suitably designed considering a superimposed load intensity of 2 T / Sq.m. However the minimum thickness of base slab shall be not less than 150 mm having double layered reinforcement. RCC peripheral drain to dispose storm water shall be provided around area paving and shall be connected to nearest NTPC storm water drain.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 89 OF 245



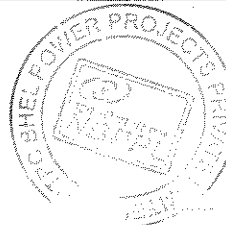
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CLAUSE NO.	CIVIL WORKS 		
9.02.00	p) Trenches All trenches for cables, pipes or any other underground facility as detailed out elsewhere shall be of RCC M - 30 grade. Cable trenches shall be provided with precast RCC M - 30 grade or chequered plate covers. The portion of cable trenches which is inside the building shall be provided with chequered plate covers and others with precast RCC covers. Thickness of chequered plate shall not be less than 6 mm. Cable trenches as well as precast covers shall be provided with edge protection angles and lifting hooks. All embedments / blockouts as required for supporting pipes, cables etc. shall be provided. Weight of Trench precast covers shall not weigh more than 65 kg. RCC Cable trenches shall be filled with sand after Installation of cables, upto top level. All outdoor cable trench's top edge shall be +200 mm from FGL (finished ground level) and for cable trenches inside the building top edge shall flush with FFL (Finished floor level) of buildings unless specified otherwise. All cable entry to the building shall be above ground level. All cable / pipe entry shall be properly sealed. q) Walkways Permanent walkways at least 600 mm 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. Permanent walkways at least 1000 mm clear width shall also be provided for access to fan and around gear box with aluminium gratings with clear opening size not more than 50 MM x 50 mm and grating thickness of 50 mm on RCC supports at fan deck level.		
	Switch Gear / Control Room for Cooling Tower It shall be single storeyed 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 cooling tower & associated cable trenches. Cable trenches, cable trestle, insert plates, chequered plates in MCC room, angles, earthing mat, fencing, gate etc as required as per system requirement shall be provided.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 90 OF 245



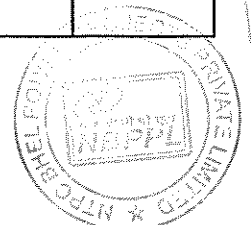
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CLAUSE NO.	CIVIL WORKS			
9.03.00	DESIGN CRITERIA			
9.03.01	R.C.C. Structures			
	The design of all RCC structures shall be carried out using Working Stress Method of design as outlined in IS : 456. Design of structures such as staircase etc. which are not in contact with water / water spray / moist air shall be carried out adopting material stresses as given in IS : 456. However, design of structures which are in contact with water / water spray / moist air, for example columns, beams, fins, walkways, slabs, etc. shall be carried out adopting concrete stresses as given in IS : 456 & limiting the stresses in reinforcement to the values as given in IS : 3370. In addition, a crack width check on sections designed as above shall be carried out. The crack width (calculated as per provisions of IS 456) shall not exceed 0.2mm. in case the calculated crack width is more than 0.2mm, the section shall be revised to ensure that crack width is less than 0.2 mm. The design of liquid retaining structures like C.W. basin, sump, outlet channel, hot water distribution channel shall be as given herein below.			
	(a.) Design of CW Basin wall, sump, column foundations, outlet channel, duct, sludge pit, Hot water distribution basin / Hot water Channel shall be designed as Uncracked section as per IS : 3370 (Part - I to IV). The allowable stresses for concrete and steel shall be as per IS : 3370 (Part - I to IV). The C.W. basin, ducts, sludge pit, etc. shall be designed for the following conditions :			
	(1.) Water filled inside upto the designed level and no earth outside.			
	(2.) Earth pressure plus 2.5 T / M2 surcharge (Vertical direction) plus ground water table at Finished Graded ground Level (FGL) outside and no water inside.			
	(b.) For uplift due to ground water table the basin slab foundation 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.			
	(c.) Fan deck shall also be designed for rolling loads due to movement of equipment during Installation / maintenance operation.			
	(d.) All RCC structures shall comply to durability requirements for severe exposure conditions as per IS:456 (2000).			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 91 OF 245

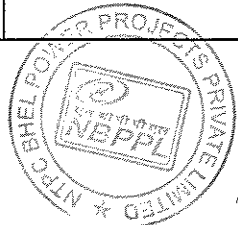


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CLAUSE NO.	CIVIL WORKS	एन टी पी सी NTPC	
9.03.02	Fan Supporting Structures <u>Static Analysis & Design</u> The following load conditions and load combinations shall be considered for the design of the Fan supporting structures. - Machine Load - Load case-1 + unbalance load for the balance of the fan corresponding to Q 16 as per VDI 2056. - Load case-1 + unbalance load corresponding to one blade failure load condition. The strength design of the Fan supporting structure shall be done for worst loading combinations as stated above. <u>Dynamic Analysis</u> (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 :- - For unbalance load corresponding to Q 16 balance grade of the fan as per VDI 2056. - For unbalance load corresponding to one blade failure condition. The amplitude so calculated shall be within the permissible values as specified by the fan manufacturer or IS : 2974 (Part - IV), whichever is more stringent.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 92 OF 245

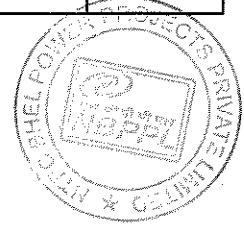


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CLAUSE NO.	CIVIL WORKS 		
9.03.03	Mid Bearing Supporting Structure The intermediate supporting structure for motor, gear box and pillow block if provided shall be so arranged that it does not cause any torsional moments on the beams / pedestals on 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.		
9.03.04	Fan Stack The fan stack shall be made of RCC with minimum 150 mm thickness with reinforcement provided on both faces. Design of the fan stack shall be made on the basis of relevant stipulations of IS : 11504 for Natural Draught Cooling Towers.		
9.03.05	Steel Structure These structures shall be designed, fabricated and erected as per IS: 800. All mild steel parts or structural steel works used in the cooling towers shall be hot dip - galvanised as per IS : 4759 with 610 gm / sq.m. coating. Nails and all components coming in direct contact with water shall be of stainless steel of AISI 304 or equivalent. 1. All welds shall be subject to 100% visual examination. 2. Dye penetration test on welds shall be carried out. 3. Welding shall be done as per approved procedures and by qualified welders. Galvanising shall be checked / tested for all tests as per IS : 2629. For all steel structures outside cooling towers, painting shall be as per details specified elsewhere in this specification.		
9.03.06	The minimum cement content as specified in subsequent clauses of this specification shall be applicable for all structures of cooling towers.		
9.03.07	Test for water tightness The water tightness of C.W. basin, outlet channel, hot water channel and all other water retaining structures shall be tested for water tightness as per the provisions of IS : 3370.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS 

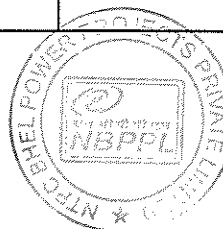
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
9.03.08	STOPLOG GATES AND TRASH RACK FOR COOLING TOWER Stoplog gates The stoplog gate shall cover the clear opening of the cold water channel and effectively stop the water leakage. Clear size of the stoplog gates shall be equal to the clear opening size. The capacity of the hoist (Min 2 ton capacity) shall be decided to match with provided size of the stoplog gate. Structural design of stoplog gate shall conform to IS : 5620 and IS : 4622 (latest). Maximum water level for designing the stoplog gates shall be taken as maximum water level in the CT basin. Suitable lifting beam shall be provided to operate the stoplog gates. Stoplog gate and its lifting arrangement shall designed for a condition when basin is empty and water upto full level on the other side. Proper rubbers seal shall be provided in the stoplog to avoid any leakage of water. All gates shall be hot dip galvanized as per IS:4759 with 610 gm/sqm coating. Alternatively, all gates shall be painted with sealed spray zinc coating conforming to BS:5493 (Table – 3, Part-8) for very long (20 or more) years of maintenance interval. 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 stoplog gates in the required position. Leakage Tests of Stoplog Gates Leakage tests shall be carried out with the stoplog gates lowered onto the sill. Before observation for leakage, the stoplog gate 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 Liters / Minute / Meter length of seal under maximum head. Material Specifications of stop log gate All material used in the fabrication of stoplog gate 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. Materials for the various components of Stoplog gates		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 94 OF 245



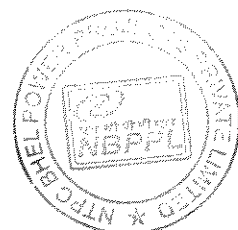
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CLAUSE NO.	CIVIL WORKS			एनटीपीसी NTPC
	Sl. No.	Component Parts	Recommended Materials	Reference
	1.	Stoplog Gate Leaf	Structural steel	IS : 2062
	2.	Stoplog Gate Frames and 1st stage embedded parts	Structural steel	IS : 2062
	3.	2 nd stage embedment	Stainless steel	SS 316 L 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 of equivalent	04 Cr 19 Ni
	8.	Seal seats	Stainless steel	SS 316 L or IS 1570 (Part -5)
	9.	Lifting pin	Stainless steel	IS 1570 (04 Cr, 19 Ni)
	10.	Guide	Corrosion resistant steel	IS : 6603
	11.	Guide shoe	Structural steel	IS : 2062
	12.	Track	Structural steel	IS : 2062
	13.	Guides	Corrosion resistant steel.	IS : 6603
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 95 OF 245

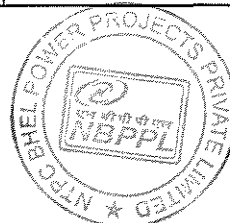


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CLAUSE NO.	CIVIL WORKS			
9.03.09	LOADING			
	For consideration of loads on structures and load combinations IS : 875 (Part -1 to 5) Code of Practice for design loads (other than Earthquake) for Buildings and Structures shall be followed.			
	Site specific seismic data and wind data shall be followed for design of cooling towers.			
	Live Loads			
	The following live loads (minimum) shall be adopted for the design of buildings, structures:			
	a)	Roof / Fan deck	500 Kg / Sq. M.	
	b)	RCC Floors	500 Kg / Sq. M.	
	c)	Stair, landings	500 Kg / Sq. M.	
	d)	Chequered & Grating floor	400 Kg / Sq. M.	
	e)	Culverts and its allied structure	As per I.R.C. class A' loading for two lane and 70R for single lane roads.	
f)	Basin, sump and duct	Earth pressure; water pressure as applicable and additional surcharge load of 2.50 T/Sq. M.		
g)	Covers for H.W. channels / H.W. distribution basin	300 Kg / Sq. M.		
h)	Walkways inside cooling towers	300 Kg / Sq. M.		
i)	Underground pipes and ducts	Earth pressure and surcharge load of 2.50 T / Sq. M.		
j)	Cover of cable / pipe trenches	500 kg / sq.m. or as per (e) above as the case may be.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 96 OF 245

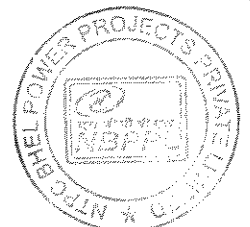


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	ANNEXURE-A Specification For High Performance Moisture Compatible Corrosion Resistant Coating System a) Providing & applying High Performance Moisture Compatible Corrosion Resistant Coating System manufactured as per technical specifications of Central Electrochemical Research Institute, Karaikudi, (C.S.R.I. 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 <table><tr><td>Base</td><td>High Performance Moisture Compatible Corrosion Resistant Coating System CECRI know-how system</td></tr><tr><td>Volume Solids</td><td>70%</td></tr><tr><td>Specific Gravity (ASTM-D-1475)</td><td>1.25 ± 0.1</td></tr><tr><td>Dry Film Thickness (ASTM-D-1186)</td><td>160 ± 10 µm per coat</td></tr><tr><td>Coverage</td><td>4 - 4.5 sq.m/ ltr</td></tr><tr><td>Touch Dry</td><td>2 Hours</td></tr><tr><td>Recoating</td><td>24 Hours</td></tr></table> PROPERTIES OF COATING <table><tr><td>Salt Spray (ASTM-B 115)</td><td>2000 Hours</td></tr><tr><td>Resistance to sea water (Carried out upto 6 months)</td><td>Passes</td></tr><tr><td>Coating Resistance (Carried out upto 6 months)</td><td>10⁹ Ω. cm²</td></tr><tr><td>Adhesion (ASTM-D 4541)</td><td>4.5 kN minimum</td></tr><tr><td>Flexibility (ASTM 3363)</td><td>1/8" passes</td></tr><tr><td>Elongation</td><td>33%</td></tr><tr><td>Impact (ASTM G 14-04)</td><td>45 cm passes</td></tr></table>	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	Salt Spray (ASTM-B 115)	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 kN minimum	Flexibility (ASTM 3363)	1/8" passes	Elongation	33%	Impact (ASTM G 14-04)	45 cm passes	
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SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS																												
		PAGE 97 OF 245																												



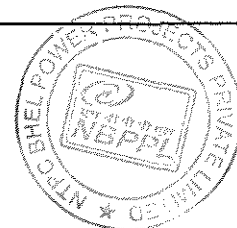
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	d) Paint material & its application method shall be obtained from any manufacturer who has been granted License by CECRI, Karaikudi for technical know how for High Performance Moisture Compatible Corrosion Resistant Coating System. The application method of coating shall be got duly approved from CECRI, Karaikudi.		
10.00.00	CW SYSTEM & MAKE-UP WATER SYSTEM		
10.01.01	A cooling water pump house (CWPH) for housing cooling water pumps and Raw water pump house (RWPH) for housing make-up 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 stoplogs for the respective pump bay dimensions along with electrically operated hoisting arrangements. Steel embedments required for stoplogs 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 of respective pump bay dimension shall also be supplied for each pump house. Steel embedments required for trashracks shall be provided for all the bays. c) Stoplogs, trashracks and hoists shall be supplied in accordance with the specifications covered elsewhere.		
10.01.02	The sub-structure of pump houses including their forebays shall be RCC with M-30 grade of concrete conforming to IS: 456. The superstructure of pump houses shall consist of structural steel frames. The pump houses shall be structurally separated from their forebays by providing an expansion joint. The pump houses shall be provided with separate maintenance bay.		
10.01.03	The CW Pump House and Raw water Pump House shall have structural steel framed super structure with permanently colour coated metal decking as roof and permanently colour coated metal cladding on exterior face. However, brick wall cladding shall be provided up to a height of 900mm from Finished Floor Level (FFL). Above 900mm brick wall, the sheet metal cladding shall be provided with adequate overlapping with brick wall. Steel framed structure shall be made-of rolled steel section or built- up sections.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 98 OF 245



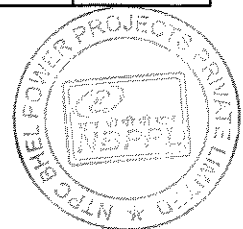
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CLAUSE NO.	CIVIL WORKS 		
10.02.00	Sump model study for CWPH Sump model study for cooling water pump house shall be as specified elsewhere in the specification.		
10.03.00	Design requirement for CWPH & RWPH Design of substructure shall be divided into two parts, namely, i) Stability analysis, and ii) 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 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:		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 99 OF 245



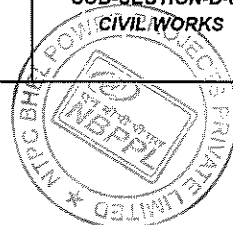
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CLAUSE NO.	CIVIL WORKS 
	a. Check for overturning Factor of safety against overturning, i.e, the ratio of stabilizing moment to overturning moment shall be as per IS: 456. For the above condition, uplift due to maximum Ground water table (GWT) acting 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. b. 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. c. 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 house to counter the uplift due to ground water.
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B SUB-SECTION-D-01 CIVIL WORKS PAGE 100 OF 245

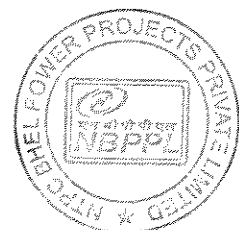


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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	b) Structural Analysis 1) Base Slab Base slab of the pump house shall be designed as a raft foundation supported at locations of piers. Following load cases shall be considered: i) Maximum water level in the 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		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 101 OF 245

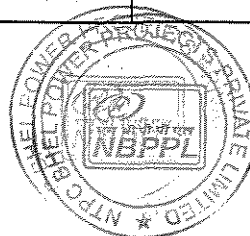


CLAUSE NO.	CIVIL WORKS	एन टी पी सी NTPC	
	face and the outside, i.e., earth side shall be designed as cracked section as per IS : 456. Since end piers are fixed at base and supported (hinged) at top by deck slab, there will be negligible yielding of the wall at top. This will give rise to earth pressure at rest and therefore an earth pressure at rest, $K_0 = (1 - \sin \phi)$ is considered where ϕ =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, K_0, shall be considered for design. Back walls shall be designed by working stress method as per IS: 456 (latest), 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 (latest), with crack width limited to be 0.2 mm. Floor slab of switchgear room and 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 102 OF 245



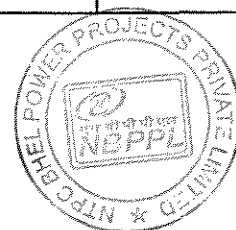
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC																						
10.04.00 10.04.01	C.W. Ducts CW ducts from C.W. pump house up to condensers and from condensers up to cooling towers shall run through concrete encased steel lined ducts. The concrete encasement shall be of minimum 500mm thick with square shape outside. M20 grade PCC encasement shall be provided other than locations of duct crossing road, rail or any other facility where RCC encasement of grade M25 shall be adopted. Top of CW duct encasement shall be minimum 1.5 m below grade/formation level. The minimum thickness of steel pipes shall be as follows including corrosion tolerance of 2 mm: <table border="0"> <tr> <td>a)</td><td>For pipes upto and including 2200 mm dia</td><td>-</td><td>12 mm</td></tr> <tr> <td>b)</td><td>For pipes above 2200 mm upto and including 3200 mm dia.</td><td></td><td></td></tr> <tr> <td></td><td>(i) Duct parallel to A-row</td><td>-</td><td>20 mm</td></tr> <tr> <td></td><td>(ii) Ducts below road and running along road</td><td>-</td><td>16 mm</td></tr> <tr> <td></td><td>(iii) Balance area</td><td>-</td><td>14 mm</td></tr> </table> Maximum velocity of water in ducts shall not exceed 2.2 M / Sec. Required number of stub connections shall be provided to fix air release valves. Flow measurement devices as required shall also be provided. Suitable tapoffs shall be provided in the duct to connect CW chlorination, CW blow down, CW treatment and ash handling plant as specified elsewhere in the specification. Based on the transit analysis, sufficient number of stub connection shall be provided in the duct to fix air release valves and gate valves. All additional measures as necessary for protection against corrosion of C.W. pipes and to take care of any adverse soil characteristics shall be provided by the Bidder. All duct installation & jointing shall be strictly in accordance with the stipulation given in the specification (structural steel work). All the joints of liners shall be butt welded joints. All field joints shall be tested for 100% radiography. 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 discharge pressure at rated capacity or 1.5 times the shut off head whichever is higher and shall be generally water tight to Engineer's satisfaction. The duct shall be tested for the designed shut off pressure. The testing pressure shall be			a)	For pipes upto and including 2200 mm dia	-	12 mm	b)	For pipes above 2200 mm upto and including 3200 mm dia.				(i) Duct parallel to A-row	-	20 mm		(ii) Ducts below road and running along road	-	16 mm		(iii) Balance area	-	14 mm
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SINGRAULI STPP STAGE-III (1x500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 103 OF 245																				



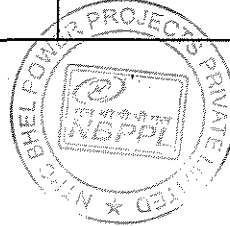
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CLAUSE NO.	CIVIL WORKS			एनटीपीसी NTPC
	held for minimum period of 30 minutes without any signs of leakage or failure of weld. Any in flow / leakage of water from the duct shall be sealed / repaired at Bidder's cost. However, tests in part of length 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 shall be provided in the duct to facilitate maintenance / dewatering of CW duct at centre to centre spacing of 150m (max.) both in intake & discharge ducts. Atleast one manhole shall be provided at the deepest point for both intake & discharge duct. Design of C.W. ducts shall be done for the following conditions. i) Internal Pressure Condition: Following cases shall be considered for the design of pipe: a) Maximum design water pressure b) Surge or water hammer pressure of 5.0 Kg / Sq.cm. c) Pressure, under testing condition ii) External Pressure Condition: The pipe shall be designed for external pressure due to soil overburden, surcharge loading of 2.0 Ton / Sq.m., vacuum condition in pipe, backfill soil, ground water, uplift during empty condition etc., taken together. iii) Practical Requirements: Design shall also be checked for handling stresses. Both stresses and the deflection of pipe shall be within the limits for the above design conditions. Deflection of the pipe under worst loading condition shall be restricted to 2 (two) percent of the pipe diameter. For the concrete encased pipe, the design of pipe shall also be checked under concreting condition during construction. Moreover, temporary bracing shall be provided inside the pipe to limit the deflection within 2% of diameter of pipe during construction.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 104 OF 245	



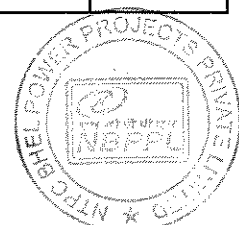
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	The design of C.W. steel pipe liners with concrete encasement shall be as per "Design and Construction of Buried Thin Walled Pipes" CIRIA (Construction Industry Research and Information Association, London) report and also as per American Water Works Association (AWWA) Manual. Steel lined C.W. duct shall be designed ignoring the internal lining (if any) and external coating/ encasement. Corrosion allowance of minimum 2mm shall be kept over and above the designed thickness.		
10.05.00	CW Channel		
10.05.01	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.		
10.05.02	Each cooling tower (CT) discharge channel shall be designed to carry a discharge of 30,000 Cu.m / hr. with minimum water level in cooling tower basin and considering minimum value of rugosity coefficient (n) of 0.018 for concrete surface. The CW channel (on down stream of intersection of CT discharge channels from two cooling towers) shall be designed to carry discharge of 60,000 cum/hr, in addition to make-up water quantity discharged into it.		
10.05.03	The channel shall be designed with (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 out side, 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. The channel shall be checked against uplift due to 50% of the total water head considering ground water table upto FGL. In addition pressure release valves (flap 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 200 mm. Suitable contraction, construction and expansion joints at regular intervals shall be provided in the channel as per relevant Indian or International standards. Expansion, contraction and construction joints shall be provided in the channel as per relevant IS Codes.		
10.06.00	Forebay Structure Forebay consists of retaining wall and forebay slab. The walls shall be analysed as a cantilever wall for stability against overturning and sliding, similar to end piers of the pump house. Pressure release valves (flap valves) and under drainage arrangements shall be provided below the forebay slab to prevent uplift of the forebay slab. Size and spacing of pressure release valves shall be designed by the Bidder to take care of the uplift due to ground water table. However, centre to centre		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS 
			PAGE 105 OF 245



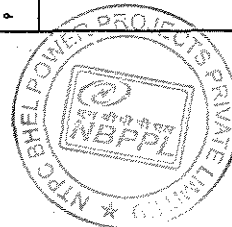
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CLAUSE NO.	CIVIL WORKS	
	spacing of PRV shall not exceed 5000mm. The forebay slab shall be designed against uplift due to 50% of the total water head considering ground water table upto FGL. Minimum thickness of wall at top shall be 200 mm. Hand rails with 32NB (medium) pipe shall be provided on both walls of the forebay.	
10.07.00	Stoplogs and Trash Racks for CWPB & RWPH	
10.07.01	Stoplog 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 (Min 5 ton capacity) provided to handle it in the cooling water pump house and raw water pump house. Structural design of stop log shall conform to IS: 5620 and IS: 4622 (latest). 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.	
10.07.02	Trash Racks Bar screen trash rack is to be provided at inlet of the sump of the cooling water pump house and raw water pump house, in order to prevent ingress of timber & other floating particles which could damage the Pumps. Trash racks shall be with clear opening size of 50 mm. x 50mm. (max.), i.e., the spacing of the vertical and horizontal bars shall be 50mm. Each bay of pump sump shall be provided with Type - 1 trash rack (removable section rack), conforming to IS: 11388 (latest). Centre to centre spacing of trash bars shall be 50mm (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 (Min. 5 tonne capacity). Trash 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 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.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B
SUB-SECTION-D-01 CIVIL WORKS		PAGE 106 OF 245



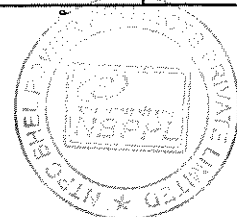
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CLAUSE NO.	CIVIL WORKS 																		
	All trash racks should be capable of being lowered in the associated stop log groove to enable drawal of clean water while a particular trash rack is raised for cleaning purpose. Suitable arrangement for storing all the stop logs and stand by trash rack shall be provided by the Bidder, to keep them in good working condition.																		
10.07.03	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.																		
10.07.04	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.																		
10.07.05	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.																		
10.07.06	Materials for the various components of Stop logs <table border="1"> <thead> <tr> <th>Sl. No.</th><th>Component Parts</th><th>Recommended materials</th><th>Reference</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Stop log Leaf</td><td>Structural steel</td><td>IS : 2062</td></tr> <tr> <td>2.</td><td>Stop log Frames and 1st stage embedded parts</td><td>Structural steel</td><td>IS : 2062</td></tr> <tr> <td>3.</td><td>2nd stage embedment</td><td>Structural steel</td><td>IS:2062</td></tr> </tbody> </table>			Sl. No.	Component Parts	Recommended materials	Reference	1.	Stop log Leaf	Structural steel	IS : 2062	2.	Stop log Frames and 1 st stage embedded parts	Structural steel	IS : 2062	3.	2nd stage embedment	Structural steel	IS:2062
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SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 107 OF 245																



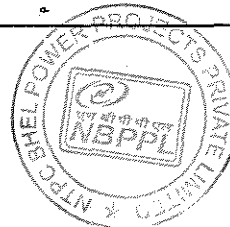
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC			
10.07.07	Sl. No.	Component Parts	Recommended materials	Reference
	4.	Wheels (the hardness of wheel track surface shall be kept 50 points higher than that of wheel tread)	Cast steel	IS : 1030
	5.	Wheel axles, wheel track	Corrosion resistant steel.	IS : 1570
	6.	Seals	Rubber	IS : 11855
	7.	Bearings	SKF of equivalent	04 Cr 19 Ni
	8.	Seal seats	Stainless steel	SS 316 L or IS 1570 (Part - 5)
	9.	Lifting pin	Stainless steel	IS 1570 (04 Cr 19 Ni)
	10.	Guide	Corrosion resistant steel	IS : 6603
	11.	Guide shoe	Structural steel	IS : 2062
	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	Structural steel	IS: 2062
	3.	Slide Block	Structural steel with bronze padding	IS 2062 & IS : 305
	4.	Track base	Stainless steel	SS 316 L or IS : 1570 (Part - 5)
	5.	Track	Stainless steel	SS 316 L or IS : 1570 (Part - 5)
	6.	Guides	Corrosion resistant steel.	IS : 6603
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS PAGE 108 OF 245



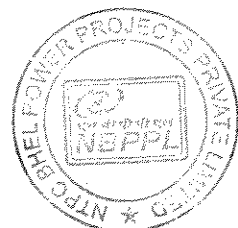
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC
10.07.08	Coating for Mild Steel parts in contact with Water a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of zinc shall be 610 gms / Sq. M. 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.	
10.08.00	Intake structure on existing discharge channel for interconnection with raw water pump house The water for raw water pump house has to be drawn from existing Singrauli discharge channel through RCC NP3 Hume pipes. Suitable intake structure has to be provided in the existing discharge channel for connection of these pipes. As the discharge channel is in running condition, suitable arrangement like temporary coffer dams, sheet piling etc. as required shall be made for interconnection of these pipes with existing discharge channel for feeding raw water pump house.	
11.00.00	DM PLANT, PT PLANT & CW TREATMENT CIVIL WORKS All pump houses covered under DM plant, PT plant and CW treatment other than chemical house, filter house and chlorination building or specifically mentioned elsewhere in the specification shall have open sheds. The open sheds shall have structural steel superstructure with permanently colour coated metal sheeting at roof and side open.	
11.01.00	Design Concepts i) All buildings shall have framed super structure. ii) Buildings with sheds shall not have any cladding. 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 shall be with minimum one brick thick on exterior face.	
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.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
PAGE 109 OF 245		



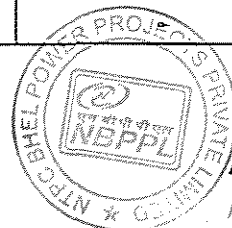
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CLAUSE NO.	CIVIL WORKS			
11.01.02	The load combinations and design criteria shall be as specified elsewhere in the specification.			
11.01.03	All liquid retaining structures shall be designed for following load conditions. Underground structures: (a.) Water filled inside up to design level and no earth outside. (b.) Earth pressure with surcharge of 2.5 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.			
11.01.04	In case of all liquid retaining / conveying structures, the structural design for shear forces shall be done as per working stress method stipulated in IS: 456. However, the nominal permissible shear stress in concrete shall be as per IS: 456 and permissible tensile stress in reinforcement steel shall be as per IS: 3370 (Par - II). The nominal (total) shear stress in concrete shall be checked as per the formula given in IS: 3370 (Part - II). In case, where nominal (total) shear stress in concrete exceeds the values specified in IS: 456, the shear reinforcement shall be provided. In no case the nominal (total) shear stress in concrete shall exceed the permissible values specified in IS: 3370 (Part - II) otherwise the section size shall be revised.			
11.01.05	In design of counterfort retaining walls of underground liquid retaining structures (counterfort provided outside i.e. towards earth side), following shall be considered. Under load combination producing tension on outer face of counter fort (i.e. face in contact with earth) the section shall be designed for cracked conditions with permissible steel stresses as per IS: 3370 (Part - II). Inside face (face in contact with liquid) shall be designed for uncracked conditions. However walls of the liquid retaining structures shall be designed for uncracked conditions for tension on either face.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 110 OF 245



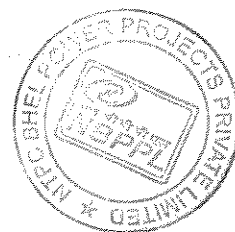
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC						
11.01.06	For load condition with earthquake / wind forces, column / beams with minimum thickness / depth of 450mm and acting as a part of liquid retaining structure may be designed by limit state method, as per IS : 456, with Partial Safety Factor for loads equal to 1.5 for all load cases considered in such load combinations. For this load combination, when the column / beam face in contact with liquid is under tension, the calculated crack width under serviceability limit state of cracking (with partial safety factor equal to 1.0 for all loads including wind / seismic load) shall be less than 0.2mm, calculated as per relevant BS code of practice, to ensure leak proof conditions. For other load combinations these columns / beams shall be designed as uncracked sections as per IS : 3370.							
11.01.07	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.							
11.01.08	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.							
11.01.09	Clear free board of at least 300 mm above design (total) water level shall be provided in all liquid retaining / conveying structures.							
11.01.10	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.							
11.01.11	The minimum concrete clear cover to reinforcement bars in all RCC structures shall be as per IS:3370 (Part - II). However in no case the clear cover shall be less than stipulated below.- <table><tr><td>i) Slab</td><td>15 mm</td></tr><tr><td>ii) Beam</td><td>25 mm or dia of main reinforcement whichever is greater</td></tr><tr><td>iii) Foundation / base slab</td><td>Bottom 75 mm, for foundation in direct (for isolated footing in contact with earth and 50 mm for foundation or raft / foundation resting on lean / blinding strip and foundation beams) concrete. For sides and top 75 mm.</td></tr></table>	i) Slab	15 mm	ii) Beam	25 mm or dia of main reinforcement whichever is greater	iii) Foundation / base slab	Bottom 75 mm, for foundation in direct (for isolated footing in contact with earth and 50 mm for foundation or raft / foundation resting on lean / blinding strip and foundation beams) concrete. For sides and top 75 mm.	
i) Slab	15 mm							
ii) Beam	25 mm or dia of main reinforcement whichever is greater							
iii) Foundation / base slab	Bottom 75 mm, for foundation in direct (for isolated footing in contact with earth and 50 mm for foundation or raft / foundation resting on lean / blinding strip and foundation beams) concrete. For sides and top 75 mm.							
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B						
SUB-SECTION-D-01 CIVIL WORKS		PAGE 111 OF 245						



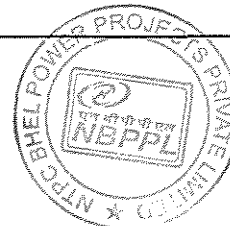
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CLAUSE NO.	CIVIL WORKS				एनटीपीसी NTPC
	iv)	Columns (below and above ground level)	50 mm		
	v)	Sump / pit walls	25 mm on liquid face & 40 mm on soil face.		
	vi)	Walls above ground	25 mm on either face.		
11.01.12	Suitable additional reinforcement and shear keys shall be provided at all construction joints in the wall of liquid retaining structures.				
11.01.13	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 sliding conditions (ratio of horizontal frictional resistance to horizontal sliding force) under static loads. To ensure an adequate factor of safety under earthquake conditions, the factor of safety against sliding shall not be less than 1.2.				
11.01.14	For detailing of Reinforcement IS: 5525, IS: 13920, IS: 4326 and SP: 34 shall be followed.				
11.01.15	Two layers of reinforcement (on inner and outer face) shall be provided for RCC sections having thickness of 150 mm and above.				
11.01.16	Minimum diameter of main and distribution Reinforcement bars in different structural elements shall be as follows::				
	Sl. No.	Structural Element	Main Reinforcement	Distribution Reinforcement / Anchor Bars	
	a)	Foundation	12 mm	12 mm	
	b)	Beams	12 mm	10 mm	
	c)	Columns	12 mm		
11.01.17	Spacing of reinforcement bars in walls and slabs of liquid retaining / conveying structures shall not be more than 200 mm.				
11.01.18	Suitable shrinkage reinforcement shall be provided at top face of foundations. Minimum shrinkage reinforcement shall be 10 mm dia. @ 200mm c / c.				
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS	PAGE 112 OF 245

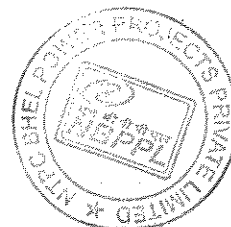


08785

CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
11.01.19	Minimum Reinforcement in all elements of liquid retaining / conveying structures shall be 0.24 % of cross sectional area.		
11.01.20	Minimum tensile Reinforcement in each direction for all foundation slabs / rafts shall be 0.2% of cross sectional area.		
11.01.21	Minimum thickness of foundation slab / raft and base slab of all liquid retaining tanks / pits shall not be less than 250 mm.		
11.01.22	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.		
11.01.23	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.		
11.01.24	All water retaining structures shall be tested for water tightness as per provisions of IS: 3370 and IS: 6494.		
11.01.25	Finishing Schedule Finishing schedule shall be as specified elsewhere in architectural specification.		
11.02.00	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. tile 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).		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 113 OF 245

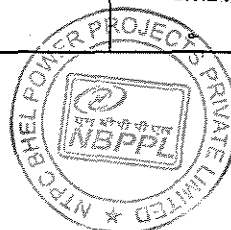


CLAUSE NO.	CIVIL WORKS	
	Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles : The floor shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 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. 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.	
11.03.00	Roof a) Roof over buildings/ structures as applicable shall have cast - in - situ RCC slab. b) Roof shed consisting of troughed permanently colour coated metal sheeting, having steel feed material of minimum bare metal thickness of 0.6mm (i.e. excluding galvanizing and colour coating) using cold rolled galvanized (to Grade 275 minimum as per IS :277) of minimum yield strength 250 MPa and of drawing Grade as per IS : 513, coated with Zinc Aluminium alloy @ 150 gm/Sq.M as per AS1397, colour coated to total minimum coating thickness of 35 microns (nominal) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint of minimum 20 microns (nominal) Dry Film Thickness (DFT) on one side over 5 micron (nominal) primer coat and 5 micron (nominal) SMP over 5 micron (nominal) primer coat on back surface (SMP shall be of category 3 of AS2728), and approved profile, sectional properties (suitable for the specified loading/ deflection and runner spacing). Fasteners shall be of specialized coating tested for 1000 hours salt spray test and conforming to Class 3 of AS3566.	
11.04.00	Not Used	
11.05.00	DM Tank Foundation	
11.05.01	General Requirements The tanks shall rest on flexible tank pad. All works pertaining to tank foundation shall be executed, as per the technical specification and as per the directions of the Engineer. After tank erection, hydro testing of tank shall be carried out, as per procedure given in Clause 11.05.08	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
		PAGE 114 OF 245



08787

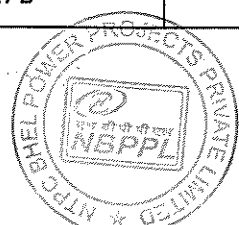
CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
11.05.02	Sub-Grade Preparation The surface of natural soil shall be thoroughly compacted by rolling or other means, as directed by Engineer, to obtain 95% of max. laboratory dry density for the soil, as per IS:2720 (Part-VII).			
11.05.03	Sand Pad Sand for filling shall be clean and well graded, conforming to IS:383, with grading Zone I to III. It shall not contain any vegetable and organic materials. Sand shall be obtained from a source, approved by the Engineer. Sand shall be blended with required quantity of cohesive fines (grain size less than 0.074 mm), so that the total fines present below 0.074 mm shall be 15% to 20%. The sand soil mixture shall be subjected to thorough mixing, to obtain a uniform mix. Sand with cohesive fines shall be spread in layers not exceeding 15cm in compacted thickness, over the area. Each layer shall be uniform in density, quality of materials and moisture content, before compaction. The moisture content shall be within two percent (2%) of optimum moisture content (OMC), on dry side of OMC, as per IS:2720 (Part -VII). Compaction of each layer shall be done by Mechanical means, as per directions of the Engineer. Each layer shall be uniformly compacted, to achieve a dry density, not less than 95% of standard proctor maximum laboratory dry density of the material, as specified. Further layer shall be placed, only after the layer already laid has been compacted to the required density and approved by the Engineer. The finished surfaces must be dressed to require grade and slope. Excess material must be removed from compaction site.			
11.05.04	Crushed Rock Ring A crushed rock ring shall be provided below the tank. The size of stone aggregates, for the ring wall shall be 50mm and down and shall be of hard black trap granite or such other approved material			
11.05.05	Laying The stone aggregate shall be laid in layers of 150mm thickness and each layer shall be compacted to obtain a hard core ring wall to the satisfaction of the Engineer. The surface shall be checked from time to time during spreading and compaction to ensure a finished surface, true to levels and grade. Fine aggregates, such as sand or			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 115 OF 245



08789

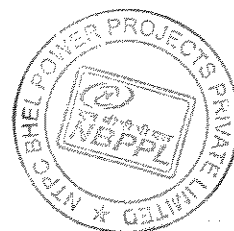
CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC																					
11.05.08	Laying The crushed rock ring where provided and areas on which the premix is to be laid shall be thoroughly cleaned of all dust and loose materials. On the cleaned surface, a tack coat at the rate of 1.0 Kg. per Sq.M. of hot Bitumen 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 given in Clause No. 6.01.02, 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.																							
	Procedure for Hydro Testing of Tank Six equidistant peripheral points are to be established and their initial levels shall be taken properly, with respect to permanent bench mark. Recording of initial levels on the tank shall begin one week in advance, of the commencement of first stage of loading. The filling up of the tank with water shall be carried out in stages, as under:																							
12.00.00		<table><thead><tr><th></th><th>Stage Filling of water (M)</th><th>Intensity of loading (T/M²)</th></tr></thead><tbody><tr><td>i)</td><td>2.0</td><td>0.0 to 2.0</td></tr><tr><td>ii)</td><td>4.0</td><td>2.0 to 4.0</td></tr><tr><td>iii)</td><td>6.0</td><td>4.0 to 6.0</td></tr><tr><td>iv)</td><td>8.0</td><td>6.0 to 8.0</td></tr><tr><td>v)</td><td>10.0</td><td>8.0 to 10.0</td></tr><tr><td>vi)</td><td>10.6</td><td>10.0 to 10.6</td></tr></tbody></table>		Stage Filling of water (M)	Intensity of loading (T/M ²)	i)	2.0	0.0 to 2.0	ii)	4.0	2.0 to 4.0	iii)	6.0	4.0 to 6.0	iv)	8.0	6.0 to 8.0	v)	10.0	8.0 to 10.0	vi)	10.6	10.0 to 10.6	
		Stage Filling of water (M)	Intensity of loading (T/M ²)																					
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	v)	10.0	8.0 to 10.0																					
	vi)	10.6	10.0 to 10.6																					
FUEL OIL HANDLING SYSTEM Structural arrangement, foundation system, cladding, miscellaneous requirement, finishes, etc., shall be as specified elsewhere in this specification.																								

SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 117 OF 245

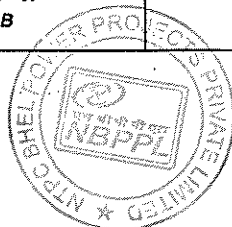


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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
12.01.01	Fuel Oil Unloading & Storage System The existing facilities for storage provided for Heavy oil (HFO /HPS /LSHS in Stage-I &II are adequate to meet the additional requirements for Stage-III also. Necessary interconnecting piping between existing HFO and LDO tanks and the new LDO tank and the pressurizing pumps of Stage-III shall be provided. A Combined unloading cum pressurizing pump house shall be provided to house the pressurizing pumps of stage-III. The civil works are to be provided for following fuel oil handling system areas as mentioned below: a) Civil works for one unloading cum pressurizing pump house. b) Foundation and dyke wall and all associated works for one LDO tank. c) Pedestals and foundations to support the interconnecting piping between existing HFO tanks and new LDO tank to the pressurizing pumps of Stage-III, as well as piping from tanker unloading area to the Unloading pump hose and further on to the LDO tank. d) Tanker unloading platform. e) Oil water separator pit. The pump house building shall have composite construction, with RCC columns and structural steel roof, i.e. steel trusses supported on RCC columns and shall have metal deck roof, with RCC slab. The roof shall be supported on steel purlins, spanning over the roof trusses. The MCC portion of the pump house shall be of lower height and shall have internal columns as well as RCC roof.		
12.01.02	Pipe / Cable Trestles and Foundations Pipe / cable racks shall be overhead & supported on pipe / cable gallery & trestles. Four legged trestles are to be provided for supporting the pipelines/cables at suitable intervals. Cross overs, operating platforms and necessary thrust resisting arrangement at pipe bends shall be provided as required. 600 mm wide grating platform with handrails shall be provided as a walkway along the length of the trestles. Cage ladders shall be provided at regular intervals.		
12.02.00	RCC dyke wall of 1.2m clear height above finished ground level shall be constructed around LDO tank enclosing a minimum area of 17M x 17M.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 118 OF 245

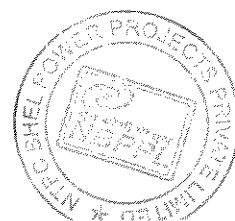


CLAUSE NO.	CIVIL WORKS	
13.00.00	COAL HANDLING STRUCTURES IN MAIN PLANT AREA	
13.01.00	Track Hopper, Machinery Hatches, Underground TP's & Tunnel Track hopper and machinery hatches shall consist of underground portion, which shall be of R. C. C., and above ground portion, which shall be of structural steel shed covered with permanently Colour coated profiled steel sheets. The structural arrangement shall essentially consists of R. C. C. frames spaced at approx. 3.0M centers with R. C. C. wall panels on the sides and R. C. C. raft at the bottom, fixed to the frames. The top beam of the R. C. C. frame supports the rail supporting beams and the coal hopper. Minimum thickness of R. C. C. raft at bottom shall be 600 mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top. No columns shall be provided inside the Machinery Hatches. The vertical and inclined portion of coal hopper, the beams and top of coal tray in the track hopper structure shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification. Expansion joints shall be provided at a maximum distance of 40m. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material. Detailing of expansion joints shall be as per details in the tender drawing. Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Arrangement shall be made for disposal of water right up to the coal slurry setting tank. Side drains and sump shall have removable type steel grating cover. Gratings shall be galvanized to grade 610 gm/m². Water proofing / Damp proofing of under ground portion of track hopper and machinery hatches, tunnels, underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments: (a) Chemical injection grouting for inner faces (details as specified elsewhere). (b) Polymer modified cementitious coating on earth side face as per the following : (1.) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS 
		PAGE 119 OF 245



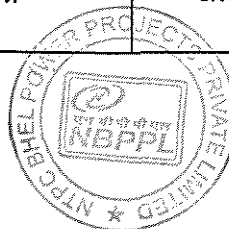
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface. (2.) 50 mm thick P. C. C. (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers (slurry mix application) as per manufacturer's specification. 50 mm thick P. C. C. (1 : 2 : 4) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft. Track hopper shall have removable type steel grating cover. The opening size for the grating shall be 400 mm x 400 mm. Machinery hatches shall have removable steel chequered plate cover. Track hopper grating shall be built of min. 150mm x 16mm thick flats in one direction and 100mm x 12mm thick flats in other direction. No painting/galvanization shall be provided in gratings. However, two coats of red oxide primer to be provided immediately after fabrication. Catwalk shall be provided along the track hopper. Each machinery hatch shall be provided with a pair of R. C. C. stair for providing access to the base of track hopper / machinery hatch. Both the stairs shall be interconnected at suitable height. Plinth protection along with drains shall be provided along the Track Hopper and around machinery hatches. However, 5m wide paving shall also be provided around machinery hatches. The track hopper is a deep underground structure which is subjected to direct load from the loaded wagons / loco due to the rake movement over it, in addition to load due to coal filled hopper and lateral earth pressure. The railway loads, analysis and design of track hopper, machinery hatches, transfer point and the portion of tunnel subjected to rail loads shall be as specified in design criteria. Coefficient of dynamic augmentation shall be worked out for a train speed of 30 kms per hour Earth pressure to be considered for design shall be due to earth pressure at rest (K_0) condition only. Earth pressure due to surcharge intensity of Railway Loads (where applicable) or Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. whichever is critical, shall be considered in the design. A minimum safety factor of 1.2 against uplift of track hopper, machinery hatches, wagon tippler, transfer points (underground or with basement) and tunnels, due to ground water shall be ensured during execution and after execution, considering		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 120 OF 245



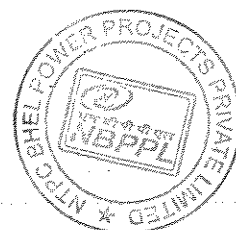
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CLAUSE NO.	CIVIL WORKS 
13.02.00	dead weight of the structure to be 0.9 times only, ground water table at adjoining formation level and soil wedge angle of not more than 15 degrees. Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case. Walkway width and hand railing shall be provided as specified in the tender drawing. Wherever, slope of tunnel exceeds 10°, R. C. C. steps shall be provided for the entire width of each walkway. Overhead / Ground Conveyor Galleries and Trestles 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 meters 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. Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor. The ground conveyors shall be located in suitably enclosed gallery of structural steel consisting of rigid portal frames spaced at regular intervals and suitably braced. Plinth protection along with drains shall be routed along the ground conveyors. For double stream conveyor gallery, two side and one central walkway of width 800 mm and 1100 mm respectively shall be provided. The 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
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B SUB-SECTION-D-01 CIVIL WORKS PAGE 121 OF 245



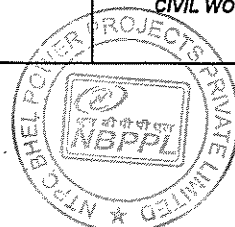
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC												
	the slope of walkway is more than 10°, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates and other drainage arrangements as specified elsewhere 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 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 100 M 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 8.0m above the road crest / rail top shall be provided. For calculation of coal 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 coal load per unit length of each moving conveyor shall be <table><tr><td></td><td></td><td>Rated Capacity of Conveyor system</td><td>1100</td></tr><tr><td>1.6</td><td>X</td><td>-----</td><td>X</td></tr><tr><td></td><td></td><td>Conveyor Belt Speed</td><td>800</td></tr></table> It should be noted that for structural design, unit weight of coal shall be assumed as 1100 Kgs. / Cu. M. instead of 800 Kgs. / Cu. M. considered for system sizing purpose. 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.			Rated Capacity of Conveyor system	1100	1.6	X	-----	X			Conveyor Belt Speed	800	
		Rated Capacity of Conveyor system	1100											
1.6	X	-----	X											
		Conveyor Belt Speed	800											
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 122 OF 245											



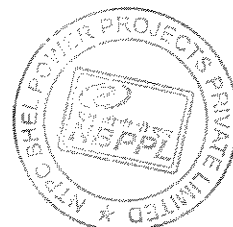
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CLAUSE NO.	CIVIL WORKS		
13.03.00	a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements. 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 P. T. F. E. 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. For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and under ground 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. Trestle columns / ground conveyor portal column base shall be kept 300 mm higher than the existing ground level. Transfer Houses The over ground portion of the transfer house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding and R. C. C. floors over structural beams. However the lower portion of side cladding 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. 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 123 OF 245

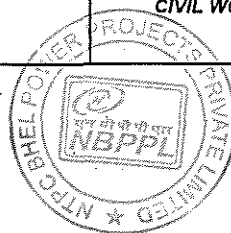


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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
13.04.00	Roof shall be provided with troughed profile permanently colour coated sheet on outside and plain permanently colour coated sheet on inside with 50mm thick mineral wool insulation in between the two sheets. A slope of 1 in 5 shall be provided for quick drainage of rain water. Mineral wool insulation (as per IS: 8183) having a density of 32 kg/cum for glass wool or 48 kg/cum for rock wool, bound in polythene bags shall be used. Crusher House The crusher house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding. The lower portion of side cladding for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of R. C. C. supported on steel beams. Roof shall be provided with troughed profile permanently colour coated sheet on outside and plain permanently colour coated sheet on inside with 50mm thick mineral wool insulation in between the two sheets. A slope of 1 in 5 shall be provided for quick drainage of rain water. Ring Granulator Type Crushers shall be supported on R. C. C. deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This R. C. C. deck shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force (due to ring granulator), frequency and amplitude criteria and other design requirements are appended elsewhere in this specification.		
13.05.00	Stacker Reclaimer Foundation Stacker - Reclaimer foundation shall be in R. C. C. and shall be designed as a continuous wall or R. C. C. framed structures (in longitudinal & transverse direction). Lateral tie beams between two rail supporting elements shall be provided at a regular interval of approx. 3.0 m center. The foundation shall be designed for the most critical combination of loads as furnished by the equipment supplier. R.C.C retaining wall on both sides of the S/R foundation shall be provided. The portion between the two rails shall be paved in concrete as per specification for grade slab of ground level specified elsewhere. However no metallic hardener finish over R. C. C. slabs is to be provided. Drains shall be provided along the rails for drainage of rain / dust suppression / floor washing water. Drains shall be routed on both sides of the foundation along the rail. Drains shall be connected to the network drainage system for finally discharge into coal settling tank. RCC drains shall be provided in Coal stockyard area with precast RCC covers.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 124 OF 245

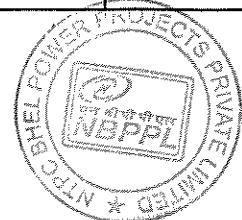


CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
13.06.00	Control building, M. C. C. Buildings These shall be R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. All air - conditioned areas, shall be provided with the suspended permanently colour coated aluminium false ceiling system.		
13.07.00	Pump Houses These shall be of R.C.C. or steel framed structure with columns, beams, slab and foundations etc. cladding shall be of brick work with plastering on both sides. Roof shall be provided with roof water proofing treatment as specified elsewhere. Underground sump and water tanks shall be of R.C.C. Galvanized steel ladder / rung ladder shall be provided for access to the roof level of the pump house and water tanks.		
13.08.00	Pent House These shall be of R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation.		
13.09.00	Toilets Toilet with potable water line facilities shall be provided in each of the following locations: (a.) Crusher House (Ground & Drive Floor) (b.) In all M. C. C. Rooms (c.) Control Building		
13.10.00	Staircases All roofs of transfer houses shall be accessible through staircase. However, for the pump houses, access to the roof will be provided by cage ladder		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 125 OF 245

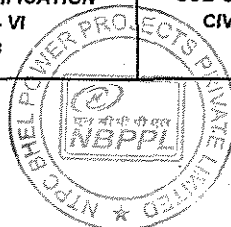


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CLAUSE NO.	CIVIL WORKS		
13.11.00	All stairs other than those of M. C. C. rooms and control rooms shall be of steel (minimum 1000 mm wide) and maximum rise should not be more than 180 mm and minimum tread width 250 mm. Stringers shall be of rolled steel channel(minimum ISMC 250) and tread shall be of 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 above platform level and pipe posts spaced not more than 1.5 metres apart. Treads and landing shall be suitable for the prescribed loading. The maximum width of openings in gratings shall not exceed 40 mm. The minimum thickness of main bars shall be 6 mm. The usual span of grating will not generally exceed 1.5 meters. Stair case gratings shall be galvanized to grade 610g/m². Out side stairs to transfer points shall be open type. Stairs of control room and M. C. C. room shall be of R. C. C. construction, and minimum 1200 mm wide, 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.		
	Trenches All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings, top level shall be 200 mm above G. L.		
	13.12.00 Drainage & Water Supply Works		
	13.12.01 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		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 126 OF 245



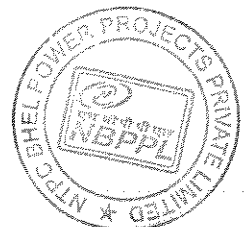
CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	conveyor galleries, transfer points, crusher building, penthouse etc. with water periodically. Minimum 4 nos. down comers shall be provided in each transfer house / crusher house. In case of conveyor galleries, the down comer shall be provided at every trestle location. Drainage of the complete coal stock pile, area around stacker reclaimer rails etc. shall be discharged into the coal slurry settling pond. For Conveyors 1 A/B, 2 A/B, 3 A/B, 4 A/B, 5 A/B, 6 A/B each down comer shall lead the water / coal slurry to pit (of 2 Cu.M capacity) to allow settling of coal. The water from the pit shall overflow into R.C.C drain, which will lead the discharge finally into drain routed alongside the nearby road. For Crusher House, Pent House, TP-1, Drive house each down comer shall lead the water / coal slurry into the peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / coal slurry to RCC drain and finally to the coal settling pond. For TP-2, TP-3, TP-4, TP-5, each down comer shall lead the water / coal slurry into the peripheral drains (Brick drains with steel gratings provided around the building) which will lead the water / coal slurry to RCC drain and finally into drain routed alongside the nearby road. For Track Hopper, machinery hatches, peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / coal slurry to a local pit (of 2 Cu. M. capacity) near each facility to allow settling of coal. The water from the pit shall overflow into R.C.C drain, and finally into drain routed alongside the nearby road. In case of Control rooms and M. C. C. 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 R.C.C drain, which will lead the discharge finally into drain routed alongside the nearby road. Suitable kick plates/Curb beams shall be provided around the floor openings, stair case landings, in the transfer points, crusher house and other buildings. Bidder's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 127 OF 245



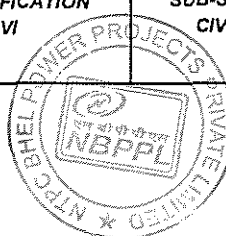
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CLAUSE NO.	CIVIL WORKS		
13.12.02	Internal and external water supply, drainage etc.:- The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in these specifications. 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 used. The scope for drainage of surface water shall include design, layout and construction of drains for and from buildings and drains required for coal stockyard area, drainage up to main coal slurry settling tank including connection with the tank. Drainage system shall be designed for maximum intensity of rainfall as 75 mm/hr and 60 % runoff coefficient. All buildings (including transfer houses and crusher house) shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth all around the periphery. All drains excepting the peripheral drains around the transfer points, crusher house, control / M. C. C. buildings, pumps house etc., shall be of R. C. C. construction. All open drains shall have removable steel grating designed for loads as specified under loading clause. Minimum thickness of grating (Galvanised to 610 gm/m²) shall be 12 mm. However at entry or road crossing point's minimum thickness shall be 40 mm. 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. However, drains in coal stockyard area shall have pre cast R. C. C. covers. RCC pre - cast cover weight shall not be more than 65 Kgs. RCC pre-cast covers near entry or at road crossings shall be designed for 10 T wheel load at centre. RCC pre - cast covers shall be designed for central point load of 75 Kgs. For rain water down comer and those to be used for conveying water / coal slurry generated from cleaning of conveyor gallery and buildings floors, Galvanised MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be used for MCC buildings, pump houses, penthouse, control rooms. Galvanised steel ERW pipes (273mm OD, 4mm thk) of steel grade Fe330 conforming to IS: 3589 with welded joints shall be used for all TP's, Crusher house, and Conveyor galleries. Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 400 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 128 OF 245

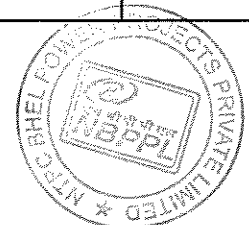


CLAUSE NO.		CIVIL WORKS		एनटीपीसी NTPC	
13.13.00	For design of building drainage system IS: 1742 shall be followed. For sanitary / sewerage pipes above ground, sand cast iron pipes conforming to IS : 1729 with leak proof lead joints. For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided. For sewerage below ground stoneware pipes conforming to IS: 651 with concrete bedding and haunch.				
	COLOUR COATED AND OTHER SHEETING WORK Permanently colour coated sheet of approved shade and colour using galvanised mild steel sheet of minimum 0.6mm BMT(bare metal thickness i.e. metal thickness excluding thickness for coating and galvanizing) galvanised to grade 275 as per IS 277, of minimum yield strength of of grade SS255 as per ASTM A653M / grade G250 as per AS 1397, coated with zinc of class designation Z275 or high tensile steel of minimum 0.5mm BMT(bare metal thickness i.e. metal thickness excluding thickness for zinc aluminium coating and colour coating) of grade SS340-Class 4 as per ASTM A792M / grade G350 as per AS 1397, coated with aluminium zinc alloy of class designation AZ150. Steel shall be colour coated with total coating thickness of 35 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face on 5 microns (nominal) primer coat and 5 microns (nominal) SMP or super polyester paint over 5 microns (nominal) primer coat on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 3 of AS2728. Coated surface shall be provided with a protected guard film (polyethylene) of about 40 microns to avoid any damage to the coating during handling. For metal deck, minimum 0.8 mm (bare metal thickness i.e. metal thickness excluding thickness for coating and galvanizing) of grade SS255 as per ASTM A653M / grade G250 as per AS 1397, coated with zinc of class designation Z275, troughed profile having nominal trough depth 44 mm and pitching of 130 mm shall be used. However alternative profile meeting the strength, defection and other functional requirements such as sections modulers and moment of inertia shall be provided. 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 purling / runner spacing.				
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS	
				PAGE 129 OF 245	

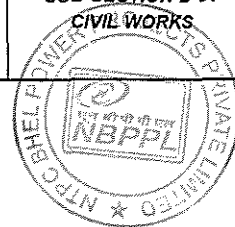


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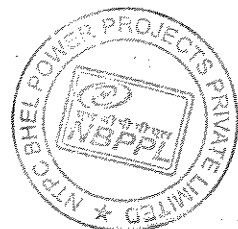
CLAUSE NO.	CIVIL WORKS 		
13.14.00	No negative tolerance shall be allowed in bare metal thickness. For wall cladding insulated / uninsulated and conveyor gallery sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm. The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries shall have troughed profile to match with the metal cladding profile. Minimum 2.0mm thick fire retardant and UV resistant polycarbonate clean sheet of GE plastic or equivalent 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. Polycarbonate sheet minimum 6mm thick multi (twin) wall fire retardant (Continuous use under temperature 100°C), impact resistant and ultraviolet resistant sheet shall be provided (as glazing) in transfer houses, pump houses, etc. Roof Details Roof slab shall be minimum 150 mm thick and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. 900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. 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 control rooms, M. C. C. rooms, penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as follows: 1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat. 2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 836 and C 898).		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 130 OF 245



CLAUSE NO.	CIVIL WORKS			एनटीपीसी NTPC
13.15.00	3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping. 4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C. Roof of transfer points and crusher house shall be provided with troughed profile permanently colour coated sheet on outside and plain permanently colour coated sheet on inside with 50mm thick mineral wool insulation in between the two sheets. A slope of 1 in-5 shall be provided for quick drainage of rain water.			
	Floors and Grade level details The floor slabs shall be minimum 150 mm thick and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom 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 & crusher house slope shall be 1:100. Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick o/p. 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 suitably. Chequered plates shall be fixed by staggered welding of suitable size. Floors of trenches shall have integral finish to concrete base. 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 R. C. C. floors (where no brick masonry walls are provided) shall be provided with one brick thick 300 mm high brick wall and 700 mm high steel hand rails all around over this brick work.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS PAGE 131 OF 245

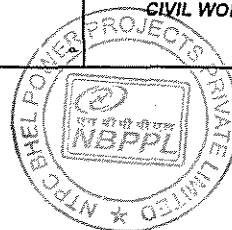


CLAUSE NO.	CIVIL WORKS		
	The grade slab shall consists of 230 mm thick rubble soling (63 mm downgraded hard stone aggregate as per IRC specification, watering and compaction to minimum of 90% Standard Proctor density, including filling the interstices of stone aggregates with sand), over well compacted earth, overlaid by 75 mm thick P. C. C. M-7.5 and 100 mm thick R. C. C. of grade M-20 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 R. C. C. slab. All buildings (including track hopper and machinery hatches, penthouse, transfer houses and crusher house) and ground conveyors 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 5 m width all round the transfer houses and crusher house 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. Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level.		
13.16.00	LOADING The loading on the Coal Handling plant structures shall be as specified elsewhere in the specification.		
13.17.00	CONCRETE All R. C. C. works to the done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows: a) M35 - For all railway load bearing structures b) M25 - For underground / sub structural R. C. C. work (other than railway load bearing structures). c) M20 - For R. C. C. superstructure works including ground floor slabs, trenches & drains. Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 132 OF 245



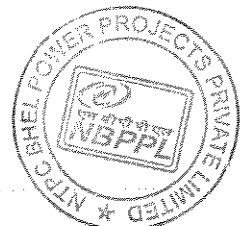
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CLAUSE NO.	CIVIL WORKS		
13.18.00	For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix. Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned. Ordinary portland cement conforming to IS: 269 or IS: 8112 shall necessarily be used for all Railway load bearing structures.		
	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 percussive 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. / cm². 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.		
	13.19.00 POLYMER MODIFIED CEMENTITIOUS COATING 13.19.01 Materials Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%).		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 133 OF 245

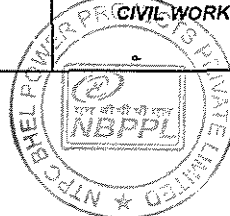


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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
13.19.02	Portland cement based dry powder. Clean, fine specially prepared quartz sand approximately 0.6 mm size. Mixing The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.		
13.19.03	Properties of Coating It must adhere to wet surface. It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm. Co - efficient of permeability shall be about 5×10^{-10} Cm / Sec. Water absorption after continuous soaking shall not be more than 1 %. The materials shall be permeable under water vapour. The material shall be resistant to acids and alkalies present in the soil and underground water with normal pH value between 4 and 14. The co - efficient of thermal expansion of the material shall be close to that of concrete.		
13.19.04	Application The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed. (a.) For Slurry Mix A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 134 OF 245



CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	rubbing down with a soft dry sponge. The coverage shall not be less than 1 : 1 Kgs. / m² in the 2 coats. A lap of 75 mm shall be provided at the joints. The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat. (b.) For Brush Topping Mix This shall be applied in two coats. A primary coat of slurry mix can also be first applied on the surface as first coat. After the coating has dried up, a coat of Brush Topping Mix shall be applied over it with a push broom or any other similar brush. It shall be left in broom finished condition. The nominal thickness shall be 1.5 mm and minimum thickness shall be 1.0 mm. A lap of 75 mm shall be provided at the joints. It shall be ensured that no pinhole exists and rebrushing shall be done to cover the pinholes, if any. The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat. Rate of application of coating shall be established to achieve the required thickness.		
13.20.00	SHOTCRETING		
13.20.01	General Requirements Generally, shotcreting shall be done in accordance with IS : 9012. Reinforcement for shotcreting shall be as detailed below, unless specified otherwise. (a.) Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting. (b.) Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied. (c.) Clear cover to reinforcement mesh shall not be less than 15 mm. Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 135 OF 245

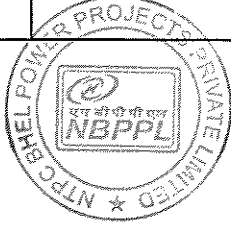


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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
13.21.00	VIBRATION ISOLATION SYSTEM		
	These specifications are meant for the design, supply and erection of vibration isolation system for supporting coal crushers (ring granulators).		
13.21.00.1	Supporting Arrangement		
	The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building. The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as "spring supported foundation". The part of the structure, which is below the spring shall hitherto be called "supporting structure". The Bidder should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the coal crushers. The vibrations isolation system supplied shall be of a proven make. The Bidder or his sub - Bidder who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the Bidder or his sub - Bidder in such machines should have been working satisfactorily for atleast five years.		
13.21.00.2	Scope of Work		
	Scope of work shall include the following :		
13.21.00.3	Engineering		
13.21.00.3.1	Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the coal crusher. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the coal crusher.		
13.21.00.3.2	Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 136 OF 245

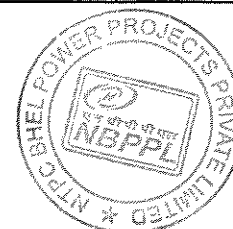


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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
13.21.00.3.3	Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure.		
13.21.00.3.4	Drawings showing embedments and their locations and details on the R. C. C. top deck.		
13.21.00.3.5	Drawings showing blockouts, recesses etc. on the top deck.		
13.21.00.3.6	Design of the supporting structure, including preparation of detailed drawings and bill of materials.		
13.21.00.4	Supply including packing and transportation to site		
13.21.00.4.1	Steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc.		
13.21.00.4.2	Frame (s) for pre-stressing of spring elements.		
13.21.00.4.3	Suitable hydraulic jacks system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units, two extra hydraulic jacks, one hand operated pump and spares for the hydraulic jack system as required.		
13.21.00.5	Erection and Commissioning		
13.21.00.5.1	Complete erection and commissioning of the vibration isolation system including :		
13.21.00.5.2	Pre-stressing of spring elements, placing of spring elements in position, checking clearances on the shuttering of the R. C. C. top deck, construction of the supporting structure and the R. C. C. top deck, releasing to pre-stress in spring elements and making final adjustments and alignments after machine installation etc.		
13.21.00.5.3	The scope of work shall be deemed to include all activities which may not have been explicitly mentioned but are reasonably implied for the successful completion of the work for which these specifications are intended.		
13.21.00.5.4	This part of the specifications is for vibration isolation system. For the construction of the supporting structure for the crusher and the top deck, the relevant parts of the specification should be referred to.		
13.21.00.6	Documentation		
13.21.00.6.1	Submission of detailed design calculation, analysis (static and dynamic) and drawings for Employer's acceptance and approval.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS 
			PAGE 137 OF 245

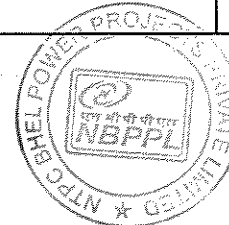
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CLAUSE NO.	CIVIL WORKS
13.21.00.6.2	Furnishing methodology of providing shuttering and its removal as well as concreting of deck slab, installation of springs and dampers and the sequence of operation.
13.21.00.6.3	Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system.
13.21.00.6.4	Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation.
13.21.00.6.5	Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply.
13.21.00.6.6	Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform.
13.21.00.6.7	Proposed erection strategy of the entire system.
13.21.00.7	Design Requirements for Crusher (Ring Granulator) Foundation
13.21.00.8	Dynamic Analysis Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis. Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria. Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor.
13.21.00.9	Isolation Efficiency The vibration isolation system shall be designed for about 90 % isolation efficiency.
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	
TECHNICAL SPECIFICATION SECTION - VI PART-B	
SUB-SECTION-D-01 CIVIL WORKS	
PAGE 138 OF 245	



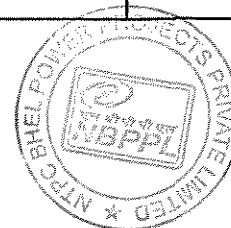
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
13.21.00.10	De-coupling A ratio of the least 10 (ten) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two (the stiffness of the spring system being lower). This ensures that dynamic analysis of the supporting structure need not be carried out.		
13.21.00.11	Frequency Criteria The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required. The first bending mode frequency of the top deck shall be at least 20 % above the operating speed.		
13.21.00.12	Unbalance Forces Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes.		
13.21.00.13	Balance quality grade Q 40 as per VDI 2060 - 1966.		
13.21.00.14	One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher.		
13.21.00.15	Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher.		
13.21.00.16	Amplitude Criteria The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions. 1) Operating speed of 750 RPM (a) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 – 1966 (b) 300 microns in case of a one hammer broken condition. (c) Amplitudes need not be checked for a three hammer broken condition.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 139 OF 245

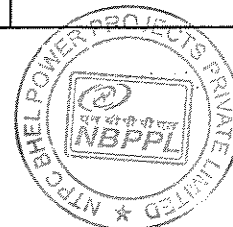


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CLAUSE NO.	CIVIL WORKS			एनटीपीसी NTPC
	2) Operating speed of 450 RPM 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966. 400 microns in case of a one hammers broken condition. Amplitude need not be checked for a three hammer broken condition. For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated. The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the R. C. C. deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vetor may be considered while superimposing the modes.			
13.21.00.17	Not Used.			
13.21.00.18	Not Used.			
13.21.00.19	Not Used.			
13.21.00.20	Transient Resonance Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition.			
13.21.01	Strength Criteria The following criteria shall apply for the design of top deck :			
13.21.01.1	Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design.			
13.21.01.2	Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 140 OF 245

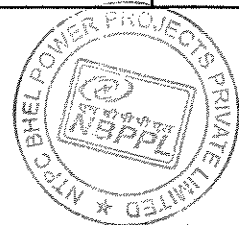


CLAUSE NO.	CIVIL WORKS एनडीपीसी NTPC
13.21.01.3	Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design.
13.21.01.4	Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted.
13.21.01.5	The R. C. C. top deck shall be at least of M25 grade of concrete as per IS : 456 - 1978.
13.21.01.6	Fatigue need not be considered for the three hammer broken condition.
13.21.01.7	For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered.
13.22.00	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.
14.00.00	CHP MAINTENANCE BUILDING A separate maintenance cum workshop building shall be provided in the coal handling plant area. This shall have workshop besides sitting space for maintenance staff. This shall be of RCC construction with infilled brick walls. This shall preferably be a two storied construction having total floor area not less than 900 Sq.m. In addition, a shed for accommodating minimum four nos. of bulldozers shall also be provided. This shed shall have a metallic roofing and cladding besides heavy-duty flooring.
15.00.00	ASH HANDLING SYSTEM & ASH WATER RECIRCULATION SYSTEM Ash handling system (both wet and dry) shall comprise of bottom ash and fly ash handling systems, which includes Ash slurry pump house, Ash water pump house, BA slurry pump house and their related sumps/tanks, Transport/Instrument Air Compressor house, Swithgear /Control/RIO rooms, supporting structures and
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	
TECHNICAL SPECIFICATION SECTION - VI PART-B	
SUB-SECTION-D-01 CIVIL WORKS	
PAGE 141 OF 245	



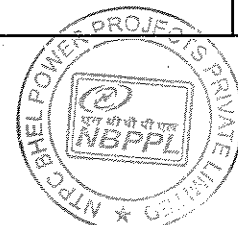
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CLAUSE NO.	CIVIL WORKS 		
	foundations for Bottom ash hopper, Buffer hoppers/Collector tanks, Economiser tanks, Settling tanks and Surge tanks, Silo Utility Building complex with Fly Ash Silos including development of silo area (i.e. paving, fencing/boundary-wall, access roads, office block and watchman cabin), miscellaneous equipment foundations, trenches, pipe racks, pedestals/thrust blocks for pipe supports (both inside and outside the plant boundary) including bridges/ culverts for road/rail/nallah etc, as required. The Silo utility area complex shall be fenced with chain linked fencing, if placed inside the plant boundary and shall be confined with boundary wall if placed out side plant boundary. Ash Water Recirculation (AWR) System shall include Ash water recirculation pump house complex near ash dyke along with related sumps/tanks, MCC/Switchgear building, maintenance room, control room, disaster management room, transformer yard, miscellaneous equipment foundations, trenches etc. The AWRPH complex shall be confined with boundary wall and a security gate with inside road and area drainage. The boundary wall shall be of one brick thick of height 2.4 m with a 600 mm high galvanized concentrina at top, such that total height is 3.0 m above formation level. The pedestals/thrust blocks for pipe supports from ash water PH to AWRPH (both inside and outside the plant boundary) including bridges/ culverts for road/rail/nallah etc, shall be provide as per the system requirement. The Compressor house, Silo utility building and all Pump houses shall have RCC framed structure, with RCC columns and metal deck roofing (filled with RCC) supported on main steel truss / girders. Other buildings like MCC /switchgear rooms, control room etc. will have RCC framed structure with cast-in-situ RCC roof slabs. All buildings shall have brick cladding. Crane girders or mono rails shall be provided as per system requirement. Fly ash silo storage area shall be provided with the sump for collection of ash water. An office block with minimum of 50 Sqm and watchman cabin with area of 5 Sqm shall be provided in this area. Toilet should be provided in all the buildings. In addition to the outer confinement, fencing should be provided all around Transformer foundations. 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 with a 600 mm high galvanised concertrina at the top, such that total height is 3.0 M above the toewall. Pipe support works shall include bottom ash slurry pipe supports, ash slurry pipe supports from ash slurry pump house to ash dyke including garlanding and space for one 600NB Ash water recirculation pipe, pipe support from AWRPH to ash dyke, dry fly ash pipe supports and RCC thrust blocks including any other supports required to complete the system-up to terminal points. Over-ground pipes shall be supported on RCC pedestals. The top of concrete shall be minimum 500 mm above ground. The footings for pedestals shall be placed at minimum depth of 1.0M below natural ground level or on weathered / hard rock. Pipes shall be suitably anchored with RCC pedestals to resist lateral and vertical movements.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 142 OF 245



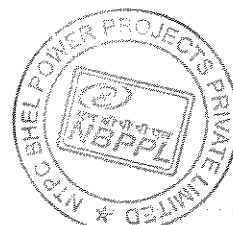
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CLAUSE NO.	CIVIL WORKS	
	Suitable single road / Inspection roads (3.75 metre wide with black topping) with 1.5M wide shoulders on both side of the road shall be provided along the route of the ash slurry pipeline from plant boundary wall to the ash dyke. All road crossings with RCC box culverts shall be constructed with the culvert top generally not more than 100 mm above the road top. Suitable 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 over head road crossings with necessary headroom clearance. Necessary modification, if required, for roadside drains and shoulders shall have to be done. 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, 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). All ash handling system/ ash water recirculation system pipe crossings with Railway Lines including MGR lines shall be laid by thrust boring for existing rail lines & by cast in situ RCC 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. All RCC liquid retaining / conveying structures shall be designed as cracked sections with reduced steel stresses, in accordance with IS : 3370 (Part 1 to 4) by working stress method. The thickness of base slab in liquid retaining / carrying structures shall be minimum 150mm. The minimum reinforcement in each direction shall not be less than 0.24% of the gross cross - sectional area. All liquid retaining structures shall be tested for water tightness as per the provisions of IS : 3370 and IS : 6494. All pump houses and other substructures shall be checked for stability: a) 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) 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) 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	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
		PAGE 143 OF 245



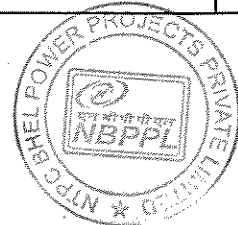
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CLAUSE NO.	CIVIL WORKS	
	condition inside and ignoring the superimposed loadings. Inclined wedge action shall be limited to 15 degree with vertical plane. Provision of pressure relief valve / flap valves etc. shall not be permitted to counter the uplift. Also FOS against uplift, to be taken as 1.0 considering the dead weight of structure and soil resting on side projections, if any, in the vertical plane. Inclined wedge action of soil shall not be considered in this case.	
16.00.00	SWITCHYARD CIVIL WORKS	
16.01.00	Civil works for 400/13kV switchyard are related to the following: (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) Modification work including dismantling work as required in existing switchyard control room building for panel erection etc., (d) Foundations for Inter Connecting Transformer (ICT), Shunt Reactor, 16MVA Colony Transformer 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 bituminous 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.	
16.02.00	All structural steel members including stub members, bolts, nuts, spring washers, etc., shall be hot dip galvanised after fabrication.	
16.03.00	Design Criteria	
16.03.01	Gantry structure, which consists of open web towers connected by girders, shall be made of structural steel conforming to Grade IS:2062 or IS:8500 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 property class 5.6. Nuts shall conform to I.S 1363 (Part 3) of property class 5. Foundation bolts shall conform to IS: 5624. Butt splice is 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	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B
		SUB-SECTION-D-01 CIVIL WORKS
		PAGE 144 OF 245



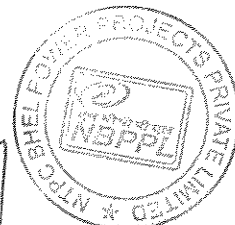
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CLAUSE NO.	CIVIL WORKS 		
16.03.02	followed for design of structures. Height & type of towers shall be established based on electrical requirements. A provision of ± 30 degree angle of deviation of line in horizontal plane and ± 20 degree deviation 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. 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 load on bus bars, shield wires, insulator strings, electrical equipment, structural members etc. The wind load calculations shall be made as per IS: 802 except the parameters basic wind speed (V_b) and terrain category as stipulated in site specific design parameters. 4) Seismic loads, 5) Temperature load, 6) Loads due to deviation of conductor (gantries shall be checked for ± 30 deg. deviation in horizontal plane and ± 20 degree deviation in vertical plane), 7) Loads due to unbalanced tension in conductor/wire, 8) Torsional load due to unbalanced vertical and horizontal forces, 9) Erection loads, 10) 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) 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 145 OF 245



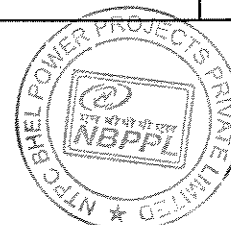
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CLAUSE NO.	CIVIL WORKS			
	(iii) The conductor tension shall be assumed as acting on only one side of the gantry for the analysis and design of switchyard gantries. (iv) The distance between terminal and dead end gantry shall be taken as 200 meters.			
16.03.03	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.			
16.03.04	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 400kV structure shall be 250NB and that for 132kV shall be 200NB. The supporting structure for CT & Wave Trap equipment shall be comprised of lattice structural steel conforming to IS 2026 and shall be designed as per IS: 802. Common raft foundation shall be provided for each pole of isolator.			
16.03.05	Special design consideration for lighting Mast: Diagonal wind condition shall be considered for lightning masts. Provision of IS: 875(Part-III) - 1987 shall apply for inclined wind condition. Lightning mass shall be provided with minimum two nos. of platforms (with 1 at top level) and an internal ladder for climbing purpose 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 Lighting Mast.			
16.04.00	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.			
16.05.00	All steel work used in construction of gantry structure should be galvanized and minimum section thickness should not be less than 4 mm. Weight of zinc coating			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS
PAGE 146 OF 245				

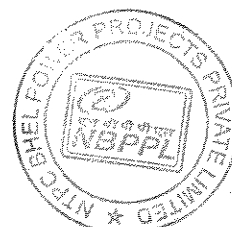


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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
	shall be at least 0.610 kg/m2 and foundation bolts shall have heavier zinc coating at least 0.80 kg/m2.			
16.06.00	The cable trenches specifications shall be as specified elsewhere in the specification.			
16.07.00	SWITCHYARD SURFACING: Entire area of the switchyard shall be provided with 150 mm thick gravel filling which shall consist of 75 mm thick stone metal filling of 40 mm stone aggregate on the top and 75 mm thick filling of 20 mm stone aggregate below. Each layer shall be compacted by using 1/2 tonne roller with 4-5 passes and suitable water sprinkling. Before laying the gravel fill, the top layer of the soil shall be treated for anti-weed considering the types of weeds found in the vicinity. The anti-weed/soil sterilization chemical shall be procured from reputed manufacturer. The Bidder shall submit necessary details pertaining to the types of weeds found in the vicinity, anti-weed/soil sterilization such as manufacturer's name, their specification, test certificate, etc., for Employer's approval. Any modification, if required in the proposed anti-weed treatment chemicals, shall have to be done by the Bidder at no extra cost to the Employer. The Bidder shall be required to furnish a performance guarantee of three years for the anti-weed treatment. This guarantee shall commence from the date of completion of work or date of handing over, whichever is later.			
16.08.00	SWITCHYARD FENCING AND GATE Chain link fence and fixing detail including materials, all quality control tests and checks etc. for the work shall be as per IS:2721. The fence shall comprise of PVC coated G.I. chain link fencing of minimum 4 mm dia wire including PVC coating and with 2.5 mm dia GI bare wire with mesh size of 75X75 mm and of a height 2.5 m above the toe wall with a 600 mm high galvanised concertina at the top, such that total fence height of 3.1m above toe wall level is achieved. Toe wall shall be minimum 200 mm above the formation level/natural ground level (NGL). The PVC coated chain link wire mesh will be stretched and attached by clips at 0.5 m intervals to 3 strands of High Tensile Spring Steel (HTSS) wire of 4 mm dia interwoven in 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. All nuts, fasteners, bolts, clamping strips, clamps, clips, etc. shall be galvanised. Above the chain link fence a 600 mm High Tensile Serrated Wire (HTSW) galvanised Concertina shall be provided at a maximum spiral pitch of 300mm and attached to 3 strands of HTSS wire by means of 'C' clips at 1 m intervals. The 3 HTSS wire strands will be attached to angle iron posts with 1/2" security fasteners.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS
				PAGE 147 OF 245

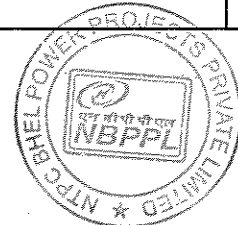


CLAUSE NO.	CIVIL WORKS
	All bolts provided in the fence work shall be minimum 12 mm diameter. Length of all bolts shall be such that after fixing in position it shall have at least 12 mm projected length beyond the nut. All nuts & bolts shall be high quality as per BIS standard and heavy duty galvanized. The threads of projected length of the all bolts beyond nut after fixing in position shall be destroyed by hammering or by any suitable means to protect from any possible theft by miscreants. All fence posts shall be 75X75X6 MS angles spaced at 2.5m c/c distance. All straining posts i.e. end posts shall be 75X75X6 MS angles. All corner posts will have two stay posts and every tenth post will have a transverse stay post. Concrete foundations for the angle iron posts and stays shall be provided. Toe walls of brick masonry with bricks of minimum 75 kg/cm² compressive strength shall be provided between the fence posts all along the run of the fence with foundation. Toe wall shall be minimum 200 mm above the formation level with 75 mm thick PCC coping (1:2:4). M.S. Gate shall be provided to provide access through the fencing to the switchyard. All MS angles used in posts and gates shall be finished by blast cleaning of steel surfaces to near white metal surface (Sa 2 ½ Swedish standard) and applying inorganic zinc silicate primer of minimum 75 microns (DFT), followed by an intermediate coat of minimum 75 micron (DFT) epoxy based titanium dioxide / micaceous iron oxide, followed by finish painting with Epoxy based colour pigmented finish Poly amide cured paint. All paints including primer shall be of reputed brand / manufacturer and as approved by the Engineer.
16.09.00	The storm water drainage for switchyard shall be as specified elsewhere in the specification.
17.00.00	SEWERAGE SYSTEM
17.01.00	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, spun C.I. pipes conforming to IS:1536 of required class shall be used.
17.02.00	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 (Part 1).
17.03.00	Sewage pump house shall be provided as per IS:4111 (Part-4).
17.04.00	Bidder shall have to provide complete arrangement for sewage disposal up to the existing sewage treatment plant / network including pumping facilities.
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B
SUB-SECTION-D-01 CIVIL WORKS	PAGE 148 OF 245



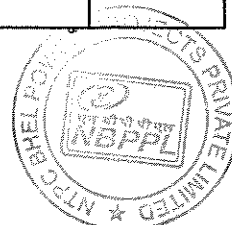
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
18.00.00	PLANT STORM WATER DRAINAGE SYSTEM		
18.01.00	All plant effluent drainage shall be through buried concrete pipes unless otherwise specifically required and all storm water drainage shall generally be through open RCC drains.		
18.02.00	Open storm water RCC drains shall be provided on both sides of the roads and shall be designed to drain the road surface as well as all the free and covered areas, etc.,		
18.03.00	Open RCC rectangular section shall be provided for all drains. RCC drains located within and along both sides of peripheral roads of the main plant area, shall be covered with perforated cast-in-situ RCC slabs of minimum 150 mm thickness with provision of openable galvanised steel grating covers of 1MX1.5M at about 7.5M intervals. All artillery drains and the drains along the periphery of building shall also have perforated precast RCC covers of minimum 50 mm thickness with provision of openable galvanised steel grating covers at about 4.0 m intervals. In areas where vehicular loads would be coming, RCC covers of suitable thickness without perforations and designed for the vehicular loading shall be provided. The thickness of side walls and bottom slab of RCC drains shall be minimum 150 mm or as per design considerations, whichever is higher. RCC box culverts shall be provided for road and rail crossings. All drains along 'A' & 'C' row of Main power house and in boiler /ESP areas shall be provided with heavy duty galvanized steel grating.		
18.04.00	All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating.		
18.05.00	Invert of the drains shall be decided in such a way that the water can easily be discharged to the natural water bodies above the high flood level.		
18.06.00	For pipe drains, concrete pipes of class NP3 (Minimum) with PCC(M-20) pipe bedding shall be used. For road and rail crossings concrete pipes of class NP3 and NP4 respectively shall be used. The pipes shall be laid as per IS:783. In this case open catch water drain shall be provided on the other side of road and connected to pipe drain through RCC manholes. RCC manholes shall be provided at every 30m interval along the length, at connection points and at every change of alignment, gradient and diameter of pipeline. The invert level of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main/trunk drains under all conditions.		
19.00.00	ROADS		
19.01.00	A detailed CBR test shall be carried out as per the procedure outlined in IS:2720 (Part XVI). Shoulders with 100mm thick lean concrete and 75mm thick PCC interlocking blocks shall be provided over compacted granular sub-base on either side of		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 149 OF 245



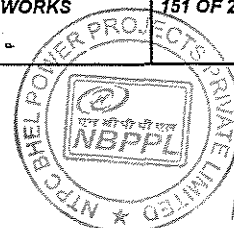
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
	the roads. Shoulders for multi-lane roads shall be 300mm raised above the road pavement level with PCC kerb stones and RC hume pipes shall be provided for cross drainage. However, WBM leveled shoulders of minimum 150 mm thickness shall be provided on either side of the single lane roads. Roads shall be designed as per IRC-37.			
19.02.00	Unless otherwise specified, all roads including access road to buildings/facilities (other than patrol road and road inside the switchyard) shall be double lane roads with 7.5 m wide black topping and 2.25 m wide shoulders on either side of the road. Patrol roads shall be single lane with 3.75 m wide black topping and 1.0 m wide shoulder on either side. Roads inside the switchyard area shall be of flexible pavement (3.75 m wide) along with 1.0 m wide shoulders on either side. The base and sub-base of the road shall be of water Bound Macadam.			
19.03.00	All roads shall be provided with edge protection on both edges of black topping using pre-cast concrete blocks of M-25 grade.			
19.04.00	All roads for the complete plant areas shall be provided by Bidder. In addition, access roads to all buildings and facilities including road approaches to ash silo area, access roads to liquid fuel storage area and other equipment areas (where access is necessary from inspection, operation & maintenance point of view) shall also be provided by Bidder. Minimum requirement for main roads is indicated on General Layout Plan (GLP). However, other additional roads, which are not specifically shown on GLP but required from functional considerations, shall also be provided by the Bidder.			
19.05.00	Finished top (crest) of roads shall be 350mm above the surrounding grade level.			
19.06.00	Road construction including bitumen macadam, water bound macadam base and sub-base shall be as per IRC standards. Minimum total thickness of black topping (premix carpeting) shall be 50 mm in 2 layers of 25 mm each. First layer shall be provided during construction and second layer after the commissioning of the plant. For premix carpet, recommendation of IRC-14 & IRC-19 shall generally be followed. Spreading of black topping work shall be carried out using mechanical paver/finisher.			
19.07.00	All culverts and RCC bridges at crossing of all roads/ rail-tracks/nallahs/ channels/ drains/ pipes/other facilities etc. RCC culvert cum road-bridge over cooling water channel etc. shall be provided by the Bidder.			
19.08.00	For RCC culverts at road crossing of pipelines supported on ground, the pipe top level generally shall not be more than 100mm above the top of the road. Suitable hump with slope not steeper than 1:30 shall be provided for the roads. Necessary modification shall be done by the Bidder for the roadside drains.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 150 OF 245



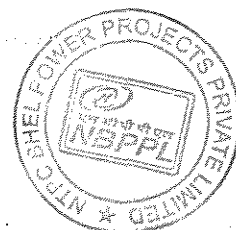
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
20.00.00	ASH DYKE – CIVIL WORKS Geotechnical investigation Detailed investigations shall be conducted by the Employer to find out the properties of foundation soil within the lagoons. The Geotechnical Data of ash dyke area is enclosed elsewhere in this specification. Design criteria The Bidder shall submit the calculations for the ash storage capacity for the ultimate stage of the dyke for 25 years of plant operation, for approval of the Engineer. Accordingly, the scheme and design for the starter dyke and raisings thereafter shall also be submitted for approval. For defining the profile of the phreatic line across the dyke section, a comprehensive seepage analysis shall be done for the ultimate height of the dyke, with full water inside and tail water (if any due to H.F.L.), on outside of the dyke, before doing the stability analysis. The slope stability analysis of the dyke for ultimate stage shall be done for steady seepage condition both for static and dynamic (earthquake) cases as per IS: 7894 –Code of Practice for Stability Analysis of Earth Dams. For the design of ash dyke, some basic design guide lines are given below: a) Lagooning system The ash disposal area has to be developed for the storage of ash generated in the full life of the power plant (25 yrs). The ash disposal area will consist of two storage lagoons, 145 acres each and one common overflow lagoon of about 15 acres. The storage lagoons shall be planned in such a way that when one lagoon is in the process of filling, the other lagoon can be constructed before the first lagoon is filled up. The starter dykes of all three lagoons shall be constructed using earth as the main construction material to be arranged by Bidder. Once the starter dyke is filled, then alternate raisings of ash dykes of 3 m height each, using ash as main construction material, may be constructed till the ultimate height is reached. Free board of 1.5 m shall be kept for starter dyke as well as in subsequent raisings. Only starter ash dyke with earth is in presently envisaged for all lagoons.. The water from the storage lagoons shall escape to the overflow lagoon (OFL) (of about 15 acres) through RCC water escape well type structures and RCC hume pipes of suitable diameter. These hume pipes shall be lined		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 151 OF 245



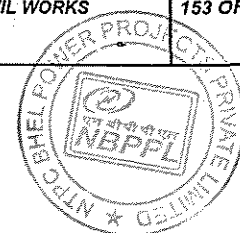
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CLAUSE NO.	CIVIL WORKS	एन टी पी सी NTPC		
	with rectangular RCC section, with minimum lining thickness of 250 mm at bottom & 150 mm on all other sides. The water from the OFL shall escape through a RCC box culvert spillway on the upstream and down stream side shall be lined with min 200 thick RCC. The outfall structure shall have stairway type energy dissipating devices on the down stream slope of the dyke. b) Design of Embankment For Layout of ash dykes along with ground contours refer Drg. No 1150-999-POC-A-002. The design of embankment shall be done by a process of successive trials and refinements. The following steps may be followed. Select a trial embankment section incorporating the available materials, with the following parameters. Top width - 6 metre minimum having a WBM road of 3.75 m wide with 100 mm and 150 mm of base & sub-base respectively. One over taking space shall be provided on each side on Top of dyke. Ramp at one location shall also be provided. Free board - 1.5 metre minimum. Higher free board shall be provided if required from the anticipated wave height and from run up point of view. Side slopes - Minimum 2.5 Horizontal to 1 Vertical. 3m wide berms shall be provided for all slopes at about 6 metre height intervals. Impervious - Bottom of all the storage lagoons shall be provided with a Liner minimum of 300 mm thick Impervious Liner . Internal drainage arrangement should be provided as follows: a) Sand chimney of minimum 0.5 metre thickness, upto 1.0 m below dyke top. b) Sand blanket of minimum 0.5m depth c) Rock toe at the downstream toe of embankment. Height of rock toe should be minimum 1.2 metre. With the above drainage arrangements, the phreatic line is expected to follow the drainage path.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 152 OF 245



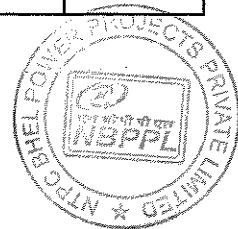
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	d) The exit gradient of seepage flow near the downstream toe shall be checked by drawing flownets. The exit gradient shall not exceed about 0.14. If the gradient is more than this value, the dyke slope will have to be flattened to reduce the gradient. c) Slope protection works a) On the downstream slopes, where the annual rainfall is less than 200cm, and where there is no existence of water collections, turf soding is sufficient. When the annual rainfall is more than 200cm, downstream slopes shall be protected by minimum 30cm thick stone pitching. Wherever, there are chances of water accumulation on the downstream side, the slope shall be protected by stone pitching of suitable thickness, depending upon the wave height likely to act on the slope, in the region from 1.5 metre above the maximum water level to 1.5 metre below the minimum water level. b) On the upstream slope, dry fly ash brick packing (brick on flat) shall be provided for the top portion, (from top of dyke to 3.0 M vertical height). c) On the top of dyke, Water Bound Macadam surfacing shall be made for movement of vehicles, which will also give protection to the earth surface against rain and wind erosion. d) Cut-off trench If foundation material is very impermeable, a nominal cut-off trench shall be provided in the portion upstream of sand chimney, to increase the drainage path of any seepage occurring at the junction between the embankment and its foundation. A minimum bottom width of 4m shall be provided for the cut-off trench to facilitate compaction with rollers. A depth of 1 to 1.5m may be adopted with 1:1 side slope in earth. If rock is available at a depth less than 1 metre, the cut-off trench may be stopped at the rock level itself. The effect of cut-off trench is not taken in the design and it is only provided as an additional precaution against piping failure in foundation. e) Filters Filters are to be provided below stone pitching and between rock toe and the embankment material.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 153 OF 245



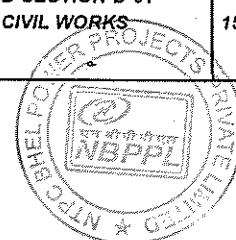
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CLAUSE NO.	CIVIL WORKS 		
	f) Instrumentation In order to monitor the performance of ash dyke during construction and operation the following instruments should be installed at approximate distance of 500 metre along the alignment of dyke and at critical locations. a) Piezometers b) Surface settlement markers Other requirements The proposed ash dyke area is 300 Acres and its boundary is about 15 Kms from the plant boundary. The ground level at the proposed ash dyke area is varying from RL 269 to RL 287. The Bidder is expected to visit actual site conditions in order to assess its actual area, distance etc, and other conditions which will have bearing on the design and construction of the ash dyke as per specified requirements and the cost thereof. The required borrow areas for dyke construction and impervious layer shall be identified and arranged by Bidder. All costs associated to borrow material / borrow areas including any royalties, tax, cess, etc. to be paid, shall be borne by the Bidder. Depth of cuts in all parts of borrow areas will be determined by the Engineer and shall be as uniform as possible. When the borrow area is located contiguous to the dyke alignment then it must be ensured that the borrow area shall not be opened within a distance of 5 times the height of embankment contiguous to the heel or the toe of the embankment or 25 metres whichever is more. The required approach roads and haul roads shall be constructed and maintained by the Bidder. The Bidder shall divert the existing roads, if any which are in the ash dyke area at his own cost before the start of work. A cut-off trench with 4.0m base width, 1.0m deep and 1:1 side slopes shall be excavated at base of the dyke and shall be filled with impervious soil as per specifications. The foundation shall be stripped for the full width of the dyke including the width of the toe drain plus 1.0 m more on both sides. U/s slope of embankment of storage lagoons & the slope of both face of Divide Bund (between storage lagoons and between OFL & storage lagoons) shall be lined for top 3.0m vertical height for protection against wave, with fly ash brick lining in fly ash brick masonry panel walls. This all bund will have sand chimney and sand blanket also to take care of any seepage water from the first lagoon when under use.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 154 OF 245



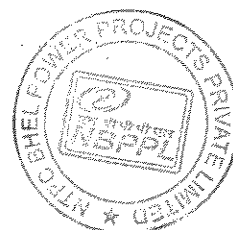
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CLAUSE NO.	CIVIL WORKS 		
	The width of road shall be 3.75m. The sub base shall be placed in two layers of 100 mm compacted thicknesses each with 90-45 mm graded stone aggregates. The base shall be placed in two layers of 75 mm compacted thicknesses each with 63-45 mm and 53-22.4 mm graded stone aggregates. Stripping the foundation The entire area of embankment shall be stripped to minimum 300 mm depth in soil or virgin ground and to minimum 500mm depth in ash bed to remove all unsuitable materials and to provide for benching. The unsuitable material shall include all debris, vegetable matter including roots, weathered and disintegrated rocks, organic silts, swamps material, that are unsuitable for use in permanent construction or that might interfere with the proper binding of the embankment with the foundation, or the proper compaction of the materials in the embankment or that may be otherwise objectionable. The stripping shall be kept far enough in advance of other items of works to ensure that no undesirable material will get mixed with approved embankment material and to allow for inspection. Unsuitable materials from stripping operations shall be disposed off to a disposal site to be arranged by the Bidder. The stripping shall be carried to the required level and to provide benching. Should the excavation be done deeper by error, the same shall be made good by filling with approved earth and properly compacted so that the required formation level is obtained. Preparation of foundation surface Foundation preparation shall be performed as per approved drawings and as described herein subsequent to stripping of foundation and excavation. No material shall be placed in any section of the fill portion of the embankment until the foundation for the section of the fill portion of the embankment has been dewatered, suitably prepared and has been approved by the Engineer. All excavations made for test pits or other sub-surface investigations and all other existing cavities, found within the area which extends below the established lines of excavation for embankment foundation, shall be filled with earth/ash of the corresponding zone and properly compacted. The foundation should be free from all organic materials, vegetable sods, and weak layers of compressive materials such as clays or low density silts. Filling the cut off trench / trenches for water escape pipes / formation of impervious core of dyke The cut off trench shall be filled up in layers not exceeding 300mm in compacted thickness using impervious soils CL or CI type having permeability less than 1×10^{-6} cm/sec, to be obtained by the Bidder from approved borrow area. The suitability or		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 155 OF 245

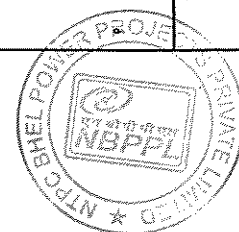


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CLAUSE NO.	CIVIL WORKS		
	otherwise of the material shall be determined by laboratory tests. In case clayey soil of the specified quality is not available, alternatively manufactured impervious soil by blending required quantity bentonite (not less than 4 percent) to available soil to achieve the specified permeability also can be used. Blending of bentonite with earth shall be done in dry form in a concrete mixer. Each layer of earth deposited shall then be compacted to have a dry density not less than 98% of the maximum dry density (standard proctor) for the soil with suitable tractor drawn heavy sheep foot tamping rollers or by any other method approved by the Engineer. The compaction shall have to be uniform throughout the length and breadth of each layer. The roller should be made to travel over the entire section of each layer so that the earth is fully compacted and the roller leaves no visible marks on the surface. Before placing the water escape pipes within the embankment, construction of dyke upto 600 mm above the RCC lining for pipes shall be carried out without actually placing the pipes. Later on, trenches shall be excavated for pipes and lining work, pits for cut-off collars and diaphragm filters. These trenches shall then be filled using naturally available CL-ML type soil (plasticity index 7-20) or with manufactured soil by blending with bentonite to achieve specified plasticity. Earth layer deposited in these trenches shall be compacted with plate compactors to have a dry density not less than 100 percent of the maximum dry density (standard proctor). The spreading of the next layer shall be carried out only after the underlying layer has been approved by the Engineer. The impervious core of the dyke shall be made with approved clayey soil brought from elsewhere and / or with manufactured soil by blending the available sandy silty soil with bentonite (not less than 2 per cent by volume) to achieve the permeability not more than 1 x 10-6 cm/ sec. The procedure for laying and compaction shall be the same as specified for the shells of dyke. Earthen Dyke The embankment shall be constructed to the lines and grades shown on the drawings. Placement of fill shall be performed in an orderly way and in an efficient and workman like manner, so as to produce fills having such quantities of density, strength and permeability as will ensure the highest practicable degree of stability and performance of the embankment. No bushes, roots, sods or other perishable or unsuitable materials shall be placed in the embankment. The suitability of each part of the foundation for placing embankment materials thereon and of all materials for use in embankment construction shall be subject to the approval of the Engineer. The dyke may be constructed in separate portions or reaches, provided that:		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 156 OF 245

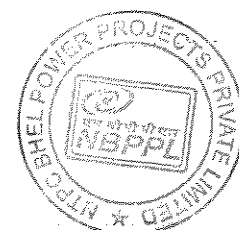


CLAUSE NO.	CIVIL WORKS 		
	i) The slopes of the bonding surfaces between the previously completed portions of the embankment and materials to be placed in each zone shall not be steeper than 2.5 horizontal to 1 vertical in case of earth and 3 H : 1 V in the case of ash. ii) The embankment is constructed right across the whole section in each portion or reach. Fill materials The materials for embankment shall be obtained from the approved borrow areas and available excavated material to the extent possible. In general all materials from the particular borrow area shall be a mixture of materials obtained for the full depth of the cut. Some earth material available from the excavation of cut-off trench etc. if found suitable can also be used for the embankment construction. Placing the fill material The distribution and gradation of materials throughout the fill shall be as shown in the approved drawings or as directed. The fills shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. The combined excavation and placing operations shall be such that the materials when compacted in the fill will be blended sufficiently to produce the specified degree of compaction and stability. No stones, cobbles or rock fragments, having maximum dimensions of more than 10 cm shall be placed in the fill. Such stones and cobbles shall be removed either at the borrow pit or after being transported to the fill but before the materials in the fill are rolled and compacted. The materials shall be placed in the fill in continuous horizontal layers; stretching right across the whole section, not more than 30 cm in compacted thickness and rolled. During construction a small transverse slope from centre towards the edges should be given to avoid pools of water forming due to rains. The surface of materials to be placed thereon, shall be moistened and/or worked with harrow, scarifier or other suitable equipment, in an approved manner to a sufficient depth to provide a satisfactory bonding surface before the next layer of fill material is placed. If the rolled surface of any fill is found to be too wet for proper compaction, it shall be raked up, allowed to dry, or shall be worked with a harrow or any other approved equipment to reduce the moisture content to the required amount and then it shall be recomacted before the next layer is placed. When compacting the fill material against steep rock abutment or walls or masonry or concrete structure the construction surface of embankment shall be sloped away from rock or masonry or concrete structures for a distance of 3 m to 4 m at an inclination not steeper than 6 horizontal to 1 vertical. If the foundation surface is too		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 157 OF 245



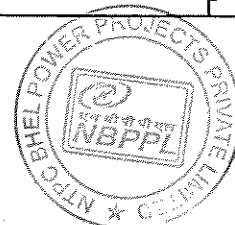
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	irregular to allow the use of a large roller directly against a structure/rock out crop, the roller shall be used to compact the fill material as close to the structure or the out crop as possible and the portion of the embankment directly abutting against the rock or the structure shall be compacted with pneumatic hand compactors/tampers in thin layers. The moisture content of the fill material placed against the rock or the structure shall be high enough to allow it to be compacted into all irregularities of the rock or the structure. Care shall be taken in placing the first layer of the fill so that no damage is caused by the hauling machinery to the base grade as this may get concealed by the spread layer or fill. Sheep foot roller shall not be employed for compacting till the thickness of the layers already compacted by other means is greater by 30 cm than the depth of the feet on the roller drum. The material for the first layer shall be at moisture content sufficient to enable bonding of the fill with the rock surface. Weather Conditions Embankment materials shall be placed only when the weather conditions are satisfactory to permit accurate control of the moisture content in the embankment materials. Moisture Control Prior to and during compacting operations, the materials in each layer of fill shall have a moisture content about 2% less than the optimum moisture content, in the case of cohesive soil. In the case of cohesion less material including ash, the placement moisture content may have only little effect on the compaction behaviour of the fill and hence appropriate moisture content required from other site considerations such as dust suppression etc, may be adopted. As far as practicable the materials shall be brought to the proper moisture content in the borrow area before excavation. If additional moisture content is required, it shall be added on the embankment by sprinkling water before rolling the layer. Bidder shall make his own arrangements for supply of water. If the moisture content is greater than required, the material shall be spread and allowed to dry before starting rolling. The moisture content shall be uniform throughout the layer of materials and ploughing, discing, harrowing or other methods of mixing may be required to obtain uniform distribution. If the moisture content is more or less than the range of the required practicable moisture content, or if it is not uniformly distributed throughout the layer, rolling shall be stopped and shall be started again only when the above conditions are satisfied. Degree of Compaction While the specification provides that equipment of a particular type is to be deployed and used, compaction shall be done to achieve 95% standard Proctor density by mechanical means. Compacted layer thickness shall be maximum 300 mm. Tamping (sheep foot) rollers or pneumatic rollers shall be used for compacting		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 158 OF 245



08831

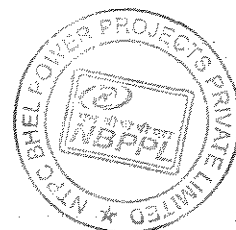
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	cohesive materials and pneumatic rollers and vibratory rollers shall be used for compacting cohesionless materials including ash. Any other suitable type of compaction equipment also can be employed after necessary field trials about their effectiveness and with approval of the Engineer. Rolling and tamping Rolling When each layer of material has been conditioned so as to have the proper moisture content uniformly distributed throughout the material, it shall be compacted by passing the roller. The exact number of passes shall be decided based on compaction trials to be conducted in field before start of work. The layers shall be compacted in strips overlapping not less than 0.6 metre. The rollers or loaded vehicles shall travel in a direction parrallel to the axis of the dyke. Density tests shall be made after rolling and the dry density attained shall be not less than 95% of maximum dry density (Standard Proctor) obtained in the Laboratory for the type of material used. Tamping Rollers will not be permitted to operate within 1.0 M of concrete and masonry structures. In locations where compaction of the fill material by means of the roller is impracticable or undesirable the material shall be specially compacted as specified here in at following locations: a) Portions of the dyke embankment adjacent to masonry structures. b) Earth/ash in dyke embankment adjacent to steep abutments, c) Earth / ash fill at locations specially designated by the Engineer. Fill shall be spread in layers not more than 30 cm. in compacted thickness and shall be moistened to have the required moisture content. When each layer of material has been conditioned to have the required moisture content it shall be compacted to achieve the dry density of not less than 95% of Maximum Dry Density (Standard Proctor) by special rollers, mechanical tampers, hand held vibratory tampers or by other approved methods, and all equipment and methods used shall be subject to approval based on evidence of actual performance. The moisture control and compaction shall be equivalent to that obtained in the fill material actually placed in the dyke embankment.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 159 OF 245



107

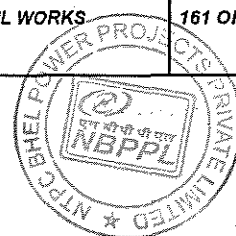
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CLAUSE NO.	CIVIL WORKS		
	Impervious Liner: The compacted thickness of liner shall not be less than 300 mm. The suitability or otherwise of the material shall be determined by laboratory tests. In case clayey soil of the specified quality is not available, alternatively soil blended with required quantity of bentonite (not less than 4 percent by volume) to achieve the specified permeability also can be used with the same specified procedure for laying and compaction. Blending shall be done by suitable means. Layer of liner laid shall be compacted to have a dry density not less than 90% of the maximum dry density (standard proctor) for the soil with suitable rollers or by any other method approved by the Engineer. Bentonite is a fine textured collidal clay. Sodium bentonite shall be used for the work. Laboratory tests shall be conducted to determine the percentage of bentonite needed to achieve the desired permeability of 1×10^{-6} cm/sec. Soil to be used for liner shall be free from organic matter, debris etc. LAYING The work broadly involves laying of clayey soil (or) mix of soil & bentonite, mixing of soil & bentonite, Spreading the mix, compacting & Testing of Permeability. Subgrade Preparation The subgrade surface should be prepared by minimum 300 mm stripping, grading, watering wherever required, removing all vegetation, rocks, and other matter which could penetrate the Impervious Liner or decrease the uniformity of the mixture. The prepared surface shall be compacted by atleast 2 passes of 8 Ton - 10 Ton roller. In case earth for formation of dyke is borrowed from inside the lagoon where impervious liner is to be provided, after borrowing fill material from the lagoon , the excavated surface shall be prepared with compaction by two passes of 8 Ton - 10 Ton roller and slope shall be maintained to 1V:4H. Mixing, placing & compaction of manufactured impervious soil For mixing of soil & bentonite, Bidder can select any of the following method. Mix in Other Place: Soil & bentonite shall be mixed thoroughly in dry condition in a mixture and water shall be added, once the mix attains uniformity, The mix will be transported to site and spread over the prepared surface of lagoon to get the compacted thickness not more than 300 mm.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 160 OF 245



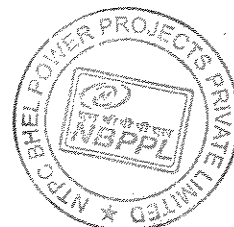
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CLAUSE NO.	CIVIL WORKS			
	Mix In Place: Alternatively soil shall be spread in layers and the required bentonite shall be spread over the soil surface. The bentonite shall be spread uniformly across the accepted subgrade surface at the specified application rate. The bentonite shall be thoroughly mixed and compacted layer thickness of 300 mm. Dressing and Trimming of the Slopes The outer slopes of the embankments shall be neatly dressed to line as the placing of the fill progresses. Compaction shall extend over the full width of the embankment and the material in the slopes shall be compacted as for the rest of structure. To ensure proper compaction at the outer edge, the fill shall be constructed for a minimum of 0.5m extra width on either edges or the outer edge trimmed to specified width and slope, as per construction drawings, after completion of the dyke section upto top, in different stretches of the alignment. No slope shall be left without trimming to design slope. The trimmed slope surface shall be checked for adequate compaction as specified in the Quality Assurance check list and under compaction, if any, shall be corrected. Provision for Settlement While forming the embankment, due allowance of 1 per cent of the vertical height or as appropriate shall be made to allow for settlement so as to maintain the top of dyke at designed elevation. Sand Blanket, Chimney and filter The material for blanket, chimney and sand filters shall consist of clean sound and well graded coarse sand. The materials shall be free from debris, wood, vegetable matter and other deleterious matter. The gradation of sand material shall meet the requirements as specified below: a) D15 (F) > 5D15 (B) or 0.1mm which ever is higher where, suffix "F" denotes filter material and "B" base material (common to all 4 types of base material as per IS: 9429)) b) Base Soil Type Filter criteria 1 D15 (F) < 9D85 (B) or 0.2mm, which ever is higher 2 D15 (F) < 0.7mm			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 161 OF 245	



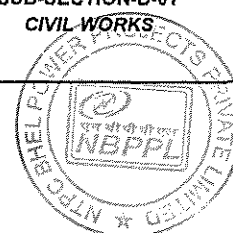
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CLAUSE NO.	CIVIL WORKS	NTPC															
	3 D15 (F) < (40-A) ----- x (4x D85(B)-0.7) +0.7mm, (40-15) where A = % passing 75 micron 4 D15 (F) < 4D85 (B) c) Max size of filter shall not exceed 75 mm. d) Material passing 75m shall not exceed 5% e) Filter material should be non-cohesive f) Limits of D10 (F) and D90 (F) for preventing segregation should be as under: <table><tr><th>D10 (F)</th><th>D90 (F)</th></tr><tr><th>Min. (mm)</th><th>Max. (mm)</th></tr><tr><td><0.5</td><td>20</td></tr><tr><td>0.5 to 1.0</td><td>25</td></tr><tr><td>1.0 to 2.0</td><td>30</td></tr><tr><td>2.0 to 5.0</td><td>40</td></tr><tr><td>5.0 to 10</td><td>50</td></tr><tr><td>10 to 50</td><td>60</td></tr></table> g) The filter materials shall be suitably compacted to a firm condition to achieve a relative density of 70%. Placing Sand Blanket Sand blanket shall be laid subsequent to site clearance, stripping and excavation, if any. The foundation area shall be cleared before laying the bottom layer of blanket material. Filter material shall be laid in layers not exceeding 15 cms. Care shall be taken to ensure that materials of different layers do not get mixed, both at the time of placing and during compaction. After the layers of filter blanket material have been laid and compacted as directed by the Engineer earth fill material shall be laid.	D10 (F)	D90 (F)	Min. (mm)	Max. (mm)	<0.5	20	0.5 to 1.0	25	1.0 to 2.0	30	2.0 to 5.0	40	5.0 to 10	50	10 to 50	60
D10 (F)	D90 (F)																
Min. (mm)	Max. (mm)																
<0.5	20																
0.5 to 1.0	25																
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2.0 to 5.0	40																
5.0 to 10	50																
10 to 50	60																
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 162 OF 245														



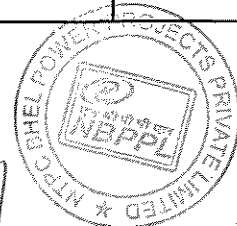
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CLAUSE NO.	CIVIL WORKS 		
	Sand Chimney Sand chimney of specified thickness shall be laid at the specified location by excavating and removing the already compacted bund material, exposing sand chimney in the lower layers earlier laid, and refilling the trench with sand in layers. The layer of sand shall be well rammed. The depth of each layer of chimney to be laid shall not be more than 15 cm or as directed by the Engineer. While excavating the earth for filling sand for chimney drain, the top layer of sand which has been mixed with earth/ash, shall also be removed. Alternatively, the sand chimney can also be laid in layers simultaneously with the laying of each layer of fill. In such case, the top level of sand layer shall always be kept at about 100 mm above earth/ash level on both sides. Each layer of sand shall be compacted. Care shall be taken to avoid mixing of earth/ash and sand. Sand filter The sand filter around the rock-toe and below rip rap shall closely follow the levels of the embankment in the area. Sand filter shall be laid subsequent to stripping of foundation and / or trimming of slope of compacted bund. The surface to receive the sand filter shall be properly cleaned before laying of filter material. The sand filter shall be laid in layers. The thickness of the layers shall not be more than 15 cms or as directed by the Engineer. The sand layer shall be well compacted. Care shall be taken that materials of different layers do not get mixed, both at the time of placing and during compaction. Graded coarse aggregate filters The coarse aggregate material shall consist of durable well graded broken rock of hard stone variety from the specified quarries and shall be approved prior to being transported to the area of deposition. The materials shall range in the size from 10mm to 75mm and shall satisfy the filter criteria. The rock material used in the aggregate filters shall satisfy the following condition: - Specific gravity shall not be less than 2.50. (As per IS: 1122) - Sulphate soundness less than 10% loss of weight after 5 (As per IS: 1126) (Five) cycles - Aggregate Impact value shall not exceed 30% (As per IS: 2386)		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 163 OF 245

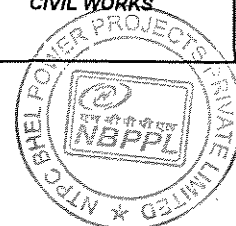


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CLAUSE NO.	CIVIL WORKS 		
	d) Water absorption shall not exceed 2.5% (As per IS: 2386) e) In slake durability test (as per IS: 10050), the percentage retained after two ten (10) minutes cycles shall be more than 85%. Placing Graded aggregate filters shall be constructed over the trimmed surface of the embankment slope, as indicated in the drawings. The aggregate filters shall be placed in layers of uniform thickness as shown in the drawings and care shall be taken to avoid segregation of coarse and fine materials and formation of pockets. Rock toe The rock material used for the rock toe shall satisfy the quality requirements. Rock toe shall be formed with rock material consisting of sound, durable and well graded broken rock obtained from approved quarries and shall be of approved quality. The materials shall range in size from 10 to 45 cm. All brush, roots or other perishable materials shall be removed from rock-fill during spreading and disposal off. The rock available from the excavation of water escape structure/ stripping / drain channel etc. which satisfy the quality requirements specified and found suitable for construction of rock toe by Engineer may be used. These shall be washed, cleared, and broken into required size and stacked separately. Similarly rock materials for rock toe satisfying the quality requirements specified can also be obtained from rock if any available within the land acquired for construction of earthen dyke, if it is found suitable. The rock shall be broken to required size and shape and will be cleaned before utilised. Placing The stone pieces shall be hand placed to obtain a stable, well graded and free draining fill. The rock toe shall be constructed in layers so that the smaller rock fragments shall be placed adjacent to the filter of embankment and the large rock fragments near the outer edge of the rock toe. The rock fill shall be hand placed, spread and roughly levelled in layers not greater than 30 cm in thickness in order to maintain a reasonably uniform surface and ensure that the completed fill will be stable and do not contain any voids having least dimension larger than 50 mm. Contamination of the rock with finer materials from any other zones shall be avoided. Accumulations of soil caused by contamination shall be removed.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 164 OF 245



CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	Rock materials shall not be dumped directly but shall be hand placed in layers. <i>Rip rap on the slope of embankment</i> Rip rap shall be hand placed on the slopes of the dam embankment as per IS: 8237 - "Code of practice for Protection of slope for reservoir embankments". The thickness of rip rap layer shall be as indicated in the drawings. The thickness shall be measured normal to slope of the embankment. The rock materials used for rip-rap shall satisfy the quality requirements specified. The rip-rap material shall consist of the most durable rock fragments or approved quality selected for the purpose. The quality of individual rock fragments shall be dense, sound and resistant to abrasion, and shall be free from cracks, seams, shale partings, conglomerate bands and other defects that would tend to increase unduly their susceptibility to destruction by water and weathering action. The shape of the individual rock fragment shall be angular. Fragments having thickness less than 50% of their maximum dimensions shall not be used as rip rap. The stones shall be evenly distributed over the paved area. The average weight of stones shall be 15 Kgs. for 300 thick rip rap and 50 Kgs. for 600 thick rip rap. These stones shall be placed on the edge with longer dimension normal to the slope. Rock fragments and spells shall be tightly driven into the interstices to wedge the rip rap in place and close direct opening to underlying slope. The wedging shall be done with the largest chip practicable, each chip being well driven home with a hammer so that no chip can be removed by hand. Stones shall be laid in a compact manner beginning at the bottom of the slope. Rip rap shall be placed along with the fill so that a minimum of break down will occur during placing and spreading. <i>Dry packing of fly ash bricks</i> Before laying the fly ash bricks, the earth surface shall be rammed and levelled. The bricks shall be packed flat starting from the lower corners of the panel and then extending to the other areas of the panel. The bricks shall be laid and packed tightly as indicated in the construction drawings. The bricks shall be tightly packed by tapping with a wooden mallet to leave minimum gap between the bricks. If required brick pieces may be used to fill up gaps if any left and rammed with wooden mallet to wedge the pieces tightly. <i>Diversion of surface & Under Ground water</i> The whole of the works shall be carried out in the dry condition. Water from any source shall be diverted or pumped as required, clear of the works. Bidder shall		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 165 OF 245



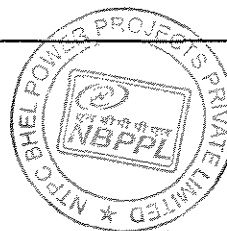
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CLAUSE NO.	CIVIL WORKS		
	make all necessary arrangement whatsoever required for keeping the work area dried by diverting and pumping of water, and also provision and operation of all temporary works including pumps, motors, fuel, piping and for the formation of any sumps, drainage channels, flumes, coffer dams and other protective works. Rainfall run-off As part of the work may have to be carried out in wet season, Bidders programme and methods must be capable of dealing with run-off from rainfall on the adjacent catchment area. The associated flow in the nullahs etc. shall be diverted clear of the works by an approved system of bunds and channels. Bidder shall supply, install and operate his own temporary pumping installation. Prevention of pollution Arrangement shall be made by the Bidder to prevent pollution of the water in any streams, springs, nullahs and lakes. Arrangements for sprinkling of water in the construction and borrow area to prevent any dust blowing also shall be done by the Bidder. Bidder shall be solely responsible and liable for all damage caused by any pollution that may take place during the execution of the works, and he shall make arrangements, as the Engineer may approve, for preventing pollution but, not withstanding such approval, the entire responsibility for any pollution shall rest with the Bidder. Inspection Test Control tests shall be carried out in laboratory from time to time to determine whether the fill produced by methods employed satisfies the requirements of the specifications. Routine field tests shall also be carried out by the Engineer and the work shall be inspected regularly. Field density test should be particularly and specially made in the following areas: - Where the degree of compaction is doubtful. - Where embankment operations are concentrated i.e. where 2 or more layers are placed one over the other on the same day. - To represent every 2000 cubic metres in case of earth and 1000 cubic metres in case of ash placed in the embankment. - At least one test for every full or part shift of compaction operations and - At least one test for every 250m length of dyke in each layer. The Engineer shall determine whether the desired results are being obtained.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 166 OF 245



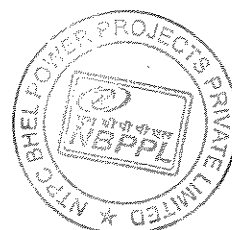
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CLAUSE NO.	CIVIL WORKS 		
	Bidder shall provide all facilities such as labour, conveyance, equipment etc. required for collection of samples and to conduct tests in situ or at laboratory. REFERENCES i) IS: 1498 : Classification and Identification of Soils for General Engineering Purposes. ii) IS: 7894 : Code of Practice for stability Analysis of Earth Dams. iii) IS: 8237 : Code of Practice for Protection of Slopes for Reservoir Embankment. iv) IS: 8826 : Guidelines for design of large Earth and Rockfilled Dams. v) IS: 9429 : Code of Practice for drainage system for Earth and Rockfill Dams, vi) Singh and Sharma: Earth and Rockfill Dams vii) USBR : Design of Small Dams viii) USBR : Earth Manual		
21.00.00	MISCELLANEOUS REQUIREMENTS		
21.01.01	Joints in Concrete Structures Construction Joints Construction joints for basement type under ground structures and all liquid retaining /carrying structures shall be made watertight by chemical injection grouting or by providing PVC water stops. The PVC water stop shall meet the requirements of IS:12200 and shall have a minimum thickness and widths of 6 mm and 230 mm respectively. In either of the cases, a suitable shear key joint shall be provided. Two - Part polysulphide sealant conforming to IS:12118 or silicon sealing compound conforming to BS shall be used for sealing of joints for liquid retaining/carrying structures.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 167 OF 245



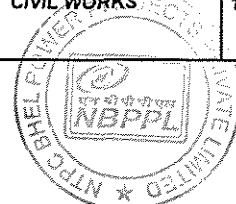
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CLAUSE NO.	CIVIL WORKS
	Preformed bitumen impregnated fibre board conforming to IS : 1838 shall be used as joint filler. The bitumen sealing compound shall be as per IS:1834. Expansions Joints In case of expansion joints, preformed bitumen impregnated 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. 21.01.02 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. 21.01.03 A screed or concrete layer not less than 100 mm thick and of grade not weaker than M 10 conforming to IS: 456 shall be provided below all water retaining structures. A sliding layer of bitumen paper or kraft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structure. 21.01.04 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. 21.01.05 Monorails, monorail girders and fixtures shall be provided, wherever required to facilitate erection / maintenance of equipment. 21.01.06 Wherever possible all floor openings shall be provided with 100 mm thick 150 mm high RCC kerb all around. 21.01.07 Angles 50 x 50 x 6 mm (minimum) with 8mm dia and 150mm long MS lugs @ 150 c/c shall be provided for edge protection all around cut outs/openings in floor slabs, 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. 21.01.08 Floor of switchgear room shall be provided with embedded M.S. channel suitable for easy movement of breaker panels.
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B SUB-SECTION-D-01 CIVIL WORKS PAGE 168 OF 245



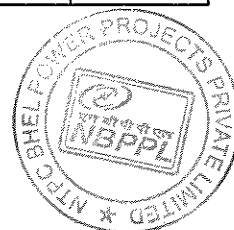
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
21.01.09	Anti termite chemical treatment shall be given to all vulnerable areas susceptible to termite including column pits, wall trenches, foundations of buildings, filling below the floors, etc., as per IS: 6313 and other relevant Indian Standards.		
21.01.10	Trenches located within switchyard and outside the buildings shall project at least 200 mm above the finished formation level so that no storm water shall enter into the trench. The bottom of the trench shall be provided with a longitudinal slope of 1:500. The downstream end of cable 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. 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. The trenches shall be given a slope of 1 in 250 in the direction perpendicular to the run of the trenches. PVC water stops shall be provided at all expansion joints of all trenches. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers.		
21.01.11	All steel platforms above grade shall be provided with 100 x 6 thick kick plates at edge of platform.		
21.01.12	Duct banks consisting of PVC conduits conforming to IS:4998 for cables shall be provided with proper sealing arrangement consisting of fire retardant sealing compound.		
21.01.13	Independent network of lines for sewerage and drainage shall be provided.		
21.01.14	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.)		
21.01.15	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.		
21.01.16	Structural steel column base plates and bolts, gussets, etc., shall not project above the floor level. These shall be encased by concrete cover upto floor level.		
21.01.17	Non-shrink flowable 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. However, for equipment foundations, high strength (minimum characteristic compressive strength of 60 N/mm ² at 28 days) ready mixed non-shrink, chloride free, cement based, free flowing, non-metallic grout as recommended by equipment manufacturer shall be used.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 169 OF 245



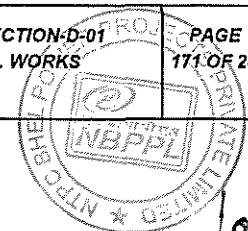
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
21.01.18	Fencing for fuel oil area, switchyard, and transformer yard area shall be of the same type as specified, elsewhere in this specification.			
21.01.19	Plant effluent shall not be mixed with either storm water or sewage.			
21.01.20	Rail-track in transformer yard area shall be provided with rigid type RCC foundation. Rail weighing 52 kg/m shall be used.			
21.01.21	All building shall be design to take care of Rain Water harvesting & ground water recharging.			
21.01.22	Ground Floor Slab & Area / Pathway Paving: For Ground floor / Area paving or path - way having earthen sub-grade, the paving work shall consist of following parts i.e. 150 mm thick RCC M - 20 Grade base slab, 75 mm thick PCC (1:4:8), 275 mm thick (compacted thickness) stone / rubble soling sub base with 63 mm down aggregate compacted to 85% of original volume and interstices filled with well graded selected sand on compacted and dressed sub - grade. Reinforcement of the RCC slab shall consists of minimum 8mm dia bars @ 200 mm c / c at top in both directions.			
21.01.23	As required suitable steel frames shall be provided around openings in the roof and external walls for mounting exhaust fans.			
21.01.24	All foundation embedments, inserts, blockouts required for mounting of equipments and supporting any other facility like pipes etc. shall be provided.			
21.01.25	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 flowable grout. Grade of grout shall be one grade higher than concrete. However minimum grade of grout shall be M - 30.			
21.01.26	All cable trenches shall be provided with suitable insert plates for fixing support angles of cable trays.			
21.01.27	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.			
21.01.28	All foundations and surfaces of substructures coming in contact with earth shall be applied with three coats of hot applied industrial bitumen conforming to IS : 702 (latest), of Grade 85 / 25, at the rate 1.7 Kg / Sq.m / coat.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 170 OF 245



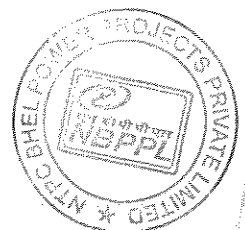
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
21.01.29	The liquid retaining face and face in contact with earth of the walls of liquid retaining / conveying structures shall be heavily trowled when concrete is wet to give a dense and smooth surface free from pores.		
21.01.30	All the liquid retaining structures shall be tested for leak proof ness with full water level in accordance with clause no. 10 of IS : 3370 (Part - I) and IS : 6494.		
21.01.31	All structures receiving acid / alkali resistant lining shall be tested for water tightness and made leak proof before lining work.		
21.01.32	No vertical joints shall be allowed in the wall of liquid retaining structures.		
21.01.33	Base slab of large tanks may be cast in number of panels viz. I, II, III etc. Starting with I, the slab panels shall be cast alternately in chess board fashion, with proper construction joints. Adjacent panels shall be cast with sufficient time interval, so that first cast concrete would have undergone most of its shrinking before the second cast concrete is poured against it. The construction joints shall be provided with chemical injection grouting treatment. The construction joints shall have continuity of reinforcement and shall be provided with suitably keys. The size of panels shall be as per IS : 3370 recommendations.		
21.01.34	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 possible and the wall should be built to its full height in the least possible time.		
21.01.35	1000mm wide x 100 mm thick plinth protection in PCC (M-15) shall be provided around all buildings, pits / sumps, clarifiers, tanks, etc.		
21.01.36	All masonry walls shall be provided with Damp Proof Course at plinth level.		
21.01.37	Wherever required PVC coated chain - link fencing shall be provided as per specification.		
21.01.38	Expansion joints for all underground structures shall be made water tight 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 230mm respectively. Two - part polysulphide sealant conforming to IS: 12118 shall be used for sealing of joints. Preformed bitumen impregnated fibre board conforming to IS: 1838 shall be used as joint filler.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 171 OF 245

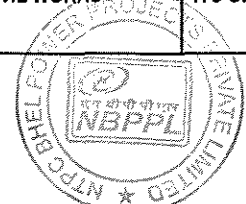


38844

CLAUSE NO.	CIVIL WORKS
21.01.39	All monorail openings in the walls shall be provided with double plate flush steel door shutters with suitable access platform and ladder as required.
21.01.40	a) All drains inside the building shall have minimum 40mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating. b) All drains outside building shall have perforated precast RCC covers of minimum 50mm thickness with provision of openable steel grating cover at about 4.0m interval. In areas where vehicular loads would be coming precast RCC covers of suitable thickness without perforations and designed for the vehicular loading shall be provided.
21.01.41	Wherever possible minimum 900 mm high hand railing shall be provided around all floor/ roof openings, projections/ balconies, platforms, walkways, steel stairs, water channels, forebay etc. All handrails and ladder pipes shall be 32 mm nominal bore MS pipes (medium class) conforming to IS: 1161 and shall be galvanised as per IS: 4736 and IS: 1239. All rungs and ladders shall also be galvanised. Minimum weight of galvanising shall be 610g/ sq.m.
21.01.42	In all buildings, suitable arrangement for draining out water collected from equipment blowdowns, leakages, floor washings, fire fighting etc. shall be provided for each floor with suitable floor drains.
21.01.43	All cable & pipe routing in outlying area shall be clubbed and shall run over ground on steel trestles or other supporting structures at a height of not less than 3000 mm above grade for easy inspection & maintenance except in some localised area (as approved by Employer) where the same can run in trenches. In case cable route is not envisaged in the area, pipe shall be routed on ground over RCC pedestals at a height of not less than 500 mm. All trenches shall be of RCC with removable RCC covers. Trenches located outside buildings shall project atleast 200 mm above the finished formation level so that no storm water shall enter into the trench. The bottom of the trench shall be provided with a slope of 1 in 500 for draining out the collected water into a sump pit to be provided at suitable location. The precast covers shall not be more than 300 mm in width. The pre-cast RCC slab covers shall not generally weigh not more than 65 kgs. Lifting hooks shall be provided in the precast covers. The trenches shall be given a slope of 1 in 200 in the direction perpendicular to the run of the trenches. PVC water stops shall be provided at all expansion joints of all trenches, with joint filler and sealing compound.
21.01.44	Water supply line & drainage of pump house shall be connected with the nearest Employer's water supply & drainage line.
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	
TECHNICAL SPECIFICATION SECTION - VI PART-B	
SUB-SECTION-D-01 CIVIL WORKS	
PAGE 172 OF 245	

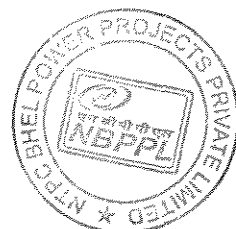


CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
21.01.45	Unless specified all sand filling shall be compacted to minimum 75% of the relative density and backfilled earth shall be compacted to minimum 90% of the Standard proctor density at OMC. However, sub - grade for the roads shall be compacted to minimum 95% of the Standard Proctor density at Optimum moisture content (OMC).		
21.01.46	All liquid retaining structures shall be leak-proof. Water proofing of all liquid retaining structures shall be done by addition of plasticiser cum water proofing admixture conforming to IS : 9103, in the concrete at the time of mixing and through external treatment by chemical injection grouting at all construction joints as described in the specification. Addition of admixture should not reduce the strength of the concrete below the specified strength in any case. In addition, limit on permeability as given in IS : 2645 shall also be met with. Further if required, chemical injection grouting treatment shall be applied to make the structure leak proof, if leakage is observed during hydro - test or otherwise, with no cost implication to the Employer.		
21.01.47	Plywood formwork shall be used for all water retaining/ conveying structures (only on the face having contact with water) and for all overground concrete works. It shall also be used for the inner face of sump of pump (i.e. faces of piers back walls, breast walls and baffle walls having contact with water. For all other areas steel/ plywood formwork shall be used.		
21.01.48	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.		
21.01.49	Structural steel column base plates and bolts, gussets etc. shall not project above the floor level. These shall be encased by concrete cover upto floor level with concrete grade M-30.		
21.01.50	Under drainage arrangement for under ground structures shall be provided as applicable in line with relevant codal provisions.		
21.01.51	2.0m wide walkway with concrete paving shall be provided connecting all buildings and facilities. The top of walkway shall be minimum 200mm above FGL.		
21.01.52	For all buildings, finished floor level (FFL) shall be minimum 500mm above finished ground level (FGL).		
21.01.53	Acid/ Alkali Resistant Lining The acid / alkali resistant lining shall be provided broadly in the areas identified above. 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		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 173 OF 245

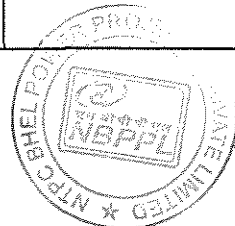


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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
21.01.54	defects is any, observed in the lining to the satisfaction of the Engineer without any extra cost during this period. Bituminous Coating Bituminous coating shall be applied on the inside faces of the water retaining structures and also on that portion of water retaining structure which are in contact with ground water. Surface to be treated shall be absolutely dry, clean and dust free. The surface shall be sand papered, before applying the coating. The external surfaces of concrete which are in contact with ground water shall be applied with hot industrial bitumen conforming to IS : 702, of grade 85 / 25. The rate of application shall not be less than 1.70 Kg / sq.m / coat, in three coats and it should be heated to about 120o C before application. Anti stripping compound shall be added wherever necessary. After application of third coat and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading sand, before back filling is done in order to allow the final coat to dry up completely.		
21.01.55	The internal surfaces of water retaining structure which are in contact with water shall be applied with two coats of bitumen paint conforming to IS : 9862, at the rate of 1.5 Kg / Sq. M. in first coat and 1.0 Kg / Sq. M. in second coat. 40mm Dia. 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 out door 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 of structures and equipment. The contractor also supply and lay necessary number of 3.0 M deep 40 mm Dia. MS rods Earthing electrodes and connecting them 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 of two locations.		
21.02.00	Concrete General a) Concrete work shall be carried out as per IS:456. Mix design concrete shall be used for 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 IS:10262. Specific approval of the Engineer shall be obtained regarding degree of quality control to be adopted for design mix.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 174 OF 245

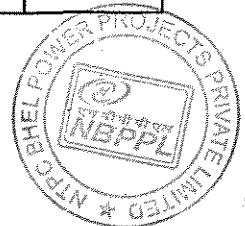


CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC																					
	b) Minimum grade of concrete for all foundations including piling shall be M25 unless noted otherwise. Minimum grade of concrete for other structures/areas (other than of machine foundations) shall be M20 except for the under ground works and outdoor works which shall be M-25 grade unless noted otherwise elsewhere in this specification. c) The grades of concrete for different machine foundations shall be as follows: <table><tr><th>Sl. No.</th><th>Description</th><th>Minimum grade of concrete</th></tr><tr><td>i)</td><td>TG Top Deck</td><td>M-35</td></tr><tr><td>ii)</td><td>ID, FD and PA fan Deck</td><td>M-30</td></tr><tr><td>iii)</td><td>Coal Mill Deck</td><td>M-30</td></tr><tr><td>iv)</td><td>Sub structure supporting top decks of TG, ID/FD/PA Fans, Mills including raft/ footings</td><td>M-30</td></tr><tr><td>v)</td><td>BFP foundations including deck</td><td>M-30</td></tr><tr><td>vi)</td><td>CW Pump House, CW Channel</td><td>M-30</td></tr></table> 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) All underground concrete structures like trenches, substructures of pump houses, all water retaining / carrying structures , etc., shall have super-plasticizer cum water proofing cement additive conforming to IS:9103. In addition, limit on permeability as given in IS:2645 shall also be met with. Special requirements for concreting of major equipment foundations shall be as given below. a) Coarse Aggregates Sound and durable crushed stone aggregates shall be used. All aggregates shall be tested for alkali aggregate reaction. Materials, which contain high percentage of reactive silica, shall not be used. In exceptional cases, high percentage of reactive silica content, aggregate may be allowed where low alkali content cement shall be used. Lime stone aggregate shall not generally			Sl. No.	Description	Minimum grade of concrete	i)	TG Top Deck	M-35	ii)	ID, FD and PA fan Deck	M-30	iii)	Coal Mill Deck	M-30	iv)	Sub structure supporting top decks of TG, ID/FD/PA Fans, Mills including raft/ footings	M-30	v)	BFP foundations including deck	M-30	vi)	CW Pump House, CW Channel	M-30
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SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 175 OF 245																					



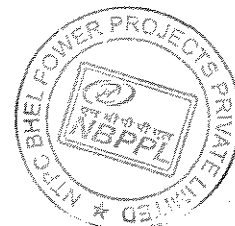
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CLAUSE NO.	CIVIL WORKS	एन टी पी सी NTPC															
	be used for foundations which are subjected to high temperature and repeated temperature cycles (like in the case of all machine foundations). However, in case other types of suitable aggregate is not available, the Engineer may allow the use of lime stone aggregate provided the Bidder gets the sample tested from a reputed testing laboratory for satisfactory performance under high temperature and repeated temperature cycle. Unless otherwise specifically approved by the engineer, the tests shall be carried out for a temperature range from 10 °C to 65 °C and for 60 (sixty) temperature cycles. b) Temperature Control of Concrete The temperature of fresh concrete shall not exceed 25 deg C when placed. For maintaining the temperature of 25 deg C in the top decks of machine foundations, crushed ice shall be used in mixing water. c) Admixture Plasticizer /super plasticizer admixture shall generally be added to the concrete for promoting workability. In addition, plasticizer/super plasticizer-cum-ratarder 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: <table><tr><td>Top decks of TG,</td><td>-</td><td>150 mm to 200 mm</td></tr><tr><td>BFP, ID/PA/FD Fans,</td><td></td><td></td></tr><tr><td>Mill deck</td><td>-</td><td>100 mm to 150 mm</td></tr><tr><td>Block foundation</td><td>-</td><td>100 mm to 150 mm</td></tr><tr><td>Column</td><td>-</td><td>100 mm to 150 mm</td></tr></table> d) Form work Plywood with film face form work shall be used for the top decks of all machine foundations and also for columns of TG foundation. e) Placing of Concrete Base Raft and top deck of machine foundations shall be cast in a single pour. f) Ultrasonic Testing Ultrasonic pulse velocity test shall be carried out for the top decks of all	Top decks of TG,	-	150 mm to 200 mm	BFP, ID/PA/FD Fans,			Mill deck	-	100 mm to 150 mm	Block foundation	-	100 mm to 150 mm	Column	-	100 mm to 150 mm	
Top decks of TG,	-	150 mm to 200 mm															
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SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 176 OF 245														



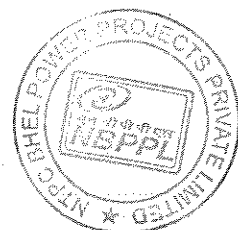
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CLAUSE NO.	CIVIL WORKS	एनडीपीसी NTPC		
	machine foundations and TG substructure to ascertain the homogeneity and integrity of concrete. In addition, additional cubes (at the rate of one cube per 150 cu.m. of concrete subject to a minimum of six cubes) 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 IS:13311 (Part-1). In case of any defect, the Bidder shall rectify the defects suitably using cement/epoxy grout, etc., g) Scheme for Concreting Weigh Batching Plants, transit mixer, concrete pump shall be mobilised. Arrangements for standby Plant and Equipment shall also be made.			
21.03.00	Formwork Plywood with film face formwork shall be used for all structures and concrete works.			
21.04.00	Fencing and Gate Fencing Fencing with gate shall be provided around transformer yard, switchyard area, fuel oil area and other areas wherever necessary due to security, safety, and statutory requirements as per following specifications. 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.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 177 OF 245



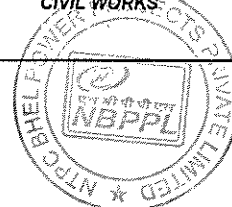
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CLAUSE NO.	CIVIL WORKS 		
21.05.00	All fence posts shall be of 75 x 75 x 6 MS angles spaced at 2.5m c/c distance. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R.C.C. foundations for the post 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 spacings. Gate All gates shall be of structural steel of minimum 3.75 metres width for single lane access road and 7.75 m width for double lane access roads. The height of gate shall be same as that of the fence. 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.		
	Grating All gratings shall be electroforged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. 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. Fabrication 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, whether shop or site weld.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 178 OF 245

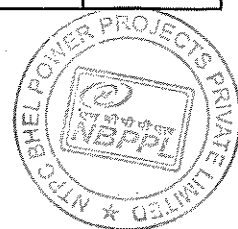


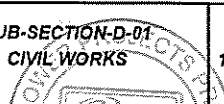
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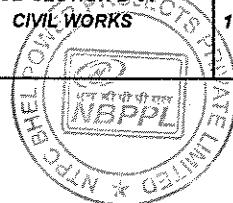
CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC				
	Welding a) Welding of Structural steel shall be done by an electric arc process and shall conform generally to relevant acceptable standards viz. IS:816, IS:9595, IS:814, IS:2014, IS:4354 and Indian Standard Hand Book for metal arc welding, and other standards, 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 downhand 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 jointed 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.					
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS		PAGE 179 OF 245



CLAUSE NO.	CIVIL WORKS 		
	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 250⁰C - 300⁰ C for one hour and later on cooled in the same oven to 100⁰C. It shall be transferred to an holding oven maintained at 60⁰C - 70⁰C. 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. 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 interpass 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 180 OF 245

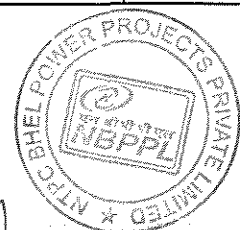


CLAUSE NO.	CIVIL WORKS											
	b) Base metal shall be preheated, notwithstanding provisions of IS:9595, to the temperature given in Table-1 prior to welding or tack welding. Preheating shall bring the surface of the base metal to the specified preheat temperature and this temperature shall be maintained as minimum temperature while welding is in progress. TABLE - 1 MINIMUM PREHEAT and INTER PASS TEMPERATURE FOR WELDING <table><tr><th>Thickness of thicker part at point of Welding</th><th>Welding using Low hydrogen electrodes or Submerged arc welding</th></tr><tr><td>Upto and including 20mm</td><td>None</td></tr><tr><td>Over 20mm and upto and including 40m</td><td>20 °C</td></tr><tr><td>Over 40mm and upto and including 63mm</td><td>66 °C</td></tr><tr><td>Over 63mm</td><td>110 °C</td></tr></table>	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 °C	Over 40mm and upto and including 63mm	66 °C	Over 63mm	110 °C	
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 °C											
Over 40mm and upto and including 63mm	66 °C											
Over 63mm	110 °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 upto 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 upto 600 deg.C and rate of application shall be 200 deg.C per hour. The post heat temperature shall be maintained for 60 minutes per 2.5cm. thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas. 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											
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS 	PAGE 181 OF 245									

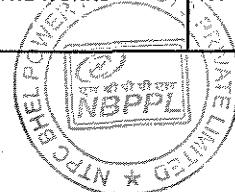


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CLAUSE NO.	CIVIL WORKS 		
	should be away from the point of restraint and towards the point of maximum freedom. b) Each case shall be carefully studied before finally following a particular sequence of welding. c) Butt weld in flange plates and/or 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 182 OF 245

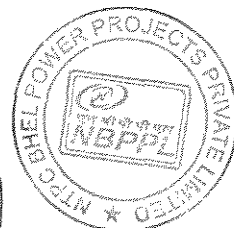


CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPG		
	l) Intermittent welds shall be permitted only when shown in the design drawings. m) The welding shrinkage shall be minimised by adopting the correct welding procedure and method. In long and slender member extra length should be provided at the time of fabrication for shrinkage. 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. 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 183 OF 245

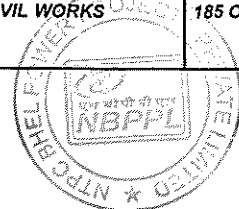


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CLAUSE NO.	CIVIL WORKS		
	c) Non-destructive and special testing Radiographic / ultrasonic or other non-destructive examination shall be carried out. All tests of welds shall be carried out by the Bidder at his own cost. The cordoning of radiation 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. Inspection and Testing a) Fillet Welds i) All fillet welds shall be checked for size and visual defects. ii) Macroetch examination on production test coupons for main fillet weld with minimum one joint per built up beam, column and crane girder, etc. iii) 25% weld length of tension members of crane girder shall be subjected to dye-penetration test. iv) On all other welds, dye-penetration test on 5% of weld length with minimum 300mm at each location shall be carried out. b) Butt Welds i) 100% visual examination. ii) Dye penetration test on all butt welds after back gouging shall be carried out.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 184 OF 245

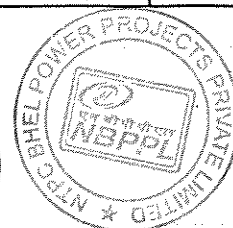


CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC
	iii) Mechanical testing of production test coupons - minimum one joint/built up beam, column and crane girder. The engineer may reduce the frequency of the test, after getting consistently satisfactory results of initial 10 tests. iv) 100% radiography test on butt welds of tension flange (bottom flange) of crane girder and bunker supporting girders. All other butt welds shall be subjected to radiography test on 10% of weld length of each welder. c) Dimensional Tolerance and Acceptance Criteria of Welds i) Every first and further every 10th set of identical structure shall be checked for control assembly at shop before erection. ii) All structures, components/members shall be checked for dimensional tolerance during fabrication and erection as per IS:7215 and IS:12843 respectively. iii) Dry film thickness after painting shall be checked by using elchometer. iv) Acceptance criteria of NDTs on welds shall be as per AWS D-1.1 (Dynamically loaded structures - Tension welds). 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. 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.
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B SUB-SECTION-D-01 CIVIL WORKS PAGE 185 OF 245

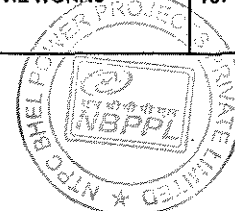


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CLAUSE NO.	CIVIL WORKS		
	b) The centre lines of all columns, elevations and girder bearings shall be marked on the sections to ensure proper alignment and assembly of the pieces at site. Erection Scheme a) The Erection Scheme for the erection of all 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., Bidder shall take up the erection work only after he has obtained the approval of the erection scheme from the Engineer. 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.		
22.00.00	GENERAL ARCHITECTURAL SPECIFICATIONS		
22.01.00	General		
	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 ht to be 1.2m. All handrails and ladder pipes (except at operating floors) shall be 50 mm nominal bore MS pipes (medium class) conforming to IS:1161 and shall be galvanised as per IS : 4736 and finished with suitable paint. All rungs and ladders shall also be galvanised. Minimum weight of galvanising shall be 610 g/sqm.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
			PAGE 186 OF 245

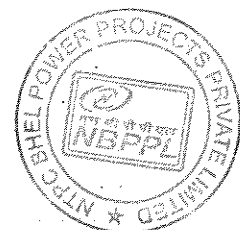


CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	For RCC stairs, passages & Atriums in buildings, around all floor openings at operating floors, 1000 mm /1200mm high hand railing with 32 NB (polished) stainless steel pipe shall be provided. b) All stairs shall have a maximum riser height of 180mm and a minimum tread width of 275 mm. Minimum clear width of stair shall be 1200 mm unless specified otherwise. c) All buildings having metal cladding shall be provided with a 150 mm high RCC toe kerb at the edge of the floor along the metal cladding. 1000 mm high hand railing shall be provided on this RCC kerb, wherever required from the safety point of view. d) In all buildings, structures, suitable arrangement for draining out water collected from equipment blowdowns, leakages, floor washings, fire fighting, etc., shall be provided for each floor. All the drains shall be suitably covered with grating or precast RCC panels. e) RCC staircase shall be provided for main entrance of Turbine building; control tower area and all other RCC construction buildings. f) Parapet, Chajjas 450mm over window and 600mm door heads, 750mm over rolling shutters, architectural facias, 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. h) Ramps & Lifts for physically challenged persons shall be provided for barrier free access to the buildings.		
22.02.00	Water Supply and Sanitation		
22.02.01	Two numbers of roof water tanks (one for storing service water and another for potable water) of adequate capacities depending on the number of users and 8 hours requirement shall be provided for each building and pump house. Polyethylene water storage tanks conforming to IS:12701 shall be used. The tanks shall be complete with all fittings including lid, float valve, stop cock, vent pipe, etc. Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal piping works for service water and potable water supply. The pipes shall be		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 187 OF 245

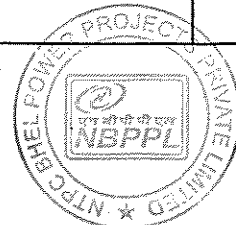


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CLAUSE NO.	CIVIL WORKS			एनटीपीसी NTPC
22.02.02	concealed, and painted with anti-corrosive bituminous paint (as per IS: 158) wherever required. Sand Cast Iron pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level. Minimum one number main toilet block each (for male and female) with required facilities shall be provided on each floor of Main plant building, and Service/office building. Attached toilets shall be provided for all senior executive rooms and conference rooms. All other buildings shall have minimum one toilet block each. The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated in subsequent clause. IS:1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS:2064 and IS:2065 shall also be followed.			
	Each Toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of Chromium plated brass (fancy type) a) One number wall mounted coloured (excluding premium colours) glazed vitreous China European water closet and flushing valve system, water faucet, toilet paper holder as per IS:2556 b) One number white glazed vitreous China Orissa pan (580 x 440 mm) and flushing valve system, toilet paper holder as per IS:2256 c) One number colour (excluding premium colours) glazed ceramic oval shaped wash basin 450x 550 mm (approx.) mounted over 18mm thick granite beveled edge counter fitted with photo-voltaic control system for water controls, bottle trap as per IS:2556 d) Urinal with all fittings with photovoltaic control flushing system as per IS:2556. e) 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 f) One toilet with required facilities shall be provided for physically challenged persons as per National Building Code requirements g) In addition to the facilities stipulated elsewhere Bathroom with rotating type chromium plated shower including all fitting and fixtures shall also be provided in toilet at ground and operating floor of main plant: h) Janitor Space			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 188 OF 245

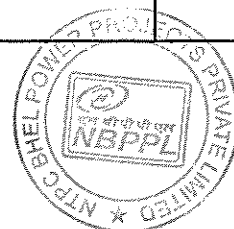


CLAUSE NO.	CIVIL WORKS 		
	i) Electric operated hand dryer with photo voltaic control. j) The pantry shall consist of one number stainless steel pantry sink, as per IS : 13983, of size 610 x 510 mm, bowl depth 200 mm with drain board of at least 450 mm length with trap, hot and cold water mixer, one number geyser of 25 liters capacity, with inlet and outlet connections, one number HDPE loft type / over head water storage tank, as per IS : 12701 and of 500 liters capacity, complete with float valve, overflow drainage pipe arrangement, GI concealed water supply pipe of minimum 12 mm dia of medium class, cast iron 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) k) Laboratory sink shall be of white vitreous china of size 600x400x200 mm conforming to IS:2556 (Part-5).		
22.03.00	Flooring Floor finishes of approved shade and colour (non - premium colours), 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.		
22.03.01	The nominal total thickness of floor finish shall be 50 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 (1 part cement, 2 part sand and 4 part stone chips by volume). Stone chips shall be 12.5 mm down well graded.		
22.03.02	Sunken RCC slab shall be provided in false flooring area and all toilet areas so as to keep the finished floor level of these areas 25 mm below as that of the surrounding area. For toilet area, sunken slabs shall be made water tight by suitable water proofing treatment.		
22.03.03	Metallic hardener topping -with ordinary grey cement - 12 mm thick (insitu) or finishing the concrete / mortar surfaces topping with neat cement slurry (with ordinary grey cement)		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 189 OF 245



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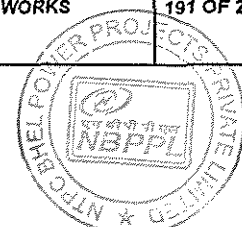
CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
22.03.04	Heavy duty cement concrete tiles 300 mm x 300 mm using white cement with pigment, with hard and abrasion resistant carborundum / quartz chips for wearing course as per IS:1237. Laying of tiles shall be as per IS:1443.		
22.03.05	Heavy duty (grade-5) dust pressed ceramic tiles (300mmx300mm as per IS 13755. Designer ceramic wall tiles of size 300 mm x 200 mm / (300x600mm). Acid, alkali and oil resistant high build self smoothing, seamless epoxy resin floor finish, on horizontal and vertical surfaces, at all levels, for all types of works, application of epoxy based primer coat, of approved colour, quality and make to give minimum thickness of 300 micron (in two coats), etc., all complete.		
22.03.06	Mirror polished Vitrified ceramic tiles (min 9.5mm thk) 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. Sizes of the tiles shall be as under: a) 400 mm x 400 mm b) 600 mm x 600 mm c) 800mm x 800mm		
22.03.07	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.		
22.03.08	PVC flooring, wherever used, shall be minimum 2 mm thick (virgin) as per IS: 3462. The laying of flooring shall be as per IS: 5318.		
22.03.09	Wherever required, carpet flooring shall be provided over cement concrete floor as in conference room of main control room complex. The carpet shall be of tile/roll form, machine/hand made tuped un-cut loop pile and lay with under lay of 10mm thick and shall be laid as per manufacturer's recommendations, in matching grains. It shall be treated with anti fungus and anti-termite before laying.		
22.03.10	Mirror polished (6 layers of polish) Granite stone (slab) - 18 mm Thk (minimum) / Flame finish (making top surface rough by burning / shot blasting) granite stone (slab) - 18 mm Thk (minimum)		
22.03.11	Mirror polished Marble stone (slab) - (Rajnagar) Plain white -18 mm thick Decorative/designer prepolished, plain and pigmented, high wearing resistance concrete tiles of 20mm thickness (minimum) in various non-standard interlocking patterns.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 190 OF 245



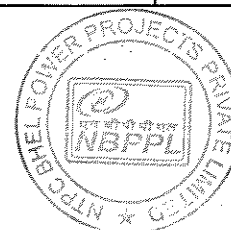
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CLAUSE NO.	CIVIL WORKS 		
22.03.12	Skirting in general shall be 150 mm high. Dado in toilets & pantries, shall be upto 2100 mm height from finished floor level. Skirting and Dado shall match with the floor finish.		
22.03.13	Wherever required, removable metallic false flooring system shall be provided. Nominal height of the false flooring shall be 600 mm. The same shall comprise of special grade steel panels (of size 600x600mm). without any dimensional tolerance 1.2mm thick die cast to shape having 1mm thick top MS sheet spot welded together to form a composite steel panel, sitting on aluminum diecasted heads & mounted on steel pedestals of 25mm dia rod of adjustable height and supporting 1.2mm thick channel frame work at-top and 2mm thick 150x150mm base plate. The top finish shall be 2mm thick antistatic PVC sheet or High pressures laminate. Cavity area below the false flooring shall be made dust proof by using Polyurethane paint.		
22.03.14	Interlocking concrete blocks of various sizes and thickness having M 35 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. Matt finish (with grooves) Porcelain tiles (for guiding band/s for visually impaired persons) 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. 24 mm x 24 mm x 3.8 mm thick (minimum) glass mosaic tiles in decorative murals and pattern.		
22.03.15	Paving a) The RCC paving minimum 150 mm thick of M20, over an underbed 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 underbed for paving shall consist of preparation and consolidation of subgrade to the required level, laying of stone soling of 225 mm compacted thickness with 63 mm and down aggregate with interstices filled with selected sand 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. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. However mill maintenance area and vehicular passage shall be provided with non-metallic hard granular finish in place of metallic hardener topping. Non metallic hard granules shall be spread over the green concrete paving slab at the rate of not less than 5 kg/ sq.m. Paving shall be provided for the following areas:		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 191 OF 245

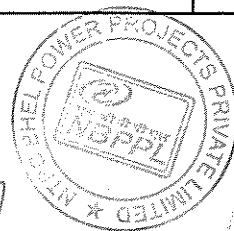


CLAUSE NO.	CIVIL WORKS 		
	thickness of 0.8mm of galvanised (with minimum rate of galvanisation of 275 gm/sq.m.) M.S. sheet or minimum 0.8mm of high tensile steel (minimum yield strength 350 MPa) coated with zinc aluminium alloy (zincalume) (coating not less than 150 gm/sq.m). Silicon modified polyester paint having DFT of minimum 20 microns shall be used for permanent coating. The sheeting shall be fixed by means of concealed fixing system or any other compatible method approved by the Engineer. RCC slab of minimum 50 mm clear thickness in excess of trough depth shall be 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 water-retaining test by maintaining the minimum water depth of 50mm over the roof surface for a period of 48 hours. Water Proofing Treatment as given below for RCC roof slabs shall be provided to ensure that the roof is watertight.		
22.05.02	Roof of all buildings having RCC framework shall have cast-in-situ RCC slab. Such roof shall be provided with roof water proofing treatment using high solid content liquid applied elastomeric water proofing membrane with separate wearing course as per ASTM - C-836 & 898. Thickness of the membrane shall be 1.5mm (min.). This treatment shall include application of polymerised mastic over the roof to achieve smooth surface and primer coat. Wearing course on the top of membrane shall consist of 25mm thick PCC (1:2:4) cast in panels of maximum 1.2 x 1.2m size and reinforced with 0.56mm dia galvanised chicken wire mesh and sealing of joints using sealing compound/elastomeric water proofing membrane. However, chequered concrete tile flooring 22 mm (min.) thick of approved colour and shade conforming to IS: 13801 shall be provided for path way of 1 m. width for access of personnel and handling of equipment and for the entire area of the roof where equipment like AC / Ventilation plant, cooling towers, etc. are provided in place of PCC wearing course. Equipment shall be installed on raised pedestal of minimum 30 cm height from the finished roof to facilitate maintenance of roof treatment in future.		
22.05.03	For efficient disposal of rainwater, the run off gradient for the roof shall not be less than 1:100 and the roof shall be provided with RCC water gutter, wherever required. Gutter shall be made water tight using suitable watertight treatment. This gradient can be provided either in structure or subsequently by screed concrete 1:2:4 (using 12.5 mm coarse aggregate) and/or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface.		
22.05.04	For Building where metal cladding is envisaged medium class galvanised mild steel pipes conforming to IS: 1239/IS:3589 with welded joints shall be provided to drain off rain water from the roof. For rest of the buildings cast-iron pipes with lead caulked joints conforming to IS:1230 shall be used. These shall be suitably concealed with masonry work, cement concrete / or sheeting work to match with the exterior finish. The number and size of down comers shall be governed by IS:1742 and IS:2527. Roof drain level of all RCC framed buildings having cast-in-situ RCC roof shall be provided with Rain water gutter and/or 45 x 45 cm size Khurras having minimum		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 193 OF 245

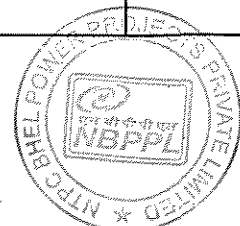


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CLAUSE NO.	CIVIL WORKS 		
	thickness of 30 mm with 1:2:4 concrete over PVC sheet of 1 m x 1 m x 400 micron and finished with 12 mm thick cement sand plaster 1:3. All the pipes shall be provided with suitable fittings and fixtures. Gratings shall be of stainless steel. Roof Water Proofing Roof water proofing treatment shall be as follows: 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 as specified in schedule of items shall be laid and 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: Screed concrete mix (1:2:4) grading having minimum 25mm thickness at the lowest point of the slope shall be laid over R.C.C. slab and shall be laid as per the slope specified elsewhere in the specification. Top surface of grading underbed shall be finished with 15mm thick cement plaster (1:4). Over the finished surface elastomeric membrane as specified in schedule of items shall be laid and 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.		
22.05.05	Roof of all buildings shall be provided with access/approach through staircase or ladder. Roof where equipment are mounted shall be provided with access through staircase.		
22.05.06	RCC parapet wall of minimum 1000 mm height (above top of slab) for all accessible roofs and 600 mm height for all non-accessible roofs shall be provided.		
22.05.07	Filletts 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 194 OF 245



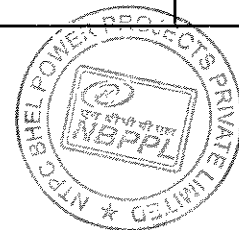
CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
22.05.08	Pathways for handling of materials and movement of personnels shall be provided with 22mm thick chequered cement concrete tiles as per IS:13801 for a width of 1000mm .		
22.06.00	Walls		
22.06.01	All walls shall be non-load bearing infill panel walls.		
22.06.02	For initial height upto 3 metres from ground floor one brick thick masonry wall shall be provided wherever metal cladding is specified.		
22.06.03	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).		
22.06.04	For Main plant building, Control tower and other buildings, the type, thickness and initial height of external cladding facing the transformer yard shall be according to the requirements of Tariff Advisory Committee (TAC). TAC requirements shall also be complied with for all other buildings while deciding cladding type & thickness. External face of Toilets, Air-conditioned and pressurised areas shall be provided with masonry wall as per functional / aesthetic requirements. (Inside the metal cladding wherever provided).		
22.06.05	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.		
22.07.00	Colour coated and other sheeting work Permanently colour coated sheet of approved shade and colour using galvanised mild steel sheet of minimum 0.6mm BMT(bare metal thickness i.e. metal thickness excluding thickness for coating and galvanizing) galvanised to grade 275 as per IS 277, of minimum yield strength of grade SS255 as per ASTM A653M / grade G250 as per AS 1397, coated with zinc of class designation Z275 or high tensile steel of minimum 0.5mm BMT(bare metal thickness i.e. metal thickness excluding thickness for zinc aluminium coating and colour coating) of grade SS340-Class 4 as per ASTM A792M / grade G350 as per AS 1397, coated with aluminium zinc alloy of class designation AZ150. Steel shall be colour coated with total coating thickness of 35 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face on 5 microns (nominal) primer coat and 5 microns (nominal) SMP or super polyester paint over 5 microns (nominal) primer coat on internal face..		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 195 OF 245



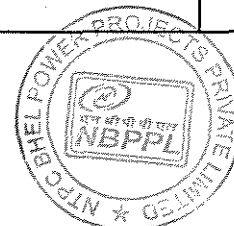
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CLAUSE NO.	CIVIL WORKS 		
	SMP and Super polyester paint systems shall be of industrial finish of product type 3 of AS2728. Coated surface shall be provided with a protected guard film (polyethylene) of about 40 microns to avoid any damage to the coating during handling. For metal deck, minimum 0.8 mm (bare metal thickness i.e. metal thickness excluding thickness for coating and galvanizing) of grade SS255 as per ASTM A653M / grade G250 as per AS 1397, coated with zinc of class designation Z275, troughed profile having nominal trough depth 44 mm and pitching of 130 mm shall be used. However alternative profile meeting the strength, deflection and other functional requirements such as sections modulers and moment of inertia shall be provided. 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 purling / runner spacing. No negative tolerance shall be allowed in bare metal thickness. For wall cladding insulated / uninsulated and conveyor gallery sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm. Sheet shall be of approved profile, sectional properties, colour and shade. For metal decking 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 over a span of 1.7 m under total super imposed loading (DL +LL) of 450 kg per Sq.M. 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. For metal roofing 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 over a span of 1.5 m 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. The maximum spacing of the fasteners shall be 390 mm c/c along the length of purlins/runners. However exact spacing shall be as per the design done by the bidder for the fasteners considering the wind load, self load and other associated loads. Minimum diameter of the fastener shall be 5.5 mm and atleast 3 nos. of fasteners shall be used per sheet.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 196 OF 245

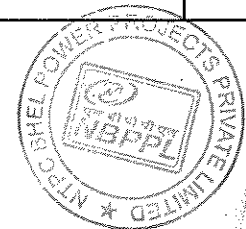


CLAUSE NO.	CIVIL WORKS 		
	Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 275 as per IS : 277 Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with 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. The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries shall have toughed profile to match with the metal cladding profile. Minimum 2.0mm thick fire retardant and UV resistant polycarbonate clean sheet of GE plastic or equivalent 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. Polycarbonate sheet minimum 6mm thick multi (twin) wall fire retardant (Continuous use under temperature 100°C), impact resistant and ultraviolet resistant sheet shall be provided (as glazing) in transfer houses, pump houses, etc. 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 sealnts with appropriate material and coating specification as mentioned above for the outer face of the sandwiched metal cladding. Overlap shall be min. 100 mm or as specified by manufacturer.		
22.08.00	Plastering		
22.08.01	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.		
22.08.02	Plaster of paris (Gypsum Anhydrous) conforming to IS:2547 shall be used for plaster of paris punning over cement plastered surfaces. The finish surface shall be smooth and shall be of 2 mm nominal thickness.		
22.08.03	All R.C.C. walls shall have minimum 12mm thick cement sand plaster 1:6.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 197 OF 245

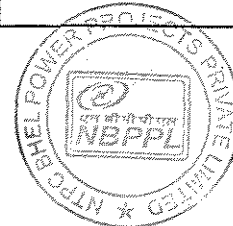


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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
22.08.04	All RCC ceilings (except areas provided with false ceiling, cable vault ceiling and metal decking) shall be provided with 6mm thick cement sand plaster 1:4.		
22.08.05	Groove of uniform size 12 x 12 mm up to 20 x 15 mm in plastered surface as per approved pattern, shall be provided as per approved drawing.		
22.08.06	All plastering work shall conform to IS:1661.		
22.09.00	Painting		
22.09.01	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.		
22.09.02	All paints shall be of approved make including chemical resistant paint.		
22.09.03	Minimum 2 finishing coats of paint shall be applied over a coat of primer.		
22.09.04	Solvent based (100% pure acrylic co-polymer resin based) paint. The paint should not contain any water sensitive ingredients. Paint to be applied in two or more coats as required on an under coat of suitable primer or one coat of cement paint on the new plastered surfaces inclusive of required tools, material and other painting accessories etc. The paint is to be applied as per the specifications, instructions and satisfaction of Engineer-in-charge. Washed stone grit plaster in two layers, under layer 12mm cement plaster 1:4 (1 cement : 4 sand) furrowing the under layer with scratching tool, applying grey cement slurry on the under layer @ 2 kg. of cement per square metre, top layer 15mm white cement plaster 1:1/2:2 (1cement : ½ sand : 2 marble chips 10mm nominal size) in panels with groove all around as per approved pattern including scrubbing and washing the top layer with brushes and water to expose the stone chipping, forming groove of uniform size from 12 mm x 12 mm upto 20 mm x 15 mm in plastered surface, as per approved pattern using wooden baton. 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 thk / polished Sadarhally grey granite slab 18 mm thk). The final, finished coating shall be fungus resistant, UV resistant, water repellant, alkali resistant, and extremely durable with colour fastness.		
22.09.05	Acrylic emulsion paint shall be as per IS:5411 (Part-I). Acrylic distemper shall be as per IS:428. Cement paint shall conform to IS:5410, white wash/colour wash shall conform to IS:627.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 198 OF 245

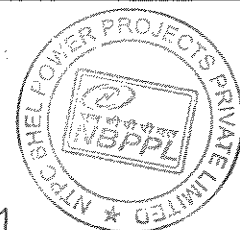


CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
22.09.06	Fire resistant transparent paint as per IS:162 shall be provided on all wood work over French polish or flat oil paint. French polish shall conform to IS:348. Flat oil paint shall conform to IS:137.			
22.09.07	All fire exits shall be painted in post office red/signal red colour shade, which shall not be used anywhere else except to indicate emergency or safety measure.			
22.09.08	For painting on concrete, masonry and plastered surface IS:2395 shall be followed. For painting on wood work IS:2338 shall be followed.			
22.09.09	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.			
22.09.10	Bitumen primer used in acid/alkali resistant treatment shall conform to IS:158.			
22.09.11	Resin bonded granular textured finish, for external applications shall consist of crushed stone / quartz chips of 2.5 mm size and of approved colour/ shade and bonded with synthetic resins, Adhesives and additives, all together in a single pack mix. For internal finish 1.2mm of approved, colour & shade (pigmented granular or flake finish) The final finish shall have UV-Resistant, fungus/bacterial resistant properties. Grooves shall be provided as per drawing and the same shall be filled with polysulphide sealant of matching colour/shade.			
22.10.00	Doors & Windows			
22.10.01	Doors, windows and ventilators of air-conditioned areas, entrance lobby of all buildings (where ever provided), and all windows and ventilators of main plant and service building shall have, electro colour dyed (anodised with 15 micron coating thickness) aluminium framework with glazing. All doors of toilet areas shall be of steel framed solid core flush shutter. All other buildings doors windows ventilators (unless otherwise specified) shall be of steel.			
22.10.02	Main entrance of the common control room and control equipment room shall be provided with air-locked lobby with provision of double doors of aluminium framework with glazing. Doors shall be of double action floor springs mounted.			
22.10.03	For common control building, double glazed wall panels with hermetically sealed glass with aluminium frame shall be provided between air-conditioned and non air-conditioned areas and on the side of common control room and control equipment room(s) to have a clear view. One glass, on external side of control room shall be tinted one.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS
PAGE 199 OF 245				

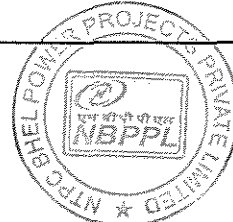


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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
22.10.04	Single glazed panels with aluminium framework shall be provided as partition between two air-conditioned areas wherever clear view is necessary.			
22.10.05	a) The doors frames shall be fabricated from 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.			
22.10.06	Steel windows and ventilators shall be as per IS:1361 and IS:1038.			
22.10.07	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.			
22.10.08	All windows and ventilators on ground floor of all buildings shall be provided with suitable grill.			
22.10.09	Fire-Proof doors with panic devices shall be provided at all fire exit points as per the recommendations of Tariff Advisory Committee (TAC). These doors shall generally be as per IS:3614. Fire rating of the doors shall be as per TAC requirements. However minimum rating shall be 2 hours. These doors shall be double cover plated type with mineral wool/wood insulation.			
22.10.10	Hollow extruded section of minimum 2 mm wall thickness as per IS:1285 shall be used for all aluminium doors, windows and ventilators.			
22.10.11	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.			
22.10.12	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.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 200 OF 245

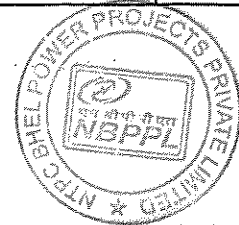


CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
22.11.00	Glazing		
22.11.01	All accessible ventilators and windows of all buildings shall be provided with min. 4mm thick float glass, plain or tinted for preventing solar radiations, unless otherwise specified.		
22.11.02	All inaccessible (where regular maintenance is not feasible) ventilators and windows of all buildings shall be provided with 6mm thick toughened glass / 6mm thick Multiwall Polycarbonate plain or tinted sheet for preventing solar radiations. The Multiwall Polycarbonate sheets shall be fire and u/v resistant, and suitable for continuous use up to a temperature of 100°C. Suitable aluminium beading shall be used. The open ends of the sheet shall be sealed as per manufacturer's recommendations.		
22.11.03	The sky light/ north light shall have Multiwall Polycarbonate sheet fixed with anodised aluminium frame of approved colour & the same shall be made leak proof.		
22.11.04	All windows and ventilators located in fire prone areas shall be provided with minimum 6 mm thick toughened glass conforming to IS:5437.		
22.11.05	For single glazed aluminium partitions and doors, float glass of 8mm or 10 mm thickness shall be used.		
22.11.06	Ground glass of minimum 4 mm thickness shall be used for all windows/ventilators in toilets.		
22.11.07	All glazing work shall conform to IS:1083 and IS:3548.		
22.11.08	6mm reflective toughened glass, with following technical characteristics: Solar factor 45% or less, U-value less than 5.7 W/ SQMK, VLT min 35%. The glass to be used should be from the manufacturers of glass like Glavebel (Belgium), Saint Gobain (France) or Fort (USA) Or equivalent. The glass should be free from distortion and thermal stress.		
22.11.09	Composite double glazing, 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, U-value less than 2.268 W/ SQMK, VLT min 30%. The glass to be used should be from the manufacturers of glass like Glavebel (Belgium), Saint Gobain (France) or Fort (USA) Or equivalent. The glass should be free from distortion and thermal stress.		
22.11.10	Glass block masonry work with glass blocks of size 190 x 190 x 90 (min), jointed with suitable adhesive complete as per the best construction practices.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 201 OF 245



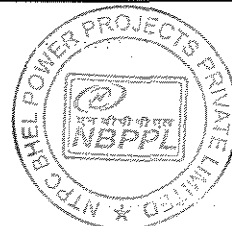
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
22.12.00	False ceiling		
22.12.01	False ceiling of 12.5 mm thick tapered/square edge glass fibre reinforced gypsum board conforming to IS : 2095 having fine texture finish, including providing and fixing of frame 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)		
22.12.02	False ceiling of 15 mm thick mineral fibre board, in tile form of size 600mm x 600mm, along with galvanised light gauge rolled form supporting system in double web construction pre painted with steel capping, of approved shade and colour, to give grid of maximum size of 1200x600. 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.		
22.12.03	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).		
22.12.04	Pre-Painted Coil coated Steel false ceiling system, at all level, for all kind of works, consisting of 0.5 mm thick galvanised as per IS : 277, alongwith galvanised supporting steel members exposed faces of galvanised member to be prepainted with regular modified polyester coating / super polyester coating minimum 20 DFT, to form panels of specified size for tile type panels and roll formed stove enamelled 0.6 mm thick steel carrier, for fixing of lineal type panels by clip on arrangement, suspended from RCC slab / structural steel or catwalkway steel channel grid above with 4 mm (minimum) galvanised wires (rods), with special height adjustment clips, providing angle section of minimum 25 mm leg width along the perimeter of ceiling, including all labour, material, supporting grid system (members minimum 0.8 mm thick and galvanised as per IS : 277) anchor fasteners for making suspension arrangement from RCC, providing openings for AC ducts, return air grills, insulation light fixtures, etc., all complete.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 202 OF 245



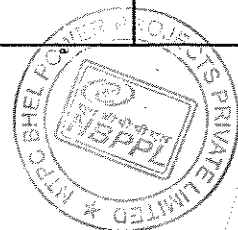
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
22.12.05	Tile type Square pattern panels of 600 mm x 600 mm size alongwith galvanised light gauge rolled form. supporting system in double web 'T' construction with pre-painted steel, with Tee support.			
22.12.06	Lineal pattern (closed type) of 100 mm nominal width, with carrier support. Metal ceiling as above in lineal/tile shape in stainless steel, bright finish instead of pre-painted coil coated finish.			
22.12.07	Mineral wool insulation shall be laid on top of false ceiling panels. Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, A.C. ducts etc.			
22.12.08	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.			
22.12.09	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 thk. 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.			
22.12.10	Suitable cut-outs shall be provided in false ceiling to facilitate fixing of lighting fixtures, AC grills, smoke detectors, etc.			
22.13.00	Interior Design A comprehensive interior design scheme shall be conceived with the intention of projecting a definite theme and aesthetic appearance to inside working environment. It shall take into account the mutlidisciplinary engineering activities involving power plant technology, and architectural & civil engineering for a smooth control hierarchy and man machine interface. All the design aspects such as flooring, false ceiling, furniture, colour scheme equipment design & layout, illumination, fire fighting, acoustics and ergonomics requirements shall be detailed out so as to present an overall unified aesthetic spatial appearance. The areas to be undertaken for this interior design process shall be control room complex including common control room, computer room, conference rooms and office areas in the main plant building and the following aspects shall be reviewed and evaluated for design. Furniture to be supplied by Bidder for the control room complex shall be as specified under C&I specification. a) Layout, keeping in view the man-machine interface and suitable ergonomic practices.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 203 OF 245



88-03876

CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
22.14.00	b) Integration of civil engineering with architecture and interior design. c) Illumination levels, noise levels, electromagnetic interference levels, taking into account the equipment and furniture. d) Comfort and safety requirements such as 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. Finishing Schedule Interior and Exterior Finishes shall be as given in Tables-B & C respectively attached at the end of these specification.		
	SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 204 OF 245



08877

CLAUSE NO.

CIVIL WORKS



TABLE - A
PROPOSED ACID /ALKALI RESISTANT TREATMENT

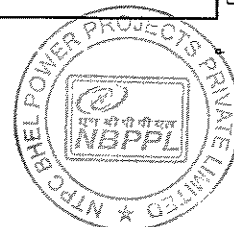
S.N O.	AREA	PRIMER (ONE COAT)	TYPE OF LINING AND THICKNESS				EPOXY COATING (TWO COATS)
	EFFLUENT TREATMENT PLANT		A.R. BRICKS	A.R. TILES	EPOXY MORTAR	BITUMASTIC	
1	<u>CPU:</u> a) Neutralisation Pit i) Floors	Bitumen	75 mm thick			18 mm thick	
	ii) Walls	Bitumen	115 mm thick			18 mm thick	
	iii) Ceiling	Epoxy					150 micron
	iv) Pillasters		115 mm thick				
	b) Effluent Drains	Bitumen	38 mm thick				
	c) Floor around equipment & dado	Bitumen	38 mm thick			12 mm thick	

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
205 OF 245



SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
205 OF 245

CLAUSE NO.

CIVIL WORKS



d) Regeneration area floor & dado	Bitumen	38 mm thick			12 mm thick	
e) Acid / Alkali storage area	Bitumen	38 mm thick			12 mm thick	
f) Degasser area floor	Bitumen	38 mm thick			12 mm thick	
g) Pedestals for supporting equipment	Bitumen	38 mm thick			12 mm thick	
h) M.S. Grating / Chequered plate	Epoxy					150 micron

Note :-

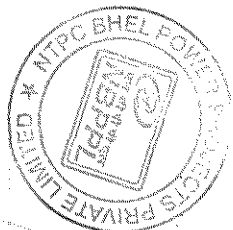
1. The above table is for general guidance only, however, actual areas/ facilities to be covered shall be as per Scope of work.
2. Suitable end sealing shall be provided.
3. Structures shall be tested for waterproofing before application of Acid / Alkali Resistant Treatment.
4. This treatment shall be applied on dry surface.
5. For laying of AR bricks / tiles, the bedding mortar shall be of potassium silicate 6 mm thickness and the pointing mortar shall be of Epoxy / furane 20 mm deep and 6 mm thickness.

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
206 OF 245



208878

CLAUSE NO.

CIVIL WORKS



TABLE -B

INTERIOR FINISHING SCHEDULE

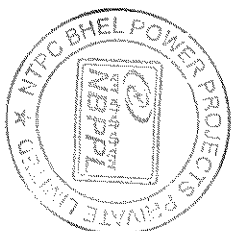
S.NO.	DESCRIPTION OF AREA	FLOORING	WALLING	CEILING
1.	Operating/Maintenance areas of workshop, pump houses, compressor house, DG set, air washer building, AC Equip Room, Hydrogen plant, Mill & Bunker Building, etc.	Cement concrete with Metallic hardener topping	Acrylic distemper over Plaster of Paris	Acrylic distemper without plaster of paris (except metal deck area)
2.	Cable Vault/cable spreader	- do -	Acrylic distemper over Plaster of Paris	Acrylic distemper without plaster of paris
3.	General storage areas	- do -	Acrylic distemper over Plaster of Paris	Acrylic distemper without plaster of paris

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
207 OF 245



08879

CIVIL WORKS

CLAUSE NO.

TABLE -B
INTERIOR FINISHING SCHEDULE

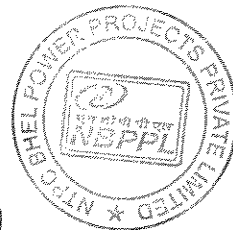
S.NO.	DESCRIPTION OF AREA	FLOORING	WALLING	CEILING
4.	a) Ground Floor i) Unloading Bay ii) Balance area including passage. b) Mezzanine floor (excluding grating area) c) Deaerator floor d) Operating Floor e) General circulation and movement areas	Cement concrete with Metallic hardener topping - do - - do - Cement concrete with Metallic hardener topping. 18 mm thick polished granite stone / Marble stone 18mm thk. Polished granite stone / marble stone/ Vitrified Ceramic tiles Vitrified Ceramic Tiles in matt finish - do -	Acrylic distemper over Plaster of Paris - do - - do - - do - - Do - - do -	Acrylic distemper without plaster of paris -do- -do- Metal deck roofing (bottom of sheeting with RAL 9002 finish) - do - Acrylic distemper without Plaster of Paris (except metal deck area) Acrylic distemper without plaster of paris - do -
5.	a) Switchgear room b) MCC Room		Acrylic distemper over plaster of paris - do -	

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
208 OF 245



0088800

CLAUSE NO.

CIVIL WORKS



TABLE -B
INTERIOR FINISHING SCHEDULE

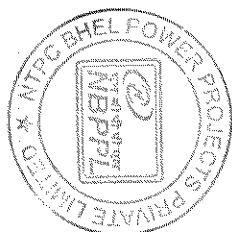
S.NO	DESCRIPTION OF AREA	FLOORING	WALLING	CEILING
6.	a) Control room area including control room, computer room, control equipment room,	Polished Granite Stone as/pattern and. Vitrified ceramic tiles (Polished unpolished)/ wooden flooring	Partition in glass with anodized Aluminium frame. Granite / vitrified ceramic tiles for wall cladding.	False ceiling in Gypsum Board as/profile. False Ceiling in Metal Panel Sheets or False ceiling Al. Lineal panels.
	b) Conference room, senior executive room	Vitrified Ceramic Tiles	Glazed partition with anodised Aluminium frame.	Mineral fibre board with aluminium frame works.
	c) Record room	Heavy duty dust pressed ceramic tiles	Acrylic distemper over plaster of paris	- do -
	d) Locker room	Heavy duty dust pressed Ceramic Tiles	Acrylic distemper over plaster of paris.	Acrylic distemper without plaster of paris Acrylic distemper without plaster of paris
7.	Toilet area	Heavy Duty Dust pressed ceramic tiles and 18mm thick. Polished granite in one piece for wash basin platform.	Designer ceramic wall tiles upto 2.1m / ceiling ht. and Acrylic distemper over plaster of Paris for balance height.	Acrylic distemper without plaster of paris/ Calcium Silicate false ceiling.

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
209 OF 245



08881

CLAUSE NO.

CIVIL WORKS



TABLE -B
INTERIOR FINISHING SCHEDULE

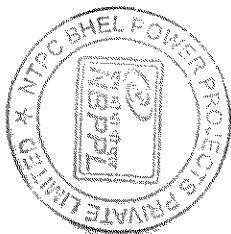
S.NO	DESCRIPTION OF AREA	FLOORING	WALLING	CEILING
8.	Canteen a) Sitting and General Area	18mm thick polished granite stone / Vitrified ceramic tiles.	Designer ceramic wall tiles upto 1.2 m, and Textured Paint for balance height. Glass mosaic tiles for murals & Glass blocks for interior purpose.	Acrylic Emulsion paint.
	b) Kitchen, Pantry and preparation area	Heavy duty dust pressed ceramic tiles and 18mm thick polished granite stone for platform.	Designer ceramic wall tiles dado upto 2.1 m. height and Acrylic distemper over plaster of paris for balance area height.	Acrylic distemper without plaster of paris
9.	Office Room, Staff Room/Library	Mirror polished vitrified ceramic tiles.	Acrylic emulsion paint over plaster of Paris.	Gypsum Board False Ceiling as/profile or Metal Panel False ceiling in approved pattern.
10.	SWAS Room	Mirror polished vitrified ceramic tiles.	Acrylic emulsion paint over plaster of Paris.	Metal panel false ceiling in approved pattern.
11.	Laboratory area	Heavy duty dust pressed ceramic tiles & Acid/alkali oil resistant epoxy resin floor finish	Designer ceramic wall tiles upto 1.2mt./ acid/alkali oil resistant finish 1.2m high dado& rest Acrylic distemper/chemical resistant paint.	Gypsum board false ceiling as/profile or chemical resistant paint.
12.	RCC Stair case	18mm thick polished Marble stone / granite stone	Marble stone / granite stone upto 1.2 m.ht. & Resin bonded granular texture finish for balance height.	Acrylic Distemper without plaster of Paris.

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
210 OF 245



08882

CLAUSE NO.

CIVIL WORKS



TABLE -B
INTERIOR FINISHING SCHEDULE

S.NO	DESCRIPTION OF AREA	FLOORING	WALLING	CEILING
13.	Entrance Lobbies and Lift areas.	18mm thick polished marble stone/ granite stone as/ pattern.	Resin bonded granular textured coating or 18mm thick polished marble/ granite cladding.	Metal panel false ceiling/ mineral fibre board false ceiling
14.	Passages and general circulation areas.	18mm thick polished Marble Stone/ granite stone.	Acrylic Distemper / acrylic emulsion paint over plaster of Paris.	- do- & Acrylic emulsion paint.
15.	Battery Room	Acid, alkali and oil resistant epoxy resin floor finish.	Acid, alkali and oil resistant epoxy resin upto 1.2m height and chemical resistant paint for balance height	Chemical Resistant paint.
16.	Oil canal, oil room, oil purification Tank and other areas where oil spillage is likely to occur.	Oil resistant paint(exoxy based) 150 micron over primer.	As above except oil canal Oil resistant Paint	As above except oil canal.
17.	Covered parking area	Pavers interlocking cement concrete blocks.	External finish	Acrylic Distemper without plaster of paris
18.	Pathways including roof area.	22mm thick concrete chequered tiles.	-	-

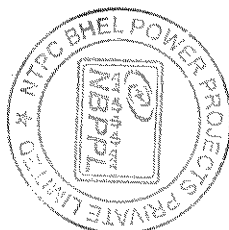
- Note :
1. All wall and roof areas above false ceiling shall be plastered and white washed.
 2. The colour and pattern of finish shall be as per approved details.
 3. All materials shall be of reputed and established brand approved by Engineer-in-charge.
 4. Wherever alternative materials are specified, 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.

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

PAGE
211 OF 245



0883

CLAUSE NO.

CIVIL WORKS

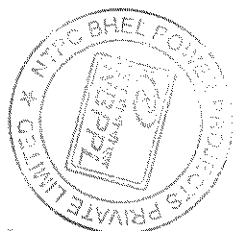


TABLE -C
EXTERIOR FINISHES SCHEDULE

Sl.No.	DESCRIPTION OF AREA	WALL AND PROJECTIONS	SOFFIT OF PROJECTIONS
1.	Main plant building	Granular textured finish of approved colour/colour combination & washed stone grit plaster over plastered surface on masonry/concrete. Approved colour/colour combination of colour coated metal cladding Stone work wall lining	Solvent based (100% pure acrylic co-polymer resin based) over plastered surface. Approved colour/colour combination of colour coated metal cladding. Granite stone (grey or Sadarhally grey)
2.	Building with concrete frame work, fire walls, etc.	Granular textured finish of approved colour. & washed stone grit plaster	Solvent based (100% pure acrylic co-polymer resin based) over plastered surface.
3.	Steel Structure, trestles, etc.	Paint of approved specification and shade.	

NOTE : 1. The colour and pattern of finish shall be as finalised by Engineer.

2. All materials shall be of reputed and established brand approved by Engineer.



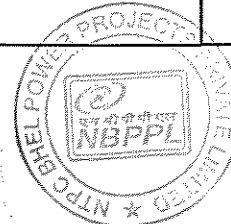
SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION - VI
PART-B

SUB-SECTION-D-01
CIVIL WORKS

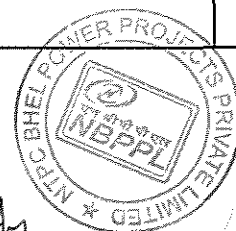
PAGE
212 OF 245

CLAUSE NO.	CIVIL WORKS	
23.00.00	MATERIALS	
23.01.00	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. However, Engineer may allow the use of other types of cement namely, ordinary portland cement & portland slag cement conforming to IS: 269 and IS: 455 respectively under special circumstances on specific request of the bidder and prior approval of the Engineer. Minimum grade of cement shall be Grade 33. Higher grade of portland ordinary cement namely Grade 43 and Grade 53 conforming to IS:8112 and IS:12269 respectively can also be used for specific application. However the ordinary portland cement shall necessarily be used for following structures. - TG foundation top deck and sub-structure excluding raft. - Spring supported decks of all machine foundations. - Structures requiring grade of concrete of M25 and above. In place of fly ash based portland pozzolana cement fly ash can be added in ordinary portland cement (Grade 43). Batching plant shall be deployed for producing the concrete. Fly ash shall conform to IS:3412. Percentage of fly ash to be mixed in concrete shall be based on trial mix.	
23.02.00	Aggregates	
	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. Fine aggregate Sand shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Sand, when used as fine aggregate in concrete shall conform to IS : 383. For plaster, it shall conform to IS : 1542 and for masonry work to IS : 2116.	
23.03.00	Reinforcement Steel	
	Reinforcement steel shall be of high strength deformed TMT steel bars of grade Fe-500 and shall conform to IS:1786.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B
		SUB-SECTION-D-01 CIVIL WORKS
		PAGE 213 OF 245



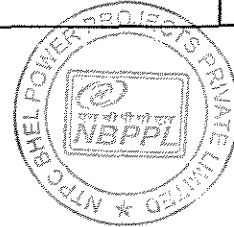
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC
23.04.00	Mild steel & medium tensile steel bars and hard drawn steel wire shall conform to grade-1 of IS:432 (Part-1) or grade A of IS:2062. Welded wire fabric shall conform to IS:1566. Structural Steel Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects.	
23.04.01	Mild Steel a) Rolled sections and plates up to and including 20mm thickness shall conform to grade designation E250A semi killed of IS: 2062. Plates beyond 20mm thickness and up to 40mm thickness shall conform to grade designation E250B killed and controlled rolling conforming to IS:2062. Plates beyond 40mm thickness, shall conform to grade designation E250B killed, normalizing rolling as per IS:2062. Plates beyond 40mm shall be ultrasonically tested as per ASTM-A578 level B. 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. 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.	
23.04.02	Medium and High Tensile Steel Rolled sections and plates up to and including 20mm thickness shall conform to grade designation E350 semi killed of IS: 2062. Plates beyond 20mm thickness and up to 40mm thickness shall conform to grade designation E350 killed and controlled rolling conforming to IS:2062. Plates beyond 40mm thickness, shall conform to grade designation E350 killed, normalizing rolling as per IS:2062. Plates beyond 40mm shall be ultrasonically tested as per ASTM-A578 level B.	
23.05.00	Bricks Fly ash lime bricks conforming to IS:12894 and fly ash clay bricks conforming to IS:13757 shall be used. The crushing strength of bricks shall be minimum 75 kg./sq cm. Minimum percentage of fly ash shall be 25%.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B
		SUB-SECTION-D-01 CIVIL WORKS
		PAGE 214 OF 245



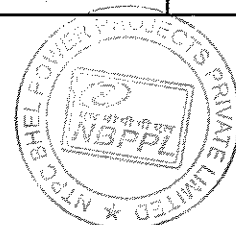
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC
23.06.00	Water Water used for cement concrete, mortar, plaster, grout, curing, washing of coarse aggregate, soaking of bricks, etc. shall be clean and free from oil, acids, alkalis, organic matters or other harmful 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.	
23.07.00	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 Tariff 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.	
24.00.00	INSPECTION, TESTING AND QUALITY CONTROL	
24.01.00	Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding), piling, 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	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 215 OF 245



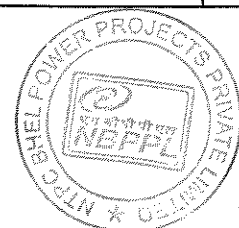
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CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC	
	specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced 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.			
24.02.00	Workmanship and dimensional shall be checked as stipulated below.			
25.00.00	PERMISSIBLE TOLERANCES			
	The dimensions of concrete as cast when compared with those on the drawings shall be within the tolerances given below in mm.			
25.01.00	Cast-in-situ concrete works			
	Description of Item/ Structural element	Permissible Deviation in mm (Max)		
	Faces of concrete in foundations and structural members against which backfill is placed	+ 25	- 10	
	Location of footing (for RCC framed structures only)	+ 25	- 25	
	Eccentricity of footing	2% of footing width in direction of misplacement but limiting to 50mm.		
	Top surfaces of slabs and of concrete to receive base plates to be grouted.	+ 5	- 5	
	Alignment of beams, lintels, columns, walls, slabs, and similar structural elements.	+ 5	- 5	
	Cross sectional dimensions of walls, slabs and similar structural elements	+ 5	- 5	
	Deviation from specified dimensions of cross-section of columns and beams.	+ 12	- 6	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B		SUB-SECTION-D-01 CIVIL WORKS
				PAGE 216 OF 245

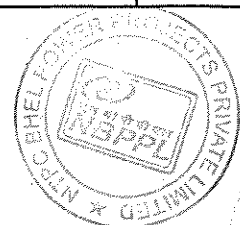


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CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC
25.02.00	Alignment of holding down bolts without sleeves	+ 1.5	- 1.5
	Alignment of holding down bolts with sleeves	+ 5	- 5
	Level of holding down bolt assemblies.	+ 10	- 10
	Embedded parts (in any direction).	+ 5	- 5
	Centres of pockets or holes with greatest lateral dimension not exceeding 150mm	+ 10	- 10
	Variation in steps:		
	Riser	+ 1.5	-1.5
	Tread	+ 3.0	-3.0
	Plumb	3 mm for every metre subject to a maximum of 10 mm.	
	Form work		
	Levels and heights	± 6 mm	
	Plumb	3mm for every metre subject to a maximum of 10 mm.	
	Unevenness of any surfaces	± 3 mm	
	Length or breadth	± 12 mm	
Diagonals	± 15 mm		
25.03.00	In case of inclined surfaces like folded plates etc, the deviation in the alignment of inclined surfaces, shall not exceed 3 mm with reference to the theoretical alignment, for a length of 1000 mm measured vertically, subject to a maximum of 10 mm.		
	Masonry		
All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpends properly aligned.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 217 OF 245

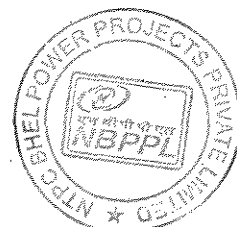


CLAUSE NO:	CIVIL WORKS			
	a) Deviation in verticality in total height of any wall of a building more than one storey in height shall not exceed +/-12.5mm. b) Deviation from vertical within a storey shall not exceed +/- 6mm per 3m height. c) Deviation from the position shown on the plan of any brickwork more than one storey in height shall not exceed 12.5mm. d) Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment shall not exceed 6mm. e) Deviation of bed joint from horizontal in any length upto 12m shall not exceed 6mm, and in any length over 12m it shall not exceed 12.5mm total. f) Deviation from the specified thickness of bed-joints, cross joints or perpends shall not exceed +/-3 mm.			
25.04.00	Plastering work The finished plastered surface shall not show any deviation more than 4 mm when checked with a straight edge of 2 metre length placed against the surface. The thickness of the plaster shall be measured exclusive of the thickness of key i.e. grooves or open joints in brickwork. The average thickness of plaster shall not be less than the specified thickness. The minimum thickness over any portion of the surface shall not be less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster. Extra thickness required in dubbing behind rounding of the corner at junctions of wall or in plastering of masonry cornices etc. shall be ignored.			
25.05.00	Pre-cast concrete work a) Length: +/-0.1 percent subject to minimum of - 5 mm and maximum of + 10 mm. b) Cross-sectional dimensions: +/- 3 mm or +/-0.1 per cent whichever is greater. c) Straightness of Bow : 1/750 of the length subject to minimum of -5mm and maximum of + 10mm. d) Squareness: When considering the squareness of the corner, the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5mm.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 218 OF 245



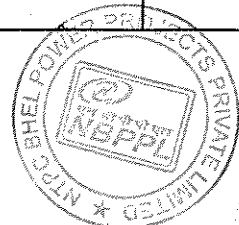
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CLAUSE NO.	CIVIL WORKS		
25.06.00	e) Flatness: The maximum deviation from a 1.5m straight edge placed in any position on a nominal plane surface shall not exceed 5mm.		
	Reinforcement work		
	Description of Item/ Structural element	Permissible Deviation in mm (Max.)	
	Placing of reinforcement		
	For effective depth 200 mm or less	+ 10	- 5
	For effective depth more than 200 mm	+ 15	- 10
	Cover to reinforcement	-	- 5
	Cutting of reinforcement		
	When minimum length specified	+ 75	-
	When maximum length specified	+75	-50
25.07.00	When maximum or minimum length not specified	+ 75	-25
	Tolerance in erected C.W. liners/pipes		
	At setting out points	25 mm in position & level	
	Between setting out point	50 mm in position & level	
	Flanges for condenser	6 mm in position & level connections and the plane of the flanges shall be within 3 mm of the required plane measured across any diameter.	
25.08.00	Other terminal points	6 mm in position & level & the plane of the flange shall be within 0.3% of the dia. or 1mm whichever is greater, of the required plane measured across any diameter.	
	Structural steel work		
25.08.01	Tolerances on dimensions for fabrication of steel structures shall be according to IS:7215.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 219 OF 245



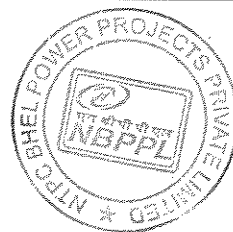
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CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC		
25.08.02	Tolerances on dimensions for erection of steel structures shall be according to IS:12843.			
25.08.03	Tests on welds shall be as per ASTM standards/IS 816 and IS 9595.			
25.08.04	Dimensional and weight tolerance of rolled steel shapes shall be as per IS 1852.			
25.09.00	Maximum deviation of finished pile from vertical 1 in 75 and other tolerance shall be as per IS: 2911, (Part 1).			
26.00.00	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 given in Annexure-II of this specification.			
27.00.00	CONSTRUCTION METHODOLOGY Construction and erection activities shall be fully mechanised 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			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 220 OF 245



08893

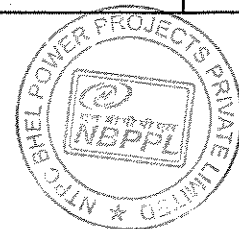
CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	be permitted. Special enclosures, for blast cleaning of steel structure surface preparation, shall be used. All handling of materials shall be with cranes. Heavy trailers shall be used for transportation. Mechanized modular units of scaffolding and shuttering shall 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 221 OF 245



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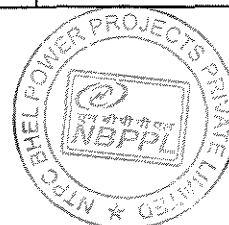
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CLAUSE NO.	CIVIL WORKS 		
	<u>ANNEXURE-II</u> <u>LIST OF CODES AND STANDARDS</u> Excavation and Filling IS :2720 Methods of test for soils(relevant parts) IS:4701 Code of practice for earth work on canals. IS:9759 Guide lines for dewatering during 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 (Part 1&2) Specification for mild steel and medium tensile steel bars and 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 buidling bricks. IS:1161 Steel tubes for structural purposes. IS:1239 Mild steel tubes, tubulars and other wrought steel filling - MS tubes. IS:1363 (Part 1-3) Hexagon head bolts, screws and nuts of productions grade - C. IS:1364 (Part 1-5) Hexagon head bolts, screws and nuts of productions grade-A & B. IS:1367 (Part 1-18) Technical supply condition for threaded fasteners.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 222 OF 245



08895

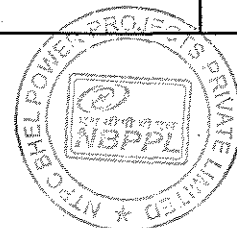
CLAUSE NO.	CIVIL WORKS 		
	IS:1489 (Part-I)	Portland-pozzolana cement. Fly ash based	
	IS:1542	Sand for Plaster.	
	IS:1566	Hard drawn steel wire fabric for concrete reinforcement.	
	IS:1786	High strength deformed steel bars & wires for concrete reinforcement.	
	IS:2062	Steel for general structural purposes.	
	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:3819	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	Method of test for strength of concrete.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 223 OF 245



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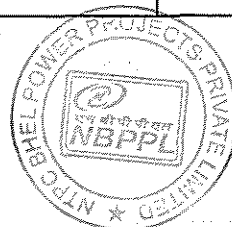
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CLAUSE NO.	CIVIL WORKS			एनटीपीसी NTPC
	IS:1199 IS:1791 IS:1834 IS:1838 IS:2438 IS:2502 IS:2505 IS:2506 IS:2722 IS:2750 IS:2751 IS:3150 IS:3366 IS:3370 (Part 1-4) IS:3558 IS:4014 (Part-1&2) IS:4326 IS:4656 IS:4925	Methods of sampling and analysis of concrete. General requirement for batch type concrete mixers. Hot applied sealing compound for joints in concrete. Preformed fillers for expansion joints in concrete pavement and structures. Specification for roller pan mixers. Code of practice for bending and fixing of bars for concrete reinforcement. Concrete vibrators - immersion type. General requirements for screed board concrete vibrators. Specification for Portable Swing weigh batchers for concrete (single and double bucket type). Steel scaffoldings Recommended practice for welding of mild steel plain and deformed bars for reinforced construction. Hexagonal wire netting for general purposes. Specification for pan vibrators. Code of practice for concrete structures for the storage of liquids. Code of practice for use of immersion vibrators for consolidating concrete. Code of practice for steel tubular scaffolding. Code of practice for earth quake resistant design and construction of buildings. Form vibrators for concrete. Concrete batching and mixing plant.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 224 OF 245



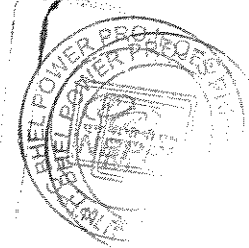
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CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC	
	IS:4990 IS:5256 IS:5525 IS:6461 IS:6494 IS:6509 IS:7861 (Part -1&2) IS:9012 IS:9103 IS:9417 IS:10262 IS:11384 IS:12118 IS:12200 IS:13311 (Part 1) (Part 2) SP-16 SP-23	Plywood for concrete shuttering work. Code of practice for sealing expansion joints in concrete lining on canals. Recommendations for detailing of reinforcement in reinforced concrete works. Glossary of terms relating to cement concrete. Code of practice for water proofing of underground reservoir and swimming pools. Code of practice for installation of joints in concrete pavements. Code of practice for extreme weather concreting. Recommended practice for shotcreting. Admixtures for concrete. Recommendations for welding cold worked bars for reinforced concrete construction. Recommended guidelines for concrete mix design. Code of practice for composite construction in structural steel and concrete. Two parts polysulphide based sealants. Code of practice for provision of water stops at transverse construction joints in masonry and concrete dams. Non destructive testing of concrete - methods of test. Ultrasonic pulse velocity. Rebound hammer. Design codes for reinforced concrete to IS:456-1978. Hand book of concrete mixes.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 225 OF 245



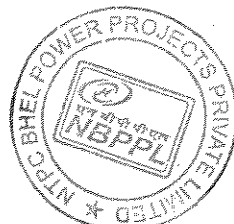
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CLAUSE NO.	CIVIL WORKS			एनटीपीसी NTPC
	SP-24 Explanatory handbook on Indian standards code for plain and reinforced concrete. (IS : 456) SP-34 Hand book on concrete reinforcement and detailing. ACI-318 American Concrete Institute code for structural concrete. Precast Concrete Works SP:7 National Building Code - Structural (Part 6/Sec.7) Design of prefabrication and system building. IS:10297 Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units. IS:10505 Code of practice for construction of floors and roofs using pre-cast reinforced concrete waffle units. Masonry & Allied Works IS:1905 Code of practice for structural use of unreinforced masonry. 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.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 226 OF 245



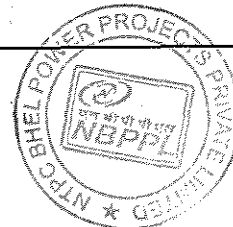
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CLAUSE NO.	CIVIL WORKS एनडीपीसी NTPC		
	IS:7178 Technical supply condition for tapping screw. IS:8183 Bonded mineral wool. IS:8869 Washers for corrugated sheet roofing. IS:12093 Code of practice for laying and fixing of sloped roof covering using plain 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		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 227 OF 245



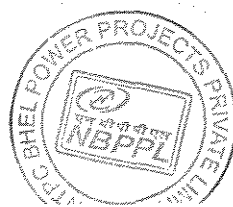
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	IS:1852 IS:2016 IS:2595 IS:2629 IS:3502 IS:3613 IS:3658 IS:3664 IS:3757 IS:4000 IS:4353 IS:4759 IS:5334 IS:5369 IS : 6623 IS:6649 IS:6911 IS:7205 IS:7215 IS:7307 (Part - I)	Rolling and Cutting Tolerances for Hot rolled steel products. Specification for Plain washers. Code of practice for Radiographic testing Hot dip galvanising of iron and steel Steel chequered plate. Acceptance tests for wire flux combination for submerged arc welding. Code of practice for liquid penetrant flaw detection. Code of practice for ultra sonic pulse echo testing contact and immersion method High strength structural bolts. High strength bolts in steel structure - code of practice. Sub merged arc welding of mild steel and low alloy steel Recommendation Hot dip zinc coating on structural steel and other allied products. Code of practice for magnetic particle flaw detection of welds. General requirements for plain washers and lock washer High strength structural nuts. Hardened and tampered washers for high strength structural bolts & nuts. Stainless steel plate, sheet and strip. Safety code for erection of structural steel. Tolerances for fabrication of structural steel. Approved test for welding procedures Fusion welding of steel.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 228 OF 245



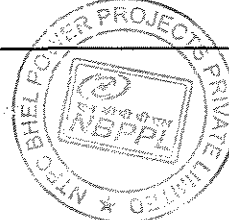
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	IS:7310 Approval test for welders working to approval welding procedure. (Part-I) Fusion welding of steel IS:9178 Criteria for design of steel bins for storage of bulk material. (Part-1 to 3) IS:9595 Recommendations for metal arc welding of carbon & carbon manganese steel. IS:12843 Tolerances for erection of steel structures. SP:6 ISI Hand book for structural Engineers. (Part 1 to 7) 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 Gypsum building plaster. (Parts 1&2) 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 Method of Test for chemical resistant tiles. (Part I & II) IS:4457 Ceramic unglazed vitreous acid resisting tiles. IS:4832 Specification for chemical resistant mortars. (Part - 1) Silicate type		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 229 OF 245



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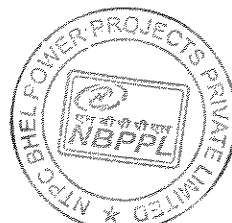
CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	(Part - 2) Resin type (Part - 3) Sulfur type IS:4860 Acid resistant bricks. IS:9510 Bitumastic acid resisting grade. Water Supply, Drainage and Sanitation IS:458 Precast concrete pipes (with & without reinforcement). IS:554 Dimensions for pipe threads, where pressure tight joints are required on the thread. 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 Mild Steel tubes, tubulars and other wrought steel fittings (Part 1&2) 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 230 OF 245



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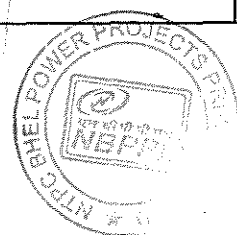
CLAUSE NO.	CIVIL WORKS			
	IS:1726	Cast iron manhole covers and frames.		
	IS:1729	Sand cast iron spigot and socket soil, water and ventilation pipes, fittings and accessories.		
	IS:1742	Code of practice for building drainage.		
	IS:2064	Selection, installation and maintenance of sanitary appliances.		
	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	Seamless or electric welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm 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:4764	Tolerance limits for sewage effluents discharged into inland surface waters.		
	IS:4827	Electroplated coating of nickel and chromium on copper and copper alloys.		
	IS:5329	Code of practice for sanitary pipe work above ground for buildings.		
	IS:5382	Rubber sealing rings for gas mains, water mains and sewers.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 231 OF 245



104

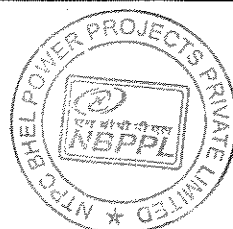
08904

CLAUSE NO.	CIVIL WORKS 		
		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:420 Putty, for use on metal frames.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 232 OF 245



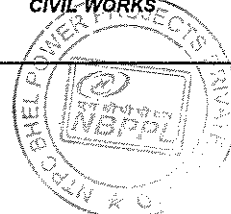
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CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	IS:451 IS:733 IS:1003 (Part I) IS:1003 (Part-1) IS:1038 IS:1081 IS:1285 IS:1341 IS:1361 IS:1823 IS:1868 IS:2202 (Part-2) IS:2209 IS:2553 (Part-1) IS:2835 IS:3548 IS:3564	Technical supply conditions for wood screws Wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes. Timber panelled and glazed shutters (doors shutters). Timber panelled and glazed shutters door shutters. Steel doors, windows and ventilators. Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators. Wrought aluminium and aluminium alloy extruded round tube & hollow section (for general engineering purposes). Steel butt hinges. Steel windows for Industrial buildings. Floor door stoppers. Anodic coatings on Aluminium and its alloys. Wooden flush door shutters (solid core type) particle board face panels and hard board face panels. Mortice locks (vertical type) Safety glass. General purposes Flat transparent sheet glass. Code of practice for glazing in buildings. Door closers (Hydraulically regulated)	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 233 OF 245



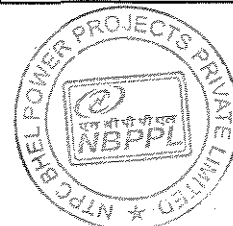
08906

CLAUSE NO.	CIVIL WORKS		एनटीपीसी NTPC
	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.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 234 OF 245



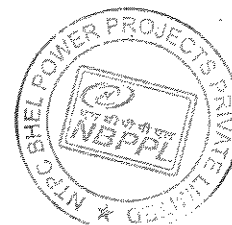
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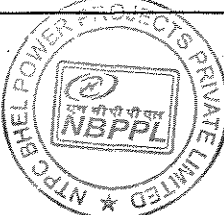
CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	IS:8042 White portland cement. IS:13755 Dust pressed ceramic tiles with water absorption of 3%, E 6% (Group B11a). IS:13801 Chequered cement concrete tiles. Painting and Allied Works IS:162 Ready mixed paint, brushing fire resisting, silicate type for use on wood, colour as required. IS:428 Distemper, oil, emulsion, colour as required. IS:1477 Code of practice for painting of ferrous metals in buildings. (Part -1) Pretreatment. (Part -2) 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 practice 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 235 OF 245



08908

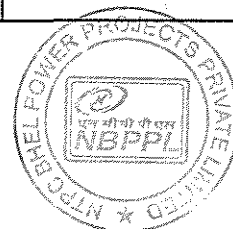
CLAUSE NO.	CIVIL WORKS			एनटीपीसी NTPC
	IS:2933	Enamel exterior, (a) under coating, (b) finishing.		
	IS:4759	Hot dip zinc coatings on structural steel and other allied products.		
	IS:5410	Specification for cement paint.		
	IS:5411 (Part-1&2)	Plastic emulsion paint.		
	IS:6278	Code of practice for white 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 236 OF 245



CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC
	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. VIN:2056 Criteria for assessing mechanical vibrations of machines. VDI:2060 Criteria for assessing the st of balance of rotating rigid bodies. DIN:2089 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 Standard specifications and Code of practice for road bridges, (Section-1) 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 Standard specifications and Code of practice for road bridges. (Section-III) Cement concrete (plain and reinforced).	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS
PAGE 237 OF 245		

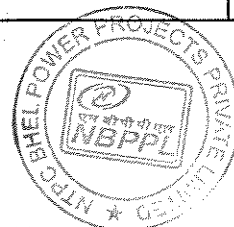
208910

CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 238 OF 245



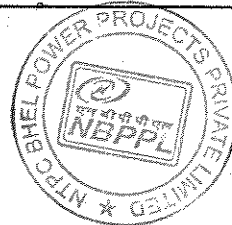
08911

CLAUSE NO.	CIVIL WORKS एनटीपीसी NTPC		
	IS:3696 Safety code for scaffolds and ladders. (Part-1&2) IS:3764 Excavation work - code of safety. IS:4081 Safety code for blasting and related drilling operations. IS:4130 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 (As updated) Act 1940) Architectural Design of Buildings SP:7 National Building Code of India SP:41 Hand book on functional requirements of buildings (other than industrial buildings) Miscellaneous IS:802 Code of practice for use of structural steel in overhead trans- (Relevant parts) mission 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. CIRIA Design and construction of buried thin-wall pipes. Publication		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS PAGE 239 OF 245

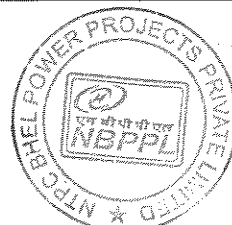


08912

CLAUSE NO.	CIVIL WORKS 																		
	Annexure-EQ 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):2002 and IS:1893 (Part 4):2005. Pending finalisation of Parts 2, 3 and 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for structures other than the buildings and industrial structures including stack-like structures. 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 and Part 4). Damping in Structures The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for: <table border="0" style="width: 100%;"> <tr> <td style="width: 5%;">a)</td><td style="width: 65%;">Steel structures</td><td style="width: 10%;">:</td><td style="width: 20%;">2%</td></tr> <tr> <td>b)</td><td>Reinforced Concrete structures</td><td>:</td><td>5%</td></tr> <tr> <td>c)</td><td>Reinforced Concrete Stacks</td><td>:</td><td>3%</td></tr> <tr> <td>d)</td><td>Steel stacks</td><td>:</td><td>2%</td></tr> </table>			a)	Steel structures	:	2%	b)	Reinforced Concrete structures	:	5%	c)	Reinforced Concrete Stacks	:	3%	d)	Steel stacks	:	2%
a)	Steel structures	:	2%																
b)	Reinforced Concrete structures	:	5%																
c)	Reinforced Concrete Stacks	:	3%																
d)	Steel stacks	:	2%																
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 240 OF 245																

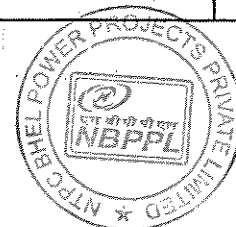


CLAUSE NO.	CIVIL WORKS	एनटीपीसी NTPC	
	Method of Analysis Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1). In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1). For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B / V_B$. However, no reduction is permitted if $\bar{V}_B$ is less than V_B. For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I. Further, the spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the building falls to the left of the peak in the spectral acceleration curve. 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.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 241 OF 245



08914

CLAUSE NO.	CIVIL WORKS 
	APPENDIX - I <u>SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT</u> The various site specific seismic parameters for the project site shall be as follows: 1) Peak ground horizontal acceleration (MCE) : 0.18 g 2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra a) for ordinary moment resisting steel frames designed and detailed as per IS:800 : 0.053 b) for braced steel frames designed and detailed as per IS:800 : 0.039 c) For special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.032 d) for steel chimney : 0.079 e) for design of structures not covered under 2 (a) to 2 (d) above and under 3 below : 0.053 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 : 0.105 Note: g = Acceleration due to gravity The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B SUB-SECTION-D-01 CIVIL WORKS PAGE 242 OF 245



208915

CLAUSE NO.

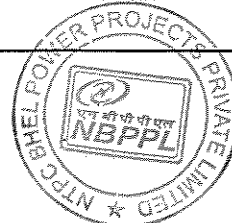
CIVIL WORKS

एनटीपीसी
NTPC

APPENDIX - I

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

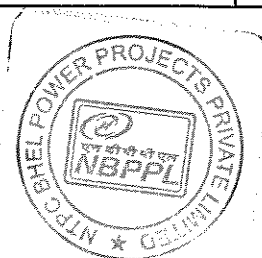
Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.040	1.368	1.289	1.226
0.050	1.743	1.570	1.435
0.060	2.126	1.844	1.632
0.070	2.514	2.113	1.820
0.080	2.907	2.378	2.001
0.090	3.305	2.638	2.174
0.100	3.706	2.895	2.342
0.110	4.111	3.150	2.506
0.108	4.030	3.099	2.473
0.110	4.111	3.150	2.506
0.115	4.315	3.276	2.586
0.120	4.520	3.401	2.665
0.125	4.520	3.526	2.743
0.130	4.520	3.650	2.820
0.135	4.520	3.650	2.820
0.140	4.520	3.650	2.820
0.145	4.520	3.650	2.820
0.150	4.520	3.650	2.820
0.200	4.520	3.650	2.820
0.250	4.520	3.650	2.820
0.300	4.520	3.650	2.820
0.350	4.520	3.650	2.820
0.370	4.397	3.650	2.820
0.410	3.968	3.383	2.820
0.430	3.784	3.226	2.753
0.450	3.616	3.082	2.631
0.520	3.129	2.667	2.277
0.555	2.932	2.499	2.133
0.560	2.905	2.477	2.114
0.565	2.880	2.455	2.096

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGETECHNICAL SPECIFICATION
SECTION - VI
PART-BSUB-SECTION-D-01
CIVIL WORKSPAGE
243 OF 245

208916

CLAUSE NO.	CIVIL WORKS			एनटीपीसी NTPC
APPENDIX – I				
<u>HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS</u> <u>(In units of 'g')</u>				
Time Period (Sec)	Damping Factor (as a percentage of critical damping)			
	2%	3%	5%	
0.570	2.854	2.433	2.077	
0.575	2.830	2.412	2.059	
0.580	2.805	2.391	2.041	
0.585	2.781	2.371	2.024	
0.590	2.758	2.351	2.007	
0.595	2.734	2.331	1.990	
0.600	2.712	2.312	1.973	
0.650	2.503	2.134	1.822	
0.700	2.324	1.981	1.691	
0.750	2.169	1.849	1.579	
0.800	2.034	1.734	1.480	
0.850	1.914	1.632	1.393	
0.900	1.808	1.541	1.316	
0.950	1.713	1.460	1.246	
1.000	1.627	1.387	1.184	
1.050	1.550	1.321	1.128	
1.100	1.479	1.261	1.076	
1.150	1.415	1.206	1.030	
1.200	1.356	1.156	0.987	
1.250	1.302	1.110	0.947	
1.300	1.252	1.067	0.911	
1.350	1.205	1.027	0.877	
1.400	1.162	0.991	0.846	
1.450	1.122	0.957	0.817	
1.500	1.085	0.925	0.789	
1.550	1.050	0.895	0.764	
1.600	1.017	0.867	0.740	
1.650	0.986	0.841	0.718	
1.700	0.957	0.816	0.696	
1.750	0.930	0.793	0.677	
1.800	0.904	0.771	0.658	
1.850	0.879	0.750	0.640	
1.900	0.856	0.730	0.623	
1.950	0.834	0.711	0.607	
2.000	0.814	0.694	0.592	

SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-D-01 CIVIL WORKS	PAGE 244 OF 245



08917

CLAUSE NO.	CIVIL WORKS			एन टी पी सी NTPC
	APPENDIX – I			
	<u>HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS</u> <u>(In units of 'g')</u>			
	Time Period (Sec)	Damping Factor (as a percentage of critical damping) 2%3%5%		
	2.050	0.794	0.677	0.578
	2.100	0.775	0.660	0.564
	2.150	0.757	0.645	0.551
	2.200	0.740	0.630	0.538
	2.250	0.723	0.616	0.526
	2.300	0.707	0.603	0.515
	2.350	0.692	0.590	0.504
	2.400	0.678	0.578	0.493
	2.450	0.664	0.566	0.483
	2.500	0.651	0.555	0.474
	2.550	0.638	0.544	0.464
	2.600	0.626	0.533	0.455
	2.650	0.614	0.523	0.447
	2.700	0.603	0.514	0.439
	2.750	0.592	0.504	0.431
	2.800	0.581	0.495	0.423
	2.850	0.571	0.487	0.415
	2.900	0.561	0.478	0.408
	2.950	0.552	0.470	0.401
	3.000	0.542	0.462	0.395
	3.050	0.533	0.455	0.388
	3.100	0.525	0.447	0.382
	3.150	0.517	0.440	0.376
	3.200	0.508	0.433	0.370
	3.250	0.501	0.427	0.364
	3.300	0.493	0.420	0.359
	3.350	0.486	0.414	0.353
	3.400	0.479	0.408	0.348
	3.450	0.465	0.402	0.343
	3.500	0.452	0.396	0.338
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B			नीरज मिश्रा/NEERAJ MITTAL अपर महाप्रबन्धक (संविदा सेवाएं) Addl. General Manager (Contract Services) एन टी पी सी CIVIL WORKS A-8A, Sector 27, Faridkot NEERAJ MITTAL NTPC LIMITED A-201301 (UP) PAGE 245 OF 245

09323

QUALITY ASSURANCE

CIVIL

E-117 TO E-118

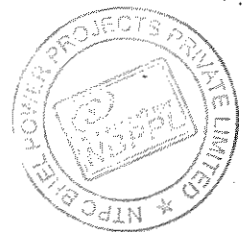
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09324

SUB-SECTION – E-117

CIVIL WORKS



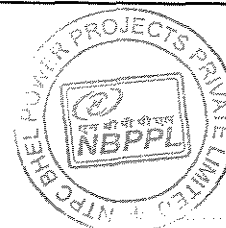
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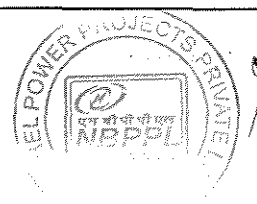
CLAUSE NO.	QUALITY ASSURANCE	
	<u>QUALITY ASSURANCE AND INSPECTION FOR CIVIL WORKS</u> 1.0.0 INTRODUCTION 1.1.0 This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification. 1.2.0 This part of the technical specification shall be read in conjunction with other parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions. 1.3.0 The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part of the technical specifications. The QA and QC activities in all respects as specified in the technical specifications/ drawings / data sheets / quality plans / contract documents shall be carried out at no extra cost to the owner. 1.4.0 The contractor shall prepare detailed construction and erection methodology scheme which shall be compatible to the requirements of the desired progress of work execution, quality measures, prior approvals if any and the same shall be got approved by the Engineer. If required, work methodology may be revised/ reviewed at every stage of execution of work at site, to suit the site conditions by the contractor at no extra cost to the owner. 2.0.0 QUALITY ASSURANCE PROGRAMME 2.1.0 The contractor shall adopt suitable Quality Assurance Programme (QAP) to ensure that the equipments and services under the scope of contract whether manufactured or performed within contractor's works or at his sub-contractor's premises or at the NTPC's site or at any other place of work are in accordance with the specifications. Such QAP shall be outlined by the contractor and shall be finally accepted by the NTPC or their authorized representative after discussions before the start of work. The QAP shall be generally in line with IS/ISO Systems. The contractor shall furnish complete QA & QC programme for the work envisaged which may include the following ① Organization structure for the management and implementation of the proposed quality assurance programme ① Quality System Manual ① Design Control System	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL
		PAGE 1 OF 32



09326

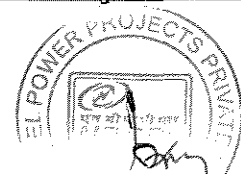
CLAUSE NO.	QUALITY ASSURANCE
	 ① Documentation and Data Control System ① Qualification data / details for Contractor's key personnel ① The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased, etc. ① System for shop manufacturing and site erection controls including process, fabrication and assembly ① Control of non-conforming items and system for corrective actions and resolution of deviations ① Inspection and test procedure both for manufacture and field activities ① Control of calibration and testing of measuring testing equipment ① System for Quality Audits ① System for identification and appraisal of inspection status ① System for authorizing release of manufactured product to the NTPC ① System for handling, storage and delivery ① System for maintenance of records ① Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of work/ equipment/component.
3.0.0	QA AND QC MANPOWER
3.1.0	The contractor shall nominate one overall QA coordinator for the contract detailing the name, designation, contact details and address at the time of post bid discussions. All correspondence related to Quality Assurance shall be addressed by the contractor's QA coordinator to NTPC. NTPC shall address all correspondence related to Quality issues to the contractor's QA coordinator. The contractor's QA coordinator shall be responsible for co-ordination of Quality activities between various divisions of the contractor and their sub-vendors on one hand & with NTPC on the other hand.
3.2.0	The contractor shall appoint a dedicated, experienced and competent QA&QC in-charge at site, preferably directly reporting to the Project Manager, supported as necessary by experienced personnel, to ensure the effective implementation of the approved QAP. An indicative structure of contractor's QA&QC manpower required to
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL PAGE 2 OF 32



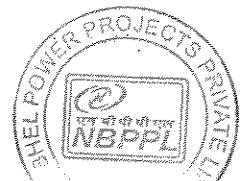
CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC	
	be deployed at site is enclosed at Annexure-I. Based on the finalized L-2 network and the approved Field Quality plan, the contractor shall finalize and submit a deployment schedule of QA&QC personnel along with their details to NTPC for approval/ acceptance and further shall ensure their availability well before the start of the concern activity.		
3.3.0	The QA&QC in-charge shall have the organizational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints. The QA&QC setup of the contractor shall consist of qualified and experienced Civil, Electrical, Mechanical Engineers and Laboratory assistants with their supporting staff both at their works and site.		
3.4.0	The deployment of man power for QA & QC set up shall be affected on the basis of agreed manpower deployment schedule, which shall be prepared by the contractor based on the L-2 network and the same shall be submitted to the engineer-in-charge for acceptance.		
4.0.0	SAMPLING AND TESTING OF CONSTRUCTION MATERIALS		
4.1.0	The method of sampling for testing of construction materials and work / job samples shall be as per the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans. All samples shall be jointly drawn, signed and sealed wherever required, by the contractor and the engineer or his authorized representative.		
4.2.0	The contractor shall carry out testing in accordance with the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer. All testing shall be done in the presence of the engineer or his authorized representative.		
4.3.0	Before execution of any civil work the contractor shall conduct full-scale suitability tests on various construction and building material such as fine and coarse aggregates, cement, reinforcement, construction chemicals, supplementary cementitious materials and construction water to ascertain their suitability for use and the concrete mix designs conducted from reputed institutes such as NCB-Ballabgarh, CSMRS-Delhi, IIT's, etc. as agreed by the engineer. The test samples for such full scale testing shall be jointly sampled and sealed by the engineer and contractor, thereafter these shall be sent to the concerned laboratory through the covering letter signed by field quality assurance (FQA) representative of the engineer.		
4.4.0	The contractor shall timely initiate the action with regard to the evaluation of aggregates and other building material including concrete mix design, so as to ensure completion of these tests before start of civil works at site, thereby not affecting any project work. The test reports and recommendations for suitability of the materials including concrete mix design shall be promptly submitted by the contractor to the engineer.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL
PAGE 3 OF 32			

09328

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC	
4.5.0	Evaluation of aggregate for potential alkali-aggregate reactivity shall be carried out as per following scope of work A. Evaluation of Aggregates for Mechanical / Physical Properties a) To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386. b) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material, soundness, silt content, clay content and organic impurities as per IS: 2386. c) To prepare evaluation report based on test results of a) and b) above and to advise regarding suitability of fine and coarse aggregates. B. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity: a) To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test). b) If rock type is limestone, alkali carbonate reactivity test shall also be carried out wherein the parameters shall be reported in conjunction with the petrographic analysis. Additionally, X-Ray diffraction test (XRD) shall be carried out to determine critical clay mineral in the rock for preliminary conclusions. For limestone aggregates to be used in dynamic foundations like TG, BFP, Fans, mills and crushers, repeated temperature cycle test shall also be carried out, to determine residual expansion of aggregate for concrete.		
5.0.0	c) To prepare a report based on test results of a) and b) above and to advise regarding suitability of aggregates to be used and further testing required if any. LABORATORY AND FIELD TESTING		
5.1.0	The field laboratory for QA and QC activities shall be constructed and set-up by the contractor in line with the indicative field QA&QC laboratory set-up enclosed at Annexure-II. The Laboratory building shall be constructed and installed with the adequate facilities to meet the requirement of envisaged test setup. Temperature and humidity controls shall be available wherever necessary during testing of samples. The quality plan shall identify the testing equipments/ instrument, which the contractor shall deploy and equip the field quality laboratory for meeting the field quality plan requirements. The contractor shall furnish a comprehensive list of testing		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 4 OF 32

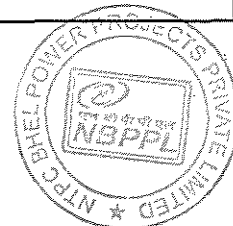


CLAUSE NO.	QUALITY ASSURANCE					
	equipments/ instrument required to meet the planned/scheduled tests for the execution of works for NTPC acceptance/ approval. The contractor shall mobilize the requisite laboratory equipment and QA&QC manpower at least 15 days prior to the planned test activity as per the schedule of tests.					
5.2.0	All equipments and instruments in the field shall be calibrated before the commencement of tests and then at regular intervals, as per the manufacturer's recommendation and as directed by the NTPC. The calibration certificates shall specify the fitness of the equipments and instruments within the limit of tolerance for use. Contractor shall arrange for calibration of equipments and instruments by an NABL / NPL accredited agency and the calibration report shall be submitted to NTPC.					
5.3.0	The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute. This includes all IITs, NCB, CSMRS, reputed government / autonomous laboratories / organizations, NITs and other reputed testing laboratories. The test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by NTPC engineer. The test report along with the recommendations shall be obtained from the laboratories without delay and submitted to NTPC.					
5.4.0	Based on the schedule of work agreed with the engineer-in-charge and the approved FQP, the contractor shall prepare a schedule of tests and submit them to the engineer-in-charge and organize to carry out the tests as scheduled / agreed.					
6.0.0	PURCHASE AND SERVICE					
6.1.0	The major items/ equipments/ components to be manufactured in the shop of the contractor i.e. in-house items and those procured from sub-vendors / sub-manufacturer / sub-contractors i.e. bought out items (BOIs) shall be listed out by the contractor in their bid proposal.					
6.2.0	An indicative list of major bought out items (not exhaustive) and services for civil works is enclosed at Annexure- III, for which the contractor shall submit the requisite details / lists of manufacturer's in their bid proposal. The list of manufacturers/ sub-vendors for all the BOIs envisaged in contract including shall be included in the bid proposal by the contractor which shall be discussed / reviewed by the NTPC during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOIs shall be agreed/ approved. If any item is left out or gets included during detailed engineering, the contractor shall propose the manufacturer's / sub-vendor's details for review / approval of NTPC, prior to initiating the procurement of such materials.					
6.3.0	Where the manufacturers are placed in details required ("DR") category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the NTPC for approval in the prescribed NTPC format no. QA-01-QAI-P-04/F1-R0 (main supplier's evaluation report) and format no. QA-01-QAI-P-04/F2-R0 (sub supplier questionnaire) within the period agreed at the time of post bid discussions.					
<table><tr><td>SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE</td><td>TECHNICAL SPECIFICATION SECTION - VI PART-B</td><td>SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL</td><td>PAGE 5 OF 32</td></tr></table>			SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 5 OF 32
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 5 OF 32			



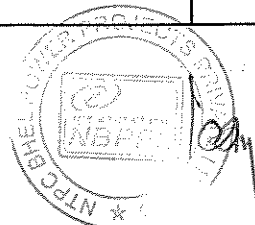
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CLAUSE NO.	QUALITY ASSURANCE			
	The contractor's proposal shall include vendor's site facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed. The formats for furnishing above details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-contractor detail submission / approval shall be furnished on format no. QS-01-QAI-P-02/F1. Such manufacturers / sub-vendors approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.			
6.4.0	To facilitate advance planning of material testing/ approval of bought out items, well before the start of activity as per L-2 network, representative samples shall be procured by the contractor from approved sub-vendors and submitted to the engineer for his approval before bulk procurement at least two months prior to start of works. In case of manufacturers test certificate (MTC) is submitted for acceptance, it shall be clearly traceable and correlated with the consignment received at site. MTC of all bought out items shall essentially contain all the test parameters / characteristics specified in the technical specifications / standards / codes. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to NTPC. Approval of material / sample by the engineer shall not relieve the contractor of his responsibility, for their conformance to the specification, as well as the requisite performance and quality of material.			
6.5.0	Structural steel supply if in the scope of the contractor shall be procured from main steel producers like SAIL, TISCO, IISCO, RINL, Essar Steel, Ispat Industries, JSW Steel, Lloyds Steel, Jindal Steel & Power. In case of non-availability of some of the sections with main steel producers the contractor may propose to procure the sections from the re-rollers of the main steel producers, the name of such re-rollers will have to be cleared by corporate quality assurance of NTPC for which details such as BIS approval, main steel producer's approval, past experience for production of sections of specified material, details of machines plants testing facilities etc., Confirmation that the process control and manufacturing of steel sections by re-rollers shall be same as that of main steel producers, that billets for re-rolling will be sourced from main steel producers only shall be furnished with regards to re-roller.			
6.6.0	Even after clearance of re-rollers, induction of billets with identified and correlated Mill test certificates (TC's) in the process of re-rolling, sampling of steel, quality checks thereof and stamping of final product for further identification and correlation with TC's prior to dispatch shall be the responsibility of the contractor and these shall be performed in presence of the authorized representative of the main Contractor.			
6.7.0	Reinforcement steel supply if in the scope of the contractor shall be procured from main steel producers like SAIL, TISCO, IISCO, RINL, Essar Steel, Ispat Industries, JSW Steel, Lloyds Steel, Jindal Steel & Power and mill test certificates (TC) is to be obtained and submitted to NTPC for co-relation. In case any size /diameter specified is not available with main steel producers and are proposed to be supplied from the conversion agent of the main steel producer the name of such conversion agent / re-roller shall have to be approved by NTPC for which details such as BIS approval, Main steel producer's approval, Past experience for production of sections of			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 6 OF 32



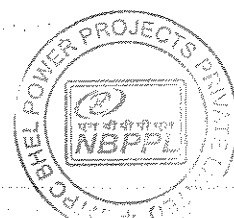
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CLAUSE NO.	QUALITY ASSURANCE	
	specified material, details of machines, plants testing facilities etc., and confirmation that the process control and manufacturing of steel sections by re-rollers is the same as that of main steel producers, that billets for re-rolling are sourced from main steel producers only shall be furnished with regards to re-roller.	
7.0.0	MANUFACTURING QUALITY PLAN AND FIELD QUALITY PLAN	
7.1.0	All materials / components and equipment covered under the scope of work, shall be procured by the contractor for the purpose of the contract, after obtaining the written approval of the NTPC, which are to be manufactured at shop/ factory of the vendor/sub vendor shall be covered under a comprehensive quality assurance programme. The contractor's purchase specifications and inquiries shall call for Manufacturing Quality Plans (MQP) to be submitted by the sub-contractor/ sub-supplier/ sub-vendor. The MQP called for from the sub-contractor shall detail out for all the components and equipment, various tests / inspection, to be carried out as per the requirements of this specification and standards mentioned therein, quality practices and procedures followed by contractor's / sub-contractor's / sub-supplier's quality control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/ performance testing. Such quality plans of the vendors / sub-vendors shall be submitted to the NTPC for approval in the prescribed format no. QS-01-QAI-P-09/F1-R1 for MQP and such approved quality plans shall form a part of the purchase order / contract between the contractor and sub-contractor. The quality plans shall be submitted on electronic form e.g. CD or E-mail in addition to hard copy, for review and approval of NTPC. After approval the same shall be submitted in compiled form on CD in addition to hard copy.	
7.2.0	The contractor shall furnish copies of the reference documents/ plant standards / acceptance norms/ tests and inspection procedure etc., as referred in quality plans. These quality plans and reference documents/standards etc. will be subject to NTPC approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, NTPC shall identify customer hold points (CHP), i.e. test/ checks which shall be carried out in presence of the NTPC engineer or his authorized representative and beyond which the work shall not proceed without consent of NTPC in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to NTPC along with technical justification for approval and dispositioning.	
7.3.0	Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the NTPC for reference / record by the contractor along with a report of the purchase orders placed so far for the contract.	
7.4.0	Well before the start of the work, the contractor shall prepare and submit the Field Quality Plans (FQP) on the format No. QS-01-QAI-P-09/F2-R1, and obtain approval of NTPC, which shall detail out for all the works, equipments, services, quality practices and procedures etc in line with the requirement of the technical	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL PAGE 7 OF 32

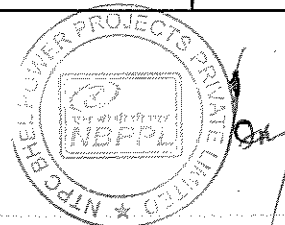


09332

CLAUSE NO.	QUALITY ASSURANCE		
	specifications to be followed by the contractor at site. This FQP shall cover for all the items / activities covered in the contract / schedule of items required, right from material procurement to completion of the work at site. An Indicative Field Quality Plan for civil works is enclosed at Annexure – IV-A (Indicative FQP for civil works) & Annexure – IV-B (Indicative FQP for structural steel works).		
7.5.0	Monthly progress reports on MQP / FQP submission / approval shall be furnished by the contractor on the format No. QS-01-QAI-P-02/F1-R0. List of items requiring quality plans and sub-supplier approval shall be finalized with the contractor on the format no. QS-01-QAI-P-01/F3-R1 during the post bid discussions.		
8.0.0	DISPOSITIONING OF NON CONFORMITIES		
8.1.0	The non-conformity for the site works on being detected / noted shall be reported by the contractor in the standard format no. QS-01-FQA-P-08/F1-R0 (Issue 2) of NTPC under the system of dispositioning of non conformity report (NCR) to the engineer. The dispositioning of the NCR relating to equipment, assemblies, materials condition or process during construction / erection shall describe the proposed correction and also include the preventive / corrective action plan for future.		
9.0.0	QUALITY AUDIT		
9.1.0	NTPC reserves the right to carry out quality audit and quality surveillance of the quality management and control activities, systems and procedures of the contractor or their sub-contractor. The contractor shall provide all necessary assistance to enable the NTPC carry out such audit and surveillance. The contractor shall also take necessary measures, raise NCRs wherever required based on the audit findings / observations.		
10.0.0	QA DOCUMENTATION PACKAGE		
10.1.0	The contractor shall be required to submit the QA documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark. Typical contents of QA documentation pertaining to field activities as per approved MQP, FQP and other agreed manuals / procedures, prior to commissioning of individual system shall generally contain the Quality Plan, Material mill test reports, Non-destructive examination results / reports, Heat Treatment Certificate/Record, Non-conformance Reports, CHP, Certificate of Conformance (COC) and MDCC.		
11.0.0	GENERAL QA REQUIREMENTS		
11.1.0	The contractor shall ensure that the works, BOIs and services under the scope of contract whether manufactured or performed within contractor's works or at his sub-contractor's premises or at the NTPC's site or at any other place of work are in accordance with the NTPC technical specification, applicable standards / codes, approved drawings / data sheets / quality plans and BOQ. All the works, BOIs and services shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL
			PAGE 8 OF 32

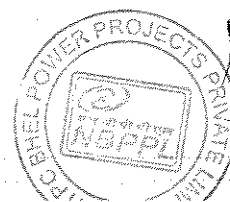


CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC	
11.1.1	STORAGE AND HANDLING OF CONSTRUCTION MATERIALS All materials shall be stacked and stored by the Contractor as per IS-4082 and as per the requirements specified in NTPC Technical Specification.		
11.1.2	EXCAVATION AND FILLING WORKS The contractor shall submit a work methodology covering various items of works for all stages of excavation and filling works. This methodology shall broadly include the quantity wise and classification wise identification of source of excavation and filling, suitability tests as per specification requirements, method of stockpiling, transportation, placement, spreading , compaction, equipment, list of protocols, in-situ tests, third party lab test if required, acceptance checks for final clearance. For blasting work at site if required, the contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The contractor shall install and operate equipment (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the technical specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NTPC, highlighting the scope of services / work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (man-in-charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the contractor. Tolerance for finished surface level shall be within 20 mm of the level shown in the drawing. For an unimportant area, tolerance up to +75mm shall be acceptable at the discretion of the engineer. However, these tolerances shall be applicable for localized areas only. Acceptance criteria shall be a) When only one set of sample is tested, then all individual samples collected and tested should pass without any deviation b) For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation. c) Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 9 OF 32

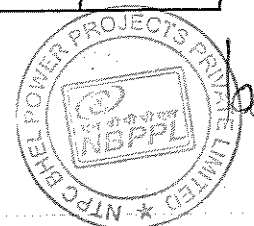


09334

CLAUSE NO.	QUALITY ASSURANCE			
11.1.3	MASONRY AND ALLIED WORKS			
	The execution, finishing, testing and acceptance of masonry related works shall be as per the provisions of technical specifications / relevant practices IS code. Local depressions on account of faulty workmanship, broken / chipped edges shall not be acceptable.			
	All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpends properly aligned. Unless specified otherwise the tolerances in construction of masonry works shall be as below:			
	Sl. No.	Type of Check	Tolerance	
		Deviation in verticality in total height of any wall of a building	Shall not exceed $\pm$ 12.5mm (more than one storey) $\pm$ 6mm per 3m height (within a storey)	
		Deviation from the position shown on the plan of any brickwork	Shall not exceed 12.5mm (more than one storey)	
		Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	Shall not exceed 6mm	
		Deviation of bed joint from horizontal in any length, and it	Shall not exceed 6mm (upto 12m) Shall not exceed 12.5mm total (in any length over 12m)	
		Deviation from the specified thickness of bed-joints, cross-joints or perpends	Shall not exceed $\pm$ 3mm	
		Finished plastered surface	Deviation not more than 4 mm when checked with a straight edge of 2 m length placed against the surface	
	The average thickness of plaster	Not be less than the specified thickness		
	The minimum thickness over any portion of the surface	Not less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 10 OF 32

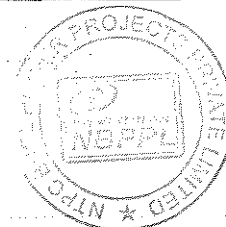


CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC	
11.1.4	CONCRETE WORKS For concreting works provisions of technical specifications and IS: 456 shall apply. A detailed methodology for concrete works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted. . The methodology for concrete works shall broadly contain the suitability of source of aggregates, cement, admixture, water and reinforcement steel, etc. The available concrete mix design recommended from a specialist institute, results of trial mix carried out at site, method / control of batching, mixing, transportation, layer wise placement, compaction, fixing / removal of form work, staging, fixing of water stops at appropriate locations along with specials, expansion joints, contraction joints and construction joints, cover blocks and method of curing, methodology of repair of newly placed hardened concrete, testing and sampling of concrete during production and placement and acceptance checks for final clearance. The equipment, deployment of manpower and machinery shall arranged by the contractor to ensure the continuous rate of placement of specified grade of concrete so as to prevent segregation, bleeding, formation of cold joints, temperature control for concreting in extreme weather conditions and for mass concreting works. Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing concrete in case of ordinary Portland cement, not be less than 10 days for concrete exposed to dry and hot weather conditions, at least 10 days or period may be extended to 14 days where mineral admixtures or blended cements are used. Approved curing compounds may be used in lieu of moist curing with the permission of engineer-in-charge. Reinforcement steel shall conform to relevant IS codes. Lapping / spacing of reinforcement shall be so staggered that under no circumstances more than 50% of bars at any cross section shall be lapped. Corrosion resistance Steel shall be used for the foundations wherever specified in the technical specification. Sample test for 3% of the number of mechanical bars grips subject to a minimum of three, shall be carried out up to the yield strength of reinforcement of bars. Ultrasonic pulse velocities (UPV) test as per IS 13311 Part I, for top deck and column of T.G. foundation, to ascertain the homogeneity and integrity of concrete. Test cubes @ 150 cum of concrete, subject to minimum of 6 cubes, shall be additionally sampled for being used, for carrying out UPV test on cubes. UPV test shall be carried out by a specialized agency. Test shall be conducted for the water tightness of the liquid retaining structures as per technical specifications, IS 3370 and IS 6494. All the materials, equipments, processes used in pre cast concrete work shall conform to the requirements for the cast-in-situ concrete.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 11 OF 32

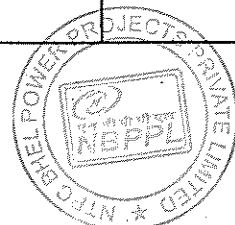


09336

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC		
	If fly ash is used in concrete, source of supply shall be checked for suitability as per IS 3812 (Part-I). Routine tests for retention of particles on 45μ sieve and loss on ignition shall be carried out on each lot of fly ash before its use. The storage of fly ash shall be similar to that of cement. Separate Silo for fly ash shall be provided in the batching plant. Validation of Mix design using fly ash shall be carried out by an approved specialist agency, before start of concrete production. The acceptance criteria of concrete shall be in accordance with clause no.16 of IS 456. However in exceptional circumstances and that too in non-critical areas, the engineer may accept concrete work which is marginally unacceptable as per the criteria laid down in IS 456. For such accepted work, payment shall be made at a reduced rate pro rata to the concrete cube strength obtained, against that stipulated. All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference. - Testing data / report of aggregates including petrographic examination & potential reactivity of aggregate and repeated temperature cycle tests wherever specified - Mix design details and record of trial mixes carried out at site - Testing records of admixture as per IS-9103 / ASTM C494 including third party test reports. - Approved scheme for concreting - Hourly records of concreting including pour card - Protocol indicating the dimensional tolerance and details of inserts - Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used - Bar bending schedule - Location and details of mechanical anchoring used for reinforcement - Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings - Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification			
SINGRAULI STPP STAGE-III (1X600 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 12 OF 32

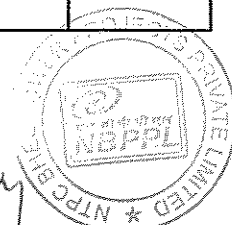


CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC																																									
	l. Temperature control record of concrete at the time of placement if applicable m. Details of curing, staging and fixing / removal of formwork, checklist for formwork as per Clause 9.9 and Annexure-C of IS 14687 including all machine foundations n. Batching Plant shall be calibrated regularly at least once in a 3 months. Computerized output shall be taken for each batch of production of concrete. For concreting works of ash pipe pedestals, mixer with weight batcher may be used. Production and supply of concrete from batching plant shall conform to the provisions of IS 4926 o. Dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances for pre cast members as per NTPC Technical Specification. Load test on Pre cast members (except pre- cast tiles to be laid in the reservoir) shall be carried out @ 2% up to 1000 nos., @1% from more than 1000 nos. precast members of one type. The load test shall be carried out as per the provisions of IS-456 <table border="1"> <thead> <tr> <th colspan="4">TOLERANCES</th></tr> <tr> <th colspan="2">Description of Item/ Structural Element</th><th>Max (mm)</th><th>Min (mm)</th></tr> </thead> <tbody> <tr> <td colspan="4">Cast In Situ Concrete</td></tr> <tr> <td>1.</td><td>Faces of concrete in foundations and structural members against which back fill is placed</td><td>+25</td><td>-10</td></tr> <tr> <td>2.</td><td>Eccentricity of footing as percentage of footing width in the direction of placement</td><td colspan="2">2% but limited to 50mm</td></tr> <tr> <td>3.</td><td>Top surfaces of slabs and of concrete to receive base plates to be grouted</td><td>+5</td><td>-5</td></tr> <tr> <td>4.</td><td>Alignment of beams, lintels, columns, walls, slabs and similar structural elements</td><td>+5</td><td>-5</td></tr> <tr> <td>5.</td><td>Cross sectional dimensions of walls, slabs and similar structural elements</td><td>+5</td><td>-5</td></tr> <tr> <td>6.</td><td>Deviation from specified dimensions of cross-section of columns and beams</td><td>+12</td><td>-6</td></tr> <tr> <td>7.</td><td>Alignment of holding down bolts without sleeves</td><td>+1.5</td><td>-1.5</td></tr> </tbody> </table>	TOLERANCES				Description of Item/ Structural Element		Max (mm)	Min (mm)	Cast In Situ Concrete				1.	Faces of concrete in foundations and structural members against which back fill is placed	+25	-10	2.	Eccentricity of footing as percentage of footing width in the direction of placement	2% but limited to 50mm		3.	Top surfaces of slabs and of concrete to receive base plates to be grouted	+5	-5	4.	Alignment of beams, lintels, columns, walls, slabs and similar structural elements	+5	-5	5.	Cross sectional dimensions of walls, slabs and similar structural elements	+5	-5	6.	Deviation from specified dimensions of cross-section of columns and beams	+12	-6	7.	Alignment of holding down bolts without sleeves	+1.5	-1.5		
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SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 13 OF 32																																								



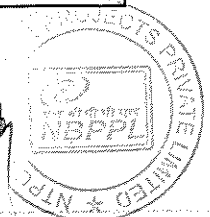
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CLAUSE NO.	QUALITY ASSURANCE 			
	TOLERANCES			
	Description of Item/ Structural Element		Max (mm)	Min (mm)
	8.	Alignment of holding down bolts with sleeves	+5	-5
	9.	Level of holding down bolt assemblies	+10	-10
	10.	Embedded Parts (in any direction).	+5	-5
	11.	Level of embedment for equipment support	+1.5	0
	12.	Level of embedment for other embedded parts	+5	-5
	13.	Centers of pockets or holes with greatest lateral dimension not exceeding 150mm	+10	-10
	14.	Variation in steps		
		⊙ Riser	+1.5	-1.5
		⊙ Tread	+3.0	-3.0
	Pre- Cast Concrete			
	15.	Length: +/- 0.1 percent	+/- 5	+ 10
	16.	Straightness or Bow 1/750 of the length	+/- 5	+/- 10
	17.	Cross-sectional dimensions	+/- 3 mm or +/- 0.1 percent whichever is greater	
	18.	Squareness:	When considering the squareness of the corner the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5 mm.	
	19.	Flatness:	The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm.	
	Placing of reinforcement and for cover		Clause 12.3.1 and 12.3.2 of IS 456	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 14 OF 32



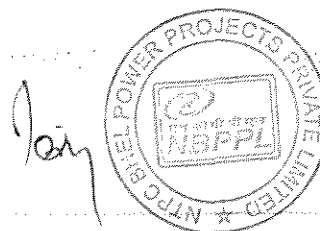
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CLAUSE NO.	QUALITY ASSURANCE			
11.1.5	TOLERANCES			
	Description of Item/ Structural Element	Max (mm)	Min (mm)	
	Formwork			Clause 9.6 of IS 14687 and 11.1 of IS 456
	Batching			Clause 10.2.2 of IS 456
	STRUCTURAL STEEL WORK For structural steel works provisions of technical specifications and IS: 800 shall apply. A detailed methodology for structural steel works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted. The contractor shall submit the welding procedures specification (WPS), heat treatment procedures, NDT procedures etc. at least ninety days before scheduled start of erection work at site. All welding and brazing shall be submitted to the NTPC and carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NTPC. All brazers, welders and welding operators employed on any part of the contract either in the contractor's / sub-contractor's works or at site or elsewhere shall be qualified as per AWS D1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NTPC. The records of welding procedure qualification and welder qualification test results shall be furnished to the NTPC for approval. However, where required by the NTPC, the tests shall be conducted in presence of NTPC / authorized representative. No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes. All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification. The NDT operator shall be qualified as per SNT-TC-1A (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 15 OF 32



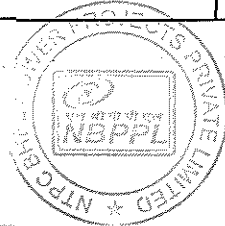
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CLAUSE NO.	QUALITY ASSURANCE																																										
	report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NTPC. Low hydrogen electrode (AWS E-7018) for welding of High/Medium tensile steel, for M.S (IS 2062 Gr. A/Gr. B, IS 8500) sections thickness above 20mm shall be used. Preheating and Post weld heat treatment requirements shall be complied as specified in the technical specification / approved WPS. The requirements of pre-heating shall be <table border="1"> <thead> <tr> <th>Thickness of thickest part at the area of welding / heat affected zone</th> <th>Welding using other than low hydrogen welding electrodes IS 2062</th> <th>Welding using low hydrogen welding electrodes or submerged arc welding IS 2062</th> </tr> </thead> <tbody> <tr> <td>Upto 20 mm (including)</td> <td>None</td> <td>None</td> </tr> <tr> <td>Over 20 mm to 40 mm (including)</td> <td>Not allowed</td> <td>20° C</td> </tr> <tr> <td>Over 40 mm to 63 mm (including)</td> <td>Not allowed</td> <td>66° C</td> </tr> <tr> <td>Over 63 mm</td> <td>Not allowed</td> <td>110° C</td> </tr> </tbody> </table> The following tests / checks shall be carried out for structural steel works <table border="1"> <thead> <tr> <th>SL. NO.</th> <th>TESTS / CHECKS</th> <th>QUANTUM / STANDARD</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Physical and chemical properties of material if supply in the scope of contractor</td> <td>As per relevant codes, review of correlated mill test certificates or check testing in absence of MTC</td> </tr> <tr> <td>2.</td> <td>Ultrasonic test on plates above 40mm</td> <td>As per ASTM A435</td> </tr> <tr> <td>3.</td> <td>Welding procedure & welders qualification test</td> <td>AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards</td> </tr> <tr> <td colspan="3">Fillet Weld</td> </tr> <tr> <td>4.</td> <td>Macro-etch examination on production test coupons for main fillet welds</td> <td>Minimum one joint per built up beams, columns and crane girder etc.</td> </tr> <tr> <td>5.</td> <td>tension member of crane girder</td> <td>Dye penetration test on 25% weld length</td> </tr> <tr> <td>6.</td> <td>All other fillet welds</td> <td>DPT on 5% of weld length with</td> </tr> </tbody> </table>				Thickness of thickest part at the area of welding / heat affected zone	Welding using other than low hydrogen welding electrodes IS 2062	Welding using low hydrogen welding electrodes or submerged arc welding IS 2062	Upto 20 mm (including)	None	None	Over 20 mm to 40 mm (including)	Not allowed	20° C	Over 40 mm to 63 mm (including)	Not allowed	66° C	Over 63 mm	Not allowed	110° C	SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD	1.	Physical and chemical properties of material if supply in the scope of contractor	As per relevant codes, review of correlated mill test certificates or check testing in absence of MTC	2.	Ultrasonic test on plates above 40mm	As per ASTM A435	3.	Welding procedure & welders qualification test	AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards	Fillet Weld			4.	Macro-etch examination on production test coupons for main fillet welds	Minimum one joint per built up beams, columns and crane girder etc.	5.	tension member of crane girder	Dye penetration test on 25% weld length	6.	All other fillet welds	DPT on 5% of weld length with
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SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 16 OF 32																																							



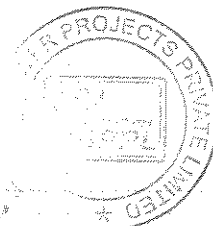
09341

CLAUSE NO.	QUALITY ASSURANCE		
	SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
			minimum 300mm at each location
		Butt Weld	
	7.	DPT	100% after back gouging on all butt welds except for coal bunker bins 10% after back gouging-For coal bunker bins
	8.	Mechanical testing of production test coupons	Minimum one joint per built up beam, column and crane girder.
	9.	Radiography test on butt welds (In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the engineer)	100% RT on butt welds of tension flange (bottom flange) of crane girders 10% RT weld length of each welder on butt welds, except for crane girders and coal bunker 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins
	10.	Ultrasonic testing on full penetration welds (other than butt welds)	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints
	11.	Control assembly check in shop before erection	1 st and further every 10 th set of identical structure
	12.	Dimensional tolerances during fabrication and erection	as per IS-7215 and IS-12843
	13.	Surface Preparation and Paint thickness	SA 2 1/2, By elcometer random after each coat, each member
		CW Liners site fabrication (Field shop) test	
	14.	WPS,PQR& welder's Qualification	100%
	15.	DPT on root run	100% DPT for pipes upto 1200mm diameter
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL PAGE 17 OF 32

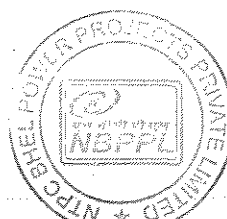


09342

CLAUSE NO.	QUALITY ASSURANCE		
	SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
11.1.5.1	16.	DPT after back gouging	100% DPT for pipes above 1200mm diameter
	17.	UT	Not recommended.
	18.	RT	5% RT
	19.	DPT on finished butt welds	10% DPT
	20.	Hydraulic tests	1.5 times the design pressure or 2 times the working pressure which ever is higher.
	CW Liners erection site test		
	21.	WPS,PQR& welder's Qualification	100%
	22.	DPT on root run	100% DPT for pipes upto 1200mm diameter
	23.	DPT after back gouging	100% DPT for pipes above 1200mm diameter
	24.	UT	Not recommended.
	25.	RT	5% RT
	26.	DPT on finished butt welds	10% DPT
	27.	Hydraulic tests	1.5 times the design pressure or 2 times the working pressure which ever is higher.
			In cases where hydraulic test is not possible the same may be substituted with 100%RT
	28.	Tolerances	As per approved drawings, as per IS : 7215 for fabrication and IS : 12843 for erection of steel structures
11.1.5.1 STOPLOG AND TRASH RACKS Structural design shall be as per IS 5620 and IS 4622 and as per details given in technical specifications. The trash rack to be provided shall be Type-1 trash rack (removable section rack), conforming to IS: 11388 (latest). Filling valves shall be provided in the stop logs to balance the water pressure before lifting the stop log.			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 18 OF 32

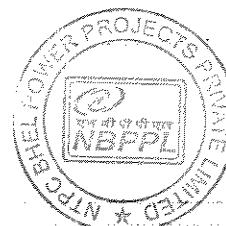


CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC	
	Leakage test shall be carried out in the stop logs as per the methodology specified in the technical specification. The leakage measured shall not be more than 5 liters/minute /meter of length of seal under maximum head. Radiographic examination or magnetic particle testing or other comparable tests shall be carried out for determining the soundness of steel castings and shall be conducted by the contractor as per the technical specification requirements. The contractor shall submit a manufacturing and field quality plans in NTPC format incorporating all the quality aspects mentioned in the technical specifications. The lifting beam is to be tested for twice the weight of the heaviest component to be lifted by the beam. IS 13591 shall be referred for measurement of the deflection and acceptance criteria.		
11.1.5.2	COAL TAR ANTI-CORROSION TAPE Coal tar anti corrosion tape shall conform to the requirements of IS:15337. The Manufacturers test certificate for each lot of supply of the coal tar anti corrosion tape shall contain the softening point, needle penetration, filler content, breaking load in the longitudinal direction, service temperature, direct impact test, cathodic disbonding, microbiological tests and solubility. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to NTPC. Tests for Adhesion, holiday test, mass, thickness shall be carried out randomly at site.		
11.1.6	PAINTING WORKS Painting works shall be carried out as per the provisions of technical specifications. A detailed methodology for painting works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.		
11.1.7	The methodology for painting works shall broadly contain the source of approved brand of paints, shot / sand blasting as specified, minimum acceptable size of shot used for blasting, application of primer, intermediate coat and final coat, experience of applicator, etc. testing of painting work and acceptance checks for final clearance. For PU coating works if specified, material shall be procured from NTPC approved source and the application of the PU coating shall be carried out by an experienced authorized applicator of the material supplier approved by NTPC. A separate quality plan and methodology for PU coating works shall be submitted by the contractor for approval of NTPC. Based on the approved quality plan, the tests on material and works shall be got conducted at specialist laboratories like IICT Hyderabad, CECRI Karaikudi. SHEETING WORKS All bought out items shall be procured from the manufacturer's approved by engineer and tested as per relevant IS Codes/ Specification. Raw material of colour coated		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 19 OF 32

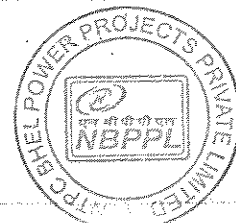


09344

CLAUSE NO.	QUALITY ASSURANCE			
11.1.8	sheets shall meet the chemical & physical properties as per relevant standards / codes referred in the approved data sheet. It shall be tested for bare metal thickness, thickness of coatings, type of coating/paint, hardness of painted surface as per IS14246 (2H pencil hardness), flexibility test, bend test as per ASTM D 328/ IS 14246 at 180 degree, dimensional check after profiling of sheets, cross hatch test, salt spray test as per ASTM B-117/ IS 9844 for minimum 1000 hrs one sample per batch at random. For true representative sampling, three samples shall be taken from each batch out of which one sample shall be sent for salt spray test as per IS14246, the samples may be chosen from the batches offered for inspection, one at the beginning of supply, another at the middle of supply and the third towards the end of the supply. Bonded Mineral Wool Insulation shall meet the requirements of thickness, density, thermal Conductivity, all other tests as per the technical specifications and IS-8183. For sheet installation no gas cut opening shall be allowed at the site, whenever opening is specified these shall be properly cut in the factory and shall be filled with lipping / flashing for true shape / dimension etc. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating, and cause corrosion. TILE WORKS The execution, finishing, testing and acceptance of tile works shall be as per the provisions of technical specifications. The material for tile works shall be procured from the NTPC approved brand / source. Local depressions on account of faulty workmanship, tiles / natural stones with cracked or broken / chipped edges shall not be acceptable. The tests shall be carried out on acid resistant bricks / tile- water absorption, compressive strength, resistance to acid, flexural strength, dimensions and all other tests as per IS 4860 and IS 4457, bitumastic ready mixed paint as per IS 158, bitumastic as per IS 9510, potassium silicate, resin type and sulphur type mortars as per IS 4832, part I, II and III, surface preparation for painting as per IS 2395, epoxy painting shall be carried for required coating thickness and dry film thickness.			
11.1.9	FIRE PROOF DOORS Fire Proof doors shall be tested for the requirements mentioned in IS-3614 Part-I&II and The Technical Specification. The type test of the doors shall be carried out at CBRI Roorkee for minimum 2 hours fire rating and its Fabrication drawing shall also be approved by CBRI, Roorkee. DFT of paint of Fire Proof Doors and its fittings and fixtures as per BOQ shall be checked. The doors shall be finished with suitable fire retardant painting system			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 20 OF 32	

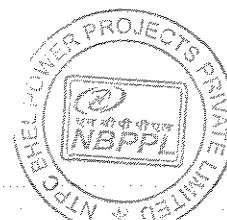


CLAUSE NO.	QUALITY ASSURANCE	
11.1.10	WATER PROOFING The execution, finishing, testing and acceptance of water proofing works shall be as per the provisions of technical specifications. The material for the works shall be procured from the NTPC approved brand / source and the works shall be executed by the authorized applicator of the supplier. Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried elastomeric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel / drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and well junctions etc. which have been subjected for testing. The above testing shall be carried out prior to application of wearing course.	
11.1.11	PILING WORK For piling works provisions of technical specifications, approved drawings, BOQs and relevant IS codes / standards shall apply. The piling works shall be executed by the agency meeting the qualifying requirements as specified. A detailed methodology for piling works shall be submitted by the contractor to NTPC for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted. The methodology for piling works shall broadly contain the method of boring, stability of bore hole, termination criteria, tests / checks for termination level, fabrication of cage, cage lowering, concrete batching / mixing, transportation, placing, recording of the time of construction operations, method of conducting initial and routine load tests, testing and sampling of concrete during production and placement and acceptance checks on piles for final clearance. The equipment, deployment of manpower and machinery shall be arranged by the contractor to prevent the collapse of bore hole and to ensure continuous rate of placement of specified grade of concrete. The piling works shall be executed as per the technical specifications, approved drawings, relevant codes / standards, FQP and BOQ. In addition to the requirements of technical specifications, the following shall also be ensured while execution of piling works: - Time gap between completion of pile boring and start of concreting should be kept to the minimum. However the maximum time gap shall not be more than 6 hours. - Muck Debris should be removed from the pile bore by air lift technique (by keeping the tremie & air pipe as close as to bottom of pile bore) i.e. after completion of boring, after completion of SPT (wherever applicable), after lowering reinforcement cage, but before start of concreting.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL PAGE 21 OF 32



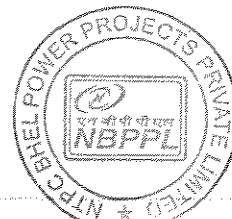
09346

CLAUSE NO.	QUALITY ASSURANCE	
	c) Density of bentonite slurry shall be checked from the sample taken from the bottom of pile bore(not at 1.0 m above the bottom of the pile bore) d) Minimum two welding sets shall be kept ready to join the two cages of reinforcement by engaging 3 or more welders. This will ensure the lowering of R/F cage in minimum time. e) While lowering the R/F cage into the pile bore, two hooks shall always be used to ensure balanced/symmetrical insertion of cage into the pile bore. f) Concrete cover blocks at the junction of two R/F cage shall be ensured before lowering the second segment. g) Surge concreting of about 1.0 cum shall be ensured at the start of concreting (i.e. in the first pour), by suddenly allowing to fall through the tremie pipe from the funnel. This will help in displacing left out muck/debris in the pile bore (by the impact). h) Continuous feeding of concrete shall be ensured by deploying at least two transit concrete mixers (if required to be deployed) and mixing done through concrete batching plant (if deployed). Cold joints in the pile shall be avoided. i) In a pile group, SPT shall be carried out at termination level in the pile, taken up first. j) Bentonite slurry circulation to be ensured from start of boring to start of concreting. Flushing of bentonite slurry will only ensure maintaining of density of bentonite slurry uniformly and will not allow bentonite jelly to settle at the bottom, whereas air lift technique with bentonite circulation will ensure removal of muck debris from the bottom of pile bore. k) Properties of drilling mud shall be checked prior to commencement of the piling work and thereafter, minimum once per week or as found necessary by the engineer. One sample consisting of 3 specimens shall be tested for the above. l) Low strain pile integrity test on all job piles and test piles shall be conducted as specified in the Technical Specification. This test shall be suitably used to identify the piles for routine tests. High Strain dynamic test shall be done as per the technical specification. The frequency of the test shall be as per the BOQ m) For Working Piles: Minimum one sample consisting of 6 test cubes shall be made for first ten piles. Out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength. Minimum one sample of 6 test cubes for every 25 nos. of piles shall be tested, out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL
		PAGE 22 OF 32

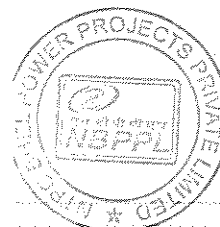


09347

CLAUSE NO.	QUALITY ASSURANCE	एनटीपीसी NTPC	
11.1.12	PILE LOAD TEST Pile load testing shall conform to the requirements of IS-2911 (Part IV) and the technical specification. Initial load tests as specified in the contract documents shall be conducted to assess the safe load carrying capacity of pile before start of work. To verify the load carrying capacity of the working piles, routine load test shall be conducted. Pile load-testing procedure and the test setup / scheme shall be submitted for approval of NTPC. The contractor shall use the test setup having arrangement for anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge for both vertical compression and uplift (tension) Load test (initial) on piles. The cost of reaction system / piles shall deem to be included in the cost of test piles All the gauges and instruments shall be calibrated before the start of the tests on test piles and working piles and the calibration record shall be verified before start of execution of the test.		
	WATER SUPPLY, DRAINAGE & SANITATION Material used for sanitary and plumbing fittings and fixtures shall conform to and be tested as per the requirements of relevant IS Codes specified in NTPC technical specification. The obstructions in sewer lines shall be checked by inserting a smooth ball, of diameter 13 mm less than the pipe bore at the high end of the sewer or drain. If absence of any obstructions, such as yarn or mortar projecting through the joints, ball shall roll down the invert of the pipe and emerge at the lower end. The straightness shall be checked by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of the light may be observed. The mirror will also indicate obstruction in the barrel, if the pipeline is not straight. The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under test / working condition of pressure and flow, when all draw-off taps are closed. The service pipes shall be checked for satisfactory support and protection from damage, corrosion and frost.		
11.1.13	ARCHITECTURAL & MISC. WORKS Material used for sanitary and plumbing fittings and fixtures, floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in NTPC technical specification. Fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. shall be checked for correctness of locations and smoothness of operation and fixtures. All controls and locking devices shall give fault free performance. Door and window shutters shall operate without jamming. The clearance at head and jamb		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL PAGE 23 OF 32

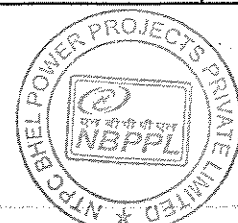


CLAUSE NO.	QUALITY ASSURANCE	एन टी पी सी NTPC
	for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 2.5 mm. Materials used in glass and glazing shall be procured from source approved by NTPC and shall conform to the requirements of the Technical Specification and IS Codes. False ceiling panels shall be best quality material in thickness and properties called for in the specification / schedule of items. Material Test Certificate to be submitted before bulk supply. All bought items covered in the scope of contract shall be procured from sources approved by NTPC and shall conform to the requirements of the technical specifications and referred standards /codes.	
11.1.14	ROAD WORK Quality Assurance and testing requirements for roadwork shall be as per the MOSRTH-Specification (Section 900), IRC specifications or CPWD specifications as specified in the technical specifications and BOQ of the contract. The testing and sampling shall include the checks on earth work for embankment and subgrade, sub bases and bases and bituminous constructions. The sampling and testing of concrete pavements shall be as per the respective items of earthwork, subgrade / sub-base, concrete, etc.	
12.0.0	SHOP TEST EOT Cranes,Other cranes & Hoist 1.0 HOOKS 1.01 ALL TESTS INCLUDING PROOF LOAD TEST AS PER RELEVANT IS/BS/DIN SHALL BE CARRIED OUT. 1.02 MPI/DPT SHALL BE CARRIED OUT AFTER PROOF LOAD TEST. 2.0 STEEL CASTING 2.01 DPT ON MACHINED SURFACE SHALL BE CARRIED OUT. 3.0 GIRDERS, END CARRIAGE,CRAB, GEAR BOX AND ROPE DRUM 3.01 THE PLATES OF THICKNESS 25MM AND ABOVE SHALL BE ULTRASONICALLY TESTED. 3.02 NDT REQUIREMENTS ON WELDMENTS SHALL BE AS FOLLOWS: a) BUTT WELDS IN TENSION:- 100% RT AND 100% DPT	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL
		PAGE 24 OF 32



09349

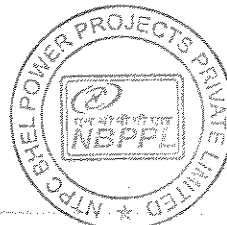
CLAUSE NO.	QUALITY ASSURANCE		
13.0.0	b) BUTT WELDS IN COMPRESSION:- 10% RT AND 100% DPT c) BUTT WELDS IN ROPE DRUM:- 100% RT AND 100% DPT d) FILLET WELDS:- RANDOM 10% DPT 4.0 FORGING (WHEEL, GEARS, PINIONS, AXLE, HOOKS & HOOK TRUNION) 4.01 ALL FORGINGS GREATER THAN OR EQUAL TO 50 MM DIAMETER OR THICKNESS SHALL BE SUBJECTED TO ULTRASONIC TESTING. 4.02 DPT/MPI SHALL BE DONE AFTER HARDFACING AND MACHINING. 5.0 WIRE RPOE SHALL BE TESTED AS PER RELEVANT STANDARD. 6.0 REDUCTION GEARS SHALL BE TESTED FOR REDUCTION RATIO, BACKLASH & CONTACT PATTERN. GEAR BOX SHALL BE SUBJECTED TO NO-LOAD RUN TEST TO CHECK FOR OIL LEAKAGE, TEMPERATURE RISE, NOISE AND VIBRATION. 7.0 THE CRANES SHALL BE COMPLETELY ASSEMBLED AT SHOP FOR FINAL TESTING. ALL TESTS FOR DIMENSION, DEFLECTION, LOAD, OVERLOAD, HOISTING MOTION, CROSS TRAVEL ETC. AS PER IS-3177 SHALL BE CARRIED OUT AT SHOP. 8.0 ALL-ELECTRIC HOISTS SHALL BE TESTED AS PER IS-3938 AND CHAIN PULLEY BLOCKS SHALL BE TESTED AS PER IS-3832.		
	CATHODIC PROTECTION Quality of cathodic protection system shall be as per given table.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 25 OF 32



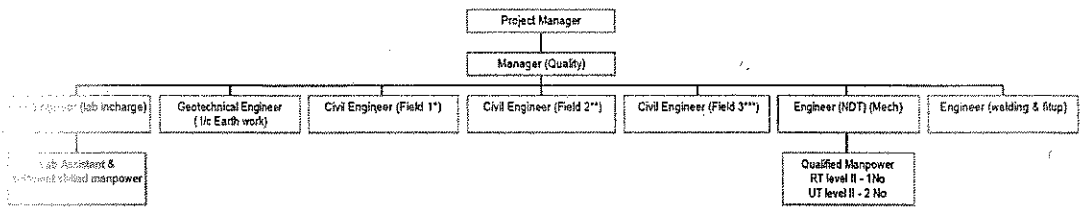
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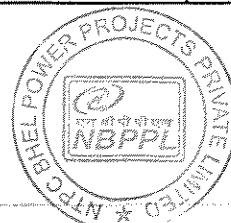
CLAUSE NO.		QUALITY ASSURANCE										एनटीपीसी NTPC	
IMPRESSED CURRENT CATHODIC PROTECTION													
Transformer Rectifier Unit													
Attributes/ Characteristics →	Items/ Components / Sub- assembly ↓	Make, Model, Type, Rating & Finish	Chemical & Mechanical Tests	Sheet Steel Pretreatment & Painting process checks	Operational & Functional Checks	Conform to relevant Standard	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features of TRU as per NTPC specification	Efficiency Test on TRU & Transformer	Heat Run Test	Ratio & Polarity Test on TRU	HV & IR Test	
Rectifier Transformer (IS : 2026)	Y				Y				Y			Y	
Electronic Components	Y				Y								
PCB & Electronic Cards	Y				Y								
Control & Selector Switches (IS : 6875)	Y			Y	Y								
Indicating Meters (IS : 1248)	Y			Y	Y								
Indicating Lamps (IS : 13947)	Y			Y	Y								
Air Break Switches / Fuses (IS : 13947 / 13703)	Y			Y	Y								
Control Terminal Blocks (IS : 13947)	Y				Y								
Control Transformer (IS : 12021)	Y			Y	Y								
Push Buttons (IS : 4794)	Y			Y	Y								
MCB (IS : 8828)	Y			Y	Y								
PVC insulated Copper control wires (IS : 694)	Y				Y								
Sheet Steel (IS : 513)	Y	Y	Y		Y								
Synthetic Rubber Gaskets	Y	Y			Y								
Annunciator	Y			Y									
Transformer Rectifier Unit	Y					Y	Y	Y	Y	Y	Y	Y	
Notes: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents. 2. Makes of all major Bought Out Items will be subject to NTPC approval.													

SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 26 OF 33



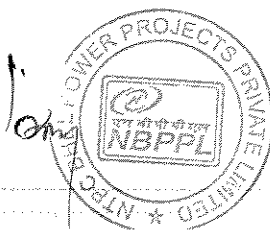
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CLAUSE NO.	QUALITY ASSURANCE				
ANNEXURE-I					
QA&QC ORGANISATION SETUP					
 <pre> graph TD PM[Project Manager] --> MQ[Manager (Quality)] MQ --> EIC[Engineer (Sub incharge)] MQ --> GE[Geotechnical Engineer (If Earth work)] MQ --> CE1[Civil Engineer (Field 1*)] MQ --> CE2[Civil Engineer (Field 2**)] MQ --> CE3[Civil Engineer (Field 3***)] MQ --> EMDT[Engineer (NDT) (Mech)] MQ --> EW[Engineer (welding & fitup)] EIC --> LA[Lab Assistant & Skilled manpower] EMDT --> QM[Qualified Manpower RT level II - 1 No UT level II - 2 No] </pre>					
NOTE:					
1. The above organization setup is minimum however their deployment shall be as per the agreed deployment schedule. The contractor shall prepare a manpower deployment schedule in line with the finalized work plan and the same shall be submitted to the engineer-in charge for acceptance/ approval.					
2. The contractor shall mobilize the QA& QC manpower in line with the finalized manpower deployment schedule and shall ensure their availability well in advance (15 days approx.) of the beginning of the concerned activity/ work.					
3. The contractor shall further mobilize required number of skilled & supporting staff and additional resources, if any to meet the work schedule.					
4. * For concrete work - 2 Nos (one for foundation work & one for superstructure)					
5. ** For lines and levels - 1 No.					
*** For Finishes and cladding work - 1 No					
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION - VI PART-B		SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	
				PAGE 27 OF 33	



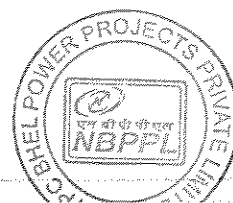
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CLAUSE NO.	QUALITY ASSURANCE																																																																		
	ANNEXURE - II																																																																		
	TYPICAL QA/QC LAB EQUIPMENT																																																																		
	Project:		Package:																																																																
	<table border="1"> <thead> <tr> <th>S.No</th> <th>Equipment</th> <th>Nos.</th> </tr> </thead> <tbody> <tr><td>1</td><td>Vicat Apparatus with deskpot</td><td>2</td></tr> <tr><td>2</td><td>Le chatelier flask</td><td>2</td></tr> <tr><td>3</td><td>Le chatelier Mould</td><td>2</td></tr> <tr><td>4</td><td>Cube Moulds for cement testing</td><td>12</td></tr> <tr><td>5</td><td>Vibration Machine</td><td>1</td></tr> <tr><td>6</td><td>Length comparator</td><td>2</td></tr> <tr><td>7</td><td>Shrinkage Bar mould</td><td>2</td></tr> <tr><td>8</td><td>Sieve shaker</td><td>1</td></tr> <tr><td>9</td><td>Sieves for sand, coarse & fine aggregate</td><td>1 set for each</td></tr> <tr><td>10</td><td>Sieves for coarse aggregate for Road</td><td>1 set</td></tr> <tr><td>11</td><td>Proctor testing equipment</td><td>2 sets + 18 cores</td></tr> <tr><td>12</td><td>Slump testing equipment</td><td>6 sets</td></tr> <tr><td>13</td><td>Oven</td><td>2</td></tr> <tr><td>14</td><td>Physical balance</td><td>1</td></tr> <tr><td>15</td><td>Rapid moisture meter</td><td>2</td></tr> <tr><td>16</td><td>Thermometer</td><td>4</td></tr> <tr><td>17</td><td>Burret</td><td>2</td></tr> <tr><td>18</td><td>Measuring cylinders</td><td>9</td></tr> <tr><td>19</td><td>Measuring flasks</td><td>3</td></tr> <tr><td>20</td><td>Compression testing machine</td><td>2 sets of 2000 kN capacity each</td></tr> </tbody> </table>	S.No	Equipment	Nos.	1	Vicat Apparatus with deskpot	2	2	Le chatelier flask	2	3	Le chatelier Mould	2	4	Cube Moulds for cement testing	12	5	Vibration Machine	1	6	Length comparator	2	7	Shrinkage Bar mould	2	8	Sieve shaker	1	9	Sieves for sand, coarse & fine aggregate	1 set for each	10	Sieves for coarse aggregate for Road	1 set	11	Proctor testing equipment	2 sets + 18 cores	12	Slump testing equipment	6 sets	13	Oven	2	14	Physical balance	1	15	Rapid moisture meter	2	16	Thermometer	4	17	Burret	2	18	Measuring cylinders	9	19	Measuring flasks	3	20	Compression testing machine	2 sets of 2000 kN capacity each			
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				PAGE 28 OF 32																																																															



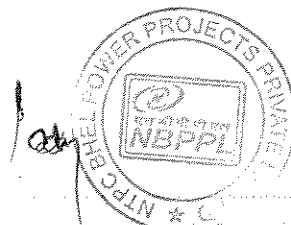
09353

CLAUSE NO.	QUALITY ASSURANCE			
	21	Cube moulds	30	
	22	Electronic balance	2 (12 kg capacity), 2 (200 mg capacity)	
	23	pH balance	As per requirement	
	24	Radiographic facilities	As per requirement, Party should deploy BARC approved agency for carrying out RT	
	25	Mechanical weighing machine	1 (100 kg capacity)	
	26	Ultrasonic testing machine	As per requirement	
	27	D.P. Test kit	10	
	28	Vernier 300 mm, 600 mm	2	
	29	Micrometer (0.25 mm) out side (25.00)	2	
	30	Radiography film viewer	2	
	31	Inside Micrometer 25-750 dia	2	
	32	Digital elcometer for paint thickness	2	
	33	Baking oven for electrode	3	
	34	Portable ovens	2	
	35	Rebar detector to locate the reinforcement before core cutting operation	1	
	36	Concrete coring machine (55mm, 60mm upto 150 mm dia core bit)	1	
	37	Rebound hammer	1	
	38	Ultrasonic pulse velocity tester	May be arranged from specialist laboratory.	
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 29 OF 32



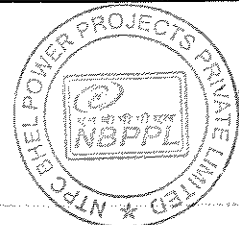
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CLAUSE NO.	QUALITY ASSURANCE 		
	Note : 1. The equipments listed above are indicative and required to be mobilised as minimum requirement. additional equipment if any ,required for successful completion of work shall be provided /arranged by the contractor. 2. All test reports/ inspection reports have to be computerized and maintained on LAN with an access to the owner 3. Computers - 2 Nos shall be deployed with Windows operating system and connected to the NTPC server 4. Based on the schedule (L2/L3 Network), Quality control & Quality Assurance work plan shall be finalized by the contractor and the same shall be submitted to the engineer-in-charge for acceptance/approval. The Finalized work plan shall be maintained on the computer to be accessed by the owner for database and day to day monitoring.		
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 30 OF 32



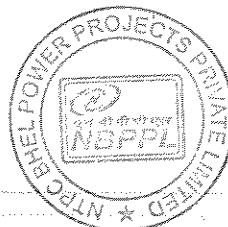
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CLAUSE NO.	QUALITY ASSURANCE																																																										
	ANNEXURE – III																																																										
	INDICATIVE LIST OF BOUGHT OUT ITEMS FOR CIVIL WORKS																																																										
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SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL	PAGE 31 OF 32																																																							



09356

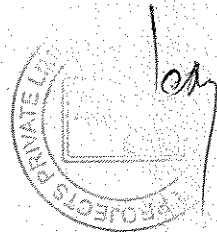
CLAUSE NO.	QUALITY ASSURANCE		
	14.	Anodized Aluminum Sections	
	15.	Fittings and fixtures for water supply works	
	16.	PVC Pipes and accessories	
	17.	Polyethylene water storage tank	
	18.	Heavy duty anchor fasteners	
	19.	Stop log, Trash Rack, Lifting Beam etc.	
	20.	PTFE Bearing	
	21.	Flexible Open Bellow Strap	
	22.	HDPE Liner	
	23.	Cathodic protection system	
	24.	Anti weed treatment	
	25.	HSFG Bolts	
	26.	Any other specific high value and critical bought out item required, meeting the specification requirements	
Note: The Bidders are required to indicate the list of proposed manufacturers/ sub-vendors for each of the BOI in their Bid proposal, which shall be discussed for finalization at post bid			
SINGRAULI STPP STAGE-III (1X500 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION - VI PART-B	SUB-SECTION-E-117 QUALITY ASSURANCE CIVIL PAGE 32 OF 32



09357

SUB-SECTION – E-118

INDICATIVE FIELD QUALITY PLAN

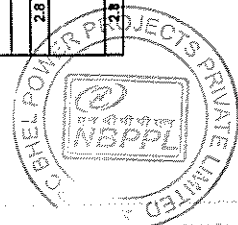


09358

INDICATIVE FIELD QUALITY PLAN										ANNEXURE- IV A	
LOGO	SUPPLIERS NAME AND ADDRESS:	ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INV; FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	QIP NO. : REV. NO. : DATE : PAGE :	Page 1 of 17 0	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR Reference Document	Acceptance Norms	Format of Record	Remarks			
Sl. No	Activity and operation	Characteristics / Instruments	Class of check	Type of Check	Quantum Of check						
1	2	3	4	5	6	7	8	9	10		
1	GENERAL REQUIREMENTS										
A	Setting up of Field QA&QC laboratory	As agreed / required	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings	SR	✓	Functioning of laboratory equipment in proper working condition to be verified on monthly basis		
B	Availability of requisite laboratory set up and equipment in good working condition well before commencement of concerned activity	As agreed / required	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	✓			
C	Submission of QA & QC manpower deployment schedule based on agreed L-2 network		A	Physical	Once prior to start of work	Tech Specs and Const. Drawings		✓			
D	Availability of QA& QC manpower based on deployment schedule		A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	✓			
E	Sampling for testing of building materials, concrete mix design etc.	As agreed / required	A	Physical	Once per each source	Tech Specs and Const. Drawings	SR/IR	✓	Test report along with the recommendations from specialist agency to be submitted to NTPC.		
F	Submission of schedule of tests to be done monthly / quarterly and maintenance of the same on a computer connected to LAN of NTPC for monitoring		A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	✓			
G	Stacking and storage of construction materials and components at site	As per IS:4062	B	Physical	Random	Tech Specs and Const. Drawings and IS: 4062	SR	✓			
2	EXCAVATION AND FILLING IN FOUNDATION WORKS										
2.1	Excavations- Nature, type of soil/rock before and during excavations	As agreed / required	B	Visual	Random in each shift	Tech Specs and Const. Drawings	SR				
2.2	Initial ground level before start of excavations	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR	✓			
2.3	Final slope and Dimensions of excavations	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR				
2.4	Final excavation levels	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR	✓			
2.5	Side slope of final excavation	As agreed / required	B	Measurement	Random in each shift	Tech Specs and Const. Drawings	SR				
2.6	Excavation in Hard Rock- If required	As agreed / required	B	Physical	Random in each week	Indian Explosive Act 1940/nil statutory norms, Tech Specs and Const. Drawings IS:4061, Tech Specs and Const. Drawings	SR	✓	NTPC approved specialist blasting agency such as CMRI, NIRM shall be deployed at site for trial blasts. design		
2.7	Excavation in Hard Rock (Blasting Prohibited)	As agreed / required	B	Physical	Random in each week	Tech Specs and Const. Drawings	SR	✓	blasts, blast vibration monitoring etc. Seismographs shall be deployed at site for monitoring of blast operation		
2.8 A	Suitability of borrow fill material - If earth is brought from area within the NTPC acquired area	As agreed / required	B	Visual	Random in each shift	As per technical specifications					

TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE



09359

SUPPLIERS NAME AND ADDRESS:		INDICATIVE FIELD QUALITY PLAN				ANNEXURE-IV A			
LOGO	ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INV, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	QIP NO. : REV. NO. : DATE :	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR		Quantum Of check	Acceptance Norms	Format of Record	Remarks	
Sr. No	Activity and operation	Class of check	Type of Check	Quantum of Check	Acceptance Norms	Format of Record	Remarks		
i	Grain size analysis	B	Physical	One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV), Tech Specs and Const. Drawings	SR/TR	The parameters should not be worse than the parameter of the existing soil in plant area		
ii	Liquid & plastic limit	B	Physical	One in every 2000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV), Tech Specs and Const. Drawings	SR/TR	The parameters should not be worse than the parameter of the existing soil in plant area		
iii	Shrinkage limit	B	Physical	One in every 5000 cum for each type and source of fill materials subject to a min. of 2 samples	IS:2720 (Pt.IV), Tech Specs and Const. Drawings	SR/TR	The parameters should not be worse than the parameter of the existing soil in plant area		
iv	Free Swell Index	B	Physical	One in every 5000 cum for each type and source of fill materials	IS:2720 (Pt.XI), Tech Specs and Const. Drawings	SR/TR	The parameters should not be worse than the parameter of the existing soil in plant area		
v	Chemical Analysis								
a	Organic Matter	B	Physical	One in every 5000 cum for each type and source of fill materials	IS:2720 Pt.XXII, Tech Specs and Const. Drawings	SR/TR			
b	Calcium carbonate	B	Physical	One in every 5000 cum for each type and source of fill materials	Part XXIII of IS-2720, Tech Specs and Const. Drawings	SR/TR			
c	pH value	B	Physical	One in every 5000 cum for each type and source of fill materials	Part XXVI of IS-2720, Tech Specs and Const. Drawings	SR/TR			
d	Total soluble sulphate	B	Physical	One in every 5000 cum for each type and source of fill materials	Part XXVII of IS-2720, Tech Specs and Const. Drawings	SR/TR			
2.9 Standard proctor Test	Optimum moisture content and max. dry density before fill	A	Physical	One in every 2000 cum for each type and source of fill materials	IS:2720 (Pt.VII), Tech Specs and Const. Drawings	SR/TR			
2.10 Moisture content	Moisture content of fill before compaction	A	Physical	One in every 2000 cum for each type and source of fill materials	IS:2720 (Pt.III), Tech Specs and Const. Drawings	SR/TR			
2.11 Degree Of Compaction Of Fill / Backfill	Dry density by core cutter method — OR — Dry density in place by sand displacement method	A	Physical	i) For foundation fill/ backfill one for every 10 foundations for each compacted layer. ii) For area filling, one every 1000 SQM area for each compacted layer.	IS:2720 (Pt. XXIX), Tech Specs and Const. Drawings IS:2720 (Pt. XXVIII), Tech Specs and Const. Drawings	SR/TR			
i	Relative density (Density Index)	A	Physical	As per IS: 2720, balance oven etc.	IS:2720 (Pt. XIV), Tech Specs and Const. Drawings	SR/TR			
ii	Relative density (Density Index)	A	Physical	As per IS: 2720, balance oven etc.	IS:2720 (Pt. XIV), Tech Specs and Const. Drawings	SR/TR			

TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

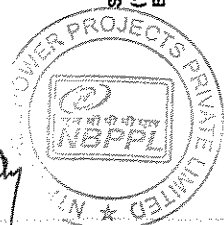
SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

09360

INDICATIVE FIELD QUALITY PLAN										ANNEXURE- IV A	
LOGO	SUPPLIER NAME AND ADDRESS	ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	Q.P. NO. : REV. NO. : DATE : PAGE :	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	Quantum Of check	Type of Check	Class of check	Remarks	Format of Record	Acceptance Norms	Remarks
Sl. No	Activity and operation	Characteristics / Instruments	Class of check	Reference Document	Quantum Of check	Type of Check	Class of check	Remarks	Format of Record	Acceptance Norms	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
iii		Dry Density by proctor needle penetration	B	Physical	Random checks to be carried out for each compacted layer				SR/IR		
3.0	CAST-IN-SITU CONCRETE										
3.1	CEMENT	Releasing of cement	A	Testing	At Random				Test Report		Each consignment of cement shall be duly correlated with manufacturer's TC. In case the cement is supplied by the contractor one sample from each lot shall be tested for setting time and compressive strength. Acceptance norms shall be as per relevant IS. If cement is stored more than 60 days in godown of contractor same shall be retested for comp. Strength & setting time.
3.2	Coarse Aggregate	Moisture content	B	Physical	Once for each stack of 100 Cum. or part there of. Except during monsoon when this has to be done every day before start of concreting			IS : 456 IS : 383/Tech Spec	SR/LB		Accordingly water content of the concrete will be adjusted
ii		Specific gravity, water absorption	A	Physical	Once for each source & IS: 2386 Part-III, for every change of source			IS: 2386 Part-III, IS: 383/Tech Spec	SR/LB/ Test Report		These tests will be carried out while establishing design mix and the results to be intimated to NTPC.
iii		Sieve analysis, flakiness index, elongation index.	B	Physical	One per 100 cum. of source			IS: 2386 Part-I, Spec	SR/LB		-do-
iv		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)	A	Physical	Once per source/ on every change of source			IS: 2386 Part-II, Spec	SR/LB/ Test Report		Experts opinion regarding suitability of the aggregates shall be obtained from the specialist agency finalized during preaward.
v		Soundness	A	Physical	-do-			IS: 2386 Part-V, IS: 383	SR/LB/ Test Report		Experts opinion regarding suitability of the aggregates shall be obtained from the specialist agency finalized during preaward.
vi		Alkali aggregate reactivity	A	Physical	-do-			IS: 2386 (Part-VIII) IS: 383 /Tech Spec/ASTM C-1260 / ASTM 1263	SR/LB/ Test Report		The aggregate type (deleterious/innocuous) result should be supported by petrographic examination
vii		Petrographic examination	A	Physical	-do-			IS: 2386 Part-VIII, IS: 383 /Tech Spec	SR/LB/ Test Report		Petrographic report shall be supported by the analysis and recommendation by a specialist institute.
viii		Crushing value abrasion value and impact value	A	Physical	-do-			IS: 383, IS: 2386 Part IV/Tech Spec	SR/LB/ Test Report		
3.3	Fine Aggregate	Moisture content, water absorption	B	Physical	To be done every day/ before start of work			IS: 2386 Part-III	SR/LB/IR		Accordingly water content of the concrete will be adjusted.
i		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)	B	Physical	Once per source/ on every change of source			IS: 2386 Part-II, IS: 383	SR/LB/IR		Acceptance limit as per relevant IS code

TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE



09364

INDICATIVE FIELD QUALITY PLAN										ANNEXURE-IV A	
LOGO	SUPPLIERS NAME AND ADDRESS:	ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVL. FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	Q/R NO. : REV. NO. : DATE : PAGE :	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR		Page 2 of 17 0	Quantum Of check	Type of Check	Class of check	Remarks	
Sl. No	Activity and operation	Characteristics / Instruments	Class of check	Type of Check	Quantum Of check	Acceptance Norms	Format of Record	Remarks			
i	2	3	4	5	6	7	8	9	10		
iii		All other tests similar to coarse aggregates as mentioned above.				IS:3386, IS:3833	SR/LB/TR	✓	except test for flatness index elongation index, abrasion value,		
3.4	Water										
i	Test for acidity & alkalinity by using neutralization of water using	Buret, conical flask, pipette etc	B	Testing	One per 3 month for each source.	IS:3025 part 22 and 23 (for test procedure), IS:456 (for acceptance), IS:3025 part 18 (organic), IS:456	SR/LB/TR	✓	100 ml of water should not require more than 5 ml 0.2N NaOH (using		
ii	Tests for ascertaining limit of solids	As per IS Code	B	Physical	One per 3 month for each source.	IS:3025 part 18 (organic), IS:456	SR/LB/TR	✓			
iii	Tests for pH Value	pH meter	B	Testing	One per 3 month for each source	IS:3025, IS:456	SR/LB/TR	✓			
3.5	CONCRETE										
i	Total mix to ascertain the workability and cube strength	After receiving the recommended mix design from specialist agency,	A	Physical	One for each mix proportion	NTPC tech specification	SR/LB	✓	Necessary correction for moisture content and water absorption according to mix design recommendation may be carried out during the trial mix		
ii	Crushing strength (works Tests cubes)	IS:516	A	Physical	One set of 8 cubes per 50 CuM or part thereof for each grade of concrete per shift whichever is earlier.	IS:516, IS:456, NTPC Tech. Spec.	SR/LB/ Test Report	✓	Min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength.		
iii	Workability - slump test	IS:1199	B	Physical	At the time of concrete pouring at site	IS:456/NTPC Tech. Spec.	SR/LB/TR	✓	At the time of concrete pouring at site		
iv	Water content	As per IS:9103	B	Physical	Once per shift	As per approved design mix.	SR/LB	✓	At batching plant		
vi	Admixtures for Concrete	Type of admixture	A	Testing	For each lot received at site	Designed mix and IS:9103	Test Report	✓	Admixture of appld. Brand and tested quality shall be used (each lot of admixture will included with brochure in which the type of admixture and its properties shall be clearly indicated)		
	Complete testing of admixtures	As per IS:9103	A	Physical / Chemical laboratory test	For each approved brand / type of admixture	IS:9103	Test Report	✓	Test report from NTPC acceptable Laboratory for the jointly sampled admixture		
	Suitability and review of MTC		A	Testing	For each lot received at site		SR/LB/TR	✓	Relative density, pH and slump retention on each batch / lot of admixture and to compare these properties with MTC and test report of specialist agency		
3.6	Concrete conveying, placing & compaction										
i	Mixing of concrete	Mixing of concrete shall be done in a approved mixer such as to produce a homogenous mix			To be calibrated at the time of starting and subsequently once in three months, and shall conform to IS:4925	Review of calibration chart/ Certificate, IS 4925		✓			
ii	Arrangement for transportation & placement of concrete.	As required	C	Visual	100%	Before clearance for concreting	Inspection Report	✓			
iii	Calibration of Batching Plant	Batcher should comply with requirement of IS 4925/IS:4925	A	Physical	To be calibrated at the time of starting and subsequently once in three months, and shall conform to IS:4925	Review of calibration chart/ Certificate	Calibration Certificate	✓	Cement consumption at batching plant shall also be obtained through comp. Output. Provision of online printer is mandatory		

TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

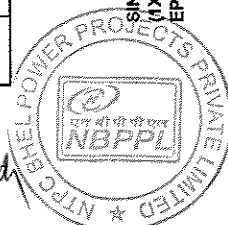
SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

09362

SUPPLIERS NAME AND ADDRESS		INDICATIVE FIELD QUALITY PLAN										ANNEXURE- IV A	
LOGO	ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVA, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	REV. NO. : DATE : PAGE :	0	PROJECT: CONTRACT NO. MAIN CONTRACTOR	Reference Document	Acceptance Norms	Format of Record	Remarks					
Sl. No	Activity and operation	Class of check	Type of Check	Quantum Of check	As per construction/erection methodology (to be approved one week prior to start of work)	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation
I	Handing and Transportation of concrete	As required	Physical	100%	As per construction/erection methodology (to be approved one week prior to start of work)	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	Free fall or drop shall be limited to 150 cm unless permitted. Concrete should be placed within 30 min of its removal from mixure.
IV	Placement of concrete	Visual	Physical	100%	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation	As per construction/erection methodology and tech.specs / No segregation
V	Temperature Control of Concrete for top deck of TGs Foundations.	Thermometer	Physical	100%	Temperature as per technical specification	Temperature as per technical specification	Temperature as per technical specification	Temperature as per technical specification	Temperature as per technical specification	Temperature as per technical specification	Temperature as per technical specification	Temperature as per technical specification	Temperature as per technical specification
vii	Placement	Visual	Physical	100%	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology
viii	Compacting	As required	Physical	At Random	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology	As per approved construction methodology
ix	Curing	As required	Physical	At Random	Period of curing as per IS 456 (use gunny bags / curing compound)	Period of curing as per IS 456 (use gunny bags / curing compound)	Period of curing as per IS 456 (use gunny bags / curing compound)	Period of curing as per IS 456 (use gunny bags / curing compound)	Period of curing as per IS 456 (use gunny bags / curing compound)	Period of curing as per IS 456 (use gunny bags / curing compound)	Period of curing as per IS 456 (use gunny bags / curing compound)	Period of curing as per IS 456 (use gunny bags / curing compound)	Period of curing as per IS 456 (use gunny bags / curing compound)
3.7 TEST/CHECK ON RCC STRUCTURE IN HARDENED CONDITIONS													
i	Ultrasonic test on top deck of TG foundation	IS:13311	Physical	As required by NTPC Engineer	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311
ii	Core Test	IS:516	Physical	As required by NTPC Engineer	IS:516	IS:516	IS:516	IS:516	IS:516	IS:516	IS:516	IS:516	IS:516
iii	Rebound Hammer test	IS:13311	Physical	As required by the NTPC engineer	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311	IS:13311
iv	Dimensional check on finished structures & Dimensional tolerances	As required	Measurement	Approved Drawing	As per IS:456/tech. Specification	As per IS:456/tech. Specification	As per IS:456/tech. Specification	As per IS:456/tech. Specification	As per IS:456/tech. Specification	As per IS:456/tech. Specification	As per IS:456/tech. Specification	As per IS:456/tech. Specification	As per IS:456/tech. Specification
v	Water Tightness Test of liquid retaining structure/tanks	As required	Test	100%	IS:3370/ Tech. Specification	IS:3370/ Tech. Specification	IS:3370/ Tech. Specification	IS:3370/ Tech. Specification	IS:3370/ Tech. Specification	IS:3370/ Tech. Specification	IS:3370/ Tech. Specification	IS:3370/ Tech. Specification	IS:3370/ Tech. Specification
3.8 REINFORCEMENT STEEL													
i	Physical and Chemical Properties for each lot as per relevant IS codes	As required/agreed	Review of MTC	Each batch of delivery	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings
ii	Freedom from cracks surface flaws, Lamination.	As agreed / required	Visual	Random in each shift	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings
3.9 PLACEMENT OF REINFORCEMENT STEEL													
i	Bar bending schedule with necessary lap, Spacers & Chairs	As agreed / required	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	Approved Drawings, Tech Specs and Const. Drawings, IS:2502
ii	Bending of bars, cutting tolerance	As agreed / required	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings
iii	Acceptance - Cover, spacing of bars, spacers and chairs after the reinforcement cage is put inside the	As agreed / required	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings	Approved Drawings, Tech Specs and Const. Drawings
3.10 STAGING AND FORMS													
i	Materials and accessories	As agreed / required	Visual	Once before start of work	As per relevant IS, Tech Specs and Const. Drawings	As per relevant IS, Tech Specs and Const. Drawings	As per relevant IS, Tech Specs and Const. Drawings	As per relevant IS, Tech Specs and Const. Drawings	As per relevant IS, Tech Specs and Const. Drawings	As per relevant IS, Tech Specs and Const. Drawings	As per relevant IS, Tech Specs and Const. Drawings	As per relevant IS, Tech Specs and Const. Drawings	As per relevant IS, Tech Specs and Const. Drawings
ii	Soundness of staging, shuttering and scaffolding including application of mould oil / release agent	As agreed / required	Visual	Once before start of work	As per manufacturer's spec and as per IS:984 4014, 4990, Tech Specs and Const. Drawings	As per manufacturer's spec and as per IS:984 4014, 4990, Tech Specs and Const. Drawings	As per manufacturer's spec and as per IS:984 4014, 4990, Tech Specs and Const. Drawings	As per manufacturer's spec and as per IS:984 4014, 4990, Tech Specs and Const. Drawings	As per manufacturer's spec and as per IS:984 4014, 4990, Tech Specs and Const. Drawings	As per manufacturer's spec and as per IS:984 4014, 4990, Tech Specs and Const. Drawings	As per manufacturer's spec and as per IS:984 4014, 4990, Tech Specs and Const. Drawings	As per manufacturer's spec and as per IS:984 4014, 4990, Tech Specs and Const. Drawings	As per manufacturer's spec and as per IS:984 4014, 4990, Tech Specs and Const. Drawings

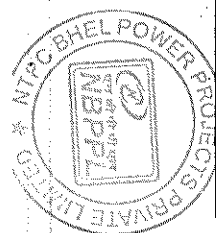
TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

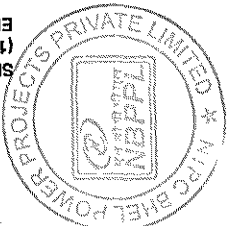
SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE



09363

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN						ANNEXURE-IV A		
		ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	QP NO. : REV. NO. : DATE : PAGE :	Page 6 of 17 0	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	Reference Document	Acceptance Norms	Format of Record	Remarks	
Sl. No	Activity and operation	Characteristics / Instruments	Class of check	Type of Check	Quantum Of check					
1	2	3	4	5	6	7	8	9	10	
iii		Acceptance of formwork before start of concreting	B	Physical / visual	Before start of each concreting	As per provisions and tolerances, Tech Specs and Const. Drawings		SR	✓	
3.11	EMBEDDED PART (INCLUDING LAYING OF RAILS & ANCHOR)									
i		Position / alignment / levels of embedded parts / bolt hole / pipe sleeves / rails / PVC pipes / etc	As agreed / required	B	Physical/ measurement	100%	As per drawing, Tech Specs and Const. Drawings	SR/ Protocol	✓	Exposed surface of the embedded parts other than holding down bolts are to be painted with primer, chlorinated, rubber based zinc phosphate
ii		Welding / tying of embedment to reinforcement	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR		
3.12	PRE-CAST CONCRETE									
i		Crushing strength	compression strength testing machine	A	Physical	one sample of six cubes per 50m m3 or part thereof	IS:516 & IS: 458	SR/LB	✓	A minimum of three specimen shall be tested for 7 and 28 days compressive strength
ii		Workmanship and dimensions	Visual	B	Physical	100%	As per IS:456/NTPC Tech. specification.	Register		
iv		Load Test	As required	B	Physical	2% up to 1000 nos. and 1% for more than 1000 nos. for each type	IS:456/ As decided by NTPC Site Engr. incharge.	Inspection Report	✓	
3.13	JOINTS IN CONCRETE									
i		Joint material - bitumen impregnated fibre board, PVC water stops, Sealing compound, Expanded polystyrene board, Hydrophilic strip, Acrylic polymer etc.	As per manufacturer Standards	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings, IS 1838, IS 1834, IS 12200	MTC	✓	
ii		Acceptance of installation	As agreed / required	B	Acceptance	Each installation randomly	Tech Specs and Const. Drawings			
3.14	DAMP PROOF COURSE									
i		Material - Hot bitumen and water proofing materials etc	As agreed / required	A	Review of MTC	Each batch of delivery at site	Tech Specs and Const. Drawings, IS 702	SR	✓	
ii		Acceptance of damp proof course	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR		
3.15	GROUTING									
i		Material	As agreed / required	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR	✓	
		Type of mix - fluid mix, plastic mix, stiff mix etc.	As agreed / required	B	Physical	Prior to start of work	Tech Specs and Const. Drawings	SR	✓	
ii		Mixing, placement, application and grout pressure	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR		
iii		Compressive strength	As agreed / required	A	Physical	Random in each shift	Tech Specs and Const. Drawings	SR	✓	
iv		Acceptance of the grouts	As agreed / required	B	Physical	Each grout section	Tech Specs and Const. Drawings	SR		
4.00	BRICK MASONRY									
4.1	Test on Bricks									
		Dimensions, shape, compressive strength, water absorption, warpage, efflorescence.	As agreed / required	A	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 nos. or part thereof	IS: 1077, IS:13757, IS: 12854 / Tech Specs and const. Drawings	Inspection Report	✓	Efflorescence shall be checked at each source.
4.2	Test on Mortar									
i		Compressive strength, consistency	As agreed / required	B	Test	At random	IS 2250-1981, Tech Specs and Const.	LB		
ii	Sand	Grading	As agreed / required	B	Test		IS:2116	SR/LB		
4.3	Masonry construction									
		Workmanship, verticality and alignment	As agreed / required	B	Visual/ Physical	100%	IS 2212, IS 1905, Tech Specs and Const. Drawings	SR/LB		





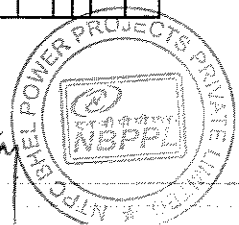
SUPPLIERS NAME AND ADDRESS:	ITEM : CIVIL WORK EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	CLASS OF TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE	RECORD	REMARKS	INDICATIVE FIELD QUALITY PLAN	
								PROJECT: 0	CONTRACT NO.
LOGO	OP NO.: REV. NO.: DATE: PAGE:	5	6	7	8	9	10		
5.00 FINISHING AND ALLIED WORKS									
5.1 PLASTERING- MATERIAL									
i Sand	Detritious Material	B	Physical	Once per source	IS : 2386 (Part-I&II) & IS : 2116, Tech Specs and Const. Drawings	SR			
ii	Grading	B	Physical	50 Cum/or part thereof	IS:1642 & Apprd. drgs, Tech Specs and Const. Drawings	SR	Table -I of IS:2116		
iii Galvanised wire mesh	Galvanised hexagonal wire netting for half plastering	B	Review of MTC/ Test Report	Each batch of delivery	IS:3150 Tech Specs and Const. Drawings	SR			
5.2 PLASTERING - WORKMANSHIP									
i	Curing	C	Physical	100%	Tech specifications, construction drawings and agreed methodology	SR			
ii	Thickness and finishing of plaster, grooves etc	B	Visual/ Measurement	Random in each shift	As per IS 1661 , Tech Specs and Const. Drawings	SR&B			
iii	Thickness of plastering system	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR	Deviation not more than 4 mm when checked with straight edge of 2 m length		
5.3 STONE GROUT PLASTER/ GRANULAR TEXTURED COAT FINISH									
i	Material	B	Approved and review of MTC	For each lot received at site	Tech Specs and Const. Drawings	SR			
ii	Thickness, finishing and grooves etc	B	Visual/ Measurement	Random in each shift	Tech Specs and Const. Drawings	SR			
6.00 SHEETING AND OTHER WORKS									
6.1 PAINTING SYSTEM - CONCRETE WORKS AND PLASTERED MASONRY SURFACES									
6.1.1 PAINTING SYSTEM - STEEL WORKS									
i	Painting Materials and accessories	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR&MTC	Mfr.'s T.C. shall be correlated with the consignment received.		
ii	Surface preparation	C	Physical/ Visual	Random in each shift	IS:2935 (Part - I), Tech Specs and Const. Drawings	SR			
iii	Acceptance of painted surfaces	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR			
6.1.1 PAINTING SYSTEM - STEEL WORKS									
i	Painting Materials and accessories	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR&MTC	Mfr.'s T.C. shall be correlated with the consignment received.		
ii	Substitution of painting methodology	B	For Review of painting system work	Before start of painting	Tech Specs and Const. Drawings	SR			
iii	Surface preparation	B	Measurement/ Physical/ Visual	Each Erection Mark	Relevant codes/ standards	SR			
iv	Primer Thickness	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR			
v	DFT of paint	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR			
vi	Acceptance of painted surfaces	B	Visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR			
6.2 Modular treated panel	As required	A	Review of test report	Each batch of delivery	Tech Specs and Const. Drawings	SR&LR			
6.3 Permanently colour coated sheets , metal decking	As agreed / required	B	Visual	Random in each shift	Tech Specs and Const. Drawings	SR	Prevention of distortion / bleaching / water staining		

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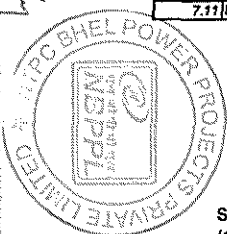
Sl. No.	SUPPLIER'S NAME AND ADDRESS	INDICATIVE FIELD QUALITY PLAN					ANNEXURE-IV A			
		ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INV. FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	GP NO. : REV. NO. : DATE : PAGE :	Quantum of check	Type of Check	Acceptance Norms	Format of Record	Remarks		
1	2	Characteristics / Instruments	Class of check	5	Visual/Physical	Random in each shift	SR	No gas cutting of sheets acceptable. PQR for structural steel shall also be applicable.		
ii		Installation, lap, alignment, workmanship.	B		Visual/Physical	Random in each shift	SR	Experienced workers under supervisors recommended/appointed by manufacturer to be deployed		
iii		Finishing and acceptance	B		Visual/Physical	Random in each shift	SR	All tests as per specification		
6.4	INSULATION WORKS									
i	Material	Insulation material, galvanised wire net, aluminium foil, fasteners	A		EIC Approved source and review of MTC test reports	For each lot received at site	SR / LB	From approved source / fabricated as per MQP		
ii		Acceptance of each type of installation	B		Visual/Physical	Each installation	SR / LB			
6.5	PRE-ENGINEERED BUILDING									
i	Installation and acceptance	As agreed / required	A		EIC Approved source and review of MTC test reports	For each building	SR / LB			
7.00	DOORS, WINDOWS VENTILATORS & GRILL									
7.1	Steel doors									
i	Materials (MS sheet, fasteners, hinges, jambs, lock strike plate etc)	As agreed / required	A		Visual/Physical test report	For each lot received at site	SR / LB	Review of test report		
ii	Flush Door shutters, teak boarding	As agreed / required	A		EIC Approved source and review of MTC test reports	For each lot received at site	SR	Review of test report		
iii	Hollow metal doors (material and dimensions)	As agreed / required	A		Visual/Physical test report	For each lot received at site	SR	Review of test report		
iv	Acceptances	As agreed / required	B		Visual/Physical test report	Random	SR / LB			
7.2	Anodised aluminium works									
i	Materials-Aluminium sections, alkali res	As agreed / required	A		Visual/Physical test report	For each lot received at site	SR / LB	Review of test report		
ii	Particle Door	As agreed / required	A		EIC Approved source and review of MTC test reports	For each lot received at site	SR	Review of test report		
iii	Acceptance	As agreed / required	B		Visual/Physical test report	Random	SR			
7.3	Fire proof doors									
i	Source of supply	As agreed / required	A		Review of purchase order (unpriced copy) / drawings of suppliers / certificate of CBRI	For each source	SR	Procured from Approved parties as per relevant IS/Tech. The door drawing proposed for supply should have been tested and approved by CBRI Rookies for the similar dimensions for minimum 2 hours fire rating.		
ii	Receipt inspection	As agreed / required	A		Visual/Physical test report	For each lot received at site	SR			
iii	Finishing and acceptance	As agreed / required	B		Visual/Physical test report	Random	SR			
7.4	Rolling shutters									
i	Surface finish and thickness of plate of approved make and DFT	As agreed / required	A		Physical / visual / review of MTC	Random for each lot of delivery	SR			
ii	Finishing and acceptance	As agreed / required	B		Physical and acceptance	Random	SR			

TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE



SUPPLIERS NAME AND ADDRESS:		INDICATIVE FIELD QUALITY PLAN				ANNEXURE- IV A			
LOGO		ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	QIP NO. : REV. NO. : DATE : PAGE :	Page 9 of 17 0	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / Instruments	Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3	4	5	6	7	8	9	10
7.5	Steel windows / Grills/ Louvre								
i		Material fabrication and fixtures	As agreed / required	A	Physical / visual / review of MTC	Each lot of delivery	IS: 1038 / IS:1361, IS: 7452 and Tech Specs and Const. Drawings	SR	✓
ii		Finishing and acceptance	As agreed / required	B	Visual / physical	Random	IS: 1038 / IS:1361, IS: 7452 and Tech	SR	✓
7.6	Glass and glazing								
i	Clear float glass, wired glass, tinted glass, curtain glass, hermetically sealed glass	Material	As agreed / required	B	EIC Approved source and review of MTC/ test reports	For each lot received at site	IS: 14900, IS:1081, IS: 3548, IS:5437 Tech Specs and Const. Drawings	SR	✓
ii		Installation finishing and acceptance	As agreed / required	B	Visual/ Physical	Random	Tech Specs and Const. Drawings	SR	Leak proof installation with neoprene gasket
7.7	Curved dome on roof/ Poly Carbonate Sheet								
i	Source of supply	Impact strength, K value, light transmission value with class-I fire rating	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings	SR	✓
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings	SR	
7.8	Reflective toughened glass								
i		Material	As agreed / required	A	Review of MTC	For each lot received at site	Tech Specs and Const. Drawings	SR	✓
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings	SR	
7.9	False Ceiling								
i		Materials (gypsum glass, glass fibre membrane, fibre board acoustical files etc)	As agreed / required	A	Visual / physical / MTC	For each lot received at site	IS:2095, IS:8183, Tech Specs and Const. Drawings	SR	✓ Compare MTC with technical specification and requirement
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings	SR	
7.10	WATER PROOFING								
		Methodology for the application of water proofing system	As required	B	Review	for each type of treatment	Tech Specs and Const. Drawings	SR	✓ Experienced workers under supervisors recommended/ appointed by manufacturer to be deployed
7.10.1	General Requirement- Water Proofing								
	Polyurethane based coating, polyester scrim cloth, extruded HD dimpled polyurethane	Material	As agreed / required	A	EIC Approved source and review of MTC/ test reports	For each lot received at site	ASTM C-836, ASTM C898 and Tech Specs /Const. Drawings	SR	✓ MTC shall contain all the parameters specified in the technical specifications
ii		Acceptance of water proofing work	As agreed / required	B	Physical	100%	ASTM C898, Tech Specs and Const. Drawings		
7.10.2	Roof / Basement Treatment								
i	Graded under bed	Levels / slopes	As required	C	Physical	100%	Tech Specs and Const. Drawings		
ii	Elastomeric coatings	Material- Primer coat, finishing coat	As required	B	EIC Approved source and review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR	✓
iii	Wearing course	Materials - PCC, chicken wire mesh, elastomeric sealant	As required	B	Review of MTC	Each lot of delivery	Tech Specs and Const. Drawings	SR	✓
iv		Acceptance of water proofing work	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings		
7.11	Fencing and Gates								



SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

09366

09367

LOGO	SUPPLIER NAME AND ADDRESS	INDICATIVE FIELD QUALITY PLAN										ANNEXURE-IV A	
		ITEM : CIVIL WORK	Q.P. NO. :	REV. NO. :	DATE :	PROJECT :	CONTRACT NO.	Reference Document	Acceptance Norms	Format of Record	Remarks		
		SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	0										
		Characteristics / Instruments	3	4	5	6	7	8	9	10			
		Activity and operation											
		PVC coated chain link fencing (IS 2720), Welded wire mesh (IS 1586), Reinforced barbed type galvanised (IS 2829) etc.		A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC			MTC shall contain all the parameters specified in the technical specifications		
		Structural steel, painting in system, castor wheel, ball and bearing, fasteners and fasteners		A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC			MTC shall contain all the parameters specified in the technical specifications		
		Alignments, erection painting, DFT etc.		B	Physical / measurements	Each installation	Tech Specs and Const. Drawings	SR					
		Acceptance of the installation and working		B	Physical / measurements	Each installation	Tech Specs and Const. Drawings	SR					
		FLOOR FINISHES AND ALLIED WORKS											
		Cement Concrete Flooring		B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR					
		Glaze/PVC strips in joints		B	Physical	100%	Tech Specs and Const. Drawings	SR					
		Finishing and acceptance		B	Physical	100%	Tech Specs and Const. Drawings	SR					
		7.12.2 Tiles											
		Ceramic, vitrified, glass mosaic, acid alkali resistant, heavy duty cement concrete tiles		A	EIC Approved source and review of MTC/ test reports	Each lot of delivery	IS:13755, IS:1237, IS:8042, Tech Specs and Const. Drawings	SR			MTC shall contain all the parameters specified in the technical specifications		
		Finishing and acceptance		B	Physical	100%	IS: 1443, Tech Specs and Const.	SR					
		7.12.3 Interlocking Blocks											
		Materials		A	EIC Approved source and review of MTC/ test reports	Each lot of delivery	BS:5717, Tech Specs and Const. Drawings	SR			MTC shall contain all the parameters specified in the technical specifications		
		Finishing and acceptance		B	Physical	100%	BS:7533 (P13), Tech Specs and Const.	SR					
		7.12.4 Kota Stone, Granite and Marble											
		Quality, texture, thickness, colour for each lot of delivery from approved source		B	Physical	Each batch of delivery	Tech Specs and Const. Drawings	SR					
		Finishing and acceptance		B	Physical	100%	Tech Specs and Const. Drawings	SR					
		7.12.5 Metallic / non-metallic hardener											
		Material		B	Physical	Each batch of delivery	Tech Specs and Const. Drawings	SR					
		Finishing and acceptance		B	Physical	100%	Tech Specs and Const. Drawings	SR					
		7.12.6 Acid / alkali and oil resistant high built seamless epoxy based resin and treatment											
		Bricks, vitreous tiles, mortar, sealing, paints, coatings, sheets, filers etc		A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR			Experienced workers under supervisors recommended/appointed by manufacturer to be deployed		
		Material		B	Physical	Random in each shift	Tech Specs and Const. Drawings, IS	SR			DFT minimum 300 microns		
		Surface preparation		B	Physical	100%	Tech Specs and Const. Drawings	SR					
		Finishing and acceptance		B	Physical	100%	Tech Specs and Const. Drawings	SR					
		7.12.7 Rubber Flooring											
		Material		A	EIC Approved source and review of MTC/ test reports	Each batch of delivery	IS:809, Tech Specs and Const. Drawings	SR			MTC shall contain all the parameters specified in the technical specifications		
		Finishing and acceptance		B	Physical	100%	Tech Specs and Const. Drawings	SR					
		7.13 Doors/Windows Sections											

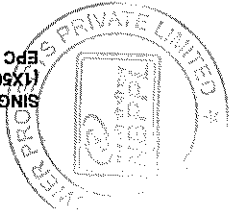
TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

INDICATIVE FIELD QUALITY PLAN										ANNEXURE- IV A	
LOGO	SUPPLIERS NAME AND ADDRESS:		ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.				PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR		Page 11 of 17		
	Sl. No	Activity and operation	Characteristics / Instruments	Class of check	Type of Check	Quantum Of check	Acceptance Norms	Format of Record	Remarks		
	1	Material - Rolled Steel Z Sections, T-iron frames sections, Pipes etc.	Review of MTC/ make / Physical checks, tests (If MTC is not available) Acceptance of Steel Glazed doors and T-iron frames sections after being	4 A B	3 Review of MTC for each delivery Physical and acceptance	5 For each batch of delivery Random for each Installation	7 Tech Specs and Const. Drawings Tech Specs and Const. Drawings	8 SR SR	10 ✓ ✓		
	8.0 WATER SUPPLY / SANITORY INSTALLATIONS										
	8.1 Water supply fittings and fixtures										
	i	Materials	GI/MS pipes and fittings	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	IS:1239, IS:4738, IS:8745, IS:2633, IS:2829, Tech Specs and Const. Drawings	SR	✓		
	ii	Disinfection Before use	As agreed / required	B	Physical	Each installation	IS:2055, tech specs and const drawings	SR	✓		
	iii	Hydraulic test	As agreed / required	A	Physical	Each installation	Tech specs and const drawings	SR	✓		
	iv	Acceptance and working	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings	SR			
	8.2 Sand cast iron / cast Iron pipes										
	i	Material	SCJ / CI pipes and fittings / joints	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	IS: 1728, IS:1536, IS:1538, Tech Specs and Const. Drawings	SR	✓		
	ii	Material	Acceptance and leakage	B	Physical	Random	Tech Specs and Const. Drawings	SR			
	8.3 Sanitary fittings and fixture										
	i	Material	Sanitary items and fixtures i.e. water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap containers, geyser, water cooler, etc. water supply / sanitation pipes, manhole cover and frames etc	B	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR	✓		
	ii	Material	Acceptance of installations of all sanitary items and fixtures	B	Acceptance	100%	Tech Specs and Const. Drawings	SR			
	8.2 RCC Pipes										
	i	Material	RCC pipes	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	IS: 488, Tech Specs and Const. Drawings	SR	✓		
	ii	Material	Acceptance and leakage	B	Physical	Random	Tech Specs and Const. Drawings	SR			
	8.3 Water Storage Tanks										
	i	Material	Over head / lift type	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	IS:12701, Tech Specs and Const. Drawings	SR	✓		
	ii	Material	Acceptance and leakage	B	Acceptance	Random	IS:12701, Tech Specs and Const. Drawings	SR			
	9.0 SPECIAL ITEMS										
	9.1 Earthing Mat (Grounding System)										
	i	Material	Earthing mat	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs / Manufacturers, IS 3043	SR/MTC	✓		
	ii	Material	Weild size & length	B	Visual/ Measurement	100%	Tech Specs and Const. Drawings		Low hydrogen electrode as per NTPC approval shall be used.		
	iii	Material	D.P test	A	Physical	10% at random	Tech Specs and Const. Drawings	TR	✓		

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Sl. No	Activity and operation	Characteristics / Instruments	Class of check	Type of Check	Quantum Of check	7	8	9	10	
iv	Earth test	Earth test kit	A	Physical	100%	IS:3043, Tech Specs and Const.	SR	✓		
9.2	Bitumen layer for tank foundation									
i	Material	Grade of bitumen	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	IS :73, As per relevant IS and Tech. Specs /MTC	SR/MTC	✓	
ii	Acceptance and workmanship	Application / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR		
9.3	Composite Aluminium Panels and structural glazing									
i	Material	Type of aluminium panels / structural glazing / fasteners and fixtures / silicon sealant	As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	Technical specifications / drawings	SR/MTC	✓	MTC shall cover all the properties / parameters as per technical specifications
ii	Acceptance and workmanship	Installation / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR		
9.4	Pressure Release Valves									
i	Material		As agreed / required	A	EIC Approved source and review of MTC/ test reports	Each lot of delivery as per Specifications	IS: 4558, Technical specifications / drawings	SR/MTC	✓	
ii	Acceptance and workmanship	Acceptance / Installation / workmanship	As agreed / required	B	Physical	Random	IS:4558, Tech Specs and Const. Drawings	SR		
10.0	ANTI WEED TREATMENT									
i	Anti-weed treatment materials	As agreed / required	A	Physical and MTC Review	Each batch of delivery	Tech Specs and Const. Drawings	SR	✓		
ii	Execution of treatment	As agreed / required	B	Physical	Random check for each treatment	Tech Specs and Const. Drawings	SR			
11.0	PILING WORK									
11.1	Execution									
i	100 mm Dia Borehole	As required	A	Physical	100%	NTPC Tech. Specs	SR/LB	✓		If carried out by the contractor
ii	Pile layout	Total station	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	✓		
iii	Recording ground level	As required	B	Measurement	Random	IS:2911, as per appd. Drawings and technical specification	SR/LB	✓		
iv	Cleaning/Flushing of pile bore	As required	B	Visual	Random	As per appd. Drawings and technical specification	SR/LB	✓		
v	Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	✓		
vi	Trial mix to ascertain the workability and cube strength	After receiving the recommended mix design from specialist agency.	B	Physical	One for each mix proportion	NTPC tech specification	SR/LB	✓		Necessary correction for moisture content and water absorption according to mix design recommendation may be carried out during the trial mix
vii	Cement content	As required	B	Physical	Once per shift	As per approved design mix.	SR/LB	✓		At batching plant
viii	Pouring of concrete to project above cutoff level.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	✓		
ix	Pile termination level	SPT & core recovery	A	Soil data	As per NTPC specifications	As per appd. Drawings and technical specification	SR	✓		

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SINGAPORE STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

LOGO	SUPPLIERS NAME AND ADDRESS	ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVY, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	INDICATIVE FIELD QUALITY PLAN					ANNEXXURE- IV A		
			Q.P. NO. : REV. NO. : DATE : PAGE :	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
			5	6	7	8	9	10		
1	Activity and operation	Characteristics / Instruments	4	5	6	7	8	9	10	
11.2	Testing	Bentonic	IS:2720	Physical / testing	Once per source	As per IS:2720 / tech. Specs.	SRLB	✓	Review of test report	
II		Density check on sample of mud collected from pile bore bottom	Sample collection	A	Physical	As per Tech. Spec.	SRLB	✓	Tests to be done before placing concrete. Samples to be collected from pile bore bottom	
III		Slump test of concrete	IS:1199	Physical	Every 2 hrs at pouring point of concrete	IS:2911, As per appd. Drawings and technical specification	SRLB	✓		
IV		Cube sampling for works cube test	IS:456	Physical	One set of 6 cubes per 50 Cum of part thereof for each grade of concrete per shift which ever is earlier.	IS:2911, As per appd. Drawings and technical specification	SRLB	✓		
V		Initial pile load test, Vertical (Compression), Lateral (horizontal) and pullout (tension).	IS:2911 / as required	A	Testing	100% for 3 nos. for each type or as specified in BOC / Tech. Spec.	SRLB	✓	In case of compression test method the loading shall be cyclic.	
VI		Routine pile tests, compression and horizontal	Calibrated dial gauges etc. as required.	A	Testing	100% for 0.5% of the total number of piles provided for each type of test/Tech. Spec.	SRLB	✓	Routine Test shall be conducted by direct loading method.	
VII		Integrity Tests	PEM	A	Testing	100% test/Tech. Spec.	Test	✓	CMP	
12.0	FOUNDATION SYSTEM									
12.1	SHALLOW FOUNDATIONS									
I		Foundation excavation - Location, Layout, size, depth etc	As required / agreed	Physical	Each location	As per technical specifications and construction drawings	SR		Lines and levels to be checked	
II		Foundation casting - Layout, Shape, dimensions, Reinforcement, concreting, curing etc	As required / agreed	Physical	Each foundation	As per technical specifications and construction drawings	SR		Lines and levels to be checked. Concrete Grade to be checked as per Mix Design	
13.0	ROAD WORKS									
13.1	Construction of Sub-Grade and earthenward shoulders									
I		Standard proctor Test	As per IS: 2720	Physical	One in every 2000 cum of fill materials	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 2720 (P.IV)	SR/TR	✓	In cutting or existing levelled ground - quantity of check shall be one per 1000 SGM	
II		Moisture content of fill before compaction	As per IS: 2720	Physical	One in every 2000 cum of fill materials	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 2720 (P.IV)	SR/TR	✓	In cutting or existing levelled ground - quantity of check shall be one per 1000 SGM	
III		Dry density by core cutter method OR Dry density in place by sand displacement method	As per IS: 2720	Physical	One in every 500 SQM of compacted layer	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 2720 (P.IV)	SR/TR	✓	Both for embankment and cut formation quantity of check - One in every 1000 SGM areas for each compacted layer.	
IV		Lies, grade and cross section	As required / agreed	Physical	One in every 500 SQM area	As per Tech Specs and Const. Drawings	SR		Template, straight edge	
13.2	Water Bound Macadam (Non-Bituminous) for base course and sub-base course	Aggregate Impact value	Aggregate Impact value	Physical	One test per 200 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 2720 (P.IV)	SR	✓		
I		Grading	Set of IS Sieves	Physical	One test per 100 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 2720 (P.IV)	SR			
III		Flakiness test gauge	Flakiness test gauge	Physical	One test per 200 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 2720 (P.IV)	SR			

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Logo	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN				ANNEXURE- IV A				
		ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	QP NO. : REV. NO. : DATE : PAGE :	Page 14 of 17 0	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	Reference Document	Acceptance Norms	Format of Record	Remarks	
Sl. No	Activity and operation	Characteristics / Instruments	Class of check	Type of Check	Quantum Of check	7	8	9	10	
iv		Atterberg Limits of binding material	Atterberg limits determination	A	Physical	One test per 25 cum of binding material	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification.	SR	✓	
v		Atterberg Limits of portion of aggregate passing 425 micron sieve	Atterberg limits determination	A	Physical	One test per 100cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification.	SR	✓	
vi		Camber, surface, slope	As required / agreed	B	Physical	One in every 500 SQM area	As per Tech Specs and Const. Drawings	SR		Template, straight edge
13.3	Bituminous Macadam for base and binder course									
i		Quality of binder	Penetrometre with St. needle	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as applicable	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification, IS 73	SR	✓	
ii		Aggregate Impact Value / Los angeles abrasion value	Aggregate Impact Value Test apparatus	A	Physical	Once per source	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	✓	
iii		Flakiness Index and elongation index of aggregates	Flakiness test gauge	B	Physical	One test per 50 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		
iv		Shrinkage value of aggregate (Immersion tray test)	As required / agreed	B	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		
v		Water sensitivity of mix	As required / agreed	A	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	✓	
vi		Grading of aggregates	Set of Sieves	B	Physical	Two test per day per plant both on individual constituents and mixed aggregate from dryer	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		
vii		Water absorption of aggregate	As required / agreed			Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		
viii		Soundness (Magnesium and Sodium Sulphate)	As required as per IS:2386	A	Physical	Once per source by each method and on every change of source	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	✓	
ix		Percentage of fractured faces	As required / agreed	B	Physical	When gravel is used one test per 50cum of aggregates	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		
x		Binder content and aggregate grading	Bitumen extractor	A	Physical	Periodic, subject to a min of two tests per day per plant	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	✓	
xi		Control of Temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling	Thermometer	B	Physical	At regular close intervals	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		
xii		Rate of spread of mixed materials	As required / agreed	B	Physical	Regular control through checks of layer thickness	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR		
xiii		Density of compacted Layer	As required / agreed	A	Physical	One test per 250 sqm of area	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	✓	
13.4	Bituminous Surfacing - Open graded premix carpet and Seal coat									
i		Quality of binder	Penetrometre with St. needle	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as	IS 73, Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	✓	

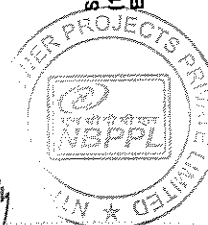
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INDICATIVE FIELD QUALITY PLAN										ANNEXURE- IV /A		
LOGO	SUPPLIERS NAME AND ADDRESS:	ITEM : CIVIL WORK SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	REV. NO. : DATE : PAGE :	Year 15/01/17 0	Quantum Of check	PROJECT: PACKAGE: CONTRACT NO. MAIN CONTRACTOR	Acceptance Norms	Format of Record	Remarks			
Sl. No	Activity and operation	Characteristics / Instruments	Class of check	Type of Check	Quantum Of check	Reference Document	8	9	10			
i	2	3	4	5	6	7	8	9	10			
ii		Aggregate Impact Value / Los angles abrasion value	A	Physical	One test per 50 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR	✓			
iii		Flatness Index and elongation Index of aggregates	B	Physical	One test per 50 cum of aggregate	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR				
iv		Shaping value of aggregate (Immersion tray test)	B	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR				
v		Water absorption test	A	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR	✓			
vi		Water sensitivity of mix	A	Physical	Initially one set of 3 representative specimen per source, and on every change of source.	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR	✓			
vii		Grading of aggregates	B	Physical	One test per 25 cum of aggregates	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR				
viii		Soundness (Magnesium and Sodium Sulphate)	A	Physical	Once per source by each method and on every change of source	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR	✓			
ix		Polished stone value	B	Physical	As required	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR				
x		Temperature of binder at application	B	Physical	At regular close intervals	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR				
xi		Binder content	A	Physical	One test per 500 cum & not less than two tests per day	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR	✓			
xii		Rate of spread of materials	B	Physical	One test per 500 cum and not less than 2 tests per day	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR				
xiii		Percentage of fractured faces	A	Physical	When gravel is used one test per 50cum of aggregates	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR	✓			
13.5	Tack Coat/ Prime coat/ fog coat											
i		Quality of binder	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:9887 as	IS 73, Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR	✓			
ii		Temperature of binder at application	B	Physical	At regular close intervals	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR				
iii		Rate of spread of binder	B	Physical	One test per 500 cum and not less than 2 tests per day	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR				
13.6	RCC Pavements	Concrete - Material, Mix design, Trial Mixes, Production, Transportation, Placement, Compaction, Curing, Test on green concrete, Test on hardened concrete etc.			Refer FQP for concrete Works	Refer FQP for concrete Works, Tech Specs and Const. Drawings, IRC & MOST			FQP for Concrete Works shall be application for all concrete works			
13.7	Alignment, Level, Surface regularity and rectification											
i		Horizontal alignment, Surface levels and Surface regularity	B	Physical	As per section 900 of MOSRTH specification	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	SR				

TECHNICAL SPECIFICATION
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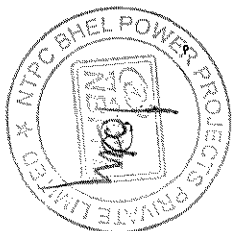
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i	2	3	4	5	6	7	8	10
ii	Rectification	As required / agreed	B	Physical	Each rectification	As per Tech Specs and Const. Drawings, Section 900 of MOSRTH specification	SR	✓
14.0	GEOTECHNICAL INVESTIGATION WORK							
14.1	Deployment of approved Geotechnical Investigation Agency - Equipments, Manpower etc	As required / agreed	A	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes	SR	✓
14.2	Execution of Geotechnical investigation locations, type etc as per scheme	As required / agreed	B	Physical	Each Location	As per technical specifications and relevant IS Codes	SR	✓
14.3	Collection of disturbed and undisturbed samples, their packing and storage	As required / agreed	B	Physical	each sampling	As per technical specifications and relevant IS Codes	SR	
14.4	Conducting filed tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc	As required / agreed	B	Physical	each field test	As per technical specifications and relevant IS Codes	SR	
14.5	Submission of Field Borings in approved format	As required / agreed	B	Review	Within 24 hours after completion of each BH	As per technical specifications and relevant IS Codes	SR	✓
14.6	Submission of laboratory test schedule and selection of samples for laboratory testing	As required / agreed	A	Review and acceptance	as per consultation with engineer during dispatch of samples to approved laboratory	As per technical specifications and relevant IS Codes	SR	✓
14.7	Submission of Final Geotechnical investigation report along with recommendations	As required / agreed	B	Physical	After completion of investigation work and review of draft reports	As per technical specifications and relevant IS Codes		✓
15.0	SLIPFORM SHUTTERING FOR CHIMNEY							
i	Submission of Slipform Work system to be used		B	Submission	Before Commencement of work	As per specifications	SR	
ii	Check for the Slipform shutters	As required	B	Physical	Before Commencement of work	As per specifications	SR	Check for water level system, Controls, Walkways etc.
iii	Details Positions and arrangement of Jack rods		B	Approval	Before Commencement of work	As per specifications	SR	Submitted to Engineer for approval
iv	Details of Proposed arrangement for continuous readings		B	Approval	Before Commencement of work	As per specifications	SR	Submitted to Engineer for approval
v	Check for All type of openings, Chases, Fixing of Blocks and similar built-up features	As required	B	Physical	100% during execution	Construction Drawings and specifications	SR	No any type of openings, chases, blocks other than shown in the construction drawings or approved by Engineer shall be executed in the concrete
vi	Details of proposed method for concrete curing and protection		B	Approval	Before Commencement of work	Construction Drawings and specifications	SR	Submitted to Engineer for approval
vii	Check of Concrete Curing and Protection	As required	B	Physical	At Random	Construction Drawings and specifications	SR	Concrete shall not remain uncured for period longer than 12 hours Rate of Sliding, Delays in Sliding, Discontinuity or stop strat siding to be checked
viii		As required	B	Physical	Each Sliding	As per specifications	SR	
ix	Monitoring of Sliding Portion Progress Height	As required	B	Physical	Six hourly intervals	As per specifications	SR	To be recorded in tabular form and on graphs immediately after each monitoring
x	Centre line in relation to the centers at the base	As required	B	Physical	Six hourly intervals	As per specifications	SR	✓ To be recorded in tabular form and on graphs immediately after each monitoring
xi	Internal wall faces in relation to the concrete at the base	As required	B	Physical	Six hourly intervals	As per specifications	SR	To be recorded in tabular form and on graphs immediately after each monitoring

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1	2	3	4	5	6	7	8	9	10	
xii	Wall thickness	As required	B	Physical	Six hourly intervals	As per specifications	SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring	
xiii	Twist	As required	B	Physical	Six hourly intervals	As per specifications	SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring	
16.0 Chimney Painting										
i	Requirements for Steel Surfaces	As Required	B	Physical	Randomly	Technical Specifications (Part-3, Module-7, CI-4.01.00), Relevant IS Codes & construction drawings	SR		No of Coats applied and DFT/WFT to be checked as per specified	
ii	Requirements for Cast Iron Surfaces	As Required	B	Physical	Randomly	Technical Specifications (Part-3, Module-7, CI-4.02.00), Relevant IS Codes & construction drawings	SR		No of Coats applied and DFT/WFT to be checked as per specified	
iii	Requirements for Concrete Surfaces	As Required	B	Physical	Randomly	Technical Specifications (Part-3, Module-7, CI-4.03.00), Relevant IS Codes & construction drawings	SR		No of Coats applied and DFT/WFT to be checked as per specified	
iv	Material Requirements	As Required	B	Physical	Randomly	Technical Specifications (Part-3, Module-7, CI-5.00.00), Relevant IS Codes & construction drawings	SR		requirement of DFT to be checked as per Specifications. Procurement to be done from approved/acceptable manufactured source	
v	Preparation of Surfaces	As Required	B	Physical	Randomly	Technical Specifications (Part-3, Module-7, CI-7.00.00), Relevant IS Codes & construction drawings	SR			
vi	Application of Paint	As Required	B	Physical	Randomly	Technical Specifications (Part-3, Module-7, CI-8.00.00), Relevant IS Codes & construction drawings	SR		As per recommendations by Manufacturer along with Relevant IS Codes and Specification requirements	
vii	Hot Dip Galvanising	As Required	B	Physical	Randomly	Technical Specifications (Part-3, Module-7, CI-9.00.00), IS 2629, IS 6159 &	SR			
LEGEND: D* Records, identified with "Tick" (✓) shall be essentially included by supplier in QA documentation. Legend to be used: Class #: A = Critical, B=Major, C=Minor; SR, TR, MTC, LB Categorization Witnessing & Accepting (As per NTPC QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report, MftrTC = Manufacturer's Test Certificate						DOC. NO.: CS - Project Code - XXX-X-QVC-G-001 REV: 0 NTPC For NTPC USE				
Signature		This document shall be read in conjunction with NTPC Tech. Specifications, BOQ, Drawings				REVIEWED BY	APPROVED BY	APPROVAL SEAL		



SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI, PART-B
FIELD QUALITY PLAN
SUB-SECTION-E-118

09374

093-75

LOGO		SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN										ANNEXURE-IV B				
			ITEM : STRUCTURAL STEEL WORK		QIP NO. : 1.0.7		PROJECT: PACKAGE: CONTRACT NO.		SUB-SYSTEM : FABRICATION & ERECTION		DATE : PAGE :						
			Characteristics / Instruments		Class# of check	Type of Check	Quantum Of check	MAIN CONTRACTOR Reference Document	Acceptance Norms	Format of Record	Remarks						
Sl. No	Activity and operation																
1	2		3	4	5	6	7	8	9	10							
1.00	STRUCTURAL STEEL MATERIAL																
i	Issued by NTPC	Material Visual Examination, Identification and marking for grade/type of steel	B	Visual	Each plate/ Section	Tech Specs and Const. Drawings											MS steel conforming to IS 2062 and IS 8500 to be clearly demarcated by application of distinct coloured paint stripes on each piece/ off-cuts of respective grades/ type of steel.
ii		Structural steel procured from NTPC approved sources- Mechanical (YS, UTS, Elg, UT if specified), and Chemical properties (CE as per IS)	A	Review	For each batch of each section delivered at site	Technical Specification and Construction Drawings, IS 2062, 8500		SR	✓								Correlated MTC shall be verified. In the event of non submission of MTC sample shall be selected by FQA for testing
1.01	PRE-WELDING REQUIREMENTS																
i		Welding Procedure Specification (WPS*)	A	Review	Each Welding Process	Technical Specification and Construction Drawings, ASME-IX/ AWS D 1.1		WPS	✓								*To be approved by COA
ii		PQR and Welder's Qualification	A	Physical	Each welder	PQR/ WQR, AWS-D1.1/ASME-IX, Technical Specification and Construction Drawings		Test Report	✓								
iii		Welding consumables	B	Physical	Random in each shift	Approved WPS, Latest NTPC Rationalized		SR	✓								
1.02	FIT-UP																
i		Marking and Cutting	B	Visual & Measurement	Each plate/ Section	Technical Specification and Construction Drawings/ Approved cutting plan		SR									
ii		Match markings for trial assembled components	B	Physical	Each fit-up	Technical Specification and Construction Drawings		SR									
iii		Weld Fit Up- Edge Preparation/ Gap/ Alignment	B	Physical	Each fit-up	Technical Specification and Construction Drawings, IS 7215		SR	✓								If required suitable stiffeners shall be provided to prevent deflection.
1.03	PRE HEATING (wherever applicable)																
i		Pre-Heating Temperature	B	Measurement	Each pre-heating	Technical Specification and Construction Drawings, Approved WPS		SR	✓								
ii		Post Weld Heat Treatment (PWHT), if required	A	Time & Temperature	Each PWHT	Technical Specification and Construction Drawings, Approved WPS		SR	✓								

TECHNICAL SPECIFICATION
SECTION-VI, PART - B
FIELD QUALITY PLAN
SUB-SECTION-E-118

SINGRAULI STPP STAGE-III
(1X500 MW)
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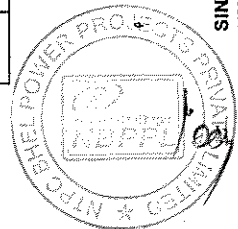


09376

INDICATIVE FIELD QUALITY PLAN										ANNEXURE-IV B	
LOGO	SUPPLIER'S NAME AND ADDRESS	ITEM : STRUCTURAL STEEL WORK			PROJECT:		CONTRACT NO.				
		SUB-SYSTEM : FABRICATION & ERECTION			REV. NO. :	2.47	0	MAIN CONTRACTOR			
SL No	Activity and operation	Characteristics / Instruments	Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks	
								7	8		
1	2	3	4	5	6	7	8	9	D-10		
1.04	WELDING REQUIREMENTS										
i	Sequence of welding		B	Physical	Random in each shift		Technical Specification and Construction Drawings, Agreed scheme	SR			
ii	Removal/ grinding of temporary attachments		B	Measurement	All cleats/ attachments	Technical Specification and Construction Drawings, Approved Drg.	Construction	SR			
iii	Completeness after welding- Dimensions/ distortion	Weld gauge	B	Visual	Each structure component	Technical Specification and Construction Drawings, IS 822		SR	✓		
2.00	NON DESTRUCTIVE AND DESTRUCTIVE TESTING										
2.1	FILLET WELDS										
i	size and visual examination	As required/ agreed	B	Visual/ Measurement	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR		As per requirement of NTPC Engineer	
ii	Macro-etch Examination on production test coupons	As required/ agreed	B	Physical	Main fillet weld with min one joint per built up beam, columns and crane girders	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR	✓		
iii	Dye Penetration Test		B	Physical	25% weld length of tension member of crane girder and 5% of weld length with min. 300mm at each location except crane girder to all other fillet welds	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR			
2.2	BUTT WELDS										
i	Visual examination	As required/ agreed	B	Visual	Random in each shift	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR		As per requirement of NTPC Engineer	
ii	DPT	As required/ agreed	B	Physical	On all butt welds after back gouging.	As per technical specifications and construction drawings, IS 822, AWS D 1.1		IR		All butt welds to be back gouged before DPT	

TECHNICAL SPECIFICATION
SECTION-VI, PART - B
FIELD QUALITY PLAN
SUB-SECTION-E-118

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

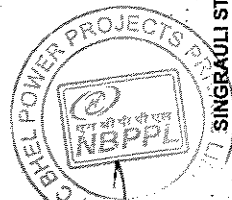


09377

LOGO	SUPPLIERS NAME AND ADDRESS:		INDICATIVE FIELD QUALITY PLAN										ANNEXURE-IV B			
			ITEM : STRUCTURAL STEEL WORK		OP NO. : 3.07		PROJECT:		MAIN CONTRACTOR Reference Document		Acceptance Norms		Format of Record		Remarks	
			SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. : 0		PACKAGE:									
			DATE :		CONTRACT NO.											
			Sl.No	Activity and operation	Characteristics / Instruments		Class# of check	Type of Check								
1	2	3	4	5	6	7	8	9	10							
iii		Mechanical testing on production test coupons	As required/ agreed	B	Physical	Min. one joint per built up beams, columns and crane girder.	As per technical specifications and construction drawings, IS 822, AWS D 1.1	IR	✓	Test on production test coupons						
iv		Radiography Test	As required/ agreed	A	Physical	100% radiography test on butt welds of tension flange (bottom flange) of crane girder. All other butt welds shall be subjected to 10% weld length of each welder.	As per technical specifications and construction drawings, IS 822, AWS D 1.1	IR	✓	Wherever RT is not feasible UT to be carried out. In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1.						
2.3	FULL PENETRATION WELDS (OTHER THAN BUTT WELDS)															
	Ultrasonic Testing															
			As required/ agreed	A	Physical	i) 100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints	As per technical specifications and construction drawings, IS 822, AWS D 1.1	IR	✓	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1.						
3.00	FOUNDATION CHECKS															
i		Dimensions and levels- Shape, lines (including diagonal checks)	Theodolite, Tape etc	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR	✓							
ii		Foundation Bolts and Embedments- Verticality, Levels, pitch distance	Theodolite, Tape, Plano wires etc	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR	✓							
4.00	PRE-ASSEMBLY CHECKS															
i		Punch Erection marks and match marks on members	-	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings			Markings for - Assembly designation, Part number, Weight, Any other important identifications.						
ii		Pre-assembly as per match mark	-	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings									

TECHNICAL SPECIFICATION
SECTION-VI, PART - B
FIELD QUALITY PLAN
SUB-SECTION-E-118

SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE



LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN						ANNEXURE-IV B			
		ITEM : STRUCTURAL STEEL WORK		QIP NO. : REV. NO. :		4 of 7 0		PROJECT:		PACKAGE:	
		SUB-SYSTEM : FABRICATION & ERECTION		DATE :		PAGE :		CONTRACT NO.		MAIN CONTRACTOR	
		Characteristics / Instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
Sl. No	Activity and operation										
1	2	3		4	5	6	7	8	9	D*	10
iii		Camber, sweep and total length after trial assembly of structure.	Theodolite, Tape, plumb, piano wires etc	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR	✓		
iv		Control assembly check at shop	Theodolite, Tape, plumb, piano wires etc	B	Visual/ Physical	Every first and tenth set of identical structure	Tech Specs and Const. Drawings				
5.00 ERECTION CHECKS											
i		Alignment, slopes, level, tolerances of erected member	Theodolite, Tape, plumb, piano wires etc	B	Measurement	Each structural member	Tech Specs and Const. Drawings	SR	✓		
ii		Tightening of bolts/ Torque including foundation bolts with lock nuts	Wrench/ Torque wrench if specified	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR	✓		
iii		Acceptance of erected structure	Theodolite, Tape, plumb, piano wires etc	B	Visual/ Physical	Each erected structure	Tech Specs and Const. Drawings, IS 7215 and IS 12843	SR	✓		
6.00 PAINTING SYSTEM											
i		Painting Materials and accessories		A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	Mfr.'s T.C. shall be correlated with the consignment received.	
ii		Submission of painting methodology		B	For Review of painting system	Before start of painting work	Tech Specs and Const. Drawings				
iii		Surface preparation	As agreed / required	B	Physical / Visual	Each Erection Mark	Tech Specs and Const. Drawings, Relevant code/ standards	SR	✓		
iv		Primer Thickness	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	✓		
v		DFT of paint	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	✓		
vi		Acceptance of painted surfaces	Elcometer	B	Visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR			
7.00 PERMANENT BOLTS AND NUTS AND WASHERS											
i		Material- Permanent mild steel Bolts, mild steel Nuts, High strength structural Bolts, Washers- Dimensions, properties, Class, storage along with MTC	Screw gauge, Vernier, Tape etc.	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓		
ii		Contact surfaces before bolting		B	Physical	Random before assembly for bolting	Tech Specs and Const. Drawings, IS 4000	SR			
iii		Inspection of the assembled bolts		B	Physical	Randomly in each shift for assembled bolts	Tech Specs and Const. Drawings, IS 4000	SR			
iv		Tensioning	As agreed / required	B	Physical	Randomly during snug tight test and after full tensioning	Tech Specs and Const. Drawings, IS 4000	SR	✓		
v		Acceptance of installed bolts		B	Physical	Each bolt	Tech Specs and Const. Drawings	SR			

09376

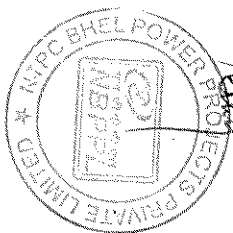
LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN						ANNEXURE- IV B					
		ITEM : STRUCTURAL STEEL WORK		QP NO. :	5 of 7	PROJECT:							
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:							
				DATE :		CONTRACT NO.							
				PAGE :	MAIN CONTRACTOR								
Sl. No	Activity and operation	Characteristics / Instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks		
1	2	3		4	5	6	7	8	9	D*	10		
8.00	ELECTROFORGED GRATINGS												
i		Material from approved source	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓		Also refer the approved MQP		
ii		Acceptance of Erection, alignment and each Installation	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR					
9.00	GALVANISED STEEL HAND RAILS												
i		Material		A	Physical	Once per lot	Grade IS:2062, Technical specifications,Galvanised as per IS 4735	SR/LB	✓		Galvanising shall be carried out as per the technical specifications.		
ii		DPT	As required	A	Physical	Random	AWS D1.1 / Technical specifications	SR/LB	✓				
10.00	CW LINERS												
10.1	MATERIALS												
	Steel Plates for liners and flanges												
i		Inspection of Materials on receipt at site	Steel tape/Visual	C	Visual	100%	Physical Visual veification , No damage	LB	✓				
ii		Storage of materials at work site	-	C	Visual	100%	As per SCC	LB	✓				
iii		Check for Pittings distortion rolling defects etc.	-	C	Visual	100%	IS 2062 gradeA	LB	✓				
iv		Plate thickness	Dmeter	C	Measurement	100%	IS 2062 gradeA	LB	✓				
10.2	FABRICATION												
i	Cut to size by gas and edge preparation	Steel Tape	-	C	Visual	100%	As per approved drawing	LB					
ii	Prebend of Plate	Template		C	By template	100%	As per approved drawing	SR					
iii	Roll to required size			C	By template	100%	As per approved drawing	-					
iv	Tack weld and provision of internal bracings to keep in proper shape			B	Measurement of Dia	100%	As per approved drawing	SR					
10.3	PAINTING												
i	Surface Finish & Paint										For embedded CW pipe		
ii	Surface preparation by wire brush	External cleaning	As reqd.	B	Visual	100%	NTPCTech Specs	Inspn Report	✓				
iii	Painting with primer coat of, Chlrinated rubber based zinc chromate primer	Elcometer	As.reqd.	B	Visual	100%	NTPC Tech Specs	Inspn Report			Uniform thickness & type of paint and shade		
iv	Coal tar Protection tape	ROUTINE TESTS:-Holiday tester,Adhesion Test,Direct Impact test, Corrosion resistance test	As reqd.	B	Visual &	Random	NTPC Tech Specs/ IS:15337	Inspn Report	✓		For uncased pipes , for other overground piping painting shall be as specified in the technical specification.		
10.4	WELDING REQUIREMENTS												
i			-	A	Visual and destructive as per ASME-IX	100%	ASME sec.IX/A Approved WPS	Test Report	✓				
ii		Welders Qualification test	-	A	Visual and destructive as per ASME-IX	100%	ASME sec.IX/A Approved WPS	Test Report	✓				

09379

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE-IV B			
		ITEM : STRUCTURAL STEEL WORK		QP NO. :	B of 7	PROJECT:				
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:				
				DATE :		CONTRACT NO.				
Sl. No	Activity and operation.	Characteristics / Instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	10
iii		Check to fit up gap	By Filler gauge	B		100%	As per approved drawing /IS-3589		Shop Register	
iv		Check of surface defects		B		100%	Free from surface defects		Shop Register	
10.5	INSPECTION OF WELDS / SHOP AND FIELD ERECTION WELDS									
i		DPT on root run and after back gauging / grinding of butt welds	DPT Kit	B	NDT	100%	IS-3558 No Line and round indication and no crack		Shop Register	✓
ii		DPT on fillet welds	DPT Kit	B	NDT	100%	-do-		-do-	✓
iii		DPT on finished butt welds	DPT Kit	B	NDT	10%	-do-		-do-	
iv		Radiography test on shop butt welds (welding done on the floor other than pit area)	RT Equipments	A	NDT	5%	ASME sec.V and ASME Sec. VIII Div.1		RT Films	✓
v		Radiography on field Butt welds (welding done on the pit)	RT Equipment	A	NDT	5%	ASME sec.V and ASME Sec. VIII Div.1		RT Films	✓
10.6	DIMENSIONS									
i		Dimensional Conformity	steel tape	B	Measurement	100%	As per approved drawing		SR	✓
ii		Tolerance OD / ovality	steel tape	B	Measurement	100%	As per approved drawing		SR	
10.7	HYDRO TESTING									
		On Fabrication Joints	Hydro test Arrangement	A	Leakage tests	100%	NTPC tech specification		SR	✓
		On Erection Joints (System Testing)	Hydro test Arrangement	A	Leakage tests	100%	NTPC tech specification		SR	✓
11.00	STOP LOG GATE, TRASH AND LIFTING BEAM									
11.1	MATERIAL									
		Check Quantity (in case of receipt) and completeness and damage, surface defects		C	Visual	100%	Challan / Release No damage, surface defect note		SR	✓
11.2	ERECTION									
		Alignment levelling	Plumb, Piano wire, water level	C	Measurement	100%	Specification/ Approved drawing		Inspection Report	Welding, if any, involved at site will be done by welders and procedure qualified as per ASME-IX in presence of NTPC(FQA)
11.3	PAINTING / SURFACE PREPARATION									
i		Shade		B	Visual	100%	Specification/ Approved drawing		Inspection Report	The type of painting/ surface treatment of parts shall be as per cl. Technical specification
ii		DFT	Elcometer	A	Measurement	Random	Specification/ Approved drawing		-do-	✓
iii	Free movement of stop log / trash rack in guides under dry and under full water condition	Lowering or raising for full length for 2/3 times		A	Physical	100%	Smooth operation, NTPC Tech. Specification, IS:4822		-do-	

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LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					ANNEXURE-IV B			
		ITEM : STRUCTURAL STEEL WORK		QP NO. :	7 of 7	PROJECT:				
				REV. NO. :	0	PACKAGE:				
		SUB-SYSTEM : FABRICATION & ERECTION		DATE :		CONTRACT NO.				
		PAGE :				MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class# of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	10
iv	Leakage for stop Log	Measurement of leakage	As reqd.	A	Physical	100%	Leakage rate within limit		-do-	Maximum leakage rate 5 litre/minute/metre length of seal under max.head as per IS:4622
v	Load test for lifting beam	Load Test	As reqd.	A	Physical	100%	No deflection /No Deformation		-do-	
12.00	FLEXIBLE OPEN ENDED BELLOW STRAP									
i		Check for the Material from approved source	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	
ii		Acceptance of installation of Strap	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings		SR	
13.00	PTFE SLIDING BEARINGS AND ELASTOMERIC BEARINGS									
i		Check for the Material from approved source	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	
ii		Acceptance of installation of bearings	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings		SR	
LEGEND: D* Records, identified with "Tick" (✓) shall be essentially included by supplier in QA							DOC. NO.: CS - Project Code - XXX-XX-QVC-G-002 REV: 0			
Legend to be used: Class #: A = Critical, B=Major, C=Minor; SR, TR, MTC, LB										
Manufact urer/ Sub supplier	Main-supplier	Categorization Witnessing & Accepting (As per owner QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report, MfrTC = Manufacturer's Test Certificate					For NTPC use			
Signature		This document shall be read in conjunction with owner Tech. Specifications, BOQ, Drawings					REVIEWED BY APPROVED BY APPROVAL SEAL			



SINGRAULI STPP STAGE-III
(1X500 MW)
EPC PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI, PART - B
FIELD QUALITY PLAN
SUB-SECTION-E-118

09304