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TENDER SPECIFICATION

TENDER NO. BHEL/NR/SCT/ANPARA – D/CIVIL/620

FOR

“Soil Improvement and Boundary Wall Package for 2 x 500 MW, Anpara-D Thermal Power Station at Anpara , Distt. Sonebhadra UP.”

PART I – TECHNICAL BID



Bharat Heavy Electricals Limited
(A Govt. Of India Undertaking)
Power Sector – Northern Region,
Plot No. 25 , Sector - 16A ,
Distt. Gautam Budh Nagar, NOIDA – 201 301(INDIA)



ISO 9001-2000, ISO 14001 and OHSAS 18001 certified company SubContract and Purchase Deptt.

Bharat Heavy Electricals Limited (A Govt. Of India Undertaking) Power Sector – Northern Region, Plot No. 25 , Sector - 16A , Distt. Gautam Budh Nagar, NOIDA – 201 301(INDIA) Phone: 0091-0120-2515476 / 2515464 / 2515479 Fax 091-0120-2515464 / 2515467 Email: sku@bhelnsr.co.in / msd@bhelnsr.co.in

TENDER NO. BHEL/NR/SCT/ANPARA – D/CIVIL/620

IMPORTANT NOTE

PURCHASER OF THIS TENDER DOCUMENT IS ADVISED TO CHECK AND ENSURE COMPLETION OF ALL PAGES OF TENDER DOCUMENT AND REPORT ANY DISCREPANCY TIMELY FOR CORRECTIVE ACTION, IF ANY, TO THE ISSUING AUTHORITY BEFORE THE BIDS ARE SUBMITTED. ORIGINAL COPY OF TENDER DOCUMENT COMPLETE IN ALL RESPECTS MUST BE SUBMITTED BACK AS PART OF THE BID WITHOUT WHICH THE SAME IS LIABLE TO BE REJECTED BY BHEL.

THIS TENDER SPECIFICATION ISSUED TO:

M/S-----

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TENDER NOTICE

Sealed tenders are invited from the contractors fulfilling qualifying requirements for the work of **“Soil Improvement and Boundary Wall Package for 2 x 500 MW, Anpara-D Thermal Power Station at Anpara , Distt. Sonebhadra UP”**

TENDER NO. BHEL/NR/SCT/ANPARA – D/CIVIL/620

QUALIFYING REQUIREMENTS:

- 1.0 Tenderer who wish to participate should have executed, within the preceding seven (7) years period reckoned as on the date of bid opening, industrial/infrastructure projects and should have achieved the following progress;
- 1.1 Installation of atleast 2,00,000 running meters of cast-in-situ driven piles/ stone column in any one (1) or more contracts, using driven pile rigs.
- ‘OR’
- 1.2 Installation of atleast 80,000 running meters of cast-in-situ driven piles/ stone column in any one (1) year in one or more contracts, using driven pile rigs.

Notes:

- (a) If the qualifying work is completed in the seven(7) year period specified above, even if it has been started earlier, the same will also be considered meeting the qualifying requirements.
- (b) The word “executed” means, tenderer should have achieved the progress specified above even if the total contract is not completed/closed.
- (c) The one (1) year period means any continuous 12 months period. However, for concurrent works, the same 12 months period shall be considered.

‘AND’

- 2.0 Party should also have an average annual turnover of minimum of Rs. 45 Crores (Rupees Forty five Crores only) during preceding three years (2005-06, 2006-07 & 2007-08). Tenderer shall submit audited balance sheets in support of same.

3.0 Tie Up arrangement

- 3.1 Tenderer not meeting QR criteria at sl. no. 1.1 OR 1.2 above completely, may be allowed to have a tie up with another party experienced in QR criteria given at sl no. 1.1 OR 1.2 above, subject to approval of BHEL. The combined experience of both the partners should meet QR at Sl no. 1.1 OR 1.2 above. In such a case, the tenderer (Lead Partner) shall submit documents related to their Tie-up arrangement in Part-I bid (Technical Bid). The composition of the Tie-up arrangement and role and responsibility of each constituent must be well defined and the document submitted shall clearly indicate who shall be the lead partner.
- 3.2 In such a case, the number of partners including the Lead Partner shall not exceed two. The tenderer (Lead Partner) shall give an undertaking that the responsibility of execution of entire work shall lie with him and also that in case of dissolution of Tie up, the Lead Partner shall be liable for completing the work as per the terms of contract without any additional cost to BHEL or without affecting project schedule. Legal documents of tie up agreement, signed by both the partners, shall be submitted as a part of technical bid.
- 3.3 For the purpose of qualifying requirements as given at sl. no. 2.0 above i.e Financial Turnover, the turnover of the tenderer (Lead Partner) shall only be considered.

NOTES:

- (i) The Tender Documents comprise of following;
- (a) General Conditions of Contract, Special Conditions of Contract, Tender Notice, Project Synopsis etc.
 - (b) Technical Specifications
 - (c) Rate Schedule
- (ii) Tender Documents with complete details are hosted in this web page. Bidder(s) intending to participate may download the tender document from the web site.
- (iii) Bidder(s) can also purchase hard copy of tender documents from this office. Tender documents (non transferable) will be issued on all working days between 09.30 Hrs. to 12.30 Hrs within the sale period i.e **upto 24.04.2009** on payment of Rs. 5,000/- (non-refundable) either in cash or by crossed demand draft in favour of BHEL, NOIDA. Request for issue of tender document should clearly indicate Tender No. and work.
- (iv) Tenders must be submitted to the undersigned 'OR' to Shri Kailash Arora, Sr. Asstt. 'OR' to Smt. Usha Kochhar, Sr. Asstt. in Room No. 104, PSNR, NOIDA latest by **15:00 Hrs. on 27.04.2009**. Technical bids shall be opened at **15.30 Hrs. on 27.04.2009**. Tenders received after the due date & time shall be liable to be summarily rejected.
- (v) Earnest Money Deposit (EMD) : Refundable, Non-interest bearing **EMD of Rs 2,00,000/-** shall be deposited by Account Payee Pay Order 'OR' Demand Draft in favour of " Bharat Heavy Electricals Limited" payable at Delhi/NOIDA . Those bidders who have already deposited ' One Time 'EMD' of Rs. 2,00,000/- with BHEL, PSNR, NOIDA need not submit EMD with the present tender.
- (vi) Tenders not accompanied with Full Earnest Money Deposit, as indicated above, will not be considered.

- (vii) All corrigenda, addenda, amendments and clarifications to this Tender will be hosted in this web page and not in the newspaper. Bidders shall keep themselves updated with all such amendments.
- (viii) BHEL reserves the right to accept or reject any or all tenders without assigning any reason whatsoever.
- (ix) BHEL takes no responsibility for any delay/loss of documents or correspondences sent by courier/post.
- (x) **BHEL reserves the right to go for a Reverse Auction instead of Opening the submitted sealed bid, which will be decided after technical evaluation. As such, the bidders should submit their best prices in the 'Sealed Price Bid'. However, bidders are required to confirm their acceptance of "General terms and conditions" governing RA specifically in their technical bid. The "General terms and conditions" governing RA are given in the SCC of the NIT. Bidders are also required to furnish following details in their techno-commercial bid, for this purpose (RA).**

Authorization of representative who will participate in the on line Reverse Auction Process;

- a. Name and Designation of official
- b. Postal Address (Complete)
- c. Telephone Nos. (Land line & Mobile both)
- d. FAX No.
- e. E-mail address
- f. Name of Place/State/Country, wherefrom he will participate in the RA.
- (xi) **Bidders shall enter into an Integrity Pact (IP) with BHEL as per format given at annexure – VIII of this NIT. The bidders are required to return this Integrity Pact (IP) alongwith Techno- Commercial bid (Part-I), duly signed and stamped by the authorized signatory who signs the bid. It may be noted that only those bidders who have entered into such an IP with BHEL would be competent to participate against this NIT i.e. entering into this pact is a preliminary qualification for the bidders. The Independent External Monitor against this NIT shall be Shri D.P. Bagchi, IAS (Retd.), Y-165, Regency Park –II, Phase –IV, DLF City, Gurgaon-122009**
- (xii) Bids, once submitted, shall not be returned.
- (xiii) Unsolicited rebate/discount shall not be accepted after bid opening.
- (xiv) Purchase Preference will be given to CPSUs as per Govt. Guidelines.

AGM/SCP



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DOMESTIC NOTICE INVITING TENDER

SUBMISSION DATE : 27.04.2009 (15:00 Hrs.)
OPENING DATE : 27.04.2009 (15:30 Hrs.)

NIT NO. / NAME OF WORK
<p>TENDER NO. BHEL/NR/SCT/ANPARA – D/CIVIL/620</p> <p>Sealed tenders are invited from the contractors fulfilling qualifying requirements for the work of “Soil Improvement and Boundary Wall Package for 2 x 500 MW, Anpara-D Thermal Power Station at Anpara , Distt. Sonbhadra UP”</p>

NOTES

1. Purchase Preference will be given to CPSU as per Govt. Guidelines.
2. Please visit our website at www.bhel.com for details of NIT.

AGM/SCP

Bharat Heavy Electricals Limited
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Power Sector – Northern Region,
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PROCEDURE FOR SUBMISSION OF SEALED TENDERS:

The tenderers must submit their tenders as required in two parts in separate sealed covers prominently superscribed as Part-I Technical bid and Part-II ,Price bid also indicating on each of the cover tender specification no., date and time as mentioned in tender notice.

TECHNICAL BID (COVER-I)

Except Price bid Part-II, complete set of tender document consisting of General conditions of Contract, “Technical specification & Special terms and condition” (Part-I) issued by BHEL shall be enclosed in Part I Technical Bid only. All schedules, data sheets and details called for in the specification shall also be submitted along with technical bid. All details / Data / Schedules including offer letter duly signed and stamped are to be submitted in duplicate.

PRICE BID (COVER-II)

Tenderers may please note that price bid is to be submitted only in original copy of Tender i.e. Price bid (Part-II) issued by BHEL and no duplicate copy of same is required.

These Two separate covers i.e. cover I & II shall together be enclosed in a third envelope (Cover-III) and this sealed cover shall be superscribed with tender specification No., due date, time and submitted to officer inviting tender as indicated in tender notice on or before due date as indicated.

PROJECT SYNOPSIS

1. Name of the Owner : Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd
2. Address : ANPARA-D TPS
District SONEBHADRA , UP
3. Installed capacity : New project
4. New Installation : 2 x 500 MW
5. Nearest Railway station : Anpara - 5 km
Renukoot -- 50 km
Varanasi - 200 km
6. Nearest City : Renukoot -- 50 km
7. Nearest Airport : Varanasi - 200 km
8. Maximum Temperature : 48 Deg C
9. Minimum temperature : Appx 2 Deg C

SECTION - III

SPECIAL CONDITIONS OF CONTRACT

Clause No.	Title

34.0	General Scope of Work
35.0	Instruction to Tenderer
36.0	Contractor's Supervision
37.0	Supervisory Staff & workmen
38.0	Tools & Plants / IMTEs
39.0	Material
40.0	Issue and accounting of cement, reinforcement & stru. Steel
41.0	Scrap & Serviceable materials
42.0	Execution of the work
43.0	Methods of measurement
44.0	Deviation
45.0	Valuation of deviation
46.0	Compliance to regulation & bylaws
47.0	Facilities to be provided by BHEL/ Contractor
48.0	Progress reporting
49.0	Drawing & documents
50.0	Delay & Extension of Time
51.0	Price Variation and over run
52.0	Income tax & Sales Tax
53.0	Time Schedule
54.0	Terms of payment
55.0	Insurance
56.0	Rate schedule cum BOQ & Variation

SECTION-III

SPECIAL CONDITIONS of CONTRACTS

34.0 GENERAL SCOPE OF WORK

34.1 This tender specification for Soil Improvement and Boundary Wall Package includes stone piling , earth work, plain & reinforced cement concrete, reinforcement, scaffolding, formwork, masonry work, plastering, drainage & sewerage, roads, M. S embedment etc. as well as including supply of all materials except those proposed to be supplied by BHEL, consumables, labour, Tools and plants, transportation and storage, sample testing etc. all complete as per BOQ, specifications and drawings for proper and successful execution of the job for 2 x 500 MW units Anpara-D Thermal Power Station of UPRUVNL at Anpara , Dist Sonebhadra UP.

34.2 The Soil Improvement and Boundary Wall Package works to be carried out are as per **Rate Schedule Cum Bill Of Quantities** Work under this package is generally related to the following area but not limited to the areas mentioned below :

- a) Steam Turbine Area
- b) Steam Generator Area
- c) ESP and ESP Control Room Area
- d) Pipe and Deaerator Bay.
- e) Control Bay.
- f) Bunkers and Mill Bay including Mill Fdns and Adjacent Conveyer Gallery and Transfer Tower.
- g) ID Fan and Duct Support Area , Chimney Area , FGD Area
- h) Ash Handling System area , Ash Silo Area
- i) Fuel Oil Area , Workshop Building , Hydrogen Plant Area
- j) Cooling Tower area , Water Systems Area
- k) CW Pump House Area
- l) Administrative Building , Canteen , O&M Building area
- m) Boundary Wall Area

34.3 **The detailed scope of work & the technical requirements for work to be executed under this specification shall be as per Specifications No PE-TS-999-600-C011 (Section D, Sub-Section ,as mentioned) , enclosed with this tender document.(Annexure-III)**

34.4 **The scope of work will also include providing 'Qualified Supervisors' for direct supervision of various works other than the scope covered under this tender. These Qualified Supervisors shall be provided for Fifty Four man-months as per site conditions. The supervisors shall possess a minimum qualification of a civil engineering diploma. They shall be deployed in all area covered under various specifications as well as other related areas as may be deemed essential based upon work requirements, though not specified. They shall be guided by BHEL Engineers to ensure smooth work progress as and when /where required /deployed.**

In case BHEL is not able to utilize the man months as per provision , a lump sum of Rs 20,000/- (rupees ten thousand only) per man month for the un-utilised man months will be recovered from the bills of the contractor.

34.5 Deleted

34.6 The scope of work will also include such other related works although they may not be specifically mentioned in the above paragraph and all such incidental items not specified but reasonably implied and necessary for completion of the job as a whole all as desired and as directed by the engineer.

The detail scope of work covered above is not a comprehensive list of items of work involved. The detail scope of work may vary considerably depending on the actual construction requirements.

34.7 **ALSO INCLUDED IN THE SCOPE**

Unless otherwise specified, the work to be provided by the contractor for the items mentioned in the "Bill of Quantities" shall include but not be limited to the following.

- a) Furnishing all labour, materials, supervision, construction plans, equipment, supplies, transport, to and from the site, fuel, electricity, compressed air, water, transit and storage insurance and all other incidental items and temporary works not shown on specified but reasonably implied or necessary for the proper completion, maintenance and handling over the works, except in accordance with the stipulations laid down in the contract documents and additional stipulations as may be provide by the engineer during the course of works.
- b) Furnishing samples of all materials required by the engineers for testing / inspection and approval for use in the works. The samples may be retained by the engineer for final incorporation in the works.
- c) Furnishing test reports for the products used or intended to be used, if called for the specifications or if so desired by the engineer.
- d) Giving all notices, paying all fees, taxes etc., in accordance with the general conditions of contract, that are required for all works including temporary works.
- e) Arranging manufacturer's supervision for items of work done as per manufacturer's specifications when so specified.
- f) Carrying out topographic survey of the entire and establish levels and coordinates at suitable intervals from existing grid levels and coordinates furnished by the owner established bench marks, setting out the locations and levels of proposed structures, constructions and marking of reference pillars and other identification works etc., The contractor shall provide the owner/BHEL such a assistance, instruments, machines, labour and materials as are normally required for examining, measuring and testing any work and the quality, weight or quantity of any material used.
- g) Providing all incidental items not shown or specified but reasonably implied or necessary for the successful completion of the work in accordance with contract.

34.8 **Health, Safety & Environment management (HSE)**

34.8.1 BHEL-Power Sector (NR) is ISO 9001-2000, ISO 14001-1996, OHSAS 18001-1999, ISO 27001 and SA-8000 certified company. Quality of work, to customer's satisfaction and system requirements is the essence of these

certifications. The contractor in all respects will organize his work, systems, environment, process control documentation, tools, plant, inspection, measuring and testing equipments etc. as per instructions of BHEL engineer.

The contractor shall also comply with applicable legislation and regulations with regards to Health, Safety and Environmental aspects for minimizing risk arising from occupational health & safety hazards, controlling pollution and wastage. The Contractor will be responsible for Health, Safety & Environment management (HSE) at site for the construction activities to be carried out by them in accordance with requirements given under section I (a) of GCC and elsewhere in this tender document. The contractor, who is awarded the work, shall have to sign an MOU w.r.t implementation of HSE conditions with BHEL (Safe Work Practices).

- 34.8.2 Besides provision with regard to SAFETY under Clause 27 of GCC, the contractor will be responsible for Health, Safety & Environment management at site for the construction activities to be carried out by them in accordance with requirements **given under section I(a) of GCC of this document**. The contractor shall continuously take special care to ensure the safety and prevention of human and equipment accidents and maintain good sanitary conditions in and around the site. All the construction work and plant operation must be carried out in the safest possible manner. The Engineer reserves the right to stop any process which, in the Engineer's opinion, is being performed dangerously. In this case the contractor must immediately adhere the requisite safety precautions and any delays attributed to the work stoppage on this account shall not affect the agreed contractual finishing dates.

The contractor shall appoint dedicated full-time Qualified Safety Officers who shall have full authority to ensure that all necessary safety precautions are observed by the Contractor's employees and sub-contractors. These appointees shall have full responsibility for the safety of all personnel within the contractor's area of the works.

- 34.8.3 Some of the common safety rules to be followed during working are as follows :-

- No body is allowed to enter at construction site without Safety Shoe.
- Never enter work area without Safety helmet & chin strap in place.
- No climbing/working allowed without proper safety belt above 2 m. height.
- Do not exceed the speed limit 25 Kmph within premises.
- No debris obstacles allowed on the roads & passages.
- Do not walk on pipelines or false ceiling.
- Maintain good Housekeeping at work site.
- No photography/ Videography allowed without permission
- All Site supervisors & engineers (including subcontractor's) must be imparted structured training on construction safety before start of the job & record to be maintained.

- Availability of qualified & trained Site Engineer at site during all working hours.
- Site Safety training to be imparted to all workers & plan to be made to cover every worker.
- Tools box talk (5-15 minutes) by supervisor prior to commencement of any job.
- All accident / incidents(Near Miss) to be reported & investigated.(formats & procedure should be finalized)
- Daily Safety Checking by Each Site Engineer along with Safety engineer.
- Weekly co-ordination meeting of all Safety engineers with BHEL safety officer.
- Monthly safety meeting with Site In-charges.
- All Safety equipment must be ISI marked & checked by Safety officer before use.
- Tag system for erection & use of scaffoldings.
- Bamboo/wooden Scaffolding material not allowed.
- LPG cylinders not allowed for gas cutting.
- Good House keeping. Separate waste bins to be used for flammable & non flammable material.
- Safety awareness programs for workers by display of boards, posters, competitions, talks etc.
- Deployment of Safety Supervisors for every 250 workers and part there of at work site.
- Display of List of First Aid trained persons.
- Testing certificates for lifting tools & tackle.
- Provision & maintenance of fire extinguishers at construction site & material stores.
- Display of emergency telephone numbers at various locations.
- For work in confined space use 24 V lamp fitting & use tools with air motors or electric tools with max. 24 V.
- For confined space entry Gas test must be done before & at regular intervals.
- Checking & tag of equipment like grinding machine, welding machine, gas cutting set etc. by supervisors before use.

34.8.4 **Contractor shall ensure following:**

1. Contractor has to maintain contact with local hospital having scanning & other ultra modern medical facilities required during emergency including Ambulance.
2. Contractor has to ensure pre employment medical check for all staff & workers.
3. Contractor has to ensure that adequate First Aid facilities with trained nurse & ambulance are available at work site for emergency purpose. This emergency set-up should include, but not limited to, following
 - Male nurse (in shifts)
 - Oxygen set up
 - Breathing apparatus

- Eye wash facility
- Stretcher
- Trauma blanket
- Medicines.

The contractor against this contract is required to arrange and maintain ambulance at site for entire contract period. The above emergency facility set up including ambulance, male nurse etc. will be shared by BHEL and its other contractors working at this project at no extra cost to BHEL and its sub-contractors. In case, under unavoidable circumstances, if the ambulance is not available / being used elsewhere, the contractor will have to arrange for the same as under clause 34.8.4.1

- 34.8.5 The Contractor shall be fully responsible for accidents caused due to him or his agents or workmen's negligence or carelessness in regard to the observance of the safety requirements and shall be liable to pay compensation for injuries. **It may be noted that non-compliance to HSE requirements will result in penal action. In case of violations of safety requirements, the Contractor shall be liable for a penalty of Rs. 500/- for the first violation and Rs. 1000/- for the subsequent violations. For serious lapses, as decided by BHEL Engineer, fines upto Rs. 5000/- at a time can be imposed.**

The amount towards penalties as above will be deducted from running bills of the Contractor. The amount so collected above will be utilized for supporting the safety activities at site. The decision of BHEL on above will be final and binding on the Contractor.

- 34.8.6 **The contractor shall comply with following towards Social Accountability;**

- (a) The contractor shall not employ any employee less than 15 years of age in pursuant to ILO convention. If any child labour were found to have been engaged, the Contractor shall be levied with expenses of bearing his education expenditure which will include stipend to substantiate appropriate education or employ any other member of family enabling to bear the child education expenditure.
- (b) The contractor shall not engage Forced/Bonded Labour and shall abide by abolition of Bonded Labour System(Abolition) Act, 1976.
- (c) The contractor shall maintain Health & safety requirement as stipulated in the Contract and Contract Labour(Regulation & Abolition) Act,1970.
- (d) The Contractor shall abide by UN convention w.r.t Human Rights and shall be liable for Discrimination/Corporal punishment for failure in meeting with relevant requirements.
- (e) The Contractor shall abide the requirement of Contract Labour(Regulation & Abolition) Act,1970 for working hours.
- (f) The Contractor shall abide by the Statutory requirement of Minimum Wages Act 1948, payment of Wages Act 1936.

(g) The Contractor shall arrange potable drinking water to its employees & workers.

34.8.7 In order to meet the environmental concerns it is expected that the contractor shall plant, protect and maintain at least **500 trees** in the vicinity of the project as per the available space and as per the advise of Engineer . In case no area is earmarked for tree plantation, the contractor may take up any other equivalent environment related project after due approval of the BHEL Engineer. for the entire duration of contract.

34.9 **The customer UPRVNL and / or their Consultant may depute their representative for checking and supervision of important stages of work. The contractor shall be required to provide all facilities for inspection of works at no extra cost to BHEL. Any defect in quality of work or deviations from drawings / specifications pointed out during such inspection shall be made good by the contractor in the same way as if pointed out by the BHEL Engineer, without any cost implication to BHEL.**

35.0 INSTRUCTIONS TO TENDERERS

35.1 The Tenderer are advised to physically visit the site and fully acquaint themselves with site conditions, transportation routes, various distances and the fact that other contractors would be working in this area their structures are to be protected. The material brought and stacked for construction should not make hindrance to other contractors. **Necessary precaution and arrangements including sprinkling of water during work as acceptable to BHEL for safety & security for the above have to be made by the contractor. No claim will be entertained by BHEL on ground of lack of knowledge and the contractor's rates shall be deemed to have taken this into account.**

35.2 The contractor, in the event of this work awarded to him, shall establish an office at site and keep posted an authorised, responsible officer with valid Power of Attorney for the purpose of the contract. Any order or instructions of the `Engineer' or his duly authorised representative, communicated to the contractor's representative at site office will be deemed to have been communicated to the contractor at his legal address.

36.0 CONTRACTOR'S SUPERVISION

36.1 The Contractor shall either himself supervise the execution of the Contract or shall appoint a competent Engineer / agent approved by the Engineer to act in his stead.

36.2 The Contractor shall employ an Engineer/ Agent having atleast a `Degree of Bachelor in Civil Engineering' from a recognised university (for any work with a contract value exceeding Rupees Twenty Lacs) or having atleast a `Diploma in Civil Engineering' from a recognised college (for work with a contract value exceeding Rs.Two lacs but not exceeding Rupees 20 Lacs).

36.3 The employment of an Engineer / Agent as aforesaid shall not be necessary if the Contractor himself is in possession of a recognised technical qualification and is in

the opinion of the Engineer capable of receiving instructions of the Engineer and of executing the work to the satisfaction of the Engineer .

- 36.4 If the Contractor fails to appoint a suitable Engineer /Agent as aforesaid, the Engineer shall have full powers to suspend the execution of work and stop payment of any money that may have become due until such date as a suitable Engineer / Agent is appointed and the Contractor shall be held responsible for the delay caused to the work and no extension of time on this account shall be given to him.
- 36.5 Orders given to the Contractor's Engineer / Agent shall be considered to have the same force as if they had been given to the Contractor himself.
- 36.6 The Contractor or his Agent shall be in attendance at the site during all working hours and shall superintend the execution of work with such additional assistance in each grade as the Engineer may consider necessary.
- 36.7 The Contractor or his accredited Agent shall attend, when required and without making any claim for doing so, either the office of the Engineer or the work site to receive instructions.
- 36.8 The BHEL Engineer shall have full powers to instruct the Contractor to arrange for immediate termination of services, in connection with this contract, of any Agent, servant or employee whose continued employment is, in his opinion, undesirable, without assigning any reason.

37.0 SUPERVISORY STAFF AND WORKMEN

- 37.1 The contractor shall deploy all the experienced skilled, semiskilled and unskilled workmen required for all the works under these specification. BHEL reserves the right to decide on the suitability of the workers and other personnel who will be deployed by the contractor. BHEL reserves the right to insist on removal of any employee of the contractor at any time, if they find him unsuitable and the contractor shall forth with remove him.
- 37.2 The supervisory staff including qualified Engineers deployed by the contractor shall ensure proper out-turn of work and discipline on the part of the labour put on the job by the contractor and in general see that the works are carried out in a safe and proper manner and in coordination with other labour and staff deployed directly by BHEL or other contractors of BHEL / BHEL's Client / other agency.
- 37.3 The work shall be executed under the usual conditions like rain, insufficient space, improper approach roads etc., effecting major construction work and in conjunction with numerous other operations at site. The contractor and his personnel shall cooperate with other personnel / contractor , coordinating his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.
- 37.4 The contractor's supervisory staff shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work and aesthetic finish are essential part of this contract. The contractor shall be responsible to ensure that assembly and workmanship conform to the dimensions and tolerances given in the drawings /documents / instructions given by BHEL Engineer from time to time.

- 37.5 It is the responsibility of the contractor to engage his workmen in shifts or on overtime basis for achieving the targets set by BHEL. The contractor's finally accepted rates shall include all these contingencies.
- 37.6 During the course of construction, if the progress is found unsatisfactory, or in the opinion of BHEL, if it is found that the skilled workmen like welder, fitters, technicians etc. deployed are not sufficient, BHEL after giving reasonable opportunity to the contractor, will induct on the work the required workmen in addition to contractor's workmen to improve the progress and recover from the contractor's bills
- 37.7 If the contractor or his workmen or employees shall break, deface, injure or destroy any part of a building, road kerb, fence, enclosure, water pipes, cables, drains, electric or telephone posts or wire, trees or any other property or to any part of erected components etc., the contractor shall make the same good at his own expense or in default, BHEL may cause the same to be made good by other workmen or by other means and deduct the expenses (of which BHEL's decision will be final) from any money due to the contractor.
- 37.8 The monthwise manpower deployment plan to be submitted as per format (at Annexure-C to general conditions of contract) is only to assess the capability as well as understanding of the contractor to execute the work. It shall be the contractor's responsibility to deploy the required manpower, for timely and successful completion of the job, to any extent over and above those indicated in the above deployment plan (including those which are not covered in the plan submitted) without any compensation on this account.

38.0 TOOLS AND PLANTS / IMTEs

- 38.1 **Normally BHEL will not provide any T& P for this package works.** However in case of emergency T&Ps may be provided by BHEL, if any, to sub-contractor on chargeable basis and the same shall be shared by other sub contractors working for BHEL at site and the allotment done by BHEL Engineer shall be final and binding.
- 38.2 Besides the T&Ps being made available to contractor free of hire charges, if any, by BHEL, all other T&Ps and IMTEs which are required for successful and timely execution of the work covered within the scope of this tender, shall be arranged and provided by the contractor at his own cost in working condition. Indicative lists of T & P and IMTEs to be arranged by the contractor are given **as per Annexure-I & Annexure-II.** In the event of the failure of contractor to bring necessary and sufficient T&Ps/ and IMTEs, BHEL will be at liberty to arrange the same at the risk and cost of contractor including transportation cost of same from any of BHEL site/place and hire charges as applicable shall be deducted from contractor's bill. Decision of BHEL in this regard shall be final and binding on contractor.
- 38.3 All distribution boards, connecting cables / welding cables, wire ropes, hoses etc. including temporary air/water / electrical connections etc. shall have to be arranged by the contractor at his own cost.
- 38.4 In case of non-availability of the T&Ps to be provided by BHEL due to breakdown, major overhauls, distribution pattern or any other reason, the contractor shall

plan/amend / alter his activities to meet erection / commissioning targets in consultation with BHEL.

- 38.5 The operation of all BHEL's T&Ps being provided free of hire charges shall be in the scope of the contractor. The contractor shall arrange at his own cost operators, fuel, and other consumables etc. for the operation. All lubricants for BHEL cranes, such as mobile oil, gear oil, break oil, hydraulic oil, torque converter oil & grease shall be provided by BHEL free of cost. The contractor will give the requirements well in advance.
- 38.6 The contractor shall engage trained and experienced operators for the operation of BHEL's T&Ps. BHEL Engineer will check their skill and performance before they are allowed to operate the same. However checking of skills by BHEL does not absolve the contractor of his responsibilities for proper & safe handling of equipment, consistent good performance of operators & regular performance evaluation of operators.
- 38.7 The day to day and routine maintenance of BHEL's T&Ps should be carried out by contractor as per manufacturer's / BHEL's maintenance schedule at his cost. These shall be maintained in good working condition during the entire period of use. T&Ps in defective / damaged condition shall be rectified promptly to the full satisfaction of BHEL engineer. Contractor shall maintain records for maintenance of major T&Ps which shall be made available for Inspection whenever required. In case of any lapses on the part of the contractor BHEL at its own discretion get the servicing / repair of equipment done at the risk and cost of the contractor with BHEL overheads.
- 38.8 The contractor shall arrange at his cost all spares needed for upkeep of all T&Ps other than cranes and Hydraulic Test pumps supplied by BHEL. For cranes, repair / replacement of filter, batteries, self, dynamo, gaskets, hoses, oil seals and rubber parts shall be the responsibility of the contractor. However, the charges of the replacement of the other damaged /worn out parts of BHEL cranes will be borne by BHEL provided the damage is not due to the negligence of the contractor. However, if there are breakdowns / damages due to negligence of the contractor, the complete service / repair charges and cost of all the spares damaged with BHEL overheads shall be to the account of contractor and shall be recovered from his RA bills.
- 38.9 All supervision and labour required for maintenance and attending breakdowns shall be arranged by the contractor at his own cost. Minimum one mechanic and two helpers shall be exclusive marked for the above work.
- 38.10 Increasing / shortening of the crane boom to suit work requirements shall have to be arranged by the indenting contractor at his cost. All necessary manpower, tools, support, consumables, illumination etc. will have to be arranged by contractor at his cost.
- 38.11 Consolidation of ground and arrangement of sleepers / sand bag filling etc. for safe operation / movement of equipment including cranes / trailers etc. shall be the responsibility of the contractor at his cost.
- 38.12 In the event of contractor not using and maintaining BHEL T&Ps according to BHEL's instructions, BHEL will have the right to withdraw such item without any notice and no claim in this regard shall be entertained and contractor shall be responsible for

delay in execution on this account. Regular utilisation report of the BHEL equipment as per requirement shall be furnished by the contractor.

- 38.13 Any loss / damage to any part of BHEL T&Ps shall be to the contractor's account and any expenditure on these accounts by BHEL will be recovered from the contractor's bill in case the contractor fails to make good the loss.
- 38.14 It shall be responsibility of the contractor to take delivery of T&Ps from stores or place of use by other contractor at project site, transport the same to site and return the same to BHEL store/ place as intimated by BHEL Engineer in project site in good working conditions after use.
- 38.15 The contractor shall return BHEL T&Ps issued to him in good working condition as and when desired by BHEL (on completion or reduction of work load). If return of T&P and IMTE is delayed by contractor, hire charges as applicable shall be levied by BHEL from time, it was requisitioned till the time of actual return. Hire charges shall also be charged on the T&Ps returned in damaged / unserviced condition to BHEL till its satisfactory repair. T&Ps returned in damaged / unserviced condition shall be got repaired by BHEL at its own discretion and entire cost of repair with BHEL overheads shall be recovered from the contractor.
- 38.16 Replacement cost including BHEL overheads in respect of irreparable / completely damaged / non return of T&Ps shall be recovered from the contractor's running bills.
- 38.17 Contractor shall ensure deployment of serviced and healthy T&Ps including cranes, lifting tackles, wire ropes, Manila ropes, winches and slings etc. History card and maintenance records for major T&Ps will be maintained by the contractor and will be made available to BHEL Engineer for inspection as and when required . Identification for such T&Ps will be done as per BHEL Engineer's advice.
- 38.18 Contractor shall ensure deployment of reliable and calibrated IMTEs (Inspection measuring and Test equipment). The IMTEs shall have test/ calibration certificates from authorised / Govt. approved / accredited agencies traceable to National / International standards. Each IMTE shall have a label indicating calibration status i.e. date of calibration, calibration agency and due date for calibration. A list of such instruments deployed by contractor at site with its calibration status is to be submitted to BHEL Engineer for control.
- 38.19 Retesting / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL Engineer with in the contract price. The contractor will also have alternate arrangements for such IMTE so that work does not suffer when the particular instrument is sent for calibration. Also if any IMTEs not found fit for use, BHEL shall have the right to stop the use of such item and instruct the contractor to deploy proper item and recall i.e. repeat the readings taken by that instrument, failing which BHEL may deploy IMTEs and retake the readings at contractor's cost.
- 38.20 BHEL shall have lien on all T&P, IMTEs & other equipment of the Contractor brought to the site for the purpose of erection, testing and commissioning. BHEL shall continue to hold the lien on all such items throughout the period of contract. No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-contractors without the prior written approval of the Engineer.

- 38.21 The monthwise T&P deployment plan to be submitted as per format (at Annexure-D to general conditions of contract) is only to assess the capability as well as understanding of the contractor to execute the work. It shall be the contractor's responsibility to deploy the required T&Ps, for timely and successful completion of the job, to any extent over and above those indicated in the above deployment plan (including those which are not covered in the plan submitted) without any compensation on this account.

39.0 MATERIALS

- 39.1 The contractor shall at his own expenses provide all materials including paints, welding electrodes etc. required for the work. **However for permanent works cement, reinforcement steel & structural steel will be issued free of cost as per terms & conditions specified in clause No. 40 from BHEL / Customer stores or at a point instructed by BHEL.**
- 39.2 All materials to be provided by the Contractor shall be of the best kind in conformity with the specifications laid down in the contract or as per relevant Indian standard and the Contractor shall, if requested by the Engineer, furnish proof to the satisfaction of Engineer that the materials so comply. **All materials supplied by the Contractor will be Royalty paid as applicable and the Contractor shall furnish proof the same along with the monthly bills .**
- 39.3 The Contractor shall, at his own expense and without delay, supply to the Engineer samples of materials proposed to be used in the works. The Engineer shall within seven days of supply of samples or within such further period as he may require will intimate to the Contractor in writing, whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the Engineer for his approval fresh samples complying with the specifications laid down in the Contract. Any delay in approval of samples (original or fresh ones) shall not make the contractor eligible for any compensation.
- 39.4 The BHEL Engineer shall have full powers for removal of any or all of the materials brought to site by the Contractor which are not in accordance with the Contract specifications or do not conform in character or quality to samples approved by him. In case of default on the part of the Contractor in removing rejected materials, the Engineer shall be at liberty to have them removed by other means. The BHEL Engineer shall have full powers to procure other proper material to be substituted for rejected materials and in the event of the Contractor refusing to comply, he may cause the same to be supplied by other means. All costs, which may attend upon such removal and / or substitution shall be borne by the Contractor.
- 39.5 The Contractor shall indemnify BHEL, its representatives or employees against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties or other charges which may be payable in respect of any article or material or part thereof included in the Contract. In the event of any claim being made or action being brought against BHEL or any agent, servant or employee of BHEL in respect of any such matters as aforesaid, the Contractor shall immediately be notified thereof, provided that such indemnity shall not apply when such infringement has taken place in complying with the specific directions issued by BHEL but the Contractor shall pay any royalties or other charges payable in respect of any such use, the amount so paid being

reimbursed to the Contractor only if the use was the result of any drawings and / or specifications issued after submission of the tender.

- 39.6 The Engineer shall be entitled to have tests carried out as specified in the Contract for any materials supplied by the Contractor other than those for which, as stated above, satisfactory proof has already been furnished, at the cost of the Contractor and the Contractor shall provide at his expense all facilities which the Engineer may require for the purpose. If no tests are specified in the Contract, and such tests are required by the Engineer, the Contractor shall provide all facilities required for the purpose and the charges for these tests shall be borne by the Contractor only. The cost of materials consumed in tests shall be borne by the Contractor in all cases except when otherwise provided.
- 39.7 In addition the Contractor shall perform / submit at his own cost such tests / samples as may be required by the Engineer out of the materials used by the company except for the costs of materials used in such tests / samples.
- 39.8 After acceptance of the Contract, if Contractor desires BHEL to supply any other materials, such material may be supplied by BHEL, if available, at rates to be fixed by the Engineer along with prevailing departmental charges (current rate of 30%). BHEL reserve the right not to issue any material. The non issue of such material will not entitle the Contractor for any compensation whatsoever either in time or in cost.
- 39.9 Material required for the works, whether brought by the Contractor or supplied by BHEL, shall be stored by the Contractor only at places approved by the Engineer. Storage and safe custody of material shall be the responsibility of the contractor.
- 39.10 BHEL's officials concerned with the Contract shall be entitled at any time to inspect and examine any materials intended to be used in or on the works, either on the Site or at factory or workshop or other place(s) where such materials are assembled, fabricated, manufactured or at any place (s) where these are lying or from which these are being obtained and the Contractor shall give such facilities as may be required for such inspection and examination.
- 39.11 All materials brought to the Site shall become and remain the property of BHEL and shall not be removed off the Site without the prior written approval of the Engineer. But whenever the Works are finally completed and advance, if any, in respect of any such material is fully recovered, the Contractor shall at his own expense forthwith remove from the Site all surplus material originally supplied by him and upon such removal, the same shall re-vest in and become the property of the Contractor.
- 39.12 It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of electrodes etc. before procurement of welding electrodes / TIG wires. On receipt of electrodes at site these shall be subjected to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch No. date of expiry etc. and produce test certificate for each lot / batch with correlation of batch / lot no. with respective test certificate. No electrode will be allowed to be used without valid test certificate.
- 39.13 All charges on account of Octroi, terminal or sales tax and other duties on material obtained for the works from any source shall be borne by the contractor.

40.0 ISSUE AND ACCOUNTING OF CEMENT, REINFORCEMENT and STRUCTURAL STEEL

- 40.1 Cement, reinforcing steel, structural steel (like plates, chequered plates, beams, channels, joist, angles, flats, tees, rolled sections , MS rounds,) for structural steel work items only (except for items where supply by contractor is envisaged like anchor bolts, doors, floor grating, MS grating covers etc.) will be issued by as a free issue materials from BHEL / UPRVNL site stores or other issue points as specified by the Engineer. Such issues would be only for permanent works. Necessary indents shall be raised by the contractor as per procedure laid down by the Engineer-in-Charge about 7 days in advance of the actual requirement for incorporation in the works.
- 40.2 Materials will be issued only for permanent works and not for making templates, other temporary works, enabling works etc. and the same shall not be taken into account for purpose of material reconciliation.
- 40.3 The contractor shall bear all other costs including the lifting, carting from issue points to works site/contractor's stores, custody and handling etc. and return of surplus/serviceable materials to Owner's stores to be designated by the Engineer-in-charge and all expenditure will be made by the contractor.
- 40.4 All steel shall be issued in available lengths / shapes and no claims for extra payment on account of issue of non-standard lengths/shapes will be entertained. For the purpose of billing and accounting only linear measurement will be taken and weight will be calculated as per the IS Co-efficient. The difference in unit weight as per IS and actual as issued, if any shall be to the contractor's account and contractor shall quote the rates for corresponding item to take care of such difference.
- 40.5 Cement, as received from the Manufacturer/ Stockiest will be issued to the contractor. The theoretical weight of each bag of cement for issue purpose will be considered as 50Kgs. Per Bag. Any type of cement and in any container as received from Manufacturer / Stockiest shall be issued to the contractor No claim whatsoever shall be entertained on this. Cement bags weighing upto 4% less will be accepted by the contractor and accounted for as 50Kg per bag.
- 40.6 The Contractor shall maintain good stores for storing the cement issued to him. The flooring of the storage house, the clearance of cement bags from the side walls. Etc., shall be as per the instructions of the Engineer-in-charge.
- 40.7 The cement stores shall be open for supervision and verification by the Engineer-in-charge or his authorised representative by any time when the Engineer-in-charge feels the need to do so
- 40.8 In the case of steel materials, the same shall be issued generally on the basis of linear measurement and the corresponding weight will be calculated as per Indian Standard. For the purpose of billing & accounting, only linear measurement will be taken and any difference in weight based on linear measurement & actual weight shall be to contractor's account. Quoted price shall be deemed to include the above & the permissible wastage mentioned. No claim whatsoever shall be entertained on account of wastage & difference in weight as referred to above.

- 40.9 Issue of stores material is subject to availability and the contractor shall not be entitled to any claim or compensation for non-supply or delay in the supply under any circumstances. The material will be issued generally during the working hours.
- 40.10 The Contractor shall bear all incidental costs including site lifting, carting from issue points to site / contractor's store, custody and handling etc., and return of surplus / serviceable / scrap materials to Owner's Storage points designated by the Owner etc. and no separate payment for such expenditure shall be made.
- 40.11 The Contractor will have to submit their design mix for different grades of Concrete keeping in view the requirements stipulated in IS:456, specifically regarding slump and Water Cement ratio and Specific Gravity of Materials brought to site as analysed in the laboratories. The design shall be used upon absolute volume method and theoretical consumption of Cement shall be worked out on this basis. For other than above designated mix Concrete items, the coefficients for consumption of cement shall be adopted as per CPWD practice. The theoretical consumption of cement thus worked out shall be binding upon the Contractor for reconciliation of Cement issued by the Owner. For any excess /under consumption based on these coefficients, the Contractor shall be penalised as per contract provisions. Though, permissible wastage specified shall be considered, while effecting penal recovery, no other allowance whatsoever shall be taken for reconciliation purposes
- 40.12 The theoretical consumption of cement , reinforcement steel and structural steel required for the work will be calculated on the basis of approved drawings / joint measurements. In the case of Cement, the theoretical consumption shall be decided by the Engineer as mentioned above and his decision in this regard shall be final and binding on the Contractor. Reinforcement and structural steel shall be measured by weight in tones. The weight will be arrived at by multiplying the used length by the sectional weight. The sectional weight will be same as were applied at the time of issue. Standard hooks, cranks, bends and authorised laps, chairs, separator pieces etc. specified in drawing or instructed by engineer as required shall be measured and paid for. No payment shall be made for binding wires, spacer block etc. required for keeping the steel in position unless otherwise specified in the contract. No extra payment will be made for modification of already embedded reinforcement, if required due to faulty fabrication or placement.
- 40.13 The contractor shall submit proper account of material / material reconciliation statement for the material drawn by him from stores once in every three months. Failing compliance of this requirement further issue of steel to the contractor may be suspended and no claim of compensation for delay in execution on this account shall be entertained.
- 40.14 All the steel thus issued shall be properly accounted for as per the following permissible wastage over the theoretical quantity / consumption incorporated in the works.

<u>Item</u>	<u>Area</u>	<u>Permissible variation</u>
(a) Cement	For all works except piling	2 %
	For piling works	7 %
(b) Reinforcement	For all works except piling	3 %

bars	For piling works	5 %
(a) Structural steel	Accountable (visible)	4 %
	Un accountable (invisible)	1 %

- 40.15 Any unused / serviceable quantity of cement, reinforcement steel & structural steel not returned in good condition & wastages / loss / consumption beyond specified / agreed limits shall be charged at penal rate of Rs 6000 per MT for cement, Rs 55,000 per MT for reinforcement steel & Rs 65,000 per MT for structural steel respectively at the time of preparing final bill, during finalisation of the contract. The decision of Engineer-in-charge with regard to applicability of penal rates shall be final & binding upon the contractor.
- 40.16 Since the steel is being issued free of cost, the scrap generated shall belong to BHEL.

41. SCRAP & SERVICEABLE MATERIALS

- 41.1 All structural steel of length above 2 M except M.S. Plates shall be considered as serviceable materials provided the materials is in good and acceptable condition. Structural steel in length less than 2 M shall be treated as scrap.
- 41.2 Plates having both sides greater than 1 Metre OR If any side is less than 1 M but greater than 0.5 M and the total area is equal or greater than 2 Sq. Metre shall be considered as serviceable.
- 41.3 All pipes measuring 2 M and above in length shall be treated as serviceable materials provided they are in good and acceptable condition. Pipe in less than 2 M length shall be treated as scrap.
- 41.4 All TMT measuring 3 M and above in length shall be treated as serviceable materials provided they are in good and acceptable condition. TMT in less than 3 M length shall be treated as scrap

42.0 EXECUTION OF WORK

- 42.1 The work shall be executed in a workman like manner and to the entire satisfaction of the Engineer and as per technical specification issued with tender, IS codes, CPWD specifications as applicable. In case of conflict, the decision of the Engineer shall be final & binding.
- 42.2 The Engineer will communicate or confirm his instructions to the Contractor in respect of the execution of the work in a "Work Site Order Book" maintained at his office and the Contractor shall visit this office daily and shall confirm receipt of such instructions by signing the relevant entries in this book. Such entries will rank as order or notices in writing within the intent and meaning of these conditions.
- 42.3 Only BHEL approved make of electrodes will be used. All electrodes shall be heated and dried in the electric electrode drying oven to the required temperature for the period specified by the Engineer before these are used in erection work. All welders shall have electrodes drying portable oven at the work spot. The electrodes brought to site will have valid manufacturing test certificate. The test certificate will have correlation with the lot no. / batch no. given on electrode packets. No electrodes will be allowed to be used in the absence of above requirement. The thermostat and thermometer of electrode drying oven will be also calibrated and test certificate from

Govt. approved / accredited test house traceable to National / International standards) will be submitted to BHEL before putting the oven in use. Periodical calibration for the same shall also be arranged by the contractor within the finally accepted rates.

42.4 SETTING OUT

42.4.1 All the works shall be set out to the true lines, grades and elevation indicated on the drawing. The contractor shall be responsible to locate and set out the works. Only one grid reference line and bench mark all be made available for setting out the works under the contract. This reference lines shall be used as datum for the works under the contract and the contractor has to establish for his work area at available points horizontal and vertical control points. The contractor shall inform BHEL well in advance of the times & places at which he wishes to do work in the area allotted to him so that suitable datum points established by him are checked by BHEL / Customer to enable the contractor to proceed with the works. Any work done without being properly located may be removed and / or dismantled by BHEL / Customer at contractors expense.

42.4.2 The contractor shall at his own expense take all proper and responsible precautions to preserve and maintain these datum marks to its true position. In the event of these marks being disturbed or obliterated by accident or due to any other cause whatsoever, the same may be deemed necessary placed by BHEL / Customer at contractor's expenses.

42.5 SITE DRAINAGE

42.5.1 All water including sub-soil water which may accumulate on the Site during the progress of the works or in trenches and excavations, including monsoon period shall be removed by the contractor from the Site to the satisfaction of the Engineer. It will also be responsibility of the contractor to de-water all the foundation pits, trenches with suitable de-watering methods like, pumping out, well point system etc. considering the depth of water table at plant site. All such expenditure on de-watering shall be deemed to be included in quoted rates.

42.6 INSPECTION AND STAGE APPROVAL OF THE WORK

42.6.1 The owner or his duly authorised representative shall have at all reasonable times access to the contractor's premises or works and shall have the power to inspect drawings or any portion of the work, examine the materials and workmanship and shall have the authority to reject any work. This would be implemented through joint inspection by the representative of the owner and BHEL and in the form of joint protocols without any extra claims and loss of time and amount.

42.6.2 All work embracing more than one process shall be subject to examination and approval at each stage thereof and the Contractor shall give due notice in writing to the Engineer when each stage is ready. In default of such notice being received, the Engineer shall be entitled to approve the quality and extent thereof at any time he may choose and in the event of any dispute, the decision of the Engineer thereon shall be final and conclusive.

42.7 UNCOVERING AND MAKING GOOD

42.7.1 The Contractor shall uncover any part of the Works and/or make openings in or through the same as the Engineer may from time to time direct for his verification and shall reinstate and make good such part to the satisfaction of the Engineer. If any such part has been covered up or put out of view after being approved by the Engineer and is subsequently found on uncovering to be executed in accordance with the Contract, the expenses of uncovering and / or making opening in or through, reinstating and making good the same shall be borne by BHEL. In any other case all such expenses shall be borne by the Contractor.

42.8 DISCREPANCIES AND ADJUSTMENT OF ERRORS

42.8.1 The several documents forming the Contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small-scale drawings and figures dimensions in preference to scale and special conditions in preference to general conditions.

42.8.2 In case of discrepancies between schedules of quantities, the specification and / or the drawings, the following order of preference shall be observed.

(a) Description in schedule of quantities.

(b) Special conditions

(c) Drawings

(d) Technical Specifications

(e) General conditions of contract

If there are varying or conflicting provisions made in any one document forming part of the contract, the Engineer shall be the deciding authority with regard to the document.

42.8.3 Any error in description, quantity in schedule of quantities or any omission there from shall not vitiate the contract or release the contractor from the execution of the whole or any part of the works comprised therein according to the drawings and specifications or from any of his obligations under the contract.

42.8.4 If on check there are found to be differences between the rates given by the contractor in words and figures or in the amount worked out by him in the schedule of quantities and general summary, the same shall be adjusted in accordance with the following rules:

(a) In the event of discrepancies between description in words and figures quoted by a tenderer, the lesser of the two will be treated as valid rate.

(b) In the event of an error occurring in the amount column of schedule of quantities as a result of wrong extension of the unit rate and quantity, the unit rate shall be regarded as firm and extension shall be amended on the basis of the rate.

(c) All errors in totaling in the amount column and in carrying forward totals shall be corrected.

- (d) The totals of various sections of bill of quantities amended shall be carried over to the general summary and the tendered sum amended accordingly. The tendered sum so altered shall, for the purpose of tender, be substituted for the sum originally tendered and considered for acceptance instead of the original sum quoted by the tenderer. Any rounding of quantities or in sections of bill of quantities or in general summary, by the tenderer, shall be ignored.

42.8.5 If neither drawing nor specification contain any mention of minor details of construction which in the opinion of the Engineer whose decision shall be final and conclusive, are reasonable and obviously and fairly intended for satisfactory completion of work, such details shall be provided by the contractor without any extra cost, as if they were specially mentioned and shall be deemed to be included in the

42.9 SAFETY CODE

42.9.1 Besides provision with regard to SAFETY under Clause 27, Contractor shall note that Explosives shall not be used on the work by contractor except with permission in writing of the ENGINEER and in manner and to the extent to which he has prescribed. Where explosives are used, the same shall be stored in a special magazine to be provided by and at the cost of the contractor who shall be liable for all damages, losses and injury to any person or property and shall be responsible for complying with all statutory obligations in these respect.

42.9.2 The contractor will be responsible for Health, Safety & Environment management at site for the construction activities to be carried out by them in accordance with requirements given under section I (a) of this document

42.9.3 Contractor shall arrange for following provisions of HSE

4. Contractor has to maintain contact with local hospital having scanning & other modern medical facilities required during emergency.
5. Contractor has to ensure pre employment medical check for all staff & workers.
6. Contractor has to ensure that adequate First Aid facilities with trained nurse & ambulance are available at work site for emergency purpose. This emergency set-up should include, but not limited to, following
 - Male nurse (in shifts)
 - Oxygen set up
 - Breathing apparatus
 - Eye wash facility
 - Stretcher
 - Trauma blanket
 - Medicines.

The contractor against this contract is required to arrange and maintain ambulance at site for entire contract and extended period. The above emergency facility set up including ambulance, male nurse etc. will be shared by BHEL and its other contractors working at Anpara-D Project at no extra cost to BHEL and its sub-contractors. In case, under unavoidable circumstances, if the ambulance is not available / being used elsewhere, the contractor will have to arrange for the same as under clause 42.9.3.3

42.10 NUISANCE

42.10.1 The Contractor shall not at any time do, cause or permit any NUISANCE on Site or do anything which shall cause unnecessary disturbance or inconvenience to owners, tenants or occupiers of other properties near the Site and to the public generally.

42.11 MATERIAL OBTAINED FROM EXCAVATION

42.11.1 Materials of any kind obtained from EXCAVATION on the Site shall remain the property of BHEL / its client and shall be disposed of as the Engineer may direct, at no extra cost.

42.12 TREASURE , TROVE , FOSSILS etc.

42.12.1 All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the site shall be the absolute property of BHEL / BHEL's client and the Contractor shall take reasonable precautions to prevent his workmen or any other person from removing or damaging any such article or thing, shall immediately upon discovery thereof and before removal acquaint the Engineer with such discovery and carryout the Engineer's directions as to the disposal of the same.

42.13 PROTECTION OF WORKS

42.13.1 Trees designated by the Engineer shall be protected from damage during the course of the Works and earth level within 1 meter of each such tree shall not be charged. Where necessary, such trees shall be protected by providing temporary fencing.

42.13.2 The contractor shall provide and maintain at his own expense all lights, guards, fencing and watching when and where necessary or required by the Engineer for the protection of the Works or for the safety and convenience of those employed on the Works or the public.

42.13.3 The contractor shall have total responsibility for protecting his works till it is finally taken over by the Engineer. No claim will be entertained by the Engineer for any damage or loss to the contractor's works and the contractor shall be responsible for the complete restoration of the damaged works to its original condition to comply with the specifications and drawings. Should any such damage to the contractor's works occur because of other party not under his supervision or control, the contractor shall make his claim directly with the party concerned. The contractor shall not cause any delay in the repair of such damaged works because of any delay in the resolution of such disputes. The contractor shall proceed to repair the work immediately and no cause thereof will be assigned pending resolution of such disputes.

42.14 RECORD FOR MATERIALS CONSUMED

42.14.1 The contractor shall maintain and furnish to the Engineer the RECORD OF MATERIALS consumed in the works for each activity. The statement showing the

theoretical vis-à-vis actual consumption of specified materials, such as structural /reinforcement steel, cement, bitumen, lead, paint etc., shall be enclosed along with the running bills submitted by the contractor. Contractor has to also furnish the test results of the materials used in the work as per IS specifications.

42.15 PROTECTION OF EMBEDMENTS, BOLTS ETC.

42.15.1 The contractor shall ensure proper protection to the satisfaction of the Engineer, of all bolts, inserts, embedments etc. from weather etc/ by greasing, rapping them with gunny bags or canvas or by any other means as directed by Engineer. Cost of such protections shall be deemed to be included in the rates quoted for the item.

42.16 CLEARANCE OF SITE AND REPAIRS.

42.16.1 Contractor has to clear the site / area where mechanical and electrical erection work is to be commenced / or in progress. The contractor shall remove construction materials and equipment lying in the vicinity and causing obstruction in the erection work within 24 hrs. notice. In case, he fails to clear the site, this will be done at his risk & cost by BHEL.

42.17 QUALITY ASSURANCE

42.17.1 The contractor has to establish / arrange at site the field testing facilities for testing of civil construction materials and concrete cubes for ensuring the proper quality, grade and strength of the materials used in the construction in line with approved field quality check list of BHEL/ its client. Contractor has to submit detailed report for testing of all material used etc. All testing shall be done as per IS code specifications/ BHEL's quality plan. If further test is required by the engineer to be carried from outside laboratory, the cost of the same shall be borne by the contractor.

42.18 COMPLETION OF WORK

42.18.1 The works shall be completed to the entire satisfaction of the Engineer and in accordance with the completion schedule as specified in the Contract, and all unused stores and materials, tools, plant, equipment, temporary buildings, site office, labour hutments and other things shall be removed and the site and work cleared of rubbish and all waste materials and delivered up clean and tidy to the satisfaction of the Engineer at the Contractor's expenses.

42.18.2 BHEL shall have power to take over from the Contractor from time to time such sections of the work as have been completed to the satisfaction of the Engineer. Such work however shall not be treated as have been completed until the extra works are executed to the satisfaction of Engineer. The Guarantee period shall commence only after handing over of the entire works.

42.18.3 The Engineer shall certify to the contractor the date on which the work is completed and the date thereof.

42.19 RECORDS AND MEASUREMENTS

42.19.1 All items having a financial value shall be entered in BHEL measurement Book so that a complete record is obtained of all works performed under the Contract.

- 42.19.2 Lump sum omissions will be entered for deduction. Measurement shall be restricted to that required to ascertain the financial liability of BHEL under the contract.
- 42.19.3 Work which fails to be measured in details shall be measured physically without reference to any local custom that may obtain excepting where it may otherwise be directed in the tender documents. The measurements shall be taken jointly by any person duly authorised on the part of BHEL and by the Contractor.
- 42.19.4 The Engineer shall give reasonable notice in writing to the Contractor of appointment for measurement.
- 42.19.5 The Contractor shall, without extra charge, provide assistance with appliances and other things necessary for measurement and shall bear all the cost of measurement of his work.
- 42.19.6 Measurement shall be entered in BHEL Measurement Book and signed and dated by both parties each day at the site on completion of measurement. If the Contractor objects to any of the measurements recorded on the behalf of BHEL, a note to that effect will be made in BHEL Measurement Book or against the item or items objected to and such note shall be signed and dated by both the parties engaged in taking the measurement.
- 42.19.7 If, as a result of such objection, it becomes necessary to re-measure the work wholly or in part the expense of such re-measurement shall be borne by the contractor.
- 42.19.8 If the Contractor's representative fails to attend when required, the Engineer shall have power to proceed by himself to take measurements and in that case these measurements shall be accepted by the Contractor as final.
- 42.19.9 The Contractor shall, once in every month, submit to the Engineer details of his claims for the work done by him upto and including the previous month which are not covered by this Contract Agreement in any of the following respects:
- (a) Deviation from the items and Specifications provided in the Contract documents.
 - (b) Extra items/new items of work.
 - (c) Quantities in excess of those provided in the Contract Schedule.
 - (d) Items in respect of which rates have not been settled.

43.0 **METHOD OF MEASUREMENT**

- 43.1 Method of measurements shall be as per standard specifications included in the tender. For other items measurements shall be as per relevant IS Codes.

44.0 **DEVIATION**

- 44.1 The Contractor shall not make any alteration in, addition to or omission from the work as described in the tender documents except in pursuance of the written instructions of the Engineer. No such deviation from the work described in the tender

documents shall be valid unless the same has been specifically confirmed and accepted by the Engineer in writing and incorporated in the Contract.

- 44.2 The Engineer may deviate, either by way of addition or deduction, from the work so described, provided that the Contract sum be not thereby varied on the whole by more than the percentage set out in the tender documents. The value of all additions and deductions shall be added to or deducted from the Contract sum. (Whenever the Engineer intends to exercise such a right his intentions shall specify the deviations which are to be made, the lumpsum assessment or the proposed basis of payment, the extra time allowed, if any, and the date for completion of the entire contract). Any objection by the contractor to any matter concerning the order shall be notified by him in writing to the Engineer within seven days from the date of such order, but under no circumstances shall the work be stopped (unless so ordered by the Engineer) owing to differences or controversy that may arise from such an objection. In the absence of such a notification of objection by the Contractor, he will be deemed to have accepted the order and the conditions stated therein.

45.0 VALUATION OF DEVIATIONS

Rates for deviated items or new items of work shall be as follows :

- 45.1 If the rates for the additional, altered or substituted work are specified in the Contract for the work, the Contractor is bound to carry out the additional, altered or substituted work at the same rates as are specified in the Contract for the work.
- 45.2 If the rates for the additional, altered or substituted work are not specifically provided in the Contract for the work, the rates will be derived from the rates for a similar class of work as are specified in the Contract for the work.
- 45.3 If the rates for the altered, additional or substituted work cannot be determined in the manner specified in above clauses the rate for such part or parts will be determined by the Engineer on the basis of prevailing market rates when the work was done and the decision given in this behalf shall be final and binding on the Contractor. Rate analysis will be worked on CPWD manual of rate analysis as guidance.
- 45.4 If the rates for the altered, additional or substituted work cannot be determined in the manner specified in above clauses, then the contractor shall within 7 days of the date of receipt of order to carry out the work inform the Engineer of the rate at which it is his intention or charge for such class of work, supported by analysis of the rate or rates claimed, and the Engineer shall determine the rate or rates on the basis of prevailing market rates and pay the Contractor accordingly. However, the Engineer, by notice in writing, will be at liberty to cancel his order to carryout such class of work and arrange to carry it out in such manner as he may consider advisable. But under no circumstance the Contractor shall suspend the work on the plea of non-settlement of rates falling under the clause or claim any compensation on that account. Elements of profit, overheads, supervision and establishment charges will be taken as 15% over direct cost.

46.0 COMPLIANCE TO REGULATIONS AND BYELAWS

46.1 The Contractor shall conform to the provisions of any statute relating to the work and regulations and bylaws of any local authority and of any water and lighting Companies or Undertaking with whose system the work is proposed to be connected. He shall, before making any variation from the drawings or the specifications that may be necessitated for such connections give the Engineer, notice specifying the variation proposed to be made and the reasons therefore and shall not carryout any such variation until he has received instructions from the Engineer in respect thereof. The Contractor shall be bound to give all notices required by statute, regulations or bye-laws as aforesaid and to pay all fees and taxes payable to any authority in respect thereof.

47.0 FACILITIES TO BE PROVIDED BY BHEL / CONTRACTOR

47.1 BHEL shall provide free of charge limited open space, for office & storage shed, as and where made available by M/s UPRVNL. It is the responsibility of the contractor to develop the area required for construction of sheds / equipment area , provide all utilities and dismantle and clear the site after completion of work or as and when required , as a part of his scope of work.

47.2 BHEL shall provide limited open space for labour colony near the plant free of rental charge. Contractor shall be responsible for providing all necessary facilities like residential accommodation, transport , electricity , water , medical facilities etc. as required under various labour laws and statutory rules and regulations framed there under to the personnel employed by him.

47.3 **Construction power, as and when available, for construction purposes will be provided free of cost** and at one point near erection site (at a distance upto 500 meters) from supply point. Further distribution of power shall be done by contractor at his cost. All wiring must comply with local regulations and will be subject to Engineer's inspection and approval before connecting supply.

47.4 **Electricity will be provided at one point on chargeable basis for labour colony. Water for labour colony will be provided free of cost at one point and has to be distributed by the Contractor at his own cost.** Meter for electricity will have to be provided by the Contractor at his own cost.

47.5 Provision of distribution lines of power from the central points to the required place with proper distribution boards observing the safety rules laid down by the authorities of the state shall be done by the contractor, supplying all the materials like cables, distribution board, switch boards, TPN, CBS, ELCBS/ MCCBS / Copper / Brass clamps, copper conductor, change over switches pipes etc. at his own cost. If any failure is caused in supply of the power and water, it is the responsibility of the contractor to make alternate arrangements at his cost. The contractor shall adjust his working shift / hours accordingly and deploy additional manpower if necessary so as to achieve the targets.

47.6 In case of power cuts / load shedding no compensation for idle labour or extension of time for completion of work will be given to contractor.

47.7 Adequate lighting facilities such as flood lamps, hand lamps and area lighting shall be arranged by the contractor at the site of construction, contractor's material storage area etc. within finally accepted rates.

47.8 No claim for damages will be entertained by the Company on account of interruptions of water supply or limitation of quantity of water as aforesaid or on account of the water so taken being not fit for construction purposes or on any other account in connection with such water supply.

47.9 CONTRACTOR HAS TO ARRANGE FOR CONSTRUCTION WATER BY PROVIDING SUITABLE BORE WELL WITHIN THE QUOTED RATES.

Contractor to satisfy himself that the water drawn by him is fit for construction / consumption and adequately treat such water at his cost when it is not found fit for the said purposes

47.10 The Contractor should make arrangements for storage of sufficient quantity of water required for work.

47.11 The Contractor shall during the progress of the work, provide, erect and maintain at his own expenses all necessary temporary workshops, stores, consumables, offices, etc. required for the proper and efficient execution of the work. The planning, setting and erection of these buildings shall have the approval of the Engineer and the Contractor shall at all times keep them tidy and in a clean and sanitary condition to the entire satisfaction of the Engineer.

47.12 On completion of work or as and when required by BHEL, all the temporary buildings, structures, pipe lines, cables etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, same will be got done by the Engineer and expenses incurred shall be recovered from the contractor along with prevailing overhead. The decision of BHEL Engineer in this regard shall be final.

48.0 PROGRESS REPORTING

48.1 Contractor is required to draw mutually agreed monthly programme in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed programme and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.

48.2 Weekly progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled programme shall be discussed for actions to be taken for achieving targets. The programme for subsequent week shall also be presented by contractor for discussions. The contractor shall constantly update / revise his work programme to meet the overall requirement. All quality problems shall be discussed during above review meetings. Necessary preventive and corrective action, shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of non-conformities.

48.3 The contractor shall submit weekly and monthly progress reports, materials reports, consumables (gases / electrodes) report and other reports as per proforma considered necessary by the Engineer.

48.4 The progress report shall indicate the progress achieved against planned , with reasons indicating delays , if any, and shall give the remedial actions which the contractor intends to take to make good the slippage or lost time , so that further

works again proceed as per the original programme and the slippages do not accumulate and effect the overall programme.

- 48.5 The daily manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.

49.0 DRAWING AND DOCUMENTS

- 49.1 The detailed drawings, specifications available with BHEL engineers will form part of this tender specification. These documents will be made available to the contractor during execution of work at site. The contractor will also ensure availability of all drawings / documents at work place.
- 49.2 Necessary drawings / documents by BHEL to carry out the construction work will be furnished to the contractor by BHEL (except those proposed to be prepared by contractor, as mentioned in this contract) on loan which shall be returned to BHEL Engineer at site after completion of work . Contractor shall ensure safe storage and quick retrieval of these documents.
- 49.3 The contractor shall maintain a record of all drawings and documents available with him in a register as per format given by BHEL Engineer. Contractor shall ensure use of pertinent drawings / data / documents and removal of obsolete ones from work place and return to BHEL.
- 49.4 The data furnished in various annexures enclosed with this tender specification are only approximate and for guidance. However, the change in the design and in the quantity may occur as is usual in any such large scale of work.
- 49.5 Should any error or ambiguity be discovered in the specification or information the contractor shall forthwith bring the same to the notice of BHEL before commencement of work. BHEL's interpretation in such cases shall be final and binding on the contractor.
- 49.6 Deviation from design dimensions should not exceed permissible limit. The contractor shall not correct or alter any dimension / details, without specific approval of BHEL.

50.0 DELAY AND EXTENSION OF TIME

- 50.1 If, in the opinion of the Engineer, the work is delayed
- (a) by reason of abnormally bad weather, OR
 - (b) by reason of serious loss or damage by fire, OR
 - (c) by reason of civil commotion, local combination of workmen, strike or lockout, affecting any of the trades employed on the work, OR
 - (d) by delay on the part of the agency or tradesmen engaged by the BHEL in executing work not forming part of the Contract, OR
 - (e) by reason of any other cause which in the absolute discretion of the Engineer is beyond the Contractor's control, then in any such case, the Engineer (or higher authority) may make fair and reasonable extension in the completion dates of the

individual items of work or the Contract as a whole. Such extension which will be communicated to the Contractor by the Engineer in writing shall be final and binding on the Contractor. No other claim in this respect for compensation or otherwise howsoever is admissible. Upon the happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the Engineer but shall nevertheless use constantly his best endeavor to prevent or make good the delay and shall do all that may reasonably be required to the satisfaction of the Engineer to proceed with the work.

51.0 PRICE VARIATION AND OVERRUN

51.1 The finally accepted rates for scope of work as defined in this tender are subjected to price variation provisions as per following formula:

$$P1 = \frac{0.75 \times P0 (F1 - F0)}{F0}$$

P1 = Increase in billing amount (variation) for the particular month of billing.

P0 = Gross billed amount for the month as per contract provisions.

F1 = All India CPI published by Labour bureau, Simla, Govt. of India, for Industrial workers (Base 2001 =100) applicable for the month under consideration i.e. for which bill has been raised.

F0 = All India CPI published by Labour bureau, Simla, Govt. of India, for Industrial workers (Base 2001 =100) **applicable for the month of opening of technical bid.**

51.2 Price variation as per above formula will be calculated and paid on the total contract value (excluding payments towards extra works and over run, if any) on month to month basis. BHEL however reserves the right to freeze variation for that much of duration of delays, from time to time, which are entirely attributable to the contractor. **Price variation on last 5% of CV will be based on average index.**

51.3 With the provision of price variation as per above clauses NO CLAIM / COMPENSATION/OVER RUN on account of any increase whatsoever, (irrespective of whether escalation are steep/ unanticipated or not compensated by the above escalation provisions in full towards minimum wages, consumables, coarse / fine aggregates, steel, wood, electrodes, gases or any other item / reason) will be payable during the entire period of execution including extended period, if any.

52.0 INCOME TAX AND SALES TAX

52.1 **TDS under Income Tax, Sales Tax, VAT etc**, if any, shall be deducted at prevailing rates on gross invoice value from the running bills unless Exemption Certificate from appropriate Authority / Authorities is furnished.

52.2 **Price quoted shall be inclusive of all taxes except service tax.** The service tax, as legally leviable & payable by the contractor under the provisions of applicable law/act, shall be paid by BHEL as per contractor's bill. However, contractor shall have to submit proof of service tax deposited by them immediately after the deposit but not later than the next bill submitted after the due date of deposit. The

contractor shall furnish proof of Service Tax registration with Central Excise Division covering the services covered under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by contractor on BHEL for this project. The contractor shall obtain prior approval of BHEL before billing the service tax amount and should submit proper CENVARIABLE invoice as per Service Tax Rules.

With introduction of Cenvat credit rules 2004 which came into force w.e.f. 10.09.2004, excise duty paid on input goods including capital goods used for providing the output service and service tax paid on input service can be taken credit of against the service tax payable on output service. As such, while offering the rates, the contractors may take into account the benefit of above provisions as the cost of input to contractors will be the cost net of excise duty and service tax and adjust their offer price accordingly to make it more competitive

- 52.3 In VAT applicable States, "Tax Invoice" if required under the relevant State VAT law shall be submitted alongwith other compliances as per concerned VAT Act.
- 52.4 Contractor shall get his organization registered with concerned sales tax/VAT authorities within 15 days of award of this contract, if applicable. The delay on this account and delay in bringing the material shall be to contractor's account and no extension of time shall be allowed on this account. The sales tax/VAT registration for this contractor shall be forwarded to BHEL within 30 days from the date of LOI. In case the contractor is already registered for sales tax/VAT with Govt. Authorities he must quote his registration no, while submitting their tender
- 52.5 Contractor has to make his own arrangement at his cost for completing the formalities, if required, with Sales Tax/VAT Authorities, for bringing their materials, plants, and equipment at site for the execution of the work, including arrangement of Road permit as applicable under this contract.

53.0 TIME SCHEDULE

- 53.1 The contractor is required to commence the work within 15 days from the date of issue of letter of intent unless BHEL decides to fix any other later date.
- 53.2 Entire work as detailed in tender specification **shall be completed within 18 months from the scheduled date of start of work** as per the programs / milestones indicated by BHEL(**Tentative programme for subject tender is given as per clause no. 53.3**). Contractor has to mobilise adequate resources to meet BHEL's commitments to their customer as indicated from time to time.
- 53.3 **The various mile stone dates to be achieved as per the current status of contract, are as below:**

MILE STONES	MONTHS
Mobilisation and Start of Work	Zero Date
Start of Stone Column Installation	1 st Month
Start of Boundary Wall Foundations	3 rd Month
Start of Boundary Wall Brickwork	6 th Month
Completion of Boundary Wall Stone Pile	12 th Month

Completion of Boundary Wall	17 th Month
Completion of Boiler Unit-1 Stone Piles	2 nd Month
Completion of ESP Unit-1 Stone Piles	3 rd Month
Completion of PH Unit-1 Stone Piles	4 th Month
Completion of Unit-1 Stone Piles	7 th Month
Completion of Unit-2 Stone Piles	13 th Month
Completion of Balance Stone Piles	17 th Month

- 53.4 In case due to reasons not attributable to the contractor, the work gets delayed and scheduled completion gets extended, time extension will be granted by BHEL but in no case over run compensation will be payable.
- 53.5 The work under the scope of this contract is deemed to be completed in all respects, only when all the works are carried out as per satisfaction of BHEL. The decision of BHEL on completion date shall be final and binding on the contractor.

54.0 TERMS OF PAYMENT

54.1 ADVANCE PAYMENT

- (a) **5%** of the contract value shall be paid as interest bearing advance against submission of a Bank Guarantee as per BHEL format given at annexure – X of this NIT for an amount equal to 1.25 times of advance valid for 24 months initially and thereafter extension for a period upto which the advance is fully adjusted. The interest chargeable shall be Prime Lending Rate of State Bank of India plus 2%.
- (b) The advance paid shall be recovered from the contractor's progressive bills to an extent of **10%** of each progressive bill amount till it is fully recovered. The BG amount shall be allowed to be reduced every six months by an amount equal to the amount adjusted against running bills.
- (c) The BG shall be returned after full adjustment of the entire amount of advance along with interest.
- 54.2 The Contractor shall be paid monthly running bill to a maximum of 95% of the value of the work actually executed on site provided the work has been executed to the satisfaction of the Engineer. **BHEL site in-charge, at his discretion can split this 95 % payment, to facilitate site operations.** The Engineer may after a measured bill allow & certify payment to the contractor on the basis of abstract measurement bill submitted by the contractor. Contractor will also submit the floppy / CD containing abstract & measurement sheets of the bill which will be returned to him after correction for further resubmission of bill. From this amount recovery such as advances, security deposit taxes etc. would be made. The certificate of the Engineer regarding such approval and passing of sums so payable shall be final and conclusive against the contractor.
- 54.3 The 2.5% Final contract value (worked out based on actual work carried out) shall be payable on completion of all pending work, rework wherever required, site clearing and reconciliation of materials.

NOTE: Above payment shall be released after working out the contract value based on actual work carried out.

- 54.4 The balance 2.5% of final contract value will be payable on submission and passing of Final bill. The certificate of Engineer regarding such approval and passing of sums shall be final and conclusive against the contractor.
- 54.5 Any certificate relating to the work done may be modified by any subsequent interim certificates or by the final certificates and no certificate of the Engineer supporting an advance payment shall of itself be conclusive evidence that any work or materials to which it relates are in accordance with the contract.

55.0 INSURANCE

Besides provisions under clause no. 29.0 of GCC regarding insurance, the following shall also be applicable. The contractor shall also take care of the same while submitting their offer.

- 55.1 BHEL / its customer shall arrange for insuring the materials of BHEL / its customer covering the risks during transit, storage, erection and commissioning.
- 55.2 If due to negligence/ carelessness on the part of the contractor, any material/ equipment gets damaged, the contractor shall submit necessary documents for lodging insurance claims as required by BHEL Engineer. BHEL shall however reserve the right to recover deductible franchise and also unsettled portion of insurance claim amount from the contractor.
- 55.3 If due to negligence/ carelessness on the part of the contractor, any surrounding properties also get damaged, the contractor shall submit necessary documents for lodging insurance claims as required by BHEL Engineer. BHEL shall however reserves the right to recover deductible franchise and to unsettled portion of insurance claim amount from the contractor.
- 55.4 The contractor may note that, if BHEL T&Ps / IMTEs are not insured, the Contractor will take necessary precautions and due care to protect the same while in his custody from any damage/ loss till the same is handed over back to BHEL. In case the damage / loss is due to carelessness/ negligence on the part of the contractor, the Contractor is liable to get them repair/ replaced immediately and in case of his failure to do so within a reasonable time ,BHEL will reserve the right to recover the loss from the contractor.

56.0 RATE SCHEDULE CUM BOQ/VARIATION

- 56.1 Contractor shall fully understand description and scope of work before quoting. The scope of work and responsibility of the contractor as mentioned under these specification shall be covered within the quoted / finally accepted rates.
- 56.2** The Tenderer shall quote the prices/rates for entire scope of work as per the rate schedule only, in part II price bid (Original). Conditional price bids or price bids with any deviation / clarification etc. are liable to be rejected. No cutting / erasing / over writing shall be done.
- 56.3 Deleted**

- 56.4 Quantities mentioned in the rate schedules are approximate only and liable for variation. The tentative contract value (CV) for entire scope of work shall be calculated as per finally quoted / accepted item rates & the quantities indicated in Rate Schedule cum BOQ.
- 56.5 Contractor's total quoted price as per rate schedule will be taken as tentative only. The contractor undertakes to erect / commission actual quantities as per advice of BHEL Engineer and accordingly the final contract price shall be worked out on the basis of quantities actually erected at site and payments will also be regulated for the same. The quantities indicated against each item may vary to any extent and no compensation will be payable in variation of Individual item quantity. **However, in case of overall reduction in contract value beyond 30%, the contractor will be eligible for compensation as per the following provision:**

“The actual executed value shall be raised by 10 % subject to the condition that the total value of work executed plus increase as above shall be limited to 70 % of the awarded contract value”

Contractors are requested to take above into account while quoting the unit rates quoted as per Rate Schedule so as to take care of such variation during execution stage.

57.0 FINAL BILL

- 57.1 As soon as possible after the completion of the work to the satisfaction of the Engineer, the Contractor shall prepare a certified final accounts on BHEL forms, in duplicate. It shall be accompanied by the all **abstracts**, vouchers, etc. in support thereof and shall be prepared in the manner prescribed by the Engineer.

58.0 LIQUIDATED DAMAGES(LD)

- 58.1 For delay in completion of work attributable to the contractor, the LD shall be applicable at the rate of ½% of the contract value per week of delay or part thereof limited to a ceiling of 10% of the contract value as mentioned under clause no.25.5 of the GCC of the tender.

59.0 SECURITY DEPOSIT

- 59.1 The contractor shall submit Security Deposit within 15 days from the date of issue of LOI as per clause no. 16.2 of the General Conditions of Contract (GCC). In case the contractor opts to furnish Bank Guarantee as a part of Security Deposit, the BG shall be issued as per the Performa enclosed as per Annexure-H of the GCC and also that the BG should be issued preferably through any of the Member Banks listed in the GCC;

For BG through any other Nationalized Bank (Not covered in the list of Member Banks of GCC), the discretion of its acceptance shall lie solely with BHEL.

60.0 OTHERS

- 60.1 In case of any contradiction between General Conditions of Contract (GCC) and Special Conditions of Contract (SCC), the latter shall prevail.
- 60.2 The tenderer shall specifically confirm he has inspected the site of work and is fully conversant with the prevailing conditions under which work is to be executed and will not raise claim of any nature due to lack of knowledge of site condition. He will also confirm that local taxation laws at the site have been clearly understood by him.
- 60.3 The Price Bids of only those bidders will be opened who will be qualified for the subject job on the basis of pre-qualification evaluation / Techno-commercial bids. BHEL reserves the right to reject the bidders with unsatisfactory past performance in the execution of a contract. BHEL's decision in this regard shall be final & binding.
- 60.4 Bidder's selection is subject to approval of BHEL's customer for this work i.e M/s UPRUVNL.

Annexure-I**INDICATIVE LIST OF T & P TO BE ARRANGED BY THE CONTRACTOR AT HIS OWN COST**

SL NO	EQUIPMENT	PART- A
1	DRIVEN PILE RIG OF REQUIRED CAPACITY WITH ACCESSORIES	20 NO. As Per Requirement (APR)
2	HYDRAULIC EXCAVATOR / POCLAIN	6 NO (APR)
3	DOZER	6 NO (APR)
4	DUMPER	50 NO (APR)
5	POWER DRIVEN EARTH RAMMER	6 NO(APR)
6	ROAD ROLLERS	6 NO(APR)
7	EARTH COMPACTOR (VIBROMAX)	4 NO(APR)
8	WATER TANKER WITH SPRINKLING FACILITY	25 NO (APR)
10	DE WATERING PUMP	10 NO (APR)
11	DIESEL OPERATED BOREWEL	5 NO (APR)
12	MOBILE LIGHTING MAST	20 NO (APR)
13	MINI BATCHING PLANT	8 NO (APR)
14	TRANSIT MIXER	5 NO (APR)
15	CONCRETE VIBRATOR	AS PER REQUIREMENT
16	12/14 MT HYDRA CRANE	AS PER REQUIREMENT
17	18 MT HYDRA CRANE	MATCHED WITH PILING RIGS (APR)

NOTES:

- 1 The above list specifies only major T&P (may not be complete to be deployed by the contractor). All additional / other tools and plants including trucks & devices, tackles, machines, measuring instruments etc. in good and safe working conditions which are required for satisfactory & timely completion of work shall also be deployed by the contractor within finally accepted rate / price
- 2 Other terms and conditions regarding above items please also refer clause 38 T&P/IMTEs).

Annexure-II**INDICATIVE LIST OF IMTEs TO BE ARRANGED BY THE CONTRACTOR AT HIS OWN COST**

SL NO	EQUIPMENT	QTY
1	TOTAL STATION	3 NO
2	THEODOLITE ONE SECOND ACCURACY	6 NO
3	AUTO LEVEL WITH STAFF	4 NO
3	COMPRESSION STRENGTH TESTING EQUIPMENT	1 NO
4	COMPRESSION STRENGTH TESTING EQUIPMENT	1 NO
5	CONSTRUCTION MATERIAL TEST EQUIPMENT	AS PER REQUIREMENT
6	CONCRETE CUBE MOULD (150 X 150 X 150) mm	2 SET
7	CONCRETE slump cone	2 SET
8	COARSE AGGREGATE SIEVES & SAND SIEVER	1 SET
9	SIEVE SHAKER	1 NO
10	AGGREGATE IMPACT TEST MACHINE	AS PER REQUIREMENT
11	HEATING OVEN	1 NO
12	PHYSICAL BALANCE FOR LAB WORK	1 NO

NOTES:

1. The above list specifies only major IMTEs (may not be complete to be deployed by the contractor). Contractor has to set up the field laboratory with facilities required for material & concrete testing. All additional / other IMTEs / measuring instruments etc. in good and safe working conditions which are required for satisfactory & timely completion of work shall also be deployed by the contractor within finally accepted rate / price.
2. Other terms and conditions regarding above items please also refer clause 38 T&P/IMTEs).

Annexure-III**LIST OF DRAWINGS & SPECIFICATIONS ENCLOSED.**

S.NO	TITLE
1.	SPECIFICATION NO PE-TS-999-600-C011, Section D, Sub-section D1 to D22 as follows:
D1	EARTHWORK IN EXCAVATION AND BACKFILLING
D2	CEMENT CONCRETE (PLAIN & REINFORCED)
D3	CARPENTRY AND JOINERY
D4	ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS
D8	MISCELLANEOUS METAL
D17	FABRICATION OF STRUCTURAL STEEL WORK
D18	ERECTION OF STRUCTURAL STEELWORK
D21	PILING



**TECHNICAL SPECIFICATION FOR
EARTHWORK IN EXCAVATION
AND BACKFILLING**

SPECIFICATION NO. PE-TS-298-600-C005

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UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

2 x 500 MW ANPARA D THERMAL POWER PROJECT

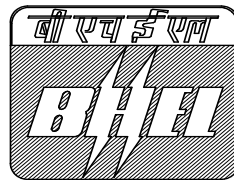
**VOLUME – II B
CIVIL, STRUCTURAL & ARCHITECTURAL WORKS**

SPECIFICATION NO. PE-TS-298-600-C005

SECTION - D

GENERAL TECHNICAL SPECIFICATION

**SUB-SECTION – D1
EARTHWORK IN EXCAVATION AND BACKFILLING**



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



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**TECHNICAL SPECIFICATION
FOR
EARTHWORK IN EXCAVATION AND BACKFILLING**

1.0.0 SCOPE

This specification covers excavation in all types of soil, soft and decomposed rock not requiring blasting and rocks requiring blasting, shoring, dewatering, filling around foundations and to grade, compaction of fills and approaches, protective fencing, lighting, etc. relevant to structures and locations covered under the scope of this contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless specified otherwise, shall include but not be limited to the following :

- a) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.
- b) Prepare and submit working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering, including drains and outfall for drainage, space for temporary stacking of spoils, disposal area, fencing, etc. and all other details as may be required by the Engineer.
- c) To carry out sampling and testing and submit to the Engineer, results of soil compaction tests whenever required by the Engineer to assess the degree of compaction.
- d) Construction, maintenance and removal after completion of magazine of proper capacity as well as design for storing of explosives required for blasting work to be carried out under the scope of this tender including procurement of necessary licenses from proper authorities.

2.2.0 Work to be provided for by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract.

2.3.0 Codes and Standards

All works under this specification, unless specified otherwise, shall conform to the latest revision and/or replacement of the following or any other Indian



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Standard Specifications and Codes of Practice. In case any particular aspect of work is not covered specifically by Indian Standard Specification any other standard practice as may be specified by the Engineer shall be followed :-

IS:1200 (Part-I) Method of Measurement of Building and Civil Engineering work; Part - I Earthwork.

IS:2720 (Part-II) Determination of Moisture Content

IS:2720 (Part-VII) Determination of Moisture content / Dry Relation using Light Compaction.

IS:2720 (Part-xiv) Determination of Density Index (Relative Density) of cohesionless soils.

IS:2720 (Part-xxix) Determination of Dry Density , in place, by core cutter method.

IS:2720 (Part- xxviii) Determination of Dry Density of soils, in place, by sand replacement methods.

IS:3764 Safety code for Excavation work.

IS:4081 Blasting and Related Drilling Operations

IS:4701 Earthwork on canals

2.4.0 **Conformity with Designs**

The Contractor is to carry out the work as per the drawings issued to him and/or Contractor's drawings which are approved by the Engineer and/or the Engineer's instructions.

2.5.0 **Materials to be used**

2.5.1 **General**

All materials required for the work shall be of best commercial variety and approved by the Engineer.

2.5.2 **Borrow Material**

Borrow material required for back-filling shall be excavated from approved locations and levels, and shall consist of material, approved by the Engineer, free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods. If specified, clean graded sand free from harmful and deleterious material from approved quarries, shall be used as fill material.



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2.6.0

Quality Control

The Contractor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work :

- a) Lines, Levels and Grades :
- i) Periodic surveys
 - ii) Establishment of markers, boards etc.
- b) Back-filling :
- i) Checking the quality of fill material
 - ii) Checking moisture content of the backfill
 - iii) Checking the degree of compaction

2.7.0

Information regarding site conditions

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the Contractor shall be taken as a guidance only and variation therefrom shall not affect the terms of the contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and / or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the contract so that he may evolve a realistic programme of execution.

3.0.0

EXECUTION

3.1.0

Setting Out

The Contractor will prepare and submit to the Engineer, detailed drawings of the excavation work as proposed to be executed by him showing the dimensions as per drawings and specification adding his Proposals of slopes, shorings, approaches, dewatering sumps, berms, etc. On receiving the approval from the Engineer with modifications and corrections, if necessary, the Contractor will set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking.

These permanent points and markers will be fixed at intervals prescribed by the Engineer and checked by the Engineer and certified by him after which the Contractor will proceed with the work. Engineer shall be provided with necessary men, material and instructions for such checking. It should be noted that this checking by the Engineer prior to start of the work will in no way absolve the Contractor of his responsibility of carrying out the work to true lines and levels and grades as per drawing and subsequent corrections, if necessary, in case any errors are noticed in the Contractor's work at any stage.



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3.2.0

Initial Levels

Initial levels of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements.

All records of levels, measurements etc. and also any drawing, cross section etc. made therefrom, shall be jointly signed by the authorised representative of the contractor and the Engineer before the commencement of work and they shall form the basis of all payments in future.

3.3.0

Clearing and Grubbing, etc.

The area to be excavated or filled shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush, etc. and levelled up. Trees upto 300mm girth shall be uprooted. Trees above 300 mm girth to be cut, shall be approved by the Engineer and then marked. Felling of trees shall include taking out roots upto 600 mm below ground level or 150 mm below formation level whichever is lower. After the tree is cut and roots taken out the pot-holes formed shall be filled with good earth in 250 mm layers and consolidated unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by the Engineer.

Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to approved disposal areas as may be specified. Ash shall be spread or removed. Useful materials, saleable timber, firewood, etc. shall be the property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Engineer.

3.4.0

Classification

All earthwork shall be classified under the following categories :

No distinction will be made whether the material is dry or wet.

a) Ordinary Soil

This shall comprise vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

b) Hard Soil



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This shall include :

- i) stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied ;
- ii) gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm ;
- iii) soling of roads, paths, etc., and hard core ;
- iv) macadam surfaces such as water bound, and bitumen/tar bound;
- v) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar, below ground level ;
- vi) soft conglomerate, where the stones may be detached from the matrix with picks ; and
- vii) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above.

c) Soft and Decomposed Rock

This shall include :

- i) limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;
- ii) unreinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;
- iii) boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin ; and
- iv) any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting.

d) Hard Rock (requiring blasting)



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This shall include :

- i) any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required ;
 - ii) reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and
 - iii) boulders requiring blasting.
- e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method.

In case of any dispute regarding classification, the decision of the Engineer shall be final.

3.5.0 Excavation for Foundations and Trenches

3.5.1 General

All excavations shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer shall be obtained by the Contractor, in each individual case, for the method he proposes to adopt for the excavations including dimension, side slopes, shoring, dewatering, disposal, etc. This approval, however, shall not in any way make the Engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner.

All excavation in open cuts shall be made true to line, slopes and grades shown on the drawing or directed by the Engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders projecting out of the excavated surfaces shall be removed, if in the opinion of the Engineer they are likely to be a hindrance to the workers.

Method of excavation shall be in every case subject to the approval of the Engineer and the Contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works.

The Contractor shall have full responsibility of the stability of the excavation and safety of the workmen. If any slip occurs, the Contractor shall remove all slipped material from the excavated pit.

All loose boulders, semi-detached rocks, not directly in excavation but so close to the area to be excavated as to be liable, in the opinion of the Engineer, to fall or otherwise endanger the workmen, equipment of the work, etc., shall be stripped off and removed away from the areas of excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion which was originally sound and safe. Any materials not requiring removal as contemplated in the work, but which, in



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the opinion of the Engineer, is later to become loose or unstable shall also be promptly and satisfactorily removed as directed by the Engineer.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the Engineer.

The rough excavation may be carried up to a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the Engineer.

If the excavation is done to a depth greater than that shown on the drawing, or directed by the Engineer, due to the Contractor's fault, the excess depth shall be filled up to the required level (with cement concrete not leaner than 1:4:8 ordinary concrete or richer) as directed by the Engineer in each individual case.

In formation of rock requiring blasting, those overcuts which are unavoidable will be made up by ordinary cement concrete 1:2:4. All excavated materials such as hard rock, boulders, bricks, dismantled concrete blocks, etc. shall be stacked separately as directed by the Engineer and shall be the property of the Owner.

3.5.2 Excavation in Ordinary Soil, Hard Soil and Soft and Decomposed Rock

The excavation in ordinary soil, hard soil, soft and decomposed rock will be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work will be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work will be checked by the Engineer thoroughly and the balance work will be carried out carefully to avoid any over-excavation. On completion, the work will be finally checked and approved by the Engineer. In certain cases, where deterioration of the ground, upheaval, slips, etc. are expected, the Engineer may order to suspend the work at any stage and instruct the Contractor to carry out the balance work just before the foundation work of the structure can be started.

3.5.3 Excavation in Hard Rock

In case where excavation, both in ordinary soil and hard rock, are involved, the ordinary soil comprising of soft, hard and dense soils (including laterite formations) and rock including weathered rocks, lateritic rocks, etc. which can be excavated without blasting, shall be completely stripped off. Further work in hard rock shall be resumed after clearance from the Engineer.

Personnel deployed for rock excavations shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of



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excavated surfaces. Where the excavated surface is such that it is not stable against sliding, necessary supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock/boulder falling from the excavated surfaces deeper than 2 metres, steel mesh anchored to the lower edge of excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained.

In case where blasting, though otherwise required, is prohibited for any reasons, the excavation shall be carried out by chiselling, wedging or any other approved method.

3.5.4 Blasting

3.5.4.1 General

Storage, handling and use of explosives shall be governed by the current explosive rules laid down by the Central and the State Governments. The Contractor shall ensure that these rules are strictly adhered to. The following instruction, wherever found in variance with the above rules, shall be considered as superseded by the above rules.

No child under the age of 16 and no person who is in a State of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives.

3.5.4.2 Storage of Explosive

Storage of explosives shall be governed by the current Explosive Rules, Explosives shall be stored in a clean, dry, well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400 m of the actual work site or any source of fire. A space surrounding the magazine shall be fenced in. The ground inside the fence shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be by one gate only and no person shall be allowed inside this fence without permission of the Officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The mezzanine shall be perfectly well drained.

Two lightning conductors shall be provided to the magazine, one at each end. The lightning conductors shall be tested once in every year.

Fuses and detonators shall be stored in separate magazines. However, detonators can be kept in an annexe adjoining the magazine provided that their number does not exceed 25,000 and that the annexe is so constructed that not less than 60 cm masonry and 100 cm of air space shall intervene between any detonators in such annexe and the interior of the main magazine. Cases containing explosives are not to be opened in a magazine. Explosive in open cases are not to be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine, but must be removed without delay to a safe distance and destroyed.



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Artificial light is not to be allowed in any magazine. No smoking shall be allowed within 100 m of a magazine.

Magazine shoes without nails shall be used while entering the magazine.

The mallets, levers, wedges etc. for opening barrels or cases are to be of wood. Inside a magazine the cases of explosives are to be carried by hand and shall not be rolled or dragged. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been longest in store are to be issued first.

Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides, special care is to be taken to keep the floor free from grains of powder or portions of explosive matter fallen on the floors due to leakage of cases etc.

The magazine shall not be opened during any duststorm or thunderstorm nor any person shall be allowed in the vicinity of the magazine.

All magazines shall be officially inspected at definite intervals and a record kept of the results of such inspections.

3.5.4.3 Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from the direct rays of the sun, naked lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each cage or package is to be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on a vehicle conveying explosives. No carriage or vessel shall be used for transporting explosives unless all iron or steel therein with which a package containing any explosive is likely to come in contact is effectually covered with lead, leather, wood, cloth or other suitable material. No lights shall be carried on the vehicle carrying explosives.

No operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

3.5.4.4 Use of Explosives

The Contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with the responsibilities imposed on him.

Holes for charging explosives shall be drilled with Pneumatic drills, the drilling pattern being so planned that the rock pieces after blasting will be suitable for handling.



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The hole diameter shall be of such a size that cartridges can easily pass down them and undue force is not required during charging. Charging operations shall be carried out by or under the personal supervision of the shotfirer. Wrappings shall never be removed from explosive cartridges. Only wooden rods shall be used for loading and stemming shotholes. Only one cartridge at a time shall be inserted and gently passed home with the wooden tamping rod.

Only such quantities of explosives as are required for the particular amount of work to be done shall be brought to the works. Should any surplus remain when all the holes have been charged, it shall be carefully removed to a point at least 300 m from the firing point.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges the electric detonators shall be connected with the exploder through the shotfiring cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current and to keep the lead wires short circuited until ready to fire. Any kinks in detonator leading wire shall be avoided.

For simultaneous firing of a large number of shotholes, use of cordtex may be done. Cordtex shall be initiated by an electric detonator attached to its side with adhesive tape, connecting wire or string.

All connections shall be made by the authorised shotfirer himself. The shotfiring cable shall not be dragged along the ground to avoid possible damage to the insulation. The shotfiring cable shall be tested for continuity and possible short circuiting before it is used each time.

The shotfirer shall always carry the exploder handle on his person until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits.

Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the Engineer.

Before any blasting is carried out, it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300 metres radius from the firing point, or as required by statutory regulations, at least ten minutes before the time of firing by sounding a warning siren. The area shall be encircled by red flags.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations the authorised shotfirer shall return to the blast area and inspect carefully the work and satisfy himself that all charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole not less than 600 mm from the misfired hole and by exploding a new charge. The authorised shotfirer shall be present during removal of the debris liable to contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.



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When blasting is conducted in the neighbourhood of roads, structures, buildings etc. controlled blasting has to be carried out by drilling shallow shotholes and filling the same with light charge of explosives.

Adequate safety precautions as per building bye-laws, safety code, statutory regulations etc. shall be taken during blasting operations.

3.5.5 Disposal

The excavated spoils will be disposed of in any or all the following manners :

- a) By using it for backfilling straightway.
- b) By stacking it temporarily for use in backfilling at a later date during execution of the Contract.
- c) i) By either spreading, Or
ii) spreading and compacting at designated filling areas and / or disposal areas.
- d) By selecting the useful material and stacking it neatly in areas designated by the Engineer for use in backfilling by some other agency.

3.5.6 Disposal of Surplus

All surplus material from excavation shall be carried away from the excavation site to designated disposal area selected by the Engineer.

All good and sound rock excavated from the pits and all assorted materials of dismantled structures shall be the property of the Owner.

3.5.7 Protection

The Engineer shall be notified by the Contractor as soon as the excavation is expected to be completed within a day so that it may be inspected by him at the earliest. Immediately after approval of the Engineer, the excavation must be covered up in the shortest possible time. But, in no case the excavation shall be covered up or worked on before approval and measurement by the Engineer. Excavated material shall be placed beyond 1.5 metres from the edge of the pit or trench or half the depth of the pit or trench whichever is more or further away if directed by the Engineer.

Excavation shall not be carried out below the foundation level of structure close by until required precautions have been taken.



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Adequate fencing is to be made enclosing the excavation.

The Contractor shall protect all under-ground services exposed by excavation. The Contractor shall also divert all surface drains, etc. affected by the excavation to maintain the working area neat and clean.

3.5.8 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

No works shall commence until surface water streams have been properly intercepted, redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems to drain surface water from working areas.

3.5.9 Dewatering

All excavations shall be kept free of water and slush. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The Contractor shall remove by pumping or other means approved by the Engineer any water inclusive of rain water and subsoil water accumulated in excavation and keep the trench dewatered until the construction of foundation structure and backfilling are complete in all respects. (except where such dewatering would need installation of well points or deep wells for which separate payment will be made) Sumps made for dewatering must be kept clear of the foundations. Method of pumping shall be approved by the Engineer but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping.

3.5.10 Timber Shoring

Timber Shoring made out of approved quality of timber shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench and the type of timbering shall be determined by the Engineer. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

3.5.10.1 Close Timbering

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 250 x 40 mm sections as directed by the Engineer. The boards shall generally be placed in position vertically in pairs, one board on each side of cutting, and shall be kept apart by horizontal walers of strong wood at maximum 1.2 metres spacings, cross strutted



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with ballies or as directed by the Engineer. The length of the bally struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical walers, which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed, so that the earth is not liable to slip out.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

3.5.10.2 **Open Timbering**

In the case of open timbering, the entire surface of the side of trench pit is not required to be covered. The vertical board of minimum 250 mm width and minimum 40 mm depth shall be spaced sufficiently apart to leave unsupported strips of maximum 500 mm average width. The detailed arrangement, sizes of the timber and the distances apart shall be subject to the approval of the Engineer. In all other respects, specification for close timbering shall apply to open timbering.

3.6.0 **Treatment of Slips**

The Contractor will take all precaution to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips do occur due to causes beyond the control of the Contractor, the same shall be removed by him and payment shall be made to him on appropriate item rate of earthwork. Slips caused due to negligence of the Contractor will be cleared and back-filled later by him.

3.7.0 **Back-filling**

3.7.1 **General**

The material used for backfilling shall consist of material, approved by the Engineer obtained directly from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits from selected areas designated by the Engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials, etc.

In certain locations, the Engineer may direct sand fillings. The sand should be clean, well graded and be of quality normally acceptable for use in concrete.

3.7.2 **Filling and Compaction in Pits and Trenches around Structures**



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As soon as the work in foundations has been accepted and measured, the spaces around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings, etc., and filled with earth in layers not exceeding 250 mm in loose thickness each layer being watered, rammed and properly compacted to achieve a dry density of not less than 90% of proctor's dry density at optimum moisture content as per IS-2720 (Part-VII) where backfilling with cohesive soil and sandy silt containing high percentage of silt. For back filling with sand having little or no silt, each layer shall be compacted to a relative density of 75% as per IS-2720 part XIV. Earth shall be rammed with approved mechanised compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Engineer. The final surface shall be trimmed and levelled to proper profile as shown in the drawing and as desired by the Engineer.

Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections done to optimise the moisture content.

3.7.3 Plinth Filling

The plinth shall be filled with earth in layers not exceeding 250 mm in loose thickness, watered and compacted as stated under clause no. 3.7.2 with approved compaction machine or manually, if specifically permitted by the Engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slope intended to be given to the floor.

3.7.4 Filling in Trenches for Water Pipes and Drains

Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 150 mm size in any direction, mixed with fine material consisting of disintegrated rock, moorum or earth as available, so as to fill up the voids as far as possible and then the mixture used for filling. The types of bedding & pipe surround material shall be as specified in the drawings.

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed.

Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150 mm, watered, rammed and compacted taking care that no damage is caused to the pipe below. Filling of trenches shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur.



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In case of excavation of trenches in rock, the filling upto a depth of 300 mm or the diameter of the pipe whichever is more, above the crown of pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash according to the availability at site. The remaining filling shall be done with rock filling of boulders of size not exceeding 150 mm mixed with fine material as available to fill up the voids, watered, rammed and compacted.

3.7.5 Filling in Disposal Area

Surplus material from excavation which is not required for backfilling will be disposed of in designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250 mm thick when loose and compacted with the help of compacting equipment. In wide areas rollers will be employed and compaction done to the satisfaction of the Engineer at the optimum moisture content which shall be checked and controlled by the Contractor.

In certain cases the Engineer may direct disposal without compaction which can be done by tipping the spoils from a high bench neatly maintaining always a proper level and grade of the bench.

3.8.0 Approaches and Fencing

The Contractor should provide and maintain proper approaches for workmen and for inspection. The roads and approaches around the excavated pits should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the Project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

3.9.0 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the Engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Excavation

On completion of excavation, the dimensions of the pits will be checked as per the drawings after the pits are completely dewatered the work will be accepted after all undercuts have been set right and all over excavations filled back to required lines, levels and grades by placing ordinary concrete of 1:4:8 proportion and/or richer and/or by compacted earth, as directed by the Engineer. The choice of grade of concrete will be a matter of unfettered discretion of the Engineer. Over excavation of the sides will be made good by the Contractor while carrying out the back-filling. The



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excavation work will be accepted after the above requirements are fulfilled and all temporary approaches encroaching inside the required dimension of the excavation have been removed.

4.2.0 Back-filling

The degree of compaction shall be sufficient to achieve a dry density of not less than 90% of proctor's dry density at optimum moisture content as per IS-2720 (Part - VII) or a relative density of 75% as per IS-2720 (Part-XIV) as applicable depending on the nature of back filling material as stated in clause no. 3.7.2 of this specification. The work of back-filling will be accepted after the Engineer is satisfied with the degree of compaction achieved.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

Details of Equipment proposed to be used for excavation, back-filling and compaction have to be submitted along with the tender.

5.2.0 After Award

After award of the Contract the successful tenderer shall submit the following for approval and adoption :

- a) The Contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation of the various foundations and the time required for back-filling and compaction after completing the foundation for structures.

The programme should show how the excavation and back-filling quantities will be balanced, minimising temporary stacking of spoils. It is to be noted that the Engineer even after initial approval of the programme, may instruct to enhance or retard the progress of work during the actual execution, in order to match with the progress of foundations without attracting any claims from the Contractor. The initial programme being submitted by the Contractor should have sufficient flexibility to take care of such reasonable variations.

- b) The Contractor shall submit drawings showing details of slopes, shorings, approaches, sump pits, dewatering lines, fencing etc. for approval of the Engineer for adoption.



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2 x 500 MW ANPARA D THERMAL POWER PROJECT

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GENERAL TECHNICAL SPECIFICATION

SUB-SECTION – D2 CEMENT CONCRETE (PLAIN & REINFORCED)

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

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1.0 SCOPE

1.1 General

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work.

1.2 This specification shall also apply to the extent it has been referred to or applicable with the special requirements of structures covered in SCOPE of IS:456.

1.3 IS:456 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate IS Code, specifications and/or replacement by any International Code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference.

2.0 GENERAL

2.1 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following :-

- a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.
- b) Except where it is excluded from the Scope of Contract, Contractor shall prepare progressively and submit for approval detailed drawings and Bar Bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.
- c) Design and prepare working drawings of formworks, scaffolds, supports, etc. and submit for approval.
- d) Submit for approval shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.
- e) Submit for approval detailed drawings of supports, templates, hangers, etc. required for installation of various embedments like



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inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

- f) Submit for approval detailed schemes of all operations required for executing the work, e.g. Material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.
- g) Design and submit for approval concrete mix designs required to be adopted on the job.
- h) Furnish samples and submit for approval results of tests of various properties of the following :
 - i) The various ingredients of concrete
 - ii) Concrete
 - iii) Embedments
 - iv) Joint seals
- i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.
- j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved proforma for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.2

Work by Others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.3

Information to be submitted by the Tenderer



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2.3.1

With Tender

The following technical information are required with the tender :

- a) Source and arrangement of processing of aggregates proposed to be adopted.
- b) Type of plant and equipment proposed to be used.
- c) Names of firms, if any, with which association is sought for to execute the special items of work in the contract.
- d) Types of formwork proposed to be used.

2.3.2

After Award

The following information and data including samples where necessary, shall be submitted by the Contractor progressively during the execution of the contract.

a) **Programme of Execution and Requirement of Materials**

The Contractor will submit a Master Programme for completion of the work giving monthwise requirements of materials for the procurement.

This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day to day programme of every month is to be submitted by the Contractor before the end of the previous month.

b) **Samples**

Samples of the following materials and any other materials proposed to be used, shall be submitted as directed by the Engineer, in sufficient quantities for approval. Approved samples will be preserved by the Engineer for future reference. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities :

- i) Coarse and fine aggregates.
- ii) Admixtures.
- iii) Plywood for Formwork.
- iv) Embedded and anchorage materials as may be desired by the Engineer.
- v) Joint sealing strips and other waterproofing materials.



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vi) Joint filling compounds.

vii) Foundation quality Rubber Pads.

c) Design Mix

Design mix as per Clauses 2.1 (g) & 3.4 of this specification giving proportions of the ingredients, sources of aggregates and cement, along with accompanying test results of trial mixes as per relevant I.S., is to be submitted to the Engineer for his approval before it can be used on the works.

d) Detail Drawings and Bar Bending Schedules

Detailed working drawings and Bar Bending Schedules in accordance with Clause 2.1(b) and 3.16.1 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.1 (c).

f) Detailed Drawings for Templates & Temporary Supports for Embedments

As per Clause 2.1 (e).

g) Mill Test Reports for Cement & Reinforcing Steel

h) Inspection Reports

Inspection Reports in respect of Formwork and Reinforcement and any other item of work as may be desired by the Engineer in accordance with Clause 2.4 of this specification.

i) Test Reports

Reports of tests of various materials and concrete as required under Clause 4.0 : SAMPLING & TESTING of this specification.

j) Any other data which may be required as per this specification.

2.4

Conformity with Design

The Contractor will prepare check lists in approved proforma which will be called 'Pour Cards'. These Pour Cards will list out all items of work involved. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all



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necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the Engineer will give written permission on the same 'Pour Card' allowing the Contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. These sheets, termed as 'Progress Cards', will be prepared by the Contractor on approved proforma. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the Engineer.

2.5 Materials to be used

2.5.1 General Requirement

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless stated otherwise and be of best approved quality.

2.5.2 Cement

Generally cement shall be 43 grade ordinary Portland Cement conforming to IS-269 . In special cases any of the following type of cement may be permitted or directed to be used with prior approval by the Engineer :

- a) 43 Grade ordinary Portland Cement conforming to IS-8112
- b) 53 Grade ordinary Portland Cement conforming to IS-12269
- c) Rapid hardening Portland Cement conforming to IS-8041
- d) Portland slag cement conforming to IS-455
- e) Portland Pozzolona Cement (flyash based) Conforming to IS- 1489 (Part -1)
- f) Portland pozzolona Cement (calcined clay based) conforming to IS-1489 (Part-2)
- g) Hydrophobic Cement conforming to IS-8043
- h) Low heat Portland Cement conforming to IS : 12600



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i) Sulphate Resisting Portland Cement conforming to IS-12330

2.5.3

Aggregates

Aggregates shall be natural or crushed gravel or crushed rock and free from deleterious material. It shall comply with the requirements of IS-383. All fine and coarse aggregate shall be tested for susceptibility to Alkali Silicate reaction in a laboratory approved by the Engineer.

a) **Coarse Aggregate**

Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as Coarse Aggregate. Only Coarse Aggregate from approved quarries and conforming to IS:383 will be allowed to be used on the works. Aggregates shall be washed to make it free from deleterious materials, if necessary.

The grading of coarse aggregates by sieve analysis shall be as per IS:383. If by the analysis the deficiency of a particular grain size is found, which could affect the density of the concrete, the Engineer may ask the contractor to avoid such quantities of aggregate of the particular size or and such quantity of aggregate of any particular size to achieve the required grading as per IS:383.

b) **Fine Aggregate**

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS:383 is termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used on works.

In certain cases there may be two types of sand, one very fine and the other very coarse. In such cases, the two types shall be combined to meet the requirements of a particular zone of IS:383. In all cases, the preferred zone is Zone - II.

In certain cases crushed stone sand may be added to natural sand in order to achieve the required grading. Crushed stone sand alone may be used only with the approval of the Engineer.

2.5.4

Water

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts or other impurities. Normally potable water is found to be suitable. Generally, IS:3550 will be followed for routine tests. Acceptance test for water shall be as per IS:3025, and Table-1 of IS:456.



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In case of doubt regarding development of strength , the suitability of water for making concrete shall be ascertained by compressive strength and initial setting time tests as per method of tests in accordance with the requirements of IS-516 & IS- 4031 respectively. The PH value of water shall generally be not less than 6.

2.5.5

Admixture

Only admixture of approved quality will be used when directed or permitted by the Engineer . The different types of admixtures which may be necessary to satisfy the concrete mix and the design requirement shall be as per the following I.S. Standards :

IS : 2645 - Integral cement water proofing compound

IS : 9103 - Indian standard specification for Admixtures for Concrete or equivalent American Codes (ASTM C494 and ASTM C260) or British Codes (BS 5075 , Part 1 to 3) and may be one of the following :

a) Accelerating admixtures :

- Set accelerating admixtures like "Sigunit Powder" or "Sigunit LN10" .

b) Retarding admixtures :

- Modified ligno sulphonate based set retarding concrete admixture like , "Plastiment R".

c) Water reducing admixtures :

- Modified sulphonated melamine formaldehyde based water reducing concrete admixture like , "Sikament" .

d) Air entraining admixtures :

- Modified ligno sulphonate based air entraining concrete admixture like "FLOMO AEP " or surface - active agents like "Sika AER".

e) **Water proofing admixtures**

- Modified ligno-sulphonate based waterproofing admixture like "Plastocrete Super".

However, the Contractor shall furnish following technical information about the admixtures (alongwith the manufacturer's



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Catalogue) which he is planning to use in different areas within the scope of work for the approval of the Engineer :

- i) Type of admixture
- ii) Mix proportion & mode of application in concrete/mortar
- iii) Manufacturer's specification & necessary quality assurance certificates (mainly on chloride & sulphate content , PH value infra red analysis & solid content.)

2.5.6 Reinforcement

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars shall be of tested quality.

2.6.0 Storage of Materials

2.6.1 General

All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and Storage of materials shall conform to IS:4082.

2.6.2 Cement

Sufficient space for storage, with open passages between stacks, shall be arranged by the Contractor to the satisfaction of the Engineer.

Cement shall be stored off the ground in dry, leak proof, well-ventillated ware-houses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected.

Different types of cement shall be clearly marked with the Type and different types of cement shall not be intermixed.

2.6.3 Aggregates

Aggregates shall be stored on planks or steel plates or on concrete or masonry surface. Each size shall be kept separated with wooden or steel or concrete or masonry bulk-heads or in separate stacks and sufficient care shall be taken to prevent the material at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The



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aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.

2.6.4 Reinforcement

Reinforcing steel shall be stored consignment-wise and sizewise off the ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease and distortions. If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.7 Quality Control

Contractor shall establish and maintain quality control for different items of work and materials as may be directed by the Engineer to assure compliance with contract requirements and maintain and submit to the Engineer records of the same.

The quality control operation shall include but not be limited to the following items of work :

a) Admixture : Type, quantity, physical and chemical properties that affect strength, workability and durability of concrete.

For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits

b) Aggregate : Physical, chemical and mineralogical qualities. Grading, moisture content and impurities.

c) Water : Impurities tests.

d) Cement : Tests to satisfy relevant IS Specifications (only association with Owner's tests, if the supply is made by Owner).

e) Formwork : Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.

f) Reinforcement : Shapes, dimensions, length of plices, clearances, ties and supports. Quality and requirement of welded splices.

Material tests or certificates to satisfy relevant IS Specification (If Contractor's supply).

g) Grades of



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- concrete : Usage and mix design, testing of all properties.
- h) Batching & Mixing : Types and capacity of plant, concrete mixers and transportation equipment.
- i) Joints : Locations of joints, water stops and filler materials. Dimension of joints, quality and shape of joint material and splices.
- j) Embedded and Anchorage Items : Material, shape, location, setting.
- k) Placing : Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.
- l) Compaction : Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping.
- m) Setting of base & Beaming plates : Lines, elevations and bedding mortar.
- n) Concrete Finishes : Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes.
- o) Curing : Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired.

3.0

INSTALLATION

All installation requirements shall be in accordance with IS:456 and as supplemented or modified herein or by other best possible standards



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where the specific requirements mentioned in this section of the specification do not cover all the aspects to the full satisfaction of the Engineer.

3.1 Washing and Screening of Aggregates

Washing and Screening of coarse aggregate shall be carried out to remove fines, dirt or other deleterious materials.

Washing of fine aggregate shall not be allowed, Fine aggregates shall be screened only to remove dirt or other deleterious materials.

However, all washing & screening of aggregates shall be carried out by approved means to ensure compliance with the aggregate specification.

3.2 Admixture

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete.

Admixtures may be permitted to be used in accordance with IS:456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or other satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.

3.3 Grades of Concrete

Structural concrete shall be of M35 grade and for other part of the work shall be as shown on the drawing as per grade classification of IS-456. In case of liquid retaining structures, IS:3370 will be followed.

3.4 Proportioning and Works Control

3.4.1 General

Proportioning of ingredients of concrete shall be made by any of the two following methods as directed by the Engineer.

- a) With preliminary tests by designing the concrete mix. Such concrete shall be called 'Design Mix Concrete'.
- b) without preliminary tests adopting nominal concrete mix. Such concrete shall be called 'Nominal Mix Concrete'.

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades permitted in accordance with IS:456, may be used if shown on drawings or approved by the Engineer. In all cases the proportioning of ingredients and works control shall be in accordance with



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IS:456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.4.2

Mix Design Criteria

Concrete mixes will be designed by the Contractor to achieve the strength, durability and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations :

- a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.
- b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.
- c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.
- d) Chemical admixtures may be used to modify the rate of hardening, to improve workability (maintaining low water - cement ratio) or as an aid to control concrete quality.
- e) The finished concrete should have adequate durability in all conditions, to withstand satisfactorily the weather and other destructive agencies which it is expected to be subjected to in actual service.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete by the Engineer. The Contractor will strictly abide by the same in his design of concrete mix installation. Notwithstanding anything mentioned in various tables given in IS:456 giving specific values and degrees of workability for different condition of concrete placing, minimum cement content and maximum water-cement ratio for concrete exposed to sulphate attack and for concrete to ensure durability under different condition of exposure, strength requirement for different grades of concrete, proportion for nominal mix concrete, values given in the tables in IS:456, shall be followed.

Various trials shall be given by the contractor with specific cement content on each trial . In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.

TABLE - I

STRENGTH REQUIREMENT OF CONCRETE

Specified Characteristic Compr-



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essive Grade of concrete
strength of 15 cm Cubes at 28
days conducted in accordance
with IS:516 (All values in
N/Sq.mm)

M - 10	10
M - 15	15
M - 20	20
M - 25	25
M - 30	30
M - 35	35
M - 40	40

Note -1: Nominal mix concrete of proportions 1:4:8 or 1:3:6 may be used as lean concrete for simple foundations for masonry walls , below the reinforced concrete foundations and mass filling . These mixes need not be designed.

TABLE - II

**MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE
DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT
VALUES OF WATER - CEMENT RATIO**

(FOR GUIDANCE)

CEMENT/TOTAL AGGREGATE RATIOS

WORKABILITY	WATER/CEMENT/RATIO	RATIO BY WEIGHT OF CEMENT OF GRAVEL AGGREGATE	RATIO BY WEIGHT OF CEMENT OF CRUSHED STONE AGGREGATE
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		20 mm size	38 mm size	20 mm size	38 mm size
Very low	0.4	01:04.8	01:05.3	01:04.5	01:05.0
Slump	0.5	01:07.2	01:07.7	01:06.5	01:07.4
0-25 mm	0.6	01:09.4	1:10	01:07.8	01:09.6
	0.7	1:10	1:12	01:08.7	01:10.6
Low	0.4	01:03.9	01:04.5	01:03.5	01:04.0
Slump	0.5	01:05.5	01:06.7	01:05.0	01:05.5
25-50 mm	0.6	01:06.8	01:07.4	01:06.3	01:07.0
	0.7	01:08.0	01:08.5	01:07.4	01:08.0
Medium	0.4	01:03.5	01:03.8	01:03.1	01:03.6
Slump	0.5	01:04.8	01:05.7	01:04.2	01:05.0
50-100 mm	0.6	01:06.0	01:07.3	01:05.2	01:06.2
High	0.4	01:03.2	01:03.5	01:02.9	01:03.3
Slump	0.5	01:04.4	01:05.2	01:03.9	01:04.6
100-175 mm	0.6	01:05.4	01:06.7	01:04.7	01:05.7
	0.7	01:06.2	01:07.4	01:05.5	01:06.5

NOTE : 1 - Notwithstanding anything mentioned above, the cement/Total aggregate ratio is not to be increased beyond 1:9.0 without specific permission of the Engineer.

NOTE : 2 - It should be noted that such high aggregate cement ratios will be required for concretes of very low slump and high water- cement ratios which may be required to be used in mass concrete work only.

NOTE : 3 - The above figures are for guidance only, the actual cement/aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes.

3.5 Strength Requirements

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland slag cement is used, shall be as per Table-2 of IS:456. All other relevant clauses of IS:456 shall also apply.

3.6 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per Table-5 of IS : 456.



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3.7 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on -

- a) The requirement of strength.
- b) The requirement of durability.

3.7.1 Strength Requirement

In case of 'Design Mix Concrete', the water-cement ratio of such value as to give acceptable test results as per IS:456, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, proportions for different grades of concrete is specified in Table-9 of IS:456 and no tests are necessary. The acceptance test criteria for nominal mix concrete shall be as per IS:456.

3.7.2 Durability Requirement

Table-5 of IS:456 gives the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemicals. Impermeability may also be an important consideration. Whenever the water-cement ratio dictated by durability consideration is lower than that required from strength criterion, the former shall be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer / super-plasticizer. However the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer. It will be preferable to use Melamine based plasticizer.

3.8 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below :



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**TABLE - III
LIMITS OF CONSISTENCY**

Degree of workability	Slump in mm with Standard Cone as per IS:1199		Use for which concrete is suitable.
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipment, roads and like.
Low	25	50	Uncongested wide and shallow R.C.C. structures.
Medium	50	100	Deep but wide R.C.C. structures with congestion or reinforcement and inserts.
High	100	150	Very narrow and deep R.C.C. structures with congestion due to reinforcement and inserts.

(NOTE : Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer)

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively where facilities exist or if required by the Engineer, the compacting factor test in accordance with IS:1199.

3.9 Size of Coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer :-

Very narrow space	- 12 mm
Reinforced concrete except foundation	- 20 mm
Ordinary Plain concrete and Reinforced concrete foundations	- 40 mm
Mass concrete	- 80 mm
Mass concrete in very large structure	- 150 mm



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Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles :

150 mm to 80 mm, 80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

3.10

Mixing of Concrete

Concrete shall always be mixed in mechanical mixer unless specifically approved by the Engineer for concrete to be used in unimportant out of the way locations in small quantities. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS:4634 on all mixers employed at site. Only those mixers whose efficiencies are within the tolerances specified in IS:1791 will be allowed to be employed.

Ingredients for design mix concrete shall be measured by weight. For small jobs portable swing weigh Bachers conforming to IS:2722 may be used.

Batching plant conforming to IS:4925 shall be used for large jobs. The accuracy of the measuring equipment shall be within + 2% of the quantity of Cement , water or total aggregates being measured and within + 5% of the quantity of any admixture being used . The batching equipment shall be fitted with an accurate mechanism for weighing separately the cement, fine



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aggregate and coarse aggregate. Water may be measured by volume or by weight. All measuring equipment should be maintained in a clean serviceable condition, and their accuracy shall be checked periodically.

Mechanical / electrical control shall be provided on the mixing equipment to ensure the batch cannot be discharged until approved mixing time has elapsed and the entire batch shall be discharged before the mixer is recharged.

Where admixtures are employed, separate containers & measuring devices shall be used.

For minor concreting works, batching by volume according to specific weight may be permitted by the Engineer. In that case the whole bags of cement shall be used and gauge boxes used for measuring aggregates.

When hand mixing is permitted by the Engineer, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch.

3.11

Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in spite of all precautions, segregation does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers which will reduce the rate of loss of water by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipments shall be kept free from set concrete.

3.12

Placing and Compacting Concrete

Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in the relevant I.S. Code for any particular aspect of work, any other standard Code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces :

- a) Earth foundation
- b) Rock foundation



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c) Formwork

d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. All excavated areas for foundations, ring beams, plinths, pile caps etc. shall be rammed & consolidated properly before blinding with nominal mix plain concrete, as per drawing and / or direction of the Engineer and shall be allowed to cure prior to setting out steel fixing, shuttering and concrete pouring for the main structural element.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed and cement slurry will be spread thoroughly on the rock foundation or construction joint just prior to placement of concrete. The cost of application of such cement slurry and mortar will be deemed to be included.

After concrete has been placed, it shall be spread, if necessary and thoroughly compacted by approved mechanical vibration to maximum subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice. In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS:4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS:2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or distorted during placing and consolidation of concrete.



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The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green concrete which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

The size of the concrete pours must be carefully considered prior to commencement to ensure the structural elements are poured in on continuous shift to avoid cold joints.

Slabs, beams and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Moulding, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation therefrom shall be set right by the Contractor as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same.

The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13 Construction Joints and Cold Joints

3.13.1 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete at certain predetermined stages. These joints will be formed in a manner specified in the drawings/ Instruction. Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12. For water retaining



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structures and leak-proof buildings suitable approved water bars will be installed at the construction joints.

Where the location of the joints are not specified, it will be in accordance with the following :

- a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.
- b) Concrete in a beam shall preferably be placed without a joint, but if provision of a joint is unavoidable, the joint shall be vertical and within the middle third of the span.
- c) A joint in a suspended floor slab shall be vertical and within the middle third of the span and at right angles to the principal reinforcement.
- d) Feather-edges in concrete shall be avoided while forming a joint.
- e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.
- f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be sub-mitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.2

Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it :

- a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systemetically vibrated.
- b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without



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disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.

- c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not rise inspite of extensive vibration, the joint will be left to harden for at least 12 - 24 hrs. It will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3.14 Repairs, Finishes and Treatment of Concrete surfaces

3.14.1 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods. All concrete work shall be inspected by the Contractor immediately after the forms are removed and he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations :

- a) Sack rubbing with mortar and stoning with carborundum stone.
- b) Cutting away the defective concrete to the required depth and shape.
- c) Cleaning of reinforcement and embedments. It may be necessary to provide an anti-corrosive coating on the inforcement.
- d) Roughening by sand blasting or chipping.
- e) Installing additional reinforcement/welded mesh fabric.
- f) Dry packing with stiff mortar.
- g) Plastering, guniting, shotcreting etc.
- h) Placing and compacting concrete in the void left bycutting out defective concrete.
- i) Groting with a cement sand slurry of 1:1 mix.



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- j) Repairing with a suitable mortar either cement or resin modified mortar.
- k) Polymer modified patching and adhesive repair mortar for beams & columns.

3.14.2

Finishing Unformed Surface

A few typical and common cases of treatment of concrete surface are cited below :

a) **Floor**

Whenever a non-integral floor finish is indicated, the surface of reinforcement concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over-trowelling, to obtain a very smooth surface, shall be done as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling by hand or by rotary power float is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples and trowel marks. A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) **Beams, Columns & Walls**

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.



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3.15

Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, polythene sheet, hessian, canvas or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor.

If permitted by the Engineer, curing compound like "ANTISOLE (WP)" may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall comply with ASTM requirements for acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water sheen from concrete surface.

It is important not to apply the curing compound when standing water is still present on concrete.

The contractor shall arrange for the manufacturer's supervision.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case any lapse on the part of the Contractor is noticed by the Engineer, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and entirely at the discretion of the Engineer.

3.16

Reinforcement



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Mild steel round bars, cold twisted and deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc., will be used as reinforcement as per drawings and directions. If necessary, in an aggressive environment, soil having corrosive properties, an anti-corrosive coating on the reinforcement or admixture in concrete to protect reinforcement from corrosion may be provided as per IS:9077, as shown on the drawing or as directed by the Engineer.

3.16.1 Bar Bending Schedules

The Contractor shall submit to the Engineer for approval Bar Bending Schedules with working drawings in triplicate, showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, within one month of receipt of the Letter of Intent or of the receipt of the relevant design drawings, whichever is later. Upon receipt of the Engineer's final approval of the Bar Bending Schedule and drawings, the Contractor shall submit 6 (six) prints of the final drawings with one reproducible print after incorporating necessary modifications or corrections, for final record and distribution. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the Contract.

3.16.2 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.3 Cutting & Bending of Reinforcement

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS:2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding to the approved Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Engineer. Reinforcing bars above 16 mm diameter shall be bent by machine producing a gradual and even motion. Bars of 16 mm or below may be bent by hand. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat(not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

Reinforcing bars, whether high yield or mild steel shall be cut using either hand held shears, guillotines or foot operated pneumatic cutters. Cutting bars using cold chisels may be allowed by the Engineer at exceptional cases.



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3.16.4

Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks irrespective of whether such supports are payable or not. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire. Tack welding of bars should not be done unless permitted by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the Contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

3.16.5

Welding

Normal bond laps in reinforcement may be placed by lap or butt welding reinforcement bars, if asked by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS:2751 and IS:456. Welded mesh fabrics conforming to IS:1566 may also be used if specified in the Schedule of Items and Drawings.

3.16.6

Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS:456, unless otherwise specified. If the bars in a lap are not of the same diameter, the smaller will guide the lap length. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for placing concrete shall be such that reinforcement in position do not have to bear extra load and get disturbed.

The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning



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reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer.

3.17 Cold Weather Concreting

When conditions are such that any operation of concreting may be expected to be done at 5 Deg.C atmospheric temperature or below the work shall conform to the requirement of Clause 14 of IS:456 and IS:7861. (Part. II).

3.18 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS:7861 (Part-I) and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 40 Deg.C while placing. Positive temperature control by precooling, postcooling or any other method, if required, will be specified.

3.19 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of clause 14 of IS:456.

3.20 Form Work

3.20.1 General

Formwork shall conform to the shape, grade, lines, levels and dimension as shown on the drawings. The contractor shall prepare design & working drawings for formwork & temporary support system for important structures and get them approved by the Engineer prior to commencement of actual work.

Materials used for the formwork inclusive of the supports and centering shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.



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The centering shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rekers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid as well as the working load, in case the Contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel or concrete of adequate strength shall be used. Alternatively, except in case of water retaining structures through rods and the tie bolts shall be sleeved with PVC conduits to allow retraction of the ties on removal of the shutters. Where required, the annulus of the conduits will be filled with expanding mortar to seal the void. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are plumb and true and thoroughly cross braced to keep them so. All floor and beam centering shall be crowned not less than 8 mm in all directions for every 5 metres span. Unless specifically described on the drawings or elsewhere to the contrary, bevelled forms 25 mm by 25 mm shall be fixed in the form-work at all corners to provide chamfering of the finished concrete edges. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.2

Cleaning and Treatment of Forms



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All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, saw dust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes, brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil based shutter release agent like "Separol/Sika form oil/ Siparol Concentrate" before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.3

Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork. Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

The design of formwork shall take into account all vertical and lateral loads that the forms will carry or be subjected to during the construction process. Besides weight and pressures of reinforced concrete and weight of the forms themselves, the design shall consider loading due to unsymmetrical placement of concrete; impact from dumping of concrete; movement of men and construction equipment; wind action and any other imposed load during construction. The contractor shall assess the magnitude of vertical live load to be taken for design of formwork duly considering his method, sequence and rate of pour of concrete. However, minimum design vertical live load to be considered shall be 750 kg/sqm excluding weight of concrete.

3.20.4

Inspection of Forms

Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.5

Removal of Forms



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Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if he so desires. The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed therefrom and have this record checked and countersigned by the Engineer regularly.

The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him. The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

Forms for various types of structural components shall not be removed before the minimum periods specified herein and the removal after the minimum periods shall also be subject to the approval of the Engineer in each case.



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UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

2 x 500 MW ANPARA D THERMAL POWER PROJECT

VOLUME – II B CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-298-600-C005

**SECTION - D
*GENERAL TECHNICAL SPECIFICATION***

**SUB-SECTION – D3
FORMWORK**

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

TABLE - IV

SCHEDULE OF REMOVAL OF FORM



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Part of Structure	Ordinary Portland Cement Concrete				Rapid Hardening Portland Cement Concrete			
	Temperature Deg.C				Temperature Deg.C			
	Above 40 Deg.C	20 Deg. - 40 Deg.C	5 Deg. - 20 Deg.	Below 5 Deg.	Above 40 Deg.C	20 Deg. - 40 Deg.C	5 Deg. - 20 Deg.	Below 5 Deg.
	Days	Days	Days	Days	Days	Days	Days	Days
a) Columns & Walls	2	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days strength	1	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days strength
b) Beam sides	3	2	3		2	1	1	
c) Slabs, 125 mm	10	7	8		7	4	5	
d) Slabs over 125 mm thick and soffit of minor beams	18	14	16		12	8	9	
e) Soffit of main beams	24	21	22		14	10	12	

Wherever exposed surfaces of concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40 Deg.C can be reduced to those of the temperature range of 20 Deg.C to 40 Deg.C subject to approval of the Engineer.

Construction joints in beams, if required to be provided, will be located within the middle third of span according to clause 3.13.1(b) of this specification. In such cases, however, entire span of beam shall have to be kept supported by formwork till its removal for the portion of beam, cast at a later date, is due and so approved by the Engineer.

If any type of cement other than ordinary portland cement and Rapid hardening portland cement is used the time of removal or forms shall be revised as approved by the Engineer such that the strength of this cement at the time of removal of forms match with strength of portland cement at the time of removal of form as mentioned above. This has to be supported by regular tests.

3.20.6 Tolerance



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The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this Specification or drawings or directed by the Engineer :

For

- a) Sectional dimension - ± 5 mm
- b) Plumb - 1 in 1000 of height
- c) Levels - ± 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in the finished concrete surface and should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.7 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.8 Classification

Generally, the 'ordinary' class formwork shall be used unless otherwise directed by the Engineer :

- a) Ordinary : These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.
- b) Plywood : These shall be used in exposed surfaces, where a specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilisation of used plywood for the 'ordinary' class, if it is still in good condition.



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- c) Ornamental: These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly.

3.21 Opening, Chases, Grooves, Rebates, Blockouts etc.

The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

- 3.22 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and Other misc. Embedded Fixtures. The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as directed and secure the same as may be required. The materials, if required to be supplied by the Contractor, shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to be painted with one coat of approved anti-corrosive paint and/or bituminous paint. If welding is to be done subsequently on the exposed surface of embedded material the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer. Items to be embedded.

- a) Inserts, hangers, anchors, frames around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.
- b) Anchor bolts and plates for machinery, equipment and for structural steel work.
- c) Steel structurals to be left embedded for future extension, special connection etc.
- d) Lugs or plugs for door and window frames occurring in concrete work.
- e) Flashing and jointing in concrete work.
- f) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

3.23 Expansion and Isolation Joints

3.23.1 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent



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leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved laboratory. Joints shall be formed true to line, level, shape, dimension and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

3.23.2

Bitumen Board/Expanded Polystyrene Board

a) **Bitumen Board**

Bitumen impregnated fibre board of approved manufacturer as per IS:1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) **Expanded Polystyrene Boards**

If required, commercial quality\of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.3

Joint Sealing Strips

Joint sealing strips may be provided at the construction, expansion and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure.

The sealing strips will be non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of



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transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation including the material and tools required for jointing, testing, protection, etc. If desired by the Engineer, joints in rubber seals may have to be vulcanised.

Non - metallic sealing strips will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features :

- i) Plain
- ii) Central bulb
- iii) Dumb-bell or flattened ends
- iv) Ribbed and Corrugated Wings
- v) V shaped

As these types of seals can be easily handled in very large lengths, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer.

The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs and the edges accurately.

a) **Rubber Sealing Strips**

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings of items and/or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer :

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75 Deg.C



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Ultimate Elongation : Not less than 350%

b) P.V.C. Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings/schedule of items and/or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly :

Specific Gravity : 1.3 to 1.35

Shore Hardness : 60A to 80A

Tensile Strength : 10 - 15 N/Sq.mm

Maximum Safe
Continuous
Temperature : 70 Deg.C

Ultimate Elongation : Not less than 275%

3.23.4 Joint Sealing Compound

When directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS:1834.

Alternatively, when directed, the expansion Joints may be filled with joint sealing compound like "Sikalastic" or approved equivalent and shall be applied as per manufacturer's specification.

3.23.5 Isolation Joints

Strong and tough alkathene or PVC sheet about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete, to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.6 Rubber Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings or as directed by the Engineer. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of



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approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24

Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stonechips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If desired by the Engineer, admixtures like Aluminium powder, 'Ironite' etc. may have to be added with the grout in proportions to be decided by the Engineer. Admixture, if directed to be added, will be measured and paid separately.

Alternatively non-shrink, free flow, cementitious grout like "Sikagrout 214/Ankor NSG" or approved equivalent specifically selected for the type of equipment to be located (vibrating, static etc.) may also be used for grouting as per manufacturer's specification with necessary approval of the Engineer.

3.25

Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose.

This yard shall be dry, properly levelled and having a hard and even as well as well drained surface to prevent excessive uneven settlement due to softening of soil during casting & curing. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 10 (Ten) days of curing and can be removed for erection after 28 (twenty eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal and must be rigid enough to prevent distortion during placing and compaction of the concrete.

Other than normal curing by applying water through spray nozzles or perforated hose curing by high pressure steam, steam vapour or other accepted processes may also be employed to accelerate the hardening of the concrete and to reduce the curing time.



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Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

All members shall be indelibly marked with a unique identification mark on a surface which will not be permanently exposed to show on which production line they were manufactured, their type, the class of concrete, the date of casting and if they are of a symmetrical section the face which will be uppermost when the member is in its correct position after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as directed by the Engineer. If centerings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement : sand mortar where called for in the drawings.

3.26 **Waterproofing of Concrete Structure**

3.26.1 **General**

Waterproofing of concrete structures shall be done by either suitable extraneous treatments like applying waterproofing paints like "Sikatop Seal" fixing bitumen felts etc. or internally by suitable design of the concrete mix, addition of suitable admixtures conforming to IS:2645 and equivalent American or British codes in the concrete or mortar at the time of mixing and/or installing water bars at the joints.

The design, material and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.2 **Water Bar/Seal/Special Treatment of Construction Joint**

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be rubber or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint should be provided as per clause 3.13.1 with or without water bar / Seal as shown on the drawing. In case of water bars being used at the construction Joint, fixing of the same has to be done carefully so



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that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods :

Method 1 : A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting in case of walls. The above bonding agent will be mixed with water which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two component epoxy resin bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days :

Compressive strength	-	55 to 60 N /Sq. mm
Flexural Strength	-	25 to 30 N /Sq. mm.
Tensile strength	-	15 N Sq. mm (approx)
Bonding strength to concrete	-	3 N / Sq. mm (approx)
Bonding strength to steel	-	20 N / Sq. mm (approx)

The whole operation shall be done as per manufacturer's specification. The contractor shall provide manufacturer's supervision.

Method 2 : One row of threaded nozzles at regular intervals not exceeding 1.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 Kg/Sq cm . The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision.

3.26.3

Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar / plaster shall conform to relevant IS code. The admixture shall not cause decrease of strength of concrete / plaster at any stage and it is free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5 %



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The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement but a lower dosage will always be preferred.

The product shall be stored in strong moisture proof packings.

However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water resistant concrete admixture shall be used to provide a waterproof concrete around 410 Kg/ Cm.m a melamine based super plasticizer will be preferable.

a) In concrete : The approved admixture shall be based on modified lignosulphonate like "Plastocrete - N/Super" or approved equivalent. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor to supervise the work, if desired by the Engineer.

b) In Plaster : The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture like "Noleak CP/Sika Latex" or approved equivalent and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.4

Bituminous or Tar Coating on External Surface

The surface to be waterproofed shall be rendered absolutely dry, clean and dust free. The surface shall be sand papered, cleaned and completely coated with hot coal tar pitch of approved manufacturer and quality as per IS:216 (not heated above 375 Deg.F) using not less than 2 Kg. per Sq.M. or with hot asphalt i.e., bitumen according to IS:73 (not heated above 400 Deg.F) using not less than 1.5 kg. per Sq.M. When the first coat has completely dried up and approved by the Engineer, the second coat shall be applied in the same manner using not less than 1.25 Kg. per Sq.M. in case of coal tar and 1 Kg. per Sq.M. in case of asphalt. Immediately after application of the second coat



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and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of sand before backfilling is done in order to allow the final coat to dry up completely. In place of hot application by coal tar / asphalt the coating of the outside surfaces of walls may be carried out using a ready to use liquid, bituminous emulsion/rubber protective coating of approved manufacturer.

3.26.5 Protective Coating on Inside Surface

Two coats of cement based to components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/ floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.6 Bitumen Felt : Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS:1322, and the workmanship to IS:1609. The bitumen felt shall be hessian base and/or fibre base as specified in Drawing/Schedule of Items. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the Contractor.

The Contractor shall execute this work in direct collaboration with one of the well known specialised approved by the Engineer.

Cleaning the surface, keeping it dry, providing necessary corner fillets and cement rendering and cutting chases, etc. shall be included in the rate for this item. If any protective brickwork on/against concrete sub-bases or walls are required, these will be paid extra under suitable items in the contract. A 20 (twenty) years' guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this item of work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.7 Polyethelene Films : Application in Walls or base of Structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder :

- i) the concrete surface shall be made smooth with 12 mm cement plaster 1:6
- ii) apply hot bitumen 80/100 grade (IS:73-1961) at the rate of 1.0 Kg/Sq.m minimum
- iii) lay black polyethelene film 250 micron (IS:2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.



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Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethelene film to be heat sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a celophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another celophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat sealing, the celophane tape is to be removed and the joints are to be tested for leaks.

- iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen.
- v) Lay hot bitument 80/100 grade (IS:73-1961) at 1.0 Kg/Sq.m minimum.
- vi) Lay 250 micron polyethelene film as second layer similar to (iii) above.
- vii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.
- viii) Apply hot bitumen (straight run grade) to IS:73-1961 at 1.0 Kg/Sq.m dusted with fine sand.
- ix) Protecting with a layer of 75 mm plain cement concrete M-100, or a layer of brick laid in cement mortar 1:6. In case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27 Protective coating on Concrete Surface

3.27.1 On Foundation

The outside faces of foundation of important structures will be protected from adverse effect of soil/ underground water, if shown on drawing or instructed by the Engineer, by using bitumen emulsion protective coating of approved manufacturer.

3.28 Waterproofing by Pressure /Chemical Grouting

Where required, waterproofing for underground concrete structure shall be done by injecting high polymer based non-shrink waterproof grouting



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compound through nozzle under pressure as per manufacturer's recommendation. The pressure during injection shall not be less than 2.5 kg/Sq.cum and the thickness of epoxy resinous emulsion waterproof paint (to be applied on the external surface of walls/slabs) shall not be less than 700 microns.

4.0 SAMPLING AND TESTING

4.1 General

The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.2 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths. Soundness Tests may also be required to be carried out if required by the Engineer. The tests shall be carried out free of charge by the Owner if cement is supplied by him. In case the Contractor is directed to arrange for the supply of cement as per the terms and conditions of the Contract the tests shall be carried out by him. In case due to any circumstances, the agency of supply is changed in the middle of the Contract, the party who bore the original contractual obligation will carry on with the test, free of charge to the other, till the end of the job. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Owner, Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the Owner or the Contractor. These tests are of great importance as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

4.3 Aggregates

The Contractor shall carry out any or all the tests aggregates as may be required by the Engineer in accordance with IS:2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.4 Water

Sampling and Testing of water being used for concrete works as per IS:3550 will be carried out by the Contractor at regular intervals and



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whenever directed by the Engineer. The final acceptance criteria in case of doubt will be as per IS:3025 & IS:456.

4.5 Admixture

4.5.1 Air Entraining Agents (A.E.A)

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After then, at regular intervals and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

4.5.2 Other Admixtures

Tests for establishing the various properties of any other admixtures which may be required to be added shall be carried out by the Contractor.

4.6 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS:516 and IS:1199 the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS:516.

Sampling procedure, frequency of sampling and test specimen shall conform to Clause 14 of IS:456.

To control the consistency of concrete from every mixing plant, slump tests and/or compacting factor tests in accordance with IS:1199 and as mentioned in Clause 3.6 of this Specification shall be carried out by the Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference.

The acceptance criteria of concrete shall be in accordance with Clause 15 of IS:456.

Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor. No payment for the dismantled concrete, the relevant formwork and reinforcement, embedded fixtures, etc. wasted in the dismantled portion shall be made. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good to the satisfaction of the Engineer.

5.0 ACCEPTANCE CRITERIA

5.1 Standard Deviation



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Standard deviation shall be based on test results and determination of Standard deviation shall conform to clause 16 of IS:456.

5.2 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to Clause 16 of IS:456.

5.3 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to Clause 17 of IS:456.

5.4 Load Test

Load tests of structural members may be required by the Engineer, when the strength of test specimen results fall below the required strength, as per 'Load Test on Parts of Structures', Clause 17.6 of IS:456. If load testing is decided by the Engineer, the member under consideration shall be subjected to a test load equal to 1.25 (one and a quarter) times the specified live load used for design and this load shall be maintained for a period of 24 (twenty four) hours before removal. The detailed procedure of the test is to be decided by the Engineer. Load tests shall not be made until the structure is at least 56 days old.

If the member shows evident failure, such changes as are necessary to make the structure adequately strong shall be made by the Contractor. Alternatively, if permitted under Statutory Regulations and at the discretion of the Engineer, the structure under test or a portion thereof may be retained as such without any modification by derating its load bearing capacity, provided the design criteria allows such derating.

A reinforced concrete beam, floor or roof shall be deemed to have passed the test if the maximum deflection at the end of 24 hours does not exceed the deflection given in Clause 17.6 of IS:456.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good by the Contractor to the satisfaction of the Engineer.

6.0 LIST OF I.S. CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular



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aspect of work is not specifically covered by Indian Standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed :-

- IS : 73 - Indian Standard Specification for Paving Bitumen
- IS : 216 - Indian Standard Specification for Coal Tar Pitch
- IS : 269 - Indian Standard Specification for 33 grade Ordinary Portland Cement
- IS : 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
- IS : 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement - Part 1 & 2
- IS : 455 - Indian Standard Specification for Portland Slag Cement
- IS : 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete
- IS : 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures
- IS : 516 - Indian Standard Specification for Methods of Test for Strength of Concrete
- IS : 737 - Indian standard specification for wrought Aluminium and Aluminium Alloy sheet and strip for general Engineering purpose. IS : 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete
- IS : 1200 - Indian Standard Specification for Method of (Part-II) Measurement Cement Concrete Works.
- IS : 1200 - Indian Standard Specification for Method of (Part-V) Measurement of Formwork
- IS : 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing
- IS : 1489 - Indian Standard Specification for Portland - Pozzolona Cement - Part 1 & 2
- IS : 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.



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- IS : 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felts
- IS : 1786 - Indian Standard Specification for high strength deformed Bars & wires for Concrete Reinforcement
- IS : 1791 - Indian Standard Specification for Batch Type Concrete Mixers
- IS : 1834 - Indian standard specification for hot applied sealing compound for joint in concrete.
- IS : 2062 - Steel for general structural purpose.
- IS : 2185 - Indian Standard Specification for Hollow and solid / solid light wt. Cement Concrete Blocks - Part - 1 & 2
- IS : 2210 - Indian Standard Specification for Design of Reinforced Concrete Shell Structures and Folded Plates
- IS : 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII
- IS : 2430 - Indian standard specification for method of sampling of Aggregate for concrete.
- IS : 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
- IS : 2505 - Indian Standard Specification for Concrete Vibrators Immersion Type
- IS : 2506 - Indian Standard Specification for Screed Board Concrete Vibrators
- IS : 2514 - Indian Standard Specification for Concrete Vibrating Tables
- IS : 2645 - Integral Cement water proofing compound
- IS : 2722 - Indian Standard Specification for Portable Swing Weigh Batcher for Concrete (Single and Double Bucket type)
- IS : 2751 - Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction
- IS : 2770 - Indian Standard Specification for Method of Testing Bond in Reinforced Concrete. Part - 1 : Pull out Test



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| IS : 3025 | - | Indian Standard Specification for Methods of Sampling and Test (Physical and Chemical) for Water & waste water - art - 1 to 37 |
| IS : 3201 | - | Indian Standard Specification for Design and Construction of Precast Concrete Trusses and purlins. |
| IS : 3370 | - | Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids Part 1 to 4 |
| IS : 3384 | - | Indian standard specification for / Bitumen primer for use in waterproofing and Danp proofing |
| IS : 3414 | - | Code of practice for Design and Installation of joints in Buildings |
| IS : 3550 | - | Indian Standard Specification for Method of Test for Routine Control for Water used in Industry |
| IS : 3558 | - | Code of Practice for use of Immersion Vibrators for Consolidating Concrete |
| IS : 3696 | - | Safety Code for Part-1 : Scaffolding and Part 2: Ladders |
| IS : 3812 | - | Indian Standard Specification for Fly Ash for Use as Pozzolone & Admixture |
| IS : 4031 | - | Indian Standard Specification for Method of Tests for Hydraulic Cement - Part - 1 to 14 |
| IS : 4082 | - | Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site |
| IS : 4090 | - | Indian Standard Specification for Design of Reinforced Concrete Archs |
| IS : 4634 | - | Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixers |
| IS : 4656 | - | Indian Standard Specification for Form Vibrators for Concrete |
| IS : 4925 | - | Indian Standard Specification for Concrete Batching and Mixing Plant |
| IS : 4926 | - | Indian Standard Specification for Ready Mixed Concrete |



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| IS : 4990 | - | Indian Standard Specification for Plywood for Concrete Shuttering work |
| IS : 4991 | - | Indian Standard Specification for Blast Resistant Design of Structure for Explosion above ground |
| IS : 4995 | - | Indian Standard Specification for Design (Part-I of Reinforced Concrete Bins for the Storage & II) of Granular and Powdery Materials |
| IS : 4998 | - | Indian Standard Specification for Design of (Part - I) Reinforced Concrete Chimneys |
| IS : 5512 | - | Indian Standard Specification for Flow Table for use in Tests of Hydraulic Cement and Pozzolanic Materials |
| IS : 5513 | - | Indian Standard Specification for Vicat Apparatus |
| IS : 5515 | - | Indian Standard Specification for Compaction Factor Apparatus |
| IS : 5751 | - | Indian Standard Specification for Precast Concrete Coping Blocks |
| IS : 5816 | - | Indian Standard Specification for Method of Test for Splitting Tensile Strength of Concrete Cylinders |
| IS : 5891 | - | Indian Standard Specification for Hand Operated Concrete Mixers |
| IS : 6452 | - | Indian Standard Specification for High Alumina Cement for Structural Use |
| IS : 6909 | - | Indian Standard Specification for Supersulphated Cement |
| IS : 6923 | - | Indian Standard Specification for Method of Test for performance of Screed Board Concrete Vibrators |
| IS : 6925 | - | Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures |
| IS : 7242 | - | Indian Standard Specification for Concrete Spreaders |
| IS : 7246 | - | Indian Standard Specification for Table Vibrators for Consolidating Concrete |
| IS : 7251 | - | Indian Standard Specification for Concrete Finishers |
| IS : 7320 | - | Indian Standard Specification for Concrete Slump Test Apparatus |



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| IS : 7861 | - | Indian Standard Specification for (Part-I Recommended Practice for hot and cold & II) Weather Concreting |
| IS : 7969 | - | Safety Code for Storage and Handling of Building Materials |
| IS : 8041 | - | Indian Standard Specification for Rapid Hardening Portland cement |
| IS : 8043 | - | Indian standard specification for hydrophobic cement |
| IS : 8112 | - | Indian Standard Specification for 43 grade Ordinary Portland Cement |
| IS : 8142 | - | Indian Standard Specification for Determining Setting time of Concrete by Penetration Resistance |
| IS : 8989 | - | Safety Code for Erection of Concrete Framed Structures |
| IS : 9013 | - | Indian Standard Specification for Method of Making, Curing and Determining Compressive Strength of Accelerated - cured Concrete Test Specimens |
| IS : 9077 | - | Code of Practice for Corrosion Protection of Steel Rails in RB and RCC Construction |
| IS : 9103 | - | Indian Standard Specification for Admixtures for Concrete. |
| IS : 9417 | - | Recommendation for welding cold worked bars for reinforced concrete construction |
| IS : 10262 | - | Recommended Guideline for concrete Mix Design |
| IS : 12269 | - | Indian standard specification for 53 grade ordinary portland cement |
| IS : 12330 | - | Indian standard specification for sulphate resisting portland cement |
| IS : 12600 | - | Indian standard specification for low heat portland cement |



**TECHNICAL SPECIFICATION FOR
FABRICATION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-298-600-C005

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**UTTAR PRADESH RAJYA VIDYUT
UTPADAN NIGAM LIMITED**

**2 x 500 MW ANPARA D
THERMAL POWER PROJECT**

**VOLUME – II B
CIVIL, STRUCTURAL & ARCHITECTURAL WORKS**

SPECIFICATION NO. PE-TS-298-600-C005

**SECTION - D
*GENERAL TECHNICAL SPECIFICATION***

**SUB-SECTION – D4
FABRICATION OF STRUCTURAL STEELWROK**

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

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**TECHNICAL SPECIFICATION
FOR
FABRICATION OF STRUCTURAL STEELWORK**

1.00 SCOPE

This specification covers supply of all raw steel materials, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork in general covered under the scope of the contract. However, for any special structures such as rail & road bridges, steel chimney, tanks, transmission towers, furnace structures, etc., the relevant Indian Standard or IRC specification and Codes of Practices shall be given due consideration over & above this specification.

2.00 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following :

- a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on contractor's design drawings approved by the Owner / Consultants.
- b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.
- c) To submit design calculations for joints and connections developed by the contractor along with detailed fabrication drawings.
- d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary bolts, nuts, washers, tie rods and welding electrodes for field connections. The field connection materials supplied by the contractor shall be in adequate quantity to avoid delay in erection.
- e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.
- f) Suitably mark, bundle and pack for transport all fabricated materials.
- g) Prepare and furnish detailed Bill of Materials, Drawing Office Despatch lists, Bolt List and any other list of bought out items



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required in connection with the fabrication and erection of the structural steelwork.

- h) Insure, load and transport all fabricated steelwork field connection materials to site.

2.2.0 Work by others

No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract.

2.3.0 Codes and standards

All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard Specification, any other standard practice, as may be specified by the Engineer shall be followed:-

LIST OF I.S. CODES - RELEVANT TO FABRICATION OF STRUCTURAL STEEL WORK

IS Codes	Description
IS : 800 -	Code of practice for general construction in steel.
IS : 801 -	Code of practice for use of cold formed light gauge steel structural members in general building construction.
IS : 806 -	Code of practice for use of steel tubes in general building construction.
IS : 808 -	Dimensions for rolled steel beams, channels and angle sections.
IS : 812 -	Glossary of terms relating to welding & cutting of metals.
IS : 813 -	Scheme of symbols for welding.
IS : 814 -	Covered electrodes for metal arc welding of carbon and carbon manganese steel.
IS : 815 -	Classification coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.



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| IS : 816 | - | Code of practice for use of metal arc welding for general construction in mild steel. |
| IS : 817 | - | Code of practice for training & testing metal arc welders. |
| IS : 818 | - | Code of practice for safety and health requirements in electric and gas welding and cutting operations. |
| IS : 819 | - | Code of practice for resistance spot welding for light assemblies in mild steel. |
| IS : 822 | - | Code of practice for inspection of welds. |
| IS : 919
(Part - 1&2) | - | Recommendations for limits and fits for engineering. |
| IS : 1161 | - | Steel Tubes for structural purposes. |
| IS : 1182 | - | Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates. |
| IS : 1200
(Part - 8) | - | Method of measurement of steel work and iron work |
| IS : 1239
(Part - 1&2) | - | Mild steel tubes, tubulars and other wrought steel fittings |
| IS : 1363
(Part - 1 to 3) | - | Hexagon head bolts, screws and nuts of product grade C. |
| IS : 1364
(Part - 1 to 5) | - | Hexagon head bolts, screws and nuts of product grade A & B. |
| IS : 1365 | - | Slotted counter sunk head screws (dia. 1.6 to 20 mm) |
| IS : 1367
(Part - 1 to 18) | - | Technical supply conditions for threaded steel fasteners. |
| IS : 1608 | - | Method for tensile testing of steel products. |
| IS : 1730 | - | Dimensions for steel plate, sheet and strip for structural and general engineering purposes. |



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- IS : 1852 - Rolling and cutting tolerances for hot-rolled steel product.
- IS : 1977 - Structural steel (Ordinary quality)
- IS : 2016 - Plain washer
- IS : 2062 - Steel for general structural purposes.
- IS : 2629 - Recommended practice for hot-dip galvanising of iron and steel.
- IS : 2633 - Method for testing uniformity of coating on zinc coated articles.
- IS : 3644 - Code of practice for ultrasonic pulse echo testing by contact and immersion method.
- IS : 3757 - High Strength Structural Bolt
- IS : 4000 - High strength bolts in steel structure
- IS : 4759 - Specifications for hot-dip zinc coatings on structural steel and other allied products.
- IS : 4923 - Hollow steel sections for structural use.
- IS : 5334 - Code of practice for magnetic particle flaw detection of weld.
- IS : 5369 - General requirements for plain washers and lock washer.
- IS : 6005 - Code of practice for phosphating of iron and steel.
- IS : 6649 - Specification for hardened and tempered washers for high strength structural bolts and nuts.
- IS : 6623 - Specification for high strength structural nuts.
- IS : 7215 - Tolerances for fabrication of steel structures.
- IS : 7280 - Bare wire electrode for submerged arc welding.
- IS : 8500 - Structural steel micro alloyed (medium & high strength quality).
- IS : 8629 - Code of practice for protection of iron and (Part - I to III) steel structures from atmospheric corrosion.
- IS : 9595 - Recommendation for metal arc welding of carbon manganese steels.



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PAINTING

- IS : 117 - Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes.
- IS : 128 - Specification for ready mixed paint, brushing, finishing, semi-gloss for general purposes, black.
- IS : 1477 - Code of practice for painting of ferrous metal (Part - I & II)
- IS : 2074 - Ready mixed paint, air-drying red-oxide zinc chrome priming.
- IS : 2339 - Specification for aluminium paints for general purposes in dual container.
- IS : 2932 - Specification for enamel, synthetic exterior type - I.
- IS : 2933 - Specification for enamel, synthetic exterior type - II.

2.4.0 Conformity with Designs

The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.

2.5.0 Materials to be used

2.5.1 General

All steel materials shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates of materials supplied by the contractor in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tonnes or less of any particular section.



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The arc welding electrodes shall conform to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and ampereage (Polarity in case of D.C. supply) for which the electrodes are suitable.

2.5.2

Steel

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable :

- 1) IS : 801 - Cold formed light gauge steel structural member.
- 2) IS : 806 - Steel tubes in general building construction.
- 3) IS : 1161 - Steel tubes for structural purpose.
- 4) IS : 1977 - Structural steel (Ordinary quality)
St-42-0
- 5) IS : 2062 - Steel for general structural purpose
- 6) IS : 8500 - Structural steel-microalloyed (Ordinary & high strength quality)

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.5.3

Electrodes

All electrodes to be used under the Contract shall comply with any of the following Indian Standard Specifications as may be applicable :

- 1) IS : 814 - Covered electrodes for metal arc welding structural steel
- 2) IS : 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.
- 3) IS : 7280 - Base wire electrode for submerged arc welding.

2.5.4

Bolts and Nuts

All bolts and nuts shall conform to the requirements of Indian Standard Specification IS:1367 - Technical Supply Conditions for Threaded Fasteners.

Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.



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a) Mild Steel : All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm^2 and a minimum elongation of 23 per cent on a gauge length of $5.6/A$, where 'A' is the cross sectional area of the test specimen : -

1) IS:1367 - Technical supply conditions for threaded fasteners.

2) IS:1608 - Method for tensile testing of steel other than sheet, strip, wire and tube.

b) High Tensile Steel : The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS:1367 or as approved by the Engineer.

2.5.5 Washers

Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract :

1) IS : 1977 - Structural steel (Ordinary Quality) St-42-0

2) IS : 2062 - Steel for general structural purpose

3) IS : 8500 - Structural steel - microalloyed (medium & high strength quality)

4) IS : 6623 - High Strength Structural Nuts

5) IS : 6649 - Hardened and tempered washers for high strength structural bolts & nuts.

2.5.6 Paints

Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS:2074 - Ready mixed Paint, Air Drying, Red Oxide - Zinc Chromate Priming.

In highly corrosive environment other type of primer such as epoxy resin based zinc rich primer (such as blast steel EZ1 of Shalimer Paints Ltd., may be necessary.

2.6.0 Storage of Material

2.6.1 General



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All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed. The Contractor shall maintain upto date accounts in respect of receipt, use and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

2.6.2 Steel

The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground sectionwise and lengthwise so that they can be easily inspected, measured and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.

2.6.3 Electrodes

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

2.6.4 Bolts, Nuts and Washers

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length and quality.

2.6.5 Paints

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

2.7.0 Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer

or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting



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~~access for inspection to all places where work is being done and in~~
providing all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work :

- 1) Steel : Quality, manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.
- 2) Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, material testing.
- 3) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.
- 4) Welders : Qualifying Tests
- 5) Welding sets : Performance Tests
- 6) Welds : Inspection, X-ray, Ultrasonic tests
- 7) Paints : Manufacturer's certificate, physical inspection reports
- 8) Galvanizing : Tests in accordance with IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.

2.8.0

Standard dimensions, forms and weights

The dimensions, forms, weights and tolerances of all rolled shapes bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.



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2.9.0

Shop Drawings

The Contractor shall submit to the Engineer the Schedule of Fabrication and delivery of structural steelwork for approval. He shall start to submit progressively for approval the shop drawings based on the approved Design Drawings and before proceeding with the fabrication work, shall get the said shop drawings approved in accordance with the contract.

The sequence of submission of shop drawings for approval shall match with the approved fabrication and delivery schedule. The approval for the shop drawings will be accorded only towards the general conformity with the design requirements as well as specification and will ensure the correctness of general arrangement for centreline dimensions and levels, Section sizes, and adequacy of connections including splice joints as to the no. of bolts, weld length, size of gusset/end plates.

The correctness of all other details like cutting lengths, matching of holes, notch dimensions, match markings, bill of materials, bolt list etc. will be entirely the contractor's responsibility. The approval of the drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The shop drawings shall include but not be limited to the following :-

- a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.
- b) Dimensional drawings of base plates, foundation bolt location etc.
- c) Details of all connections with supporting calculations.
- d) Comparison sheets to show that the proposed alternative section, if any, are as strong as the original sections shown on the Design Drawings.
- e) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.
- f) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.

The shop drawings shall give all the necessary information for the fabrication, erection and painting of the steelwork in accordance with the provisions of this Specification. Shop drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Shop drawings

shall give complete information necessary for fabrication of various components of the steelwork, including the location, type, size and extent of welds. These shall also clearly distinguish between shop and field bolts and



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welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the shop drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked-up stresses and distortion.

Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification --IS:813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

The Contractor shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract.

3.0.0 WORKMANSHIP

3.1.0 Fabrication

3.1.1 General

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS:800 - Code of Practice for use of Structural Steel in General Building Construction and other relevant Indian Standards.

3.1.2 Straightening Material

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification IS:1852 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600 Deg. C.

3.1.3 Cutting

Cutting shall be effected by shearing, cropping or sawing. Use of a mechanically controlled gas cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting

without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.



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To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges. Occasional notches or gauges not more than 4 mm deep will be permitted. Gouges greater than 4 mm, that remain from cutting, shall be removed by grinding. All re-entrant corners shall be shaped notch-free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

3.1.4 Planning of edges

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.1.5 Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams without web cleats shall be not more than 3 mm at each end, but where, for practical reasons, greater clearance is necessary, suitably designed cleatings shall be provided.

3.2.0 Bolted construction

3.2.1 Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of H8 as specified in IS:919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the



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thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for bolts shall not be formed by gas cutting process.

3.2.2 Assembly

Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the bolts shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be so assembled that they are neither twisted nor otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if directed by the Engineer.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer, one spring washer or lock-nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings.

3.3.0 Welded Construction

3.3.1 General

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS:817.

3.3.2 Preparation of Material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign material except that mill scale which withstands vigorous wire brushing may remain. Joint surfaces shall be free from fins and

tears. Preparation of edges by gas-cutting shall, wherever practicable, be done by a mechanically guided torch.



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3.3.3

Assembling

Parts to be fillet welded shall be brought in as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2 Deg.).

The work shall be positioned for flat welding whenever practicable.

3.3.4

Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses. Where it is impossible to avoid high residual stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shop splicing not more than three sub-sections, each made in accordance with this paragraph. When required by the Engineer, welded assemblies shall be stress relieved by heat treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.

3.3.5

Welding technique

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not



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~~be removed upon completion of the weld unless otherwise specified elsewhere in the Contract.~~

To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards.

3.3.6 Temperature

No welding shall normally be done on parent material at a temperature below (-) 5 Deg.C. However, if welding is to be undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5 Deg. C and 0 Deg. C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is handwarm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20 Deg. C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

3.3.7 Peening

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool. Peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

3.3.8 Equipment

These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer.

3.4.0 Finish

Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.2 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., after welding together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 2.0 mm.

3.5.0 Slab bases and caps



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Bases and caps fabricated out of steel slabs, except when cut from material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing

face which is to be grouted direct to a foundation need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.

3.6.0 Lacing bars

The ends of lacing bars shall be neat and free from burrs.

3.7.0 Separators

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.8.0 Bearing Plates

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.9.0 Architectural Clearances

Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

3.10.0 Shop connections

- a) All shop connections shall be welded as specified on the Drawings.
- b) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the Contractor will have to make the desired changes.

3.11.0 Castings

Steel castings shall be annealed

3.12.0 Shop erection

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before despatch. The parts shall be shop-erected with a sufficient number of parallel drifts to

bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchangeability.



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3.13.0 Shop painting

3.13.1 General

Unless otherwise specified, steelwork which will be concealed by interior building finish need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other mechanical cleaning methods to remove loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by through sweeping with a fibre brush.

After completion of the precleaning, the metal surface shall immediately painted with red oxide zinc chromate primer conforming to IS : 2074.

In highly corrosive environment, all steelwork shall be given a coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned by sand blasting to SA 2/1/2 grade minimum. The shop paint shall be epoxy resin based zinc rich primer such as Blast Steel EZ1 of Shalimer Paint Limited.

3.13.2 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.13.3 Contact surfaces

Contact surface shall be cleaned in accordance with Sub-clause 3.13.1 before assembly.

3.13.4 Finished surfaces



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~~Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.~~

3.13.5 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 mm of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.14.0 Galvanizing

3.14.1 General

Structural steelwork for switchyard or other structures as may be specified in the Contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS : 2629 - Recommended practice for Hot-Dip Galvanising of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

3.14.2 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, dirt, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.14.3 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after



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~~galvanizing and shall not be clogged with zinc. The threads of nuts may be~~
tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after having been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport and handling. Damages, if occur, shall be made good in accordance with the provisions of this Specification or as directed by the Engineer.

4.0.0 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.1.0 Inspection

Unless specified otherwise, inspection to all work shall be made by the Engineer or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The Contractor shall provide such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract.

The Contractor shall guarantee compliance with the provisions of this Specification.

4.2.0 Testing and Acceptance Criteria

4.2.1 General

The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost, unless otherwise specified in the Contract. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.



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4.2.2

Steel

All steel supplied by the Contractor shall conform to the relevant Indian Standards. Except otherwise mentioned in the Contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T. or less of any particular section for tests to conform to relevant Indian Standards.

All material shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance.

4.2.3

Testing Criteria for checking Lamination in raw steel plates

All raw steel plate of thickness more than 20 mm supplied by the contractor shall be checked against lamination before procurement & prior to commencement of fabrication work in the following ways as directed by the Engineer.

- a) Ultrasonic testing along the edge of specified points of the plates shall be carried out to delete lamination in the plates, if any.
- b) If the results of the tests in (a) are not satisfactory, the whole area of the plates shall be checked by ultrasonic testing at specified nodal points formed at equidistant grid locations. The spacing of the grids shall be determined from tests in (a) or as directed by the Engineer.

If the results of the above tests are not satisfactory, the plates shall not be taken up for fabrication work. Even after fabrication at shop, if the Engineer requires any ultrasonic testing to detect lamination of plates, the same shall be carried out by the Contractor. If the plates in the fabricated item is found to be laminated, the component will be rejected.

4.2.4

Welding

All electrodes shall be procured from reliable manufacturers with test certificates. The correct grade and size of electrode which has not deteriorated in storage shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tonnes of welded fabrication, the Engineer may ask for at least 1 (one) test-destructive or non-destructive including X-ray, ultrasonic test or similar. In the event of further tests as may be desired by the Engineer, if the results are found to be unsatisfactory; and if the test shows no defect. In cases of the test results showing deficiency, the Engineer shall have option to reject or instruct any remedial measures to be taken.



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4.2.5

Bolts, nuts and washers

All bolts, nuts and washers shall be procured from reputed manufacturer approved by the Engineer and shall conform to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards.

4.2.6

Shop painting

All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.

4.2.7

Galvanizing

All galvanizing shall be uniform and of standard quality when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

4.3.0

Tolerance

The tolerances on the dimensions of individual rolled steel components shall be as specified in IS:1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures other than steel railway & road bridges, structures subjected to dynamic loading (like wind, seismic etc.) and thin walled construction (like box girders) shall be as specified in IS:7215 - Tolerances for Fabrication of Steel Structures.

4.4.0

Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this Specification, the same shall be liable to rejection. No structure or part of the structure, once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check the test results obtained at the Contractor's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory.

When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue an acceptance certificate,



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~~upon receipt of which, the items will be shop painted, packed and~~
despatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

4.5.0 Delivery of materials

4.5.1 General

The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. the Owner may prescribe or control the sequence of delivery of materials, at his own discretion.

4.5.2 Marking

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

4.5.3 Packing and Shipping

All projecting plates or edges and all ends of members of joints shall be stiffened, all straight members and plates, shall be bundled, all screwed ends and machined surfaces shall be suitably packed and all bolts, nuts, washers, and small loose parts shall be packed separately in order to prevent damage or distortion during shipping.

Shipping shall be strictly in accordance with the sequence stipulated in the agreed programme. Payment may be held up for items sent in advance of the sequence till they could be erected. The Contractor shall include and provide for in his rates, the freight and other charges for despatching the materials to the worksite and also for securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All packings shall allow for easy removal and checking at site. Special precautions shall be taken against rusting, corrosion, breakage or damage otherwise of the materials. All parts shall be adequately braced to prevent damage in transit.



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Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following : -

- a) Name and address of the consignee
- b) Name and address of the consignor
- c) Gross weight of the package in tonnes and its dimensions
- d) Identification marks and/or number of the package
- e) Custom registration number, if required

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially :

- a) Name of the Contractor
- b) Number and date of the Contract
- c) Name of the office placing the contract
- d) Nomenclature of stores
- e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each.

The shipping dimensions of each package shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner.

Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor.



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~~The contractor shall ship the complete materials or part on board a vessel~~ belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges.

If, however, the Owner has to make payment of any of the above mentioned charges, the amount paid will be deducted from the progressive bills of the Contractor.

Necessary advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

The following information are required to be submitted with the Tender :

a) Progress Schedule

The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work.

- 1) Preparation and approval of shop drawings
- 2) Procurement of materials
- 3) Fabrication and shipping of all anchor bolts
- 4) Fabrication and shipping of main steelwork
- 5) Fabrication and shipping of steelwork for bunkers. Tanks and/or silos as applicable.
- 6) Fabrication and shipping of all other remaining steel work including miscellaneous steelwork
- 7) Final date of completion of all shipments

Time required for completion being one of the main criteria for selecting the successful bidder, it is desired that the bidder quotes the minimum time required by him for completing the work.

b) Shop



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~~Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity and the capacity that will be available exclusively for this contract shall be submitted.~~

c) **Matching Steel**

A rough indication of the quantities and details of matching steel sections required to start the work shall be furnished.

5.2.0

After Award

After award of the Contract the successful Tenderer is to submit the following :

- a) Complete fabrication drawings, material lists, cutting lists, bolt lists, field welding schedules based on the design drawings in accordance with the approved schedule.
- b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day of each month, giving the upto date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information.
- c) Results of any test as and when conducted and as required by the Engineer.
- d) Manufacturer's mill test report in respect of steel materials, bolts, nuts and electrodes as may be applicable.



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UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

2 x 500 MW ANPARA D THERMAL POWER PROJECT

VOLUME – II B CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

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**SECTION - D
*GENERAL TECHNICAL SPECIFICATION***

**SUB-SECTION – D8
MASONRY & ALLIED WORKS**

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

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TECHNICAL SPECIFICATION FOR MASONRY & ALLIED WORKS

1.0.0 SCOPE

This specification covers furnishing, installation, repairing, finishing, curing, protection, maintenance and handing over of masonry and allied works for use in structures and locations covered under the scope of the Contract.

2.0.0 INSTALLATION

2.1.0 Soling

2.1.1 Brick Soling

The ground shall be dressed, consolidated by ramming or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight.

2.1.2 Stone Soling

The stones for soling shall be selected on the basis of thickness of soling as shown as the drawings. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

2.2.0 Brick Edging

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.



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2.3.0 **Masonry**

2.3.1 **General**

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

2.3.2 **Mortar**

Mix for mortar shall be specified in the Schedule of Items.

When lime is used hydrated lime shall be mixed with water to form a putty and stored with care to prevent evaporation for at least 24 hours before use. Quick lime shall be slaked with enough water to make a cream, passed through a No. 10 seive and stored avoiding evaporation for seven days before use.

Lime putty and sand in proper proportion shall be mixed on a water-tight platform with necessary addition of water and thoroughly ground in a mortar mill. This mix shall be transferred to a mechanical mix, required quantity of cement added and the content mixed for at least 3 minutes. Mixtures of lime putty and sand may be stored avoiding drying out. For cement sand mortar cement and sand in requisite proportions shall be mixed dry in a mechanical mixer and then water added and mixed further. Minimum quantity of water shall be added to achieve working consistency.

Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement. No mortar which has stood for more than half an hour shall be used.

2.3.3 **Brick Masonry**

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing. Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.



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2.3.4 Exposed Brickwork

Brickwork in superstructures which is not covered by plaster shall be as shown on drawing and executed by specially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule and string. All brick-work shall be cleaned at the end of days work. If face bricks are specified in the drawings, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean and pointed as specified. Where face bricks are used carborandum stone shall be used for rubbing down.

2.3.5 Reinforced Brickworks

Reinforcements shall be as specified in the drawings. All reinforcements shall be thoroughly cleaned and fully embeded in mortar. Where M.S. bars are used as reinforcement, these shall be laped with dowels if left in R.C. columns or welded to steel stanchions.

2.3.6 Stone Masonry

Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. At least two stones shall run the full width of the wall for every square meter of surface area.

2.3.7 Exposed Stonework

Stonework which is to be kept exposed shall be as shown on drawing or described in the Schedule of Items. It shall be executed by specially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 sq.m. in area shall be built and approved by the Engineer and all works shall match with this sample.

2.3.8 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.



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2.3.9 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard water proof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

2.3.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with carborandum stone.

2.3.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be kept wet by ponding.

2.3.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

2.3.13 Encasing of Structural Steel

This shall be done by building masonry work round flanges, webs etc. and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

2.4.0 Damp Proof Course

Unless otherwise specified Damp-proof course shall be 40 mm or as per schedule thick 'artificial stone' in proportion 1:1-1/2:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by ponding for seven days.

2.5.0 Damp Proof Membrane



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Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in IS:1609. The number of courses shall be as mentioned. Sequence or work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The Contractor shall be obliged to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.

Where shown on drawing, damp proof membrane with one layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade.

3.0.0

I.S. CODES

Some of the important relevant codes for this section are :

- IS:1127 : Recommendations for dimensions and workmanship of natural building stones for masonry work.
- IS:1597 : Code of Practice for Construction of stone Masonry.
- IS:1609 : Code of Practice for laying Damp-proof treatment using bitumen felts.
- IS:2212 : Code of Practice for Brickwork.
- IS:2250 : Code of Practice for preparation and use of Masonry Mortar.
- IS:5134 : Bitumen Impregnated Paper & Board.



**TECHNICAL SPECIFICATION FOR
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2 x 500 MW ANPARA D THERMAL POWER PROJECT

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SPECIFICATION NO. PE-TS-298-600-C005

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**Bharat Heavy Electricals Limited
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**TECHNICAL SPECIFICATION
FOR
FINISH TO MASONRY & CONCRETE**

1.0.0 SCOPE

This Specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment. Before commencing finishing items the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimise damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.0.0 INSTALLATION

2.1.0 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be brushed down with stiff wire brush to remove all loose dust from joints and thoroughly washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval or the Engineer shall be taken as to the acceptability of the base.

2.2.0 Plastering

2.2.1 Mortar

Mortar for plastering shall be as specified in the drawings.

For sand cement plaster, sand and cement in the specified proportion shall be mixed dry on a watertight platform and minimum water added to achieve working consistency.



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For lime gauged plaster, lime putty or hydrated lime and sand in the required proportion shall be mixed on a watertight platform with necessary addition of water and thoroughly ground in mortar mill. This mix shall then be transferred to a mechanical mixer to which the required quantity of cement is added and mixed for at least 3 minutes.

No plaster which has stood for more than half an hour shall be used; plaster that shows tendency to become dry before this time, shall have water added to it.

2.2.2

Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats - a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat, the overall thickness of the coats shall not be less than the minimum thick-ness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambes etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

2.2.3

Finish

Generally, the standard finish shall be used unless otherwise shown on drawing or directed by the Engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the Engineer regarding the texture, colour and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough. Otherwise the interior plaster shall generally be



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finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) **Neat Cement Finish**

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. per Sq.M. and rubbed smooth with a trowel.

c) **Coloured Plaster Finish**

This shall be done in the same way as specified in Clause 2.2.2 but using coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the top coat only shall be made with coloured cement.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix-A of IS:2114 latest edition. Samples of colouring material shall be submitted to the Engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations.

d) **Pebble-dash Finish**

Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.2.2. While the mortar is still plastic small pebbles or crushed stone of size generally from 10 mm to 20 mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) **Rough-Cast Finish**

A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 mm as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) **Scraped Finish**



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Ordinary plaster as described under Clause 2.2.2 after being levelled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) **Textured Finish**

Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2. Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

2.2.4 **Curing**

All plastered surfaces after laying, shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.3.0 **Pointing to Masonry**

All joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finished with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scraped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.4.0 **Plaster with Metal Lath**

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 BG thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two layers.



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The mortar for plastering shall consist of 1 part cement, 1/2 part lime and 4 parts sand by volume, or 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.2.1. The application, finish etc. shall be as specified under relevant clause above. A 2 mm Plaster of Paris punning shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.5.0 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punning shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.6.0 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. area and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.7.0 Stone Facing

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawing for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable noncorrodable anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanised (weight of zinc coating shall not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.



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The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings.

3.0.0 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as shown on drawings.

4.0.0 I.S. CODES

Important relevant code for this Section :

- a) IS:1661 : Code of practice for cement and cement-lime plaster finish on walls & ceilings.
- b) IS:4101 : Code of practice for external facings and veneers.



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS METAL**

SPECIFICATION NO. PE-TS-298-600-C005

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UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

2 x 500 MW ANPARA D THERMAL POWER PROJECT

VOLUME – II B CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-298-600-C005

**SECTION - D
*GENERAL TECHNICAL SPECIFICATION***

**SUB-SECTION – D17
MISCELLANEOUS METAL**

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

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TECHNICAL SPECIFICATION FOR MISCELLANEOUS METAL

1.0.0 SCOPE

This specification shall generally be read in conjunction with item nos. 6.01 & 6.03.

This shall include supply, fabrication and erection of miscellaneous metal items of light nature in gates, grills, balcony and stair handrails particulars, structural mullions and transoms, ladders hangers masonry anchors, shelf angles, anchor bolts, fasteners, etc. as shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast M.S/Aluminium/Brass, cast iron, M.S. and galvanised M.S. Sheets, aluminium sheets, expanded metal, wire mesh etc. as shown on drawings and/or described.

2.0.0 INSTALLATION

2.1.0 Fabrication/Casting

2.1.1 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundry shop.

2.1.2 Shop Connections

- a) All shop connections shall be riveted or welded except when noted otherwise on drawings.
- b) Welding of steel shall be done in accordance with the IS : 816. Use of metal arc welding for general construction in Mild Steel.
- c) Welding of aluminium shall be done in accordance with IS: 2942, Arc welding of Aluminium and Alloys, Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.

2.1.3 Shop Coat



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Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill/ scale, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied by brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. Steel work shall be galvanised or galvanized and painted with a coat of zinc chromate primer. Aluminium surfaces which shall come in contact with masonry shall be given one coat of zinc chromate primer.

2.2.0 Erection

2.2.1 Bracing

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected including erection of equipment and operation of the same.

2.2.2 Temporary Bolting-Up

As erection proceeds the Contractor shall plumb up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever piles of materials, erection equipment or other loads are carried during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.2.3 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.2.4 Welding

Where specified on drawings, welding shall be done in accordance with IS : 816 for steel and IS: 2942 for Aluminium and Alloys.

2.2.5 Cutting and Fitting

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings, holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, than those shown on drawings, shall be made without the approval of the Engineer.



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2.2.6

Drifting

Correction of minor misfits and a reasonable amount of reaming and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections. Reaming that weakens the members or make it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount of reaming and slight chipping and cutting shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.2.7

Grouting

All bearing plates, loose lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1.5:3 or 1:1- 1/2:3 concrete with 6 mm down stone chips.

2.2.8

Anchor Bolting

When shown on drawings, the miscellaneous metal items shall be fixed to concrete by case hardened and drawn carbonizing steel expander nut and bolt. The Contractor shall submit the manufacturer's literature showing the average pull out and average shear values for bolts of various sizes. The bolts shall be fixed strictly as per the manufacturer's instructions.

2.2.9

Pipe Joints

M.S. Pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot jointed and caulked with hemp and molten lead.

2.2.10

Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials as used for the shop paint.

2.2.11

Making Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.



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ACCEPTANCE CRITERIA

- a) All items shall be of correct shape, size, weight etc. shown on drawings.
- b) For installed items, the tolerances shall be follows :
 - i) Permissible deviation from straightness - 1 in 1000.
 - ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.
- c) All castings shall be free from blow holes, cracks and other blemishes.

4.0.0

I.S. CODES

- IS : 226 - Structural Steel (Standard Quality)
- IS:800 - Code of practice for use of structural steel in general building construction.
- IS : 816 - Use of metal arc welding for general construction in mild steel.
- IS : 2942 - Arc welding of Aluminium and Alloys
- IS : 3150 - Hexagonal Wire Netting
- IS : 4948 - Welded steel wire fabric for general use.



**TECHNICAL SPECIFICATION FOR
PAINTING, WHITE WASHING AND
POLISHING ETC.**

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2 x 500 MW ANPARA D THERMAL POWER PROJECT

VOLUME – II B CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-298-600-C005

**SECTION - D
*GENERAL TECHNICAL SPECIFICATION***

**SUB-SECTION – D18
PAINTING, WHITE WASHING AND POLISHING ETC.**

**Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
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**TECHNICAL SPECIFICATION
FOR
PAINTING, WHITE WASHING AND POLISHING ETC.**

1.0.0 SCOPE

This specification covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster or paris, Punning false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items as shown on drawings, or as directed by the Engineer.

Copper, bronze, chromium plate, nickel, stainless steel, aluminium and monel metal shall generally not be painted or finished except if otherwise specified.

The painting Contractor shall inspect the work of others prior to the application of paint. If surface to be finished cannot be put in suitable condition for painting by customary preparatory methods, the painting contractor shall notify the Engineer in writing or assume responsibility for and rectify unsatisfactory finishing that results.

Before commencing painting, the painting Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage, disfiguration or staining by other trades. He shall also undertake normal precautions to prevent damage, disfiguration or staining to work of other trades or other installations.

2.0.0 INSTALLATION

2.0.1 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible & paint or one shade is obtained the same manufacturing batch. All paint shall be subject to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied.

All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognised manufacturers and shall be approved by the Engineer.



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All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

a) **White Washing**

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the Engineer; and shall conform to IS:712 latest edition. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank of water for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 litres of white wash water and a little quantity of indigo or synthetic ultramarine blue shall be added to the lime.

b) **Dry distemper**

Shall be made from suitable pigments, extenders, lime proof tinters, water soluble binders etc. and shall conform to IS:427.

c) **Oil Bound Washable Distemper**

Shall be of oil emulsion type, containing suitable preservatives and shall conform to IS:428.

d) **Waterproof Cement Paint**

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS:5410.

e) **Acrylic Emulsion Paint**

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide. It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild and water without any deterioration in colour, or without showing flaking, blistering or peeling.

f) **Synthetic Enamel Paint**

Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable



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and glossy finish to all exterior and interior surfaces. White and pastel shades shall resist yellowing and darkening with aging. The paint shall conform to IS:2932 and IS:2933.

g) **Aluminium Paint**

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS:2339.

h) Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

i) **French Polish**

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well known approved manufacturer. The material shall conform to IS:348.

French polish shall not be used on bare wood. It shall only be used as finishing coat on wood after the wood is pretreated with a liquid wood filler conforming to IS:345 is applied and rubbed out.

2.0.2 **Storage**

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the Contractor to prevent fire.

2.1.0 **Preparation of surface**

Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.

2.1.1 **Wood**

All surfaces shall be free from dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellac coating applied thinly & extended 25 mm beyond the area. All large, loose or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS:2338.

2.1.2 **Masonry, Concrete and Plastered Surface**

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint or other foreign and loose materials. Masonry cracks shall be cleaned out and



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patch filled with mortar similar to the original surface and uniformly textured. Where this type of re- surfacing may lead to the finishing paint being different in shade from the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with mildew or efflorescence shall be treated as below :

a) **Mildew**

All mildewed surfaces shall be treated with an approved fungicide such as ammonia cal wash consisting of 7g of copper carbonate dissolved in 80 ml. liquor ammonia and diluted to 1 litre with water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.1.3 **Metal**

All metal surfaces shall be absolutely clean, dry and free from wax, grease or dried soap films. In addition, all steel and iron surfaces shall be free from rust, surfaces shall be cleaned by mechanical power tools to remove mill scales unless otherwise approved by the Engineer for exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanised iron surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat.

2.2.0 **Application**

2.2.1 **General**

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings if used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor holes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to be free of sags, runs, crawls or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoats for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.

No work shall be done under conditions that are unsuitable for production of good results. No painting shall be done when plastering is in progress or is



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drying. Application of paint, which seals the surfaces to moisture, shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered properly by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall be done as per IS:1477 (Part 1 & 2). The total dry thickness of the film should not be less than 120 micron.

2.2.2

White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before application of the lime solution.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required. No brush marks shall show on the finished surface.

2.2.3

Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement plastered surface, the surface shall be washed with a solution of 100 gms. of zinc sulphate to 1 litre of water and then allowed to dry.

Dry distempering shall be done as per manufacturer's instruction. In applying the distempers the brush should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long as otherwise brush marks may result.

2.2.4

Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.



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2.2.5 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.2.6 Acrylic Emulsion Paint

Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be strictly as per manufacturer's specification.

2.2.7 Synthetic Enamel Paint

Shall be applied on properly prime red surface. Subsequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.2.8 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.2.9 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on while the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has began to set, shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.



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The varnish shall be minimum of two coats, with the first coat being a flattening varnish. This shall be allowed to dry hard and be flattened down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

2.2.10 French Polish

All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted. The pores in the wood shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt sienna or umber.

After application of the filler paste, the french polish shall be applied with a pad of woolen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for ease of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly dampened with methylated spirit and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.2.11 Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber or vinyl butyl paint system shall be used manufacturer's recommendation regarding the paint system exposed to moderately severe corrosive condition and subject to acid/alkali spillage and fumes, shall be followed.

2.2.12 Epoxy coating/painting

On the clean surface of concrete after properly drying of the following system is to be adopted as per manufacturer's specification :

One coat of primer of following proportion to be applied over clean and dried concrete surface by brush application.

ARALDITE GY 250 - 100 Parts by weight

HARDENER HY 840 - 50 Parts by weight

Over the primer, the uneven surface of concrete should be filled with leveling putty as mentioned above. The cost of putty is included in the item rate without fixing prior limit to consumption of putty. Two top coats of the protective treatment to be applied over the prepared smooth surface in the following proportion.

ARALDITE GY 250 - 100 Parts by weight



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HARDENER HY 830 - 45 Parts by weight

HARDENER BY 850 - 15 Parts by weight

SILICA FLOUR - 20 Parts by weight

**FLOW CONTROL
AGENT - 2 Parts by weight**

Pigment may be added if desired by Engineer. The first top coat is applied over the primer and is left to reach a tack free state. At this stage, the final top coat is applied.

2.3.0 Protection

Furniture and other movable objects, equipments, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipments shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.4.0 Cleaning up

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been spilled, splashed or splattered, including all equipments, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

3.0.0 ACCEPTANCE CRITERIA

- a) All painted surfaces shall be uniform and pleasing in appearance.
- b) All varnished surfaces shall be of uniform texture and high glossy finish.
- c) The colour, texture etc. shall match exactly with those of approved samples.
- d) All stains, splashes and splatters of paints and varnishes shall be removed from surrounding surfaces.

4.0.0 I.S. CODE

Important relevant IS Codes for this Sections are listed below :

IS:348 : Specification for French Polish

IS:427 : Specification for Distemper, dry colour as required.



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- IS:428 : Specification for Distemper oil emulsion, colour as required.
- IS:1477 : Code of Practice for painting of ferrous (I&II) metal in buildings.
- IS:2338 : Code of Practice for finishing of wood (I&II) and wood based materials.
- IS:2339 : Specification for Aluminium Paints for general purposes in dual containers.
- IS:2395 : Code of Practice for painting concrete, masonry and plaster surface.
- IS:2932 : Specification for enamel, synthetic, exterior, type-I.
- IS:5410 : Specification for cement paint, colour as required.



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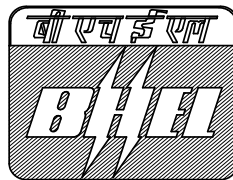
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DRIVEN CAST-IN-SITU STONE COLUMNS

SPECIFICATION NO. PE-TS-298-600-C001



Bharat Heavy Electricals Limited

Power Sector - Project Engineering Management

PPEI Building, Plot No. 25

Sector-16A, NOIDA (U.P.)-201301



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6.00.00	TESTING
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**TECHNICAL SPECIFICATION FOR
INSTALLATION OF DRIVEN CAST-IN-SITU STONE COLUMN**

1.00.00 SCOPE

This specification covers the installation of driven cast-in-situ stone columns. It also covers test to be carried out on the virgin as well as improved ground.

2.00.00 GENERAL REQUIREMENT

2.01.00 This specification covers the technical requirements for stone column.

2.02.00 The work shall include supplying and providing necessary materials, mobilization of all necessary equipments providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour etc as required to carryout the complete stone column works including necessary testing and submission of records as per schedule.

2.03.00 All works shall be executed as per the specification to the satisfaction of the Engineer.

2.04.00 The Bidder shall submit along with tender documents his tender design of detachable pile shoe based on Geotechnical data (Annexure-A) furnished by BHEL along with this specification.

2.05.00 It is essential that all equipments and instruments are properly calibrated both at commencement and immediately after the completion of tests so that they represent true values. Certificates to this effect from an approved institution shall be furnished to the Engineer. If the Engineer so desires, the Bidder shall arrange for having the instruments tested at an approved laboratory at no extra cost to BHEL and the test report shall be submitted to the Engineer. If the Engineer desires to witness such tests Bidder shall arrange to conduct the test in his presence.

2.06.00 The Bidder shall make his own arrangements for locating the coordinates and position of stone columns as per drawings supplied to him and for determining the Reduced Levels (RL) of these locations with respect to the benchmark indicated by the Engineer. Two established reference lines in mutually perpendicular direction shall be indicated to the Bidder. The Bidder shall provide at site all the required survey instruments to the satisfaction of the Engineer so that the work can be carried out accurately according to specification and drawings.

2.07.00 The Bidder shall assure the quality of stone column work including quality of sand and gravel used, integrity of stone columns etc.

2.08.00 GEOTECHNICAL DATA



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A few bore logs/ geotechnical data are furnished in Annexure-A. These are reference and are indicative only. However, the detailed geotechnical investigation report shall be made available for reference of the bidder if so required at the office of BHEL. The geotechnical data furnished is in good faith and only for the guidance of the bidder to arrive at design parameters and construction methods.

3.00.00 MATERIALS

3.01.00 General

All materials viz stone aggregate and sand shall conform to IS:383. Sand and stone aggregate mix of 1 (sand) : 2 (stone aggregate with size 50 mm and down) shall be used.

4.00.00 STONE COLUMN INSTALLATION

Installation of stone columns shall be as per procedure outlined elsewhere in the specification, relevant drawings and as per the direction of the Engineer.

4.01.00 Equipment and Accessories

4.01.01 The equipment and accessories for installation of driven cast-in-situ stone columns should depend upon the installation methodology intended to be used for constructing the stone columns. The equipments should be selected giving due consideration to the geotechnical data, ground water conditions, type of founding strata, type of structure, the required penetration in the soil/ash, availability of resources and time etc. These shall be of standard type and shall have the approval of the Engineer.

4.01.02 Among the commonly used plants, tools and accessories, there exists a large variety; suitability of which depends on the subsoil conditions, manner of operations etc. Brief definitions of some commonly used equipment are given below.

Dolly: a cushion of hardwood or some suitable material placed on the top of the casing to receive the blows of the hammer.

Drop hammer (or Monkey) : Hammer, ram or monkey raised by a winch and allowed to fall under gravity. Minimum weight of hammer to be adopted shall not be less than 4 MT.

Single or double acting hammer: A hammer operated by steam compressed air or internal combustion, the energy of its blows being driven mainly from the source of motive power and not from gravity alone.

Kentledge: Dead weight used for applying a test load during testing.



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Pile frame (or Pile rig) : A movable steel structure for deriving the casing for stone columns in the correct position and alignment by means of a hammer operating in the guides or (leaders) of the frame.

4.01.03 The list and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid.

4.02.00 Installation Procedure

4.02.01 Drive a 500/600 mm diameter M.S. casing pipe with detachable shoe (flat or conical) at the bottom using a monkey/hammer at the desired locations as shown in the construction drawings. The depth of driving the casing shall be as shown in the drawing. The height of free fall of the monkey shall be at least 1 m during driving the casing.

4.02.02 Fill the casing pipe for 1000 mm depth with desired back fill material as specified elsewhere in the specification.

4.02.03 Withdraw/lift the casing pipe for about 800 mm from the bottom.

4.02.04 After withdrawal/lifting the casing for about 800 mm, the backfill material inside the hole shall be thoroughly compacted using dynamic compaction method so as to achieve maximum compaction. Dynamic compaction may be done using a tamper/hammer operating inside the hole. The base diameter of tamper/hammer may be about 300 to 550 mm and the weight of tamper/hammer shall be at least 500 kg. The minimum height of fall of the hammer during compaction shall be 750 mm. To achieve the desired compaction of backfill material for 1000 mm depth, about 15 to 20 blows are required with a hammer of 500 kg.

4.02.05 Once the first layer is compacted, fill the casing pipe for another 1000 mm height with the desired backfill material and the procedure mentioned above shall be repeated so as to achieve maximum compaction.

4.02.06 After achieving the compaction of 2nd layer, repeat the procedure as mentioned above layer wise till the stone columns are installed up to the existing ground level.

4.02.07 While installing a large group of stone columns, the sequence of installation shall be from the centre to the periphery or one side to the other for avoiding possibility of damaging the neighbouring stone columns and heaving of soil.

4.02.08 Centre to centre spacing of stone columns shall be as per the relevant drawing.

4.03.00 Control of position and alignment

4.03.01 Stone columns shall be installed as accurately vertical as possible.



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4.04.00 Adjacent Structures

4.04.01 When working near existing structures care shall be taken to avoid any damage to such structures.

4.05.00 Reference of Stone column Installation

4.05.01 Each stone column shall be identified with a reference number.

4.06.00 Rejection and Replacement of Defective Stone columns

4.06.01 The Engineer reserves the right to reject any stone column which in his opinion is defective on account of position, alignment, quality of workmanship and materials etc. Stone columns that are defective shall be left in place as judged convenient by the Engineer without affecting the performance of adjacent stone columns. The Bidder shall install additional stone columns to substitute the defective stone column as per the directions of the Engineer at no extra cost to BHEL.

4.07.00 Recording of Stone column Data

4.07.01 The Bidder shall record all the information during installation of stone columns. Typical data sheet for recording pile data shall be as shown in Annexure-D of IS: 15284, Part I. On completion of each stone column installation, stone column record in triplicate shall be submitted to Engineer within two days of completion of installation of the stone column.

5.00.00 TESTING AND QUALITY ASSURANCE

5.01.00 Facilities required for testing of stone columns in field should be provided by the Bidder. The Bidder shall carry out all testing in accordance with the relevant Indian Standards and as per this Specification. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice and as per the directions of the Engineer. Tests shall be done in the presence of the Engineer or his authorized representative. In case the Engineer requires additional tests, the Bidder shall arrange to get these tests done and submit to the Engineer the test results in triplicate within three days after completion of any test.

5.02.00 The Bidder shall maintain records of all inspection and testing which shall be made available to the Engineer.

5.03.00 Materials found unsuitable for acceptance shall be removed and replaced by the Bidder. The work done by this unsuitable material shall be redone as per specification requirements & and to the satisfaction of the Engineer at no extra cost to the Owner.



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5.04.00**Quality Assurance Programme**

- a) The Bidder shall submit and finalize a detailed Field Quality Assurance Programme within 30 days from the date of award of the contract, 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 field quality plan, etc. On finalized field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the Engineer. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the qualified persons as frequently as possible to give accurate testing results.
- b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in Table - 1. The testing shall be done at field, laboratory or any other laboratory approved by the Engineer. However, the testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturers premises or at independent government approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to some of the specifications.

5.05.00**Testing of Materials**

5.05.01

Sand and other materials shall be tested for quality, strength and other properties.

5.05.02

Plate load test and Dynamic penetration test on virgin and improved ground shall be conducted as per required depth and location as shown in the relevant drawings.

5.05.03

The acceptance criteria shall be as mentioned in Table-1.

5.06.00**Testing for position and alignment**

5.06.01

Each stone columns shall be checked for its position and alignment as per relevant drawings.

6.00.00**FIELD TESTS**

The following tests shall be carried out as per relevant Indian Standards or as directed by Engineer.

6.01.00**DYNAMIC CONE PENETRATION TEST****6.01.01**

The specification for the equipment and accessories required for performing the test, test procedure, field observations and reporting of results shall



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conform to IS:4968, Part-I.

6.02.00 PLATE LOAD TEST

6.02.01 The specification for equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results etc shall conform to IS: 1888. The location and depth of the test shall be as given in the drawing or as indicated by the engineer-in-charge.



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ANNEXURE-A

(Bore logs are attached separately)



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TABLE -1
FREQUENCY OF SAMPLING AND TESTING

Sl. No	Type of material work	Nature of Test/ characteristics	Method of Test & frequency	No. of test	Acceptance Criteria
1.	Stone Column a) diameter b) length		Physical measurement	Each stone column	As per specification
2.	Position and Alignment	-	Physical or any Approved method	Each stone column	As per specification
3.	Stone aggregate and sand		As per IS:383		

SWAYIN & ASSOCIATES

77, SATYANAGAR, BHUBANESWAR
Web Site : www.swayinassociates.com

BORELOG DATA SHEET

NAME OF PROJECT :- 2X500 MW THERMAL POWER PROJECT AT ANAPARA-DKUP
NAME OF CLIENT :- BHARAT HEAVY ELECTRICALS LIMITED

TYPE OF BORING - ROTARY CALYX DRILL

JOB NO. :- 2008 - 09

BORE HOLE NO. :- 08
SHEET NO. :- 01

DIA OF HOLE - 150MM

DEPTH - 30.00M

COORDINATES OR
SEXTANGLES :- 18A+00/45B+63

COMMENCED ON - 09/04/08

COMPLETED ON - 11/04/08

GROUND/BED R.L. :- 272.900

DEPTH OF GROUND WATER TABLE = 6.60M

LOCATION

MAIN PLANT AREA

DESCRIPTION OF STRATA	NATURE OF STRATA	IS CLASSIFIED CATON	CHANGE OF STRATA IN MTRS.	DEPTH IN MTRS.	SYMBOL	SAMPLE DEPTH IN MTRS.	OF VALUES						'N' VALUES	SAMPLE		CORE RECOVERY %	ROD #
							20	40	60	80	100	120		140	TYPE			REF. NO.
FILLED UP POND ASH	LOOSE	SM		0.00		0.50								DS	01		
				1.00								SPT	01				
				2.00								UDS	01				
				3.00								SPT	02				
				4.00													
				5.00								UDS	02				
				6.00								SPT	03				
CLAYEY SAND	MEDIUM	SC		7.50		8.00								DS	02		
				8.00								UDS	03				
				9.00								SPT	04				
				10.00								DS	03				
CLAYEY SAND WITH GRAVEL	MEDIUM DENSE	SC		10.30		11.00								UDS	04		
				11.00								SPT	05				
				12.00								DS	04				
				13.00								UDS	05				
				14.00								SPT	06				
15.00							DS	05									

LEGEND:- UDS- UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT- STANDARD PENETRATION TEST
 W- WATER SAMPLE, WL- WATER LEVEL, P- PENETROMETRE TEST, V- VANE SHEAR TEST, C- CORE RECOVERY

No. of disturbed sample :- 12
 No. of Large diameter sample :- NIL

No. of Undisturbed sample :- 07
 No. of CORE :- NIL
 No. of S.P.T. :- 11

No. of Vane Shear Test :- NIL
 No. of Water Sample :- 01

K:\MC09\Bhel\BORELOG.FINAL

SWAYAN & ASSOCIATES

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Web Site : www.swayinassociates.com

BORELOG DATA SHEET

NAME OF PROJECT :- 2X500 MW THERMAL POWER PROJECT AT ANAPARA-DUP
NAME OF CLIENT :- BHARAT HEAVY ELECTRICALS LIMITED

TYPE OF BORING- ROTARY CALYX DRILL

JOB NO. :- 2008 - 09

BORE HOLE NO.-08
SHEET NO-02

DIA OF HOLE - 150MM

DEPTH - 30.00M

COORDINATES OR
SEXT. ANGLES :-

18A+00/45B+63

COMMENCED ON - 09/04/08

COMPLETED ON - 11/04/08

GROUND/BED R.L. :- 272.900

DEPTH OF GROUND WATER TABLE = 6.60M

LOCATION

MAIN PLANT AREA

DESCRIPTION OF STRATA	NATURE OF STRATA	IS CLASSIF- CATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES							'N' VALUES	SAMPLE					
							20	40	60	80	100	120	140		TYPE	REF. NO.	CORE RECOVERY %	ROD %		
CLAYEY SAND WITH GRAVEL	M. DENSE	SC		15.00	[Symbol]	15.00								25	DS	05				
				16.00	[Symbol]	16.00										UDS	06			
				17.00	[Symbol]	17.00											SPT	07		
				18.00	[Symbol]	18.00											DS	06		
				19.00	[Symbol]	19.00											UDS	07		
COARSE SAND WITH BOULDER	V. DENSE	SW		19.80	[Symbol]	20.00								62	SPT	08				
				21.00	[Symbol]	21.00										DS	07			
				22.00	[Symbol]	22.00											DS	08		
				23.00	[Symbol]	23.00										79	SPT	09		
				24.00	[Symbol]	24.00											DS	09		
SOFT SAND STONE	VERY DENSE	SEDIMENTARY		25.20	[Symbol]	25.00									DS	10				
				26.00	[Symbol]	26.00									>100	SPT	10			
				27.00	[Symbol]	27.00											DS	11		
				28.00	[Symbol]	28.00											DS	12		
HARD ROCK	VERY DENSE	METAMORPHIC		29.10	[Symbol]	29.00									>100	SPT	11			
				30.00	[Symbol]	30.00											CS	01	81	69

LEGEND:- UDS-UNDISTURBED SAMPLE,

DS- DISTURBED SAMPLE,

STANDARD PENETRATION TEST

WATER SAMPLE,

-WATER LEVEL

P- PENETROMETRE TEST,

V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample :- 12

No. of Undisturbed sample :-07

No. of Vane Shear Test :- NIL

No. of Large diameter sample :- NIL

No. of CORE :- 01

No. of Water Sample :-01

No. of S.P.T. :- 11

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SWAYIN & ASSOCIATES

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Web Site : www.swayinasociates.com

BORELOG DATA SHEET

NAME OF PROJECT :- 2X500 MW THERMAL POWER PROJECT AT ANAPARA-DKUP
NAME OF CLIENT :- BHARAT HEAVY ELECTRICALS LIMITED

TYPE OF BORING- ROTARY CALYX DRILL

JOB NO. :- 2008 - 09

BORE HOLE NO.-19
SHEET NO.-01

DIA OF HOLE - 150MM

DEPTH - 30.00M

COORDINATES OR
SEXTANGLES :-

19A+19/46B+50

COMMENCED ON - 30/03/08

COMPLETED ON :- 01/04/08

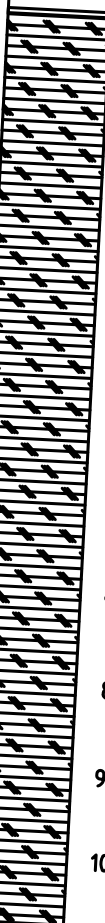
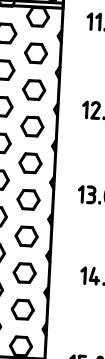
GROUND/BED R.L. :-

270.758

DEPTH OF GROUND WATER TABLE = NIL

LOCATION

MAIN PLANT AREA

DESCRIPTION OF STRATA	NATURE OF STRATA	IS CLASSIFIED- CATOIN	CHANGE OF STRATA IN MTRS.	DEPTH IN MTRS.	SYMBOL	SAMPLE DEPTH IN MTRS.	OF 'N' VALUES							'N' VALUES	SAMPLE			ROD %		
							20	40	60	80	100	120	140		TYPE	REF. NO.	CORE RECOVERY %			
FILLED UP POND ASH	LOOSE	SM	0.00	0.00		0.50									DS	01				
				1.00										05	SPT	01				
				2.00											UDS	01				
				3.00											04	SPT	02			
				4.00											UDS	02				
				5.00											06	SPT	03			
				6.00												DS	02			
				7.00												UDS	03			
				8.00												09	SPT	04		
				9.00												DS	03			
CLAYEY SAND	M. DENSE	SC	10.08	10.00		10.00									UDS	04				
				11.00										17	SPT	05				
				12.00											DS	04				
				13.00											UDS	05				
				14.00											21	SPT	06			
				15.00											DS	05				

LEGEND:- UDS-UNDISTURBED SAMPLE,

DS- DISTURBED SAMPLE,

SPT-STANDARD PENETRATION TEST

W- WATER SAMPLE,

WL-WATER LEVEL

P- PENETROMETRE TEST,

V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample :- 12

No. of Undisturbed sample :- 08

No. of Vane Shear Test :- NIL

No. of Large diameter sample :- NIL

No. of CORE :- NIL
No. of S.P.T. :- 11

No. of Water Sample :-NIL

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BORELOG DATA SHEET

NAME OF PROJECT :- 2X500 MW THERMAL POWER PROJECT AT ANAPARA-DKUP
NAME OF CLIENT :- BHARAT HEAVY ELECTRICALS LIMITED

TYPE OF BORING- ROTARY CALYX DRILL

DIA OF HOLE - 150MM

DEPTH - 30.00M

COMMENCED ON - 30/03/08

COMPLETED ON - 01/04/08

JOB NO. :- 2008 - 09

BORE HOLE NO.-19
SHEET NO-02

COORDINATES OR SECT. ANGLES :- 19A+19/46B+50

GROUND/BED R.L. :- 270.758

LOCATION

MAIN PLANT AREA

DEPTH OF GROUND WATER TABLE = NIL

DESCRIPTION OF STRATA	NATURE OF STRATA	IS CLASSIFIED CATON	CHANGE OF STRATA IN MTRS.	DEPTH IN MTRS.	SYMBOL	SAMPLE DEPTH IN MTRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES							'N' VALUES	SAMPLE		CORE RECOVERY %	ROD #			
							20	40	60	80	100	120	140		TYPE	REF. NO.					
CLAYEY SAND	M. DENSE	SC	15.00	15.00		15.00									40	DS	05				
				16.00		16.00										40	UDS	06			
SILTY SAND	DENSE	SM	16.30	17.00		17.00									40	SPT	07				
				18.00		18.00										40	DS	06			
				19.00		19.00											40	UDS	07		
				20.00		20.00											45	SPT	08		
COARSE SAND WITH GRAVELS	V. DENSE	SW	21.40	21.00		21.00									76	DS	07				
				22.00		22.00										76	UDS	08			
				23.00		23.00											76	SPT	09		
				24.00		24.00											76	DS	08		
				25.00		25.00											76	DS	09		
SOFT SAND STONE	VERY DENSE	SEDIMENTARY	25.10	26.00		26.00									>100	SPT	10				
				27.00		27.00										>100	DS	10			
				28.00		28.00											>100	DS	11		
				29.00		29.00											>100	SPT	11		
				30.00		30.00											>100	DS	12		

LEGEND:- UDS-UNDISTURBED SAMPLE,

DS- DISTURBED SAMPLE,

STANDARD PENETRATION TEST

WATER SAMPLE,

-WATER LEVEL

P- PENETROMETRE TEST,

V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample :- 12

No. of Undisturbed sample :-08

No. of Vane Shear Test :- NIL

No. of Large diameter sample :- NIL

No. of CORE :- NIL
No. of S.P.T. :- 11

No. of Water Sample :-NIL

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BORELOG DATA SHEET

NAME OF PROJECT :- 2X500 MW THERMAL POWER PROJECT AT ANAPARA-DKUP
NAME OF CLIENT :- BHARAT HEAVY ELECTRICALS LIMITED

TYPE OF BORING- ROTARY CALYX DRILL

JOB NO. :- 2008 - 09

BORE HOLE NO.-43
SHEET NO-01

DIA OF HOLE - 150MM

COORDINATES OR SECT. ANGLES:- 20A+24/44B+38

DEPTH - 25.00M

GROUND/BED R.L. :- 272.784

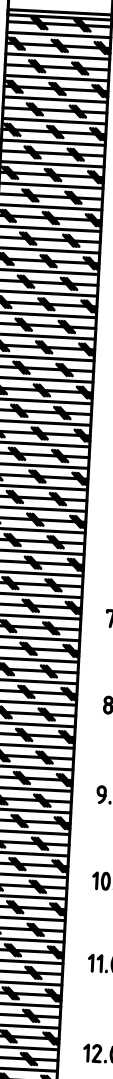
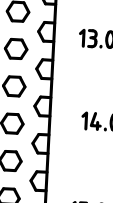
COMMENCED ON - 09/05/08

COMPLETED ON :- 10/05/08

LOCATION

MAIN PLANT AREA

DEPTH OF GROUND WATER TABLE = 11.20M

DESCRIPTION OF STRATA	NATURE OF STRATA	IS CLASSIFICATION OF STRATA IN MTRS.	DEPTH IN MTRS.	SYMBOL	SAMPLE DEPTH IN MTRS.	OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	ROD #	
						20	40	60	80	100		120	140			TYPE	REF. NO.
FILLED UP POND ASH	LOOSE TO MEDIUM DENSE	SM	0.00		0.50								DS	01		
			1.00								SPT	01				
			2.00								UDS	01				
			3.00								SPT	02				
			4.00								UDS	02				
			5.00								SPT	03				
			6.00								DS	02				
			7.00								UDS	03				
			8.00								SPT	04				
			9.00								DS	03				
			10.00								UDS	04				
			11.00								SPT	05				
CLAYEY SAND	MEDIUM DENSE	SC	12.00		12.40								DS	04		
			13.00								UDS	05				
			14.00								SPT	06				
			15.00								DS	05				
			15.00													

LEGEND:- UDS-UNDISTURBED SAMPLE,

DS- DISTURBED SAMPLE,

SPT-STANDARD PENETRATION TEST

W- WATER SAMPLE,

— WATER LEVEL

P- PENETROMETRE TEST,

V- VANE SHEAR TEST,

C-CORE RECOVERY

No. of disturbed sample :- 11

No. of Undisturbed sample :- 06

No. of Vane Shear Test :- NIL

No. of Large diameter sample :- NIL

No. of CORE :- NIL

No. of Water Sample :- 01

No. of S.P.T. :- 09

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BORELOG DATA SHEET

NAME OF PROJECT :- 2X500 MW THERMAL POWER PROJECT AT ANAPARA-DKUP
NAME OF CLIENT :- BHARAT HEAVY ELECTRICALS LIMITED

TYPE OF BORING- ROTARY CALYX DRILL

JOB NO. :- 2008 - 09

BORE HOLE NO.-43
SHEET NO-02

DIA OF HOLE - 150MM

DEPTH - 25.00M

COORDINATES OR SECT. ANGLES :- 20A+24/44B+3B

GROUND/BED R.L. :- 272.784

COMMENCED ON - 09/05/08

COMPLETED ON :- 10/05/08

LOCATION MAIN PLANT AREA

DEPTH OF GROUND WATER TABLE = 11.20M

DESCRIPTION OF STRATA	NATURE OF STRATA	IS CLASSIFIED CATON	CHANGE IN STRATA	DEPTH IN MTRS.	SYMBOL	SAMPLE DEPTH IN MTRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES							'N' VALUES	SAMPLE			ROD #	
							20	40	60	80	100	120	140		TYPE	REF. NO.	CORE RECOVERY %		
CLAYEY SAND	M. DENSE	SC		15.00		15.00	Graphical representation of 'N' values (0-140)								DS	05			
				15.70		16.00										28	UDS	06	
CLAYEY SAND				17.00		17.00											SPT	07	
				18.00		18.00											DS	06	
				18.60		19.00											DS	07	
				20.00		20.00											DS	07	
COARSE SAND WITH BOULDER	V. DENSE	SW		21.00		21.00	Graphical representation of 'N' values (0-140)								DS	08			
				22.00		22.00											DS	09	
				23.00		23.00											DS	09	
				24.00		24.00											DS	10	
				25.00		25.00											DS	11	
				26.00															
				27.00															
				28.00															
				29.00															
				30.00															

LEGEND:- UDS-UNDISTURBED SAMPLE,

WATER SAMPLE,

DS- DISTURBED SAMPLE,

-WATER LEVEL

P- PENETROMETRE TEST,

STANDARD PENETRATION TEST

V- VANE SHEAR TEST,

C- CORE RECOVERY

No. of disturbed sample :- 11

No. of Undisturbed sample :- 06

No. of Vane Shear Test :- NIL

No. of Large diameter sample :- NIL

No. of CORE :- NIL

No. of Water Sample :- 01

No. of S.P.T. :- 09

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BORELOG DATA SHEET

NAME OF PROJECT :- 2X500 MW THERMAL POWER PROJECT AT ANAPARA-D(KUP)
NAME OF CLIENT :- BHARAT HEAVY ELECTRICALS LIMITED

TYPE OF BORING- ROTARY CALYX DRILL

JOB NO. :- 2008 - 09

BORE HOLE NO.-44
SHEET NO-01

DIA OF HOLE - 150MM

DEPTH - 25.00M

COORDINATES OR
SEXT. ANGLES :- 20A+99/45B+16

COMMENCED ON - 05/05/08

COMPLETED ON - 06/05/08

GROUND/BED RL :- 272.800

DEPTH OF GROUND WATER TABLE = 12.80M

LOCATION
MAIN PLANT AREA

DESCRIPTION OF STRATA	NATURE OF STRATA	IS CLASSIFI- CATION	CHANGE OF STRATA IN MTRS.	DEPTH IN MTRS.	SYMBOL	SAMPLE DEPTH IN MTRS.	OF 'N' VALUES							'N' VALUES	SAMPLE			CORE RECOVERY %	ROD #	
							20	40	60	80	100	120	140		TYPE	REF. NO.				
FILLED UP POND ASH	LOOSE TO MEDIUM DENSE SM			0.00	0.00															
				0.50																
				1.00												03	DS	01		
				2.00													SPT	01		
				3.00													UDS	01		
				4.00												06	SPT	02		
				5.00													UDS	02		
				6.00												08	SPT	03		
				7.00													DS	02		
				8.00													UDS	03		
				9.00												10	SPT	04		
				10.00													DS	03		
11.00													UDS	04						
12.00												11	SPT	05						
13.00													DS	04						
14.00													UDS	05						
15.00												12	SPT	06						
CLAYEY SAND	MEDIUM DENSE SC		14.40 15.00	14.00 15.00										DS	05					

LEGEND:- UDS-UNDISTURBED SAMPLE,

DS- DISTURBED SAMPLE,

SPT-STANDARD PENETRATION TEST

W- WATER SAMPLE,

WL-WATER LEVEL

P- PENETROMETRE TEST,

V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample :- 09

No. of Undisturbed sample :- 08

No. of Vane Shear Test :- NIL

No. of Large diameter sample :- NIL

No. of CORE :- 04
No. of S.P.T. :- 09

No. of Water Sample :- NIL

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SWAYIN & ASSOCIATES

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Web Site : www.swayinasociates.com

BORELOG DATA SHEET

NAME OF PROJECT :- 2X500 MW THERMAL POWER PROJECT AT ANAPARA-D(KUP)
NAME OF CLIENT :- BHARAT HEAVY ELECTRICALS LIMITED

TYPE OF BORING - ROTARY CALYX DRILL

JOB NO. :- 2008 - 09

BORE HOLE NO. :- 44
SHEET NO. :- 02

DIA OF HOLE - 150MM

DEPTH - 25.00M

COORDINATES OR
SEXTANGLES :- 20A+99/45B+16

COMMENCED ON - 05/05/08

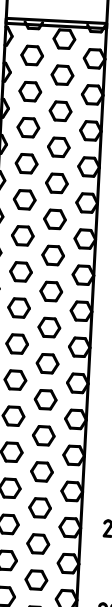
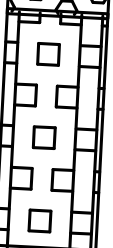
COMPLETED ON :- 06/05/08

GROUND/BED R.L. :- 272.800

DEPTH OF GROUND WATER TABLE = 12.80M

LOCATION

MAIN PLANT AREA

DESCRIPTION OF STRATA	NATURE OF STRATA	IS CLASSIFIED OR CHANGE STRATA IN	DEPTH IN MTRS.	SYMBOL	SAMPLE DEPTH IN MTRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES						'N' VALUES	SAMPLE			ROD #		
						20	40	60	80	100	120		140	TYPE	REF. NO.		CORE RECOVERY %	
CLAYEY SAND	M. DENSE	SC	15.00		15.00								20	DS	05			
			16.00		16.00									UDS	06			
			17.00		17.00										SPT	07		
			18.00		18.00										DS	06		
			19.00		19.00										UDS	07		
			20.00		20.00									33	SPT	08		
			21.00		21.00										DS	07		
			22.00		22.00										UDS	08		
			23.00		23.00									63	SPT	09		
			24.00		24.00										DS	08		
COARSE SAND WITH BOULDER	V. DENSE	SW	22.20		22.00									UDS	08			
			23.00		23.00									SPT	09			
			24.00		24.00										DS	08		
			25.00		25.00										DS	09		
			26.00															
			27.00															
28.00																		
29.00																		
30.00																		

LEGEND:- UDS- UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, STANDARD PENETRATION TEST
 WATER SAMPLE, -WATER LEVEL P- PENETROMETRE TEST, V- VANE SHEAR TEST, C-CORE RECOVERY
 No. of disturbed sample :- 09 No. of Undisturbed sample :- 08 No. of Vane Shear Test :- NIL
 No. of Large diameter sample :- NIL No. of CORE :- 04 No. of Water Sample :- NIL
 No. of S.P.T. :- 09

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TITLE: <Project Name>

QUALITY ASSURANCE TESTS AND
INSPECTION

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - IIB

SECTION "C"

REV. 0

DATE 11/4/2006

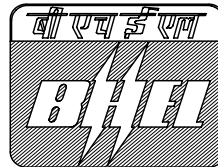
SHEET 1 of 1

VOLUME: II B

SECTION - C

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C019



Bharat Heavy Electricals Limited

Project Engineering Management

Power Sector, BHEL House

Asian Games Village Complex

Siri Fort, New Delhi-110049



TITLE: <Project Name>

**QUALITY ASSURANCE TESTS AND
INSPECTION**

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - IIB

SECTION "C"

REV. 0 DATE 11/4/2006

SHEET 2 of 2

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
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TITLE: <Project Name>

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - IIB

SECTION "C"

REV. 0

DATE 11/4/2006

SHEET 3 of 3

CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test		* For Test at S.No. 1, 2, 6 & 7 frequency of test shall be one in every 2000 M ³ for each type & source of fill material. # Frequency of test for Sr. No. 3, 4 & 5 shall be one in every 5000 M ³ for each type & source of fill material. @ For foundation filling, one for every 10 foundations for each compacted layer. However for heavily loaded foundations, each layer shall be tested. For area filling, one for every 1000 M ² area for each compacted Layer. Note: The contractor shall include provision for setting up testing laboratory with all apparatus and equipments necessary for carrying out field tests.
All tests as per Indian/International STDS	11	Y Y
Dry Density by Proctor Needle Penetration @	10	- Y
Relative Density Index @	9	- Y
Dry Density by core cutter/sand display cut @	8	- Y
Moisture Content *	7	Y -
STD Proctor Test *	6	Y -
Chemical Analysis #	5	Y -
Free Swell Index #	4	Y -
Shrinkage Limit #	3	Y -
Liquid Limit & Plastic Limit *	2	Y -
Grain Size Analysis *	1	Y -
Test Requirements Item/Components		1. EARTH WORK a) Earth Fill Material (Before Compaction) b) Earth Fill Material (After Compaction)



TITLE: <Project Name>

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - IIB

SECTION "C"

REV. 0

DATE 11/4/2006

SHEET 4 of 4

CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test		* Quantum of check for test at Sr. No 1 & 2 shall be one per 100 m ³ or part thereof or change of source whichever is earlier.	# To be done every day before start of work.	Note:	For test at Sr. No. 3, 4, 5, 6, 7, 8, 9, 11 & 12 once per source. For remaining as per IS Code.
All tests as per IS-Codes	21	Y	Y	Y	Y
Rebound Hammer Test	20	-	-	-	Y
Cement Content	19	-	-	-	Y
W.C. Ratio	18	-	-	-	Y
Slump and Compaction Factor	17	-	-	-	Y
Harmful substance	16	-	-	-	Y
pH Value	15	-	-	-	Y
Crushing Strength	14	-	-	Y	Y
Setting Time	13	-	-	Y	-
Petrographic Exam.	12	Y	Y	-	-
Silt, Clay and organic impurities	11	-	Y	-	-
Bulkage	10	-	Y #	-	-
Mortar Making Properties	9	-	Y	-	-
Deleterious Matl. And MICA content	8	Y	Y	-	-
Flakiness Index	7	Y	-	-	-
Reaction with Alkali	6	Y	Y	-	-
Soundness	5	Y	Y	-	-
Mech. Properties	4	Y	-	-	-
Specific Gravity, Density, Void, Absorption	3	Y	Y	-	-
Moisture Content	2	Y *	Y #	-	-
Particle Size and Shape Sieve analysis	1	Y *	Y *	-	-
Test Requirement Checks	Item/Components				
	2. CONCRETING				
	a) Coarse Aggregate				
	b) Fine Aggregate/ Sand				
	c) Cement				
	d) Water				
	e) Concrete				



TITLE: <Project Name>

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - IIB

SECTION "C"

REV. 0

DATE 11/4/2006

SHEET 5 of 5

CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test	* These tests shall be carried out, in case of doubt regarding grade of concrete due to poor workmanship based on results of cube strength.													
Load test on structures as per IS: 456 & core test	-	-	-	-	-	-	-	-	-	-	-	Y*	-	-
Water tightness test as per IS: 3370 & Is: 6494	-	-	-	-	Y	-	-	Y	-	-	-	-	-	-
All Tests as per Indian/International Standard/ BHEL Tech. Spec.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	-	Y
Core Test	-	-	-	-	-	-	-	-	-	-	Y	-	Y	-
Ultrasonic Test	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Verticality all	-	-	-	-	-	Y	-	-	-	-	-	-	Y	-
Work man ship	-	-	-	-	-	Y	-	-	-	-	-	-	-	-
Water Retentivity as per IS: 2250	-	-	-	-	Y	-	-	-	-	-	-	-	Y	-
Consistency as per IS: 2250	-	-	-	-	Y	-	-	-	-	-	-	-	-	-
Warpage	-	-	-	Y	-	-	-	-	-	-	-	-	-	-
Effloresces	-	-	-	Y	-	-	-	-	-	-	-	-	-	-
Water Absorption	-	-	-	Y	-	-	-	-	-	-	-	-	-	-
Compressive Strength	-	-	-	Y	Y	-	-	-	-	-	-	-	-	-
Plumb	-	Y	-	-	-	Y	-	-	-	-	-	-	-	-
Cutting tolerances	-	-	Y	-	-	-	-	-	-	-	-	-	-	-
Placement	-	-	Y	-	-	-	-	-	-	-	-	-	-	-
Dimensions	-	Y	Y	Y	-	-	-	-	-	-	-	Y	-	Y
Physical & Chemical Properties	-	-	Y	-	-	-	-	-	-	-	-	-	-	-
Cleanliness	-	Y	-	-	-	-	Y	-	-	-	-	-	-	-
Visual Exam.	Y	Y	Y	Y	-	Y	-	-	-	-	-	Y	-	Y
Joint Adequacy	Y	-	-	-	-	-	-	-	-	-	-	-	-	-
Durability, strength an soundness	Y	-	-	-	-	-	-	-	-	-	-	-	-	-
Test Requirement Checks	Item/Components													
	3. Form Work	a) Staging	b) Shuttering	4. Reinforcement	5. Bricks	6. Mortar	7. Masonary	8. Water Supply & sanitary items	9. Water retaining structures (Tank/reservoir etc.)	10. Roof water proofing	11. RCC structures	12. Doors Windows	13. Pre-cast concrete members	14. All bought out items Approval by BHEL



TITLE: <Project Name>

QUALITY ASSURANCE TESTS AND INSPECTION

SPECIFICATION NO. PE-TS-999-600-C001

VOLUME - IIB

SECTION "C"

REV. 0

DATE 11/4/2006

SHEET 6 of 6

CIVIL & STRUCTURAL WORKS

Remarks/Frequency of Test	<p>1. Quantum of check for R.T. on butt welds under tension zone shall be 100% and for remaining butt welds unless specified shall be 10%. Acceptances norms for NDTs shall be as per AWS D1.1</p> <p>2. RT on all butt welds for bunker supporting girders (Longitudinal/Transverse) shall be 100 %.</p> <p>3. RT on all butt welds for deaerator supporting girders shall be 100 %.</p> <p>4. All site fillet welds of bunker supporting structure shall be 100 % NDT.</p> <p>5. All above quality control and super vision shall be carried out by an independent inspection body.</p> <p>* 100% on "T" joints and 10% on longitudinal and circumferential butt welds.</p>
Hydraulic test	Y
All tests as per Indian/International Codes/Standards	Y
Dimensional	Y
Mechanical Test of Butt Weld Coupons	Y
Macrotech Exam. of Fillet Welds Coupons	Y
Fit up/Assy	Y
Visual Exam.	Y
Radiographic Test (RT) on Welds	Y*
Liquid Penetration Test (LPT) on Welds	Y
WPS/PQR/WQR	Y
Ultrasonic Test (UT) on Material Above 40 mm Thickness	Y
Material T.Cs	Y
Test Requirements	<p>15. Structural Steel Like Columns, Girders, Beams & Truss Etc.</p> <p>16. C.W. Pipes/Ducts</p>
Item/Components	



TITLE: <Project Name>

QUALITY ASSURANCE TESTS AND INSPECTION

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SHEET 7 of 7

CIVIL & STRUCTURAL WORKS

Warpage	16	Y	Y
Comp. Strength, bond strength working, time, chemical resistant	15	Y	Y
Compressive strength, Water absorption resistant to Acid, resistant to flexural strength, INEAD	14	.	.	.	.	.	Y	.
Positioning and location of laps and plumb level	13	.	.	.	.	Y	.	.
Storage	12	.	.	.	.	Y	.	.
Tests as per BHEL tech spec. and IS: 8183	11	.	.	.	Y	.	.	.
Check type of permanent colour coating	10	Y	Y	Y	.	.	.	.
Galvanizing test as per IS code	9	Y	.	Y	.	.	.	.
Check for coating of silicon modified polyester paint thickness	8	.	Y	Y	.	.	.	.
Dimensional conformity	7	.	Y	Y	Y	.	Y	.
T.Cs for fasteners & 'Z' spacers	6	Y	.	.	.	.	.	.
Appearance	5	Y	.	.	.	Y	.	.
Sides end laps	4	Y	.	.	.	Y	.	.
Fixing of decking sheets	3	Y	.	.	.	.	.	.
Dimensional, thickness, depth of valley etc.	2	Y	.	.	.	.	.	.
T.Cs for Physical & Chemical properties	1	Y	Y	.	.	.	.	.
Test Requirements		17. Roof Decking sheets (Supply and fixing) 18. Wall Cladding work a) Outer sheet b) Inner sheet c) Insulation d) Fixing of wall cladding 19. Acid Resistant Lining a) Acid resistant Bricks/Tiles b) Acid resistant Mortar						
Item/Components								

ANNEXURE-IV

CERTIFICATE OF DECLARATION FOR CONFIRMING THE KNOWLEDGE OF SITE CONDITIONS

**We,.....
..... Hereby declare and confirm that we have visited the project site under the subject namely,and acquired full knowledge and information about the site conditions, wage structure, Industrial climate and total work involved. We further confirm that the above information is true and correct and we will not raise any claim of any nature due to lack of knowledge of site condition.**

and Address. Tenderer's Name

Place: (Signature of the Tenderer's
With stamp)

Date:

ANNEXURE-V

NON DISCLOSURE AGREEMENT

Memorandum of Understanding

BHEL PSNR is committed to Information Security Management System as per Information Security Policy.

M/s.....

providing.....service to BHEL PSNR, Noida hereby undertake to comply with the following in line with Information Security Policy of BHEL PSNR;

- To maintain confidentiality of documents & information which shall be used during the execution of the Contract.**
- The documents & information shall not be revealed to or shared with third party which shall not be in the business interest of BHEL PSNR.**

()

M/s. BHEL, PSNR

()

M/s.....

ANNEXURE-VI

FORMAT FOR E-PAYMENT DETAILS : - BHEL-PSNR-NOIDA

(To be given in Company letterhead)

Beneficiary Name :

Bank Name & Branch :

M ICR Code (9 Digit) :

**IFSC CODE
(VALID FOR NEFT) :**

Beneficiary Account No. :

**Beneficiary E-mail ID
(for payment confirmation) :**

ANNEXURE-VII**GENERAL TERMS AND CONDITIONS OF REVERSE AUCTION (RA)**

Against this enquiry for the subject item/ system with detailed scope of supply as per our tender specification, BHEL-PSNR, NOIDA may resort to “REVERSE AUCTION PROCEDURE” i.e. **ONLINE BIDDING on INTERNET.**

1. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.
2. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on Internet.
3. In case BHEL decides to conduct reverse auction, BHEL’s service provider shall contact the vendor directly and impart them the training.
4. Business rules like event date, time, start price, bid decrement, extensions, etc. also will be communicated through service provider for compliance.
5. Vendors have to fax the compliance form in the prescribed (provided by service provider) before start of Reverse auction. Without this the vendor will not be eligible to participate in the event.
6. BHEL will provide the calculation sheet (e.g.: EXCEL sheet) which will help to arrive at “Total Cost to BHEL” like packing & forwarding charges, Taxes and duties, Freight charges, Insurance, Service tax for services and loading factors (for non-compliance to BHEL standard Commercial terms and conditions.) for each the vendor to enable them to fill-in the price and keep it ready for keying in during the auction.
7. Reverse auction will be conducted on schedule date & time.
8. At the end of reverse auction event, the lowest bidder value will be known on the network.
9. The lowest bidder has to fax the duly signed filled-in prescribed format as provided on case-to-case basis to BHEL through service provider within 24 hours of auction without fail.
10. Any variation between the on-line bid value and signed document will be considered as sabotaging the tender process and will invite disqualification of vender to conduct business with BHEL as per prevailing procedure.
11. In case BHEL decides not to go for Reverse auction procedure for this tender enquiry, the price bids and price impacts, if any already submitted and available with BHEL shall be opened as per BHEL standard practice.

INTEGRITY PACT

Between

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at “BHEL House”, Siri Fort, New Delhi – 110049 (India) hereinafter referred to as “The Principal”, which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

and

_____, (description of the party along with address), hereinafter referred to as “The Bidder/ Contractor” which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for

_____. The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint Independent External Monitor(s), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1 – Commitments of the Principal

- 1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:-
 - 1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
 - 1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.
 - 1.1.3 The Principal will exclude from the process all known prejudiced persons.
- 1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

Section 2 – Commitments of the Bidder(s)/ Contractor(s)

- 2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.
 - 2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he / she is not legally entitled to, in

order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

- 2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.
- 2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant IPC/ PC Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
- 2.1.4 The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.
- 2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

Section 3 – Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidders(s)/ Contractor(s) from the tender process or take action as per the separate “Guidelines for Suspension of Business Dealings with Suppliers/ Contractors” framed by the Principal.

Section 4 – Compensation for Damages

- 4.1 If the Principal has disqualified the Bidder(s) from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/ Bid Security.
- 4.2 If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equivalent to 5% of the contract value or the amount equivalent to Security Deposit/Performance Bank Guarantee, whichever is higher.

Section 5 – Previous Transgression

- 5.1 The Bidder declares that no previous transgressions occurred in the last 3 years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.
- 5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section 6 – Equal treatment of all Bidders/ Contractors/ Sub-contractors

- 6.1 The Bidder(s)/ Contractor(s) undertake(s) to demand from his sub-contractors a commitment consistent with this Integrity Pact. This commitment shall be taken only from those sub-contractors whose contract value is more than 20% of Bidder's/ Contractor's contract value with the Principal.
- 6.2 The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors.
- 6.3 The Principal will disqualify from the tender process all bidders who do not sign this pact or violate its provisions.

Section 7 – Criminal Charges against violating Bidders/ Contractors /Sub-contractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 –Independent External Monitor(s)

- 8.1 The Principal appoints competent and credible Independent External Monitor for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.
- 8.2 The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.
- 8.3 The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all contract documentation of the Principal including that provided by the Bidder(s)/ Contractor(s). The Bidder(s)/ Contractor(s) will grant the monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his contract documentation. The same is applicable to Sub-contractor(s). The Monitor is under contractual obligation to treat the information and documents of the Bidder(s)/ Contractor(s) / Sub-contractor(s) with confidentiality.
- 8.4 The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.
- 8.5 As soon as the Monitor notices, or believes to notice, a violation of this agreement, he will so inform the Management of the Principal and request the Management to discontinue or

take corrective action, or heal the situation, or to take other relevant action. The Monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.

- 8.6 The Monitor will submit a written report to the CMD, BHEL within 8 to 10 weeks from the date of reference or intimation to him by the Principal and, should the occasion arise, submit proposals for correcting problematic situations.
- 8.7 The CMD, BHEL shall decide the compensation to be paid to the Monitor and its terms and conditions.
- 8.8 If the Monitor has reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant IPC / PC Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the Monitor may also transmit this information directly to the Central Vigilance Commissioner, Government of India.
- 8.9 The number of Independent External Monitor(s) shall be decided by the CMD, BHEL.
- 8.10 The word 'Monitor' would include both singular and plural.

Section 9 – Pact Duration

- 9.1 This Pact begins when both parties have legally signed it. It expires for the Contractor 12 months after the last payment under the respective contract and for all other Bidders 6 months after the contract has been awarded.
- 9.2 If any claim is made / lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified as above, unless it is discharged/ determined by the CMD, BHEL.

Section 10 – Other Provisions

- 10.1 This agreement is subject to Indian Laws and jurisdiction shall be registered office of the Principal, i.e. New Delhi.
- 10.2 Changes and supplements as well as termination notices need to be made in writing. Side agreements have not been made.
- 10.3 If the Contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.
- 10.4 Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
- 10.5 Only those bidders/ contractors who have entered into this agreement with the Principal would be competent to participate in the bidding. In other words, entering into this agreement would be a preliminary qualification.

For & On behalf of the Principal
(Office Seal)

For & On behalf of the Bidder/ Contractor
(Office Seal)

Place-----

Date-----

Witness: _____

(Name & Address) _____

Witness: _____

(Name & Address) _____

FORMAT OF UNDERTAKING
(To be submitted in the bidder's letter head)

REF:

Dt.

Bharat Heavy Electricals Limited
Power Sector – Northren Region,
Plot No. 25 , Sector - 16A ,
Distt. Gautam Budh Nagar,
NOIDA – 201 301(INDIA)

Sub.: Tender for “Soil Improvement and Boundary Wall Package for 2 x 500 MW, Anpara-D Thermal Power Station at Anpara , Distt. Sonebhadra UP”

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited Anpara site before submission of our offer and noted the job content & site conditions etc.

We also confirm that we have not changed / modified the tender documents as appeared in the website and in case of observance at any stage, it shall be treated as null and void. We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in the above referred NIT and confirm our acceptance to reverse auctioning process and we hereby convey our unqualified acceptance to all terms and conditions as stipulated in the tender and NIT. In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted offer strictly in accordance with tender instructions.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized representative of the bidder)

ANNEXURE - X**BANK GUARANTEE FOR PAYMENT OF ADVANCE**

B.G. No. Date

This deed of Guarantee made this _____ day of _____ two thousand _____ by _____ (Bank) hereinafter called the "The Guarantor" (which expression shall unless repugnant to the context or meaning thereof be deemed to include its successors and assigns) in favour of M/S Bharat Heavy Electricals Limited a Company incorporated under the Companies Act, 1956, having its registered office at BHEL House, Siri Fort, New Delhi - 110049 through its unit at Power Sector-Northern Region, Noida, Distt. Gautam Budh Nagar, (U.P.) India, hereinafter called "The Company" (which expression shall unless repugnant to the context or meaning thereof be deemed to include its successors and assigns).

WHEREAS M/s. _____ (hereinafter referred to as the Contractor) have entered into a Contract arising out of Letter of Intent no. _____ dtd _____ (hereinafter referred to as "the Contract") for the --< Name of_work >-- with the Company.

AND WHEREAS the Contract inter-alia provides that the Company will pay to the Contractor interest bearing advance of Rs. _____ (Rupees _____ only) on certain terms and conditions specified in the Contract subject to the Contractor furnishing a Bank Guarantee for Rs. _____ (Rupees _____ only) in favour of the Company.

AND WHEREAS the Company has agreed to accept a Bank Guarantee from a Bank to cover the said advance.

AND WHEREAS the Contractor has approached the Guarantor and in consideration of the arrangement arrived at between the Contractor and the Guarantor, the Guarantor has agreed to give the Guarantee as hereinafter mentioned in favour of the Company.

NOW THIS DEED WITNESSES AS FOLLOWS:-

- (1) In consideration of the Company having agreed to advance a sum of Rs. _____ (Rupees _____ only) to the Contractor, the Guarantor do hereby guarantee the due recovery by the Company of the said advance with interest thereon as provided according to the terms and conditions of the Contract. If the said Contractor fails to utilise the said advance for the purpose of the Contract and /or the said advance together with interest as aforesaid is not fully recovered by the Company the Guarantor do hereby unconditionally and irrevocably undertake to pay to the Company without demur and merely on a demand, to the extent of the said sum of Rs. _____ (Rupees _____ only) any claim made by the Company on them for the loss or damage caused to or suffered by the Company by reasons of the Company not being able to recover in full the advance with interest as aforesaid.

- (2) The decision of the Company whether the Contractor has failed to utilise the said advance or any part thereof for the purpose of the Contract and / or as to the extent of loss or damage caused to or suffered by the Company by reason of the Company not being able to recover in full the said sum of Rs. _____ with interest if any shall be final and binding on the Guarantor, irrespective of the fact whether the Contractor admits or denies the default or questions the correctness of any demand made by the Company in any Court Tribunal or Arbitration proceedings or before any other Authority.
- (3) The Company shall have the fullest liberty without affecting in any way the liability of the Guarantor under this Guarantee, from time to time to vary any of the terms and conditions of the Contract or extend time of performance by the Contractor or to postpone for any time and from time to time any of the powers exercisable by it against the Contractor and either enforce or forebear from enforcing any of the terms and conditions governing the Contract or securities available to the Company and the Guarantor shall not be released from its liability under these presents by any exercise by the Company of the liberty with reference to the matters aforesaid or by reasons of time being given to the Contractor or any other forbearance, act or commission on the part of the Company or any indulgence by the Company to the Contractor or of any other matter or thing whatsoever which under the law relating to sureties would, but for this provision have the effect of so releasing the Guarantor from its liability under this guarantee.
- (4) The Guarantor further agrees that the Guarantee herein contained shall remain in full force and effect during the period till the Company discharges this Guarantee, subject to however, that the Company shall have no claim under this Guarantee after _____ i.e. (the present date of validity of Bank Guarantee unless the date of validity of this Bank Guarantee is further extended from time to time, as the case may be) unless a notice of the claim under this Guarantee has been served on the Guarantor before the expiry of the said period in which case the same shall be enforceable against the Guarantor notwithstanding the fact that the same is enforced after the expiry of the said period.
- (5) The Guarantor undertakes not to revoke this Guarantee during the period it is in force except with the previous consent of the Company in writing and agrees that any liquidation or winding up or insolvency or dissolution or any change in the constitution of the Contractor or the Guarantor shall not discharge the Guarantor's liability hereunder.
- (6) It shall not be necessary for the Company to proceed against the Contractor before proceeding against the Guarantor and the Guarantee herein contained shall be enforceable against them notwithstanding any security which the Company may have obtained or obtain from the Contractor shall at the time when proceedings are taken against the Guarantor hereunder be outstanding or unrealised.
- (7) Notwithstanding anything contained herein before, our liability under the Guarantee is restricted to Rs. _____ (Rupees _____). Our guarantee shall remain in force until _____, i.e. the present date of validity of Bank Guarantee unless the date of validity of this Bank Guarantee is further extended from time to time. Unless a claim or demand under this guarantee is made against us on or before-----, we shall be discharged from our liabilities under this Guarantee thereafter.

- (8) Any claim or dispute arising under the terms of this documents shall only be enforced or settled in the courts at New Delhi/ Delhi only.
- (9) The Guarantor hereby declares that it has power to execute this Guarantee under its Memorandum and Articles of Association and the executant has full powers to do so on its behalf under the Power of Attorney dated_____ (To be incorporated by the Bank) granted to him by the proper authorities of the Guarantor.

IN WITNESS whereof the _____(Bank) has hereunto set and subscribed its hand the day, month and year first, above written.

Signed for and on behalf of the Bank

WITNESSES

1. Name & Address
2. Name & Address

Notes:

1. The above BG shall be executed on the non-judicial stamp papers of adequate value procured in the name of the Bank in the state where the Bank is located.
- 2.The above BG is required to be sent by the executing bank directly to BHEL at the address where tender is submitted /accepted under sealed cover.