बिड संख्या/Bid Number: GEM/2025/B/6440637

दिनांक /Dated: 11-07-2025

बिड दस्तावेज़ / Bid Document

बिड विवरण/Bid Details	
बिड बंद होने की तारीख/समय /Bid End Date/Time	21-07-2025 14:00:00
बिड खुलने की तारीख/समय /Bid Opening Date/Time	21-07-2025 14:30:00
बिड पेशकश वैधता (बंद होने की तारीख से)/Bid Offer Validity (From End Date)	170 (Days)
मंत्रालय/राज्य का नाम/Ministry/State Name	Ministry Of Heavy Industries And Public Enterprises
विभाग का नाम/Department Name	Department Of Heavy Industry
संगठन का नाम/Organisation Name	Bharat Heavy Electricals Limited (bhel)
कार्यालय का नाम/Office Name	10210015-pser
कुल मात्रा/Total Quantity	3754
वस्तु श्रेणी /Item Category	Ready Mix Cement Concrete (3754 CuM) For 4X250 MW BRBCLNABINAGAR TPP FGD-BIHAR
GeMARPTS में खोजी गई स्ट्रिंग्स / Searched Strings used in GeMARPTS	Ready Mix Cement Concrete (3754 CuM) For 4X250 MW BRBCLNABINAGAR TPP FGD-BIHAR
GeMARPTS में खोजा गया परिणाम / Searched Result generated in GeMARPTS	Category not available on GeM for the text string uploaded by the buyer
अधिसूचना के लिए चयनित प्रासंगिक श्रेणियाँ / Relevant Categories selected for notification	• Batch Type Concrete Mixers as per IS 1791
एमएसएमई के लिए अनुभव के वर्षों और टर्नओवर से छूट प्रदान की गई है/MSE Exemption for Years of Experience and Turnover	No
स्टार्टअप के लिए अनुभव के वर्षों और टर्नओवर से छूट प्रदान की गई है /Startup Exemption for Years of Experience and Turnover	No
विक्रेता से मांगे गए दस्तावेज़/Document required from seller	Certificate (Requested in ATC),Additional Doc 1 (Requested in ATC),Additional Doc 2 (Requested in ATC),Additional Doc 3 (Requested in ATC),Additional Doc 4 (Requested in ATC) *In case any bidder is seeking exemption from Experience / Turnover Criteria, the supporting documents to prove his eligibility for exemption must be uploaded for evaluation by the buyer

बिड विवरण/Bid Details	
क्या आप निविदाकारों द्वारा अपलोड किए गए दस्तावेज़ों को निविदा में भाग लेने वाले सभी निविदाकारों को दिखाना चाहते हैं? संदर्भ मेनू है/Do you want to show documents uploaded by bidders to all bidders participated in bid?	No
बिड लगाने की समय-सीमा बढ़ाने के लिए आवश्यक न्यूनतम सहभागी विक्रेताओं की संख्या। / Minimum number of bids required to disable automatic bid extension	4
दिनों की संख्या, जिनके लिए बिड लगाने की समय-सीमा बढ़ाई जाएगी। / Number of days for which Bid would be auto-extended	7
बिड से रिवर्स नीलामी सक्रिय किया/Bid to RA enabled	Yes
रिवर्स नीलामी योग्यता नियम/RA Qualification Rule	H1-Highest Priced Bid Elimination
बिड का प्रकार/Type of Bid	Two Packet Bid
तकनीकी मूल्यांकन के दौरान तकनीकी स्पष्टीकरण हेतु अनुमत समय /Time allowed for Technical Clarifications during technical evaluation	2 Days
निरीक्षण आवश्यक (सूचीबद्ध निरीक्षण प्राधिकरण /जेम के साथ पूर्व पंजीकृत एजेंसियों द्वारा)/Inspection Required (By Empanelled Inspection Authority / Agencies pre-registered with GeM)	No
Payment Timelines	Payments shall be made to the Seller within **30** days of issue of consignee receipt-cum-acceptance certificate (CRAC) and on-line submission of bills (This is in supersession of 10 days time as provided in clause 12 of GeM GTC)
मूल्यांकन पद्धति/Evaluation Method	Total value wise evaluation
मध्यस्थता खंड/Arbitration Clause	No
सुलह खंड/Mediation Clause	No

ईएमडी विवरण/EMD Detail

आवश्यकता/Required	No

ईपीबीजी विवरण /ePBG Detail

आवश्यकता/Required	No

विभाजन/Splitting

बोली विभाजन लागू नहीं किया गया/ Bid splitting not applied.

एमआईआई खरीद वरीयता/MII Purchase Preference

एमआईआई खरीद वरीयता/MII Purchase Preference	Yes

एमएसई खरीद वरीयता/MSE Purchase Preference

एमएसई खरीद वरीयता/MSE Purchase Preference	Yes

1. Preference to Make In India products (For bids < 200 Crore):Preference shall be given to Class 1 local supplier as defined in public procurement (Preference to Make in India), Order 2017 as amended from time to time and its subsequent Orders/Notifications issued by concerned Nodal Ministry for specific Goods/Products. The minimum local content to qualify as a Class 1 local supplier is denoted in the bid document. If the bidder wants to avail the Purchase preference, the bidder must upload a certificate from the OEM regarding the percentage of the local content and the details of locations at which the local value addition is made along with their bid, failing which no purchase preference shall be granted. In case the bid value is more than Rs 10 Crore, the declaration relating to percentage of local content shall be certified by the statutory auditor or cost auditor, if the OEM is a company and by a practicing cost accountant or a chartered accountant for OEMs other than companies as per the Public Procurement (preference to Make-in -India) order 2017 dated 04.06.2020. Only Class-I and Class-II Local suppliers as per MII order dated 4.6.2020 will be eligible to bid. Non - Local suppliers as per MII order dated 04.06.2020 are not eligible to participate. However, eligible micro and small enterprises will be allowed to participate .The buyers are advised to refer the OM No.F.1/4/2021-PPD dated 18.05.2023.
OM_No.1_4_2021_PPD_dated_18.05.2023 for compliance of Concurrent application of Public Procurement Policy for Micro and Small Enterprises Order, 2012 and Public Procurement (Preference to Make in India) Order, 2017.

2. Purchase preference will be given to MSEs having valid Udyam Registration and whose credentials are validated online through Udyam Registration portal as defined in Public Procurement Policy for Micro and Small Enterprises (MSEs) Order, 2012 dated 23.03.2012 issued by Ministry of Micro, Small and Medium Enterprises and its subsequent Orders/Notifications issued by concerned Ministry. If the bidder wants to avail themselves of the Purchase preference, the bidder must be the manufacturer / OEM of the offered product on GeM. Traders are excluded from the purview of Public Procurement Policy for Micro and Small Enterprises and hence resellers offering products manufactured by some other OEM are not eligible for any purchase preference. In respect of bid for Services, the bidder must be the Service provider of the offered Service. Relevant documentary evidence in this regard shall be uploaded along with the bid in respect of the offered product or service and Buyer will decide eligibility for purchase preference based on documentary evidence submitted, while evaluating the bid. If L-1 is not an MSE and MSE Seller (s) has / have quoted price within L-1+ 15% (Selected by Buyer) of margin of purchase preference /price band defined in relevant policy, such MSE Seller shall be given opportunity to match L-1 price and contract will be awarded for 25% (selected by Buyer) percentage of total quantity. The buyers are advised to refer the OM No. F.1/4/2021-PPD dated 18.05.2023 OM_No.1_4_2021_PPD_dated_18.05.2023 for compliance of Concurrent application of Public Procurement Policy for Micro and Small Enterprises Order, 2012 and Public Procurement (Preference to Make in India) Order, 2017. Benefits of MSE will be allowed only if seller is validated on-line in GeM profile as well as validated and approved by Buyer after evaluation of documents submitted.
3. Estimated Bid Value indicated above is being declared solely for the purpose of guidance on EMD amount and for determining the Eligibility Criteria related to Turn Over, Past Performance and Project / Past Experience etc. This has no relevance or bearing on the price to be quoted by the bidders and is also not going to have any impact on bid participation. Also this is not going to be used as a criteria in determining reasonableness of quoted prices which would be determined by the buyer based on its own assessment of reasonableness and based on competitive prices received in Bid / RA process.

4. Reverse Auction would be conducted amongst all the technically qualified bidders except the Highest quoting bidder. The technically qualified Highest Quoting bidder will not be allowed to participate in RA. However, H-1 will also be allowed to participate in RA in following cases:

i. If number of technically qualified bidders are only 2 or 3.
ii. If Buyer has chosen to split the bid amongst N sellers, and H1 bid is coming within N.

iii. In case Primary product of only one OEM is left in contention for participation in RA on elimination of H-1.
iv. If L-1 is non-MSE and H-1 is eligible MSE and H-1 price is coming within price band of 15% of Non-MSE L-1
v. If L-1 is non-MII and H-1 is eligible MII and H-1 price is coming within price band of 20% of Non-MII L-1

Ready Mix Cement Concrete (3754 CuM) For 4X250 MW BRBCLNABINAGAR TPP FGD-BIHAR (3754 cubic meter)

(क्रमशः श्रेणी 1 और श्रेणी 2 के स्थानीय आपूर्तिकर्ता के रूप में अर्हता प्राप्त करने के लिए आवश्यक/Minimum 50% and 20% Local Content required for qualifying as Class 1 and Class 2 Local Supplier respectively)

तकनीकी विशिष्टियाँ /Technical Specifications

क्रेता विशिष्टि दस्तावेज़ /Buyer Specification Document	Download

परेषिती/रिपोर्टिंग अधिकारी तथा मात्रा/Consignees/Reporting Officer and Quantity

क्र.सं./S.No.	परेषिती/रिपोर्टिंग अधिकारी /Consignee Reporting/Officer	पता/Address	मात्रा /Quantity	डिलीवरी के दिन/Delivery Days
1	Bethanabelli Eswararao	824303,BHEL SITE OFFICE, 4x250 MW Nabinagar Project BRBCL P.O. Nabinagar Dehri-onsone, Dist. Aurangabad, Bihar - 824 303	3754	300

क्रेता द्वारा जोड़ी गई बिड की विशेष शर्तें/Buyer Added Bid Specific Terms and Conditions

1. **Buyer Added Bid Specific ATC**

   Buyer uploaded ATC document Click here to view the file.

2. **Generic**

   Buyer Organization specific Integrity Pact shall have to be complied by all bidders. Bidders shall have to upload scanned copy of signed integrity pact as per Buyer organizations policy along with bid. Click here to view the file

3. **Generic**

   Actual delivery (and Installation & Commissioning (if covered in scope of supply)) is to be done at following address

   CONSTRUCTION MANAGER
   BHEL SITE
   4X250 MW NABINAGR PROJECT BRBCL FGD PROJECT
   DIST- AURANGABAD
   PIN 824303 BIHAR
   .

4. **Generic**

Bidders are advised to check applicable GST on their own before quoting. Buyer will not take any responsibility in this regards. GST reimbursement will be as per actuals or as per applicable rates (whichever is lower), subject to the maximum of quoted GST %.

अस्वीकरण/Disclaimer

The additional terms and conditions have been incorporated by the Buyer after approval of the Competent Authority in Buyer Organization, whereby Buyer organization is solely responsible for the impact of these clauses on the bidding process, its outcome, and consequences thereof including any eccentricity / restriction arising in the bidding process due to these ATCs and due to modification of technical specifications and / or terms and conditions governing the bid. If any clause(s) is / are incorporated by the Buyer regarding following, the bid and resultant contracts shall be treated as null and void and such bids may be cancelled by GeM at any stage of bidding process without any notice:-

1. Definition of Class I and Class II suppliers in the bid not in line with the extant Order / Office Memorandum issued by DPIIT in this regard.
2. Seeking EMD submission from bidder(s), including via Additional Terms & Conditions, in contravention to exemption provided to such sellers under GeM GTC.
3. Publishing Custom / BOQ bids for items for which regular GeM categories are available without any Category item bunched with it.
4. Creating BoQ bid for single item.
5. Mentioning specific Brand or Make or Model or Manufacturer or Dealer name.
6. Mandating submission of documents in physical form as a pre-requisite to qualify bidders.
7. Floating / creation of work contracts as Custom Bids in Services.
8. Seeking sample with bid or approval of samples during bid evaluation process. (However, in bids for attached categories, trials are allowed as per approved procurement policy of the buyer nodal Ministries)
9. Mandating foreign / international certifications even in case of existence of Indian Standards without specifying equivalent Indian Certification / standards.
10. Seeking experience from specific organization / department / institute only or from foreign / export experience.
11. Creating bid for items from irrelevant categories.
12. Incorporating any clause against the MSME policy and Preference to Make in India Policy.
13. Reference of conditions published on any external site or reference to external documents/clauses.
14. Asking for any Tender fee / Bid Participation fee / Auction fee in case of Bids / Forward Auction, as the case may be.
15. Buyer added ATC Clauses which are in contravention of clauses defined by buyer in system generated bid template as indicated above in the Bid Details section, EMD Detail, ePBG Detail and MII and MSE Purchase Preference sections of the bid, unless otherwise allowed by GeM GTC.
16. In a category based bid, adding additional items, through buyer added additional scope of work/ additional terms and conditions/or any other document. If buyer needs more items along with the main item, the same must be added through bunching category based items or by bunching custom catalogs or bunching a BoQ with the main category based item, the same must not be done through ATC or Scope of Work.

Further, if any seller has any objection/grievance against these additional clauses or otherwise on any aspect of this bid, they can raise their representation against the same by using the Representation window provided in the bid details field in Seller dashboard after logging in as a seller within 4 days of bid publication on GeM. Buyer is duty bound to reply to all such representations and would not be allowed to open bids if he fails to reply to such representations.

All GeM Sellers / Service Providers are mandated to ensure compliance with all the applicable laws / acts / rules including but not limited to all Labour Laws such as The Minimum Wages Act, 1948, The Payment of Wages Act, 1936, The Payment of Bonus Act, 1965, The Equal Remuneration Act, 1976, The Payment of Gratuity Act, 1972 etc. Any non-compliance will be treated as breach of contract and Buyer may take suitable actions as per GeM Contract.

यह बिड सामान्य शर्तों के अंतर्गत भी शासित है /This Bid is also governed by the General Terms and Conditions

जेम की सामान्य शर्तों के खंड 26 के संदर्भ में भारत के साथ भूमि सीमा साझा करने वाले देश के बिडर से खरीद पर प्रतिबंध के संबंध में भारत के साथ भूमि सीमा साझा करने वाले देश का कोई भी बिडर इस निविदा में बिड देने के लिए तभी पात्र होगा जब वह बिड देने वाला सक्षम प्राधिकारी के पास पंजीकृत हो।बिड में भाग लेते समय बिडर को इसका अनुपालन करना होगा और कोई भी गलत घोषणा किए जाने व इसका अनुपालन न करने पर अनुबंध को तत्काल समाप्त करने और कानून के अनुसार आगे की कानूनी कार्रवाई का आधार होगा।/In terms of GeM GTC clause 26 regarding Restrictions on procurement from a bidder of a country which shares a land border with India, any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority. While participating in bid, Bidder has to undertake compliance of this and any false declaration and non-compliance of this would be a ground for immediate termination of the contract and further legal action in accordance with the laws.

---धन्यवाद/Thank You---

PRE QUALIFIYING CRITERIA

Buyer Specific added Additional Terms & Conditions (ATC)

JOB	SUPPLY OF READY MIX CEMENT CONCRETE (3754CuM) AT 4X250 MW BRBCL NABINAGAR THERMAL POWER PROJECT, FGD SYSTEM, BIHAR.

SL NO	CRITERIA
1.0	FINANCIAL CRITERIA
(A)	BIDDER SHOULD HAVE AVERAGE MINIMUM ANNUAL FINANCIAL TURNOVER OF RS.75.00 LACS DURING THREE CONSECUTIVE FINANCIAL YEARS 2021-22, 2022-23 AND 2023-24 AND SHOULD SUBMIT THEIR AUDITED BALANCE SHEET AND PROFIT & LOSS ACCOUNT IN SUPPORT OF THE SAME.
(B)	IN CASE AUDITED BALANCE SHEET AND PROFIT & LOSS ACCOUNT HAS NOT BEEN SUBMITTED FOR THAT THREE CONSECUTIVE YEARS INDICATED ABOVE, THEN THE APPLICABLE FINANCIAL AUDITED STATEMENTS SUBMITTED BY THE BIDDERS AGAINST THE REQUISITE YEARS WILL BE AVERAGED FOR THREE YEARS.
(C)	IF FINANCIAL STATEMENTS ARE NOT REQUIRED TO BE AUDITED STATUTORILY, THEN INSTEAD OF AUDITED FINANCIAL STATEMENTS, FINANCIAL STATEMENTS ARE REQUIRED TO BE CERTIFIED BY CHARTERED ACCOUNTANT.
2.0	TECHNICAL CRITERIA
2.1	BIDDER SHOULD HAVE EXECUTED FOLLOWING WORKS IN THE LAST 03YEARS ENDING ON THE LATEST DATE OF OFFER SUBMISSION: a) BIDDER SHOULD HAVE EXPERIENCE OF "SUPPLYING ATLEAST 1502 CUM RMC" OR "EXECUTION OF ATLEAST 1502 CUM CONCRETING WORK" OF ANY GRADE WITH BIDDER'S OWN ARRANGEMENT OF BATCHING PLANT INCLUDING SUPPLY OF ALL REQUIRED MATERIAL EXCEPT CEMENT WHICH CAN EITHER BE IN BIDDER'S OR BUYER'S SCOPE, IN TWELVE CONSECUTIVE MONTHS IN ONE RUNNING/COMPLETED PROJECT. OR b) BIDDER SHOULD HAVE EXPERIENCE OF "SUPPLYING ATLEAST 2253 CUM RMC" OR "EXECUTION OF ATLEAST 2253CUM CONCRETING WORK" OF ANY GRADE WITH BIDDER'S OWN ARRANGEMENT OF BATCHING PLANT INCLUDING SUPPLY OF ALL REQUIRED MATERIAL EXCEPT CEMENT WHICH CAN EITHER BE IN BIDDER'S OR BUYER'S SCOPE, IN TWELVE CONSECUTIVE MONTHS IN TWO RUNNING/COMPLETED PROJECT.
2.2	BIDDER SHOULD HAVE VALID PAN RELEVANT SUPPORTING DOCUMENT SHALL BE SUBMITTED
3.0	CONSIDERATION OF OFFER WILL BE SUBJECT TO CUSTOMER'S APPROVAL OF BIDDER.

GENERAL

A	CONSORTIUM / JV BIDDING IS NOT ALLOWED.
B	AFTER SATISFACTORY FULFILLMENT OF ALL THE ABOVE CRITERIA, OFFER SHALL BE CONSIDERED FOR FURTHER EVALUATION AS PER NIT AND ALL OTHER TERMS OF THE TENDER.
C	THE BIDDER SHOULD HAVE ACHIEVED THE CRITERIA SPECIFIED IN THE PRE-QUALIFICATION CRITERIA, EVEN IF THE CONTRACT HAS NOT BEEN COMPLETED OR CLOSED.
E	BIDDER SHALL SUBMIT ABOVE PRE-QUALIFICATION CRITERIA FORMAT, DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.
F	BIDDER MUST NOT BE UNDER BANKRUPTCY CODE PROCEEDINGS (IBC) BY NCLT OR UNDER LIQUIDATION / BIFR, WHICH WILL RENDER HIM INELIGIBLE FOR PARTICIPATION IN THIS TENDER, AND SHALL SUBMIT UNDERTAKING TO THIS EFFECT.

VOLUME-III
PRICE SCHEDULE, REV-00

JOB: SUPPLY OF READY MIX CEMENT CONCRETE AT 4X250 MW BRBCL NABINAGAR THERMAL POWER PROJECT, FGD SYSTEM , BIHAR.

PREAMBLE

SL NO	DESCRIPTION
1	This preamble forms part of tender document and schedule of items. The tenderer should read this preamble carefully before filling in rate. Clauses under this preamble shall be read in conjunction with other tender sections as applicable and shall have precedence over any contrary statement mentioned any where in this document.
2	The work shall be carried out as per specifications, the description of the items in this schedule and/or Engineer's instructions.
3	Items of work provided in this schedule but not covered in this specification shall be executed strictly as per instruction of the engineer.
4	Unless specifically mentioned otherwise in the tender document, the tenderer shall quote for the complete items and shall provide for the complete cost towards power, fuel, tools, tackles, equipment, constructional plants, temporary works, labour, etc. including arranging all clearances etc. required for carrying out different activities & tests, materials, levies , transport, layout, repairs, rectification, maintenance till handing over, supervisions, overheads, profits and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work according to the complete tender document and this schedule. GST & BOCW Cess shall be inclusive, as applicable. However Transit insurance shall be in the scope of BHEL.
5	The quantities of the various items mentioned in this schedule of items are approximate, based on very preliminary information and may vary to any extent or be deleted altogether. The quoted rates of each item will remain firm throughout the period of execution including extension, for reasons whatsoever, as long as variation in the total value of work executed under any part of this contract including extra items, if any but excluding any price variation remains, within twenty Five (± 25%) of the awarded price as per LOI.
6	Prior written approval of BHEL shall be sought by the contractor in case quantity variation of any item crosses +50% (plus fifty percent) limit during execution and approval to be obtained before execution of further quantity for this item.
7	In case the finally executed contract value reduces below the lower limit of Contract Value due to quantity variation specified above, the contractor will be eligible for compensation @ 15% of the difference between the lower limit of the contract value and the actual executed value.
8	The rates quoted shall be inclusive of cleaning of site of any vegetation, dressing, clearing of old structures and leveling etc. required for commencement of site activities. No separate payment will be made towards the same. However, if separate rate for such item is avalable in the rate schedule, the same shall be considered.
9	Rate shall be quoted in figures and in words in clear legible writing. No overwriting is allowed. All scoring and cancellations should be countersigned and in case of illegibility the interpretation of engineer shall be final. All entries shall be in English language.
10	All works item wise shall be measured upon completion and paid for at the rates quoted and accepted as per BHEL approved payment schedule/billing break-up.
11	The tender shall be deemed to have visited site and made himself aware of all the site conditions, studied the specifications and details of work to be done within the time schedule attached and to have acquainted himself of the conditions prevailing at site.
12	No splitting of the job is envisaged. Decision of BHEL in this regard shall be final and binding to the bidders.
13	Bidders are not allowed to alter the Price Schedule format including item description,quantity etc. and the offer is liable for rejection if the bidders submit their prices in Price Schedules modified by them, BHEL reserves the right to reject the offers of bidders who submit offers in Price Formats which are modiified / altered by them. Also putting any comments instead of rates/price in the designated column of the rate schedule shall make the offer liable for rejection.
14	Engineer's decision shall be final and binding on the contractor regarding clarification of items in the schedule with respect to the other sections / volumes of the contract.
15	Bidder has to quote their offer for all the items (including non-schedule items) otherwise their offer may not be considered for evaluation & may be liable for rejection. In case, rate for Non-Schedule items are not quoted by the bidder, it will be treated at par with rate of corresponding item of CPWD / DSR schedule as prescribed in the tender / BOQ cum Rate Schedule.
16	No interest, whatsoever, shall be payable by BHEL on the security deposit, any bank guarantee submitted or any amount due to successful bidder / contractor.
17	Bidder's GRAND Total price at sl. no. 1.0 of SCHEDULE-1 shall be considered for evaluation unless stated otherwise.
18	Items of work provided in this schedule but not covered in the specifications shall be executed strictly as per instructions of the Engineer.
19	Engineers decision shall be final and binding on the contractors regarding clarification of items in this schedule with respect to the other section of the contract.
20	In case of any discrepancy between item descriptions, relevant drawing and/ or specification clarification shall be sought at tender stage itself. Otherwise it shall be assumed that the bidder has quoted for the more stringent requirement.
21	HIERARCHY In case of any conflict / deviations amongst various documents, the order of precedence shall be as follows: a. Statutory Regulations b. NTPC specification c. Items in Schedule of quantities d. IS / BS standards e. BHEL's standard specification (with prior approval of Engineer-in-charge).

VOLUME-III
PRICE SCHEDULE, REV-00

JOB: SUPPLY OF READY MIX CEMENT CONCRETE AT 4X250 MW BRBCL NABINAGAR THERMAL POWER PROJECT, FGD SYSTEM , BIHAR.

SCH-1 - TOTAL PRICE - READY MIX CONCRETE

SL NO	DESCRIPTION	PRICE SCHEDULE REF	TOTAL PRICE (IN INR)
1.0	TOTAL PRICE OF SCHEDULE - 2 FOR SUPPLY OF READY MIX CEMENT CONCRETE AS PER THE TENDER SPCIFICATION	SCHEDULE- 2 - BREAK UP OF TOTAL PRICE	*Price to be quoted on GeM Portal*

NOTE

1.0	Taxes & duties shall be as per SCC.
2.0	Bidder shall quote GRAND total price of SCHEDULE-2 at Sl. No 1.0 above, All other amounts / rates of each item of works in respective schedules / parts will be derived based on allocated percentages. As such, any uncalled figure/ amount noted at any other place / schedule of Volume-III will not be reckoned & will stand null & void.
3.0	Bidder to note that GRAND Total price at sl. no. 1.0 above shall be considered for evaluation & awarding. As such grand total price should be complete in all respect for the full scope defined and considering all terms and conditions. Non-Schedule items shall not be considered for evaluation.
4.0	Based on the itemwise percentage allocations, the amount for the individual items of the SCHEDULE - 2 shall be arrived at. The rates of individual items shall be derived from the amount against each items after roundeding off. However, RA bill payment shall be done after rounding off the gross amount to two decimal points. Any adjustment, if required, due to such methodology, will be effected / adjusted in final bill.
5.0	Bidders to note that this is an item rate contract. Payment shall be made for the actual quantities of work executed at the unit rate arrived at as per Sl. No. 3.0 above.
6.0	Any item as per scope of work, if not included in the price quoted above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.
7.0	Price format shall not be changed by bidder in any case and it may lead to cancellation of their offer.
8.0	Evaluation Criteria:- Total Price on GeM shall be inclusive of all taxes including GST, Charges, Royalties, any state or Central Levy and other taxes for materials if any obtained for the work and for the execution of the contract. However, Transit insurance shall be in BHEL Scope
9.0	The quantity of items may vary during execution mainly due to actual requirement etc. The unit rates work out from the overall amount quoted & accepted by BHEL shall be considered and no separate unit rates shall be allowed. Unit rates shall be valid throughout the contract period.

VOLUME-III
PRICE SCHEDULE, REV-00

JOB: SUPPLY OF READY MIX CEMENT CONCRETE AT 4X250 MW BRBCL NABINAGAR THERMAL POWER PROJECT, FGD SYSTEM , BIHAR.

SCHEDULE- 2 : PRICE BREAK UP - READY MIX CONCRETE

ST No.	DESCRIPTION	UNIT	QUANTITY	WEIGHTAGE
	CONCRETE WORK: Supply of Ready Mix Concrete(For M20 and above, BHEL approved Mix Designs to be followecd,Same is attahced in TCC), Trial mix, labour, materials, equipment for handling, batching, mixing with mechanised equipments like batching plant, etc. complete as per specifications and direction of engineer in charge for the following mixes:[Transportation of concrete from batching plant shall be done by user]			
C001	Supply of Concrete of grade M7.5 (1 part cement, 4 part sand, 8 parts of 40 mm graded aggregate by volume).	CUM	227	0.052164624
C002	Supply of Concrete of grade M10 (1 part cement, 3 part sand, 6 parts of 40 mm graded aggregate by volume).	CUM	370	0.089989111
C004	Supply of Ready mix concrete with coarse sand and graded hard stone aggregate of 20mm nominal size including use of plasticizer / superplasticizer conforming to IS:9103 (latest) to achieve required slump in concrete all complete as per specification & direction for the following.			
a	M 25 Grade	CUM	1361	0.375721014
b	M 30 Grade	CUM	88	0.024956849
C006	Supply of Ready mix concrete with coarse sand and graded hard stone aggregate of 12.5 mm nominal size including use of plasticizer / superplasticizer conforming to IS:9103 (latest) to achieve required slump in concrete all complete as per specification & direction for the following.			
a	M20 grade	CUM	5	0.001340621
b	M25 grade	CUM	24	0.006656114
C009	**Supply of Concrete** conforming to IS 456 with coarse sand and graded hard stone aggregate 12.5mm/6 mm nominal size etc complete as per following Concrete of mixes:			
a	1:2:4 (1 part cement, 2 part sand, 4 parts of aggregate by volume)	CUM	10	0.002571498
b	1:1:2 (1 part cement, 1 part sand, 2 parts of aggregate by volume)	CUM	25	0.006673390
C010	Supply of Ready mix concrete of grade M35 using 20 mm nominal size stone aggregate with approved admixture (if required) to achieve required slump as per technical recomendation for **Road Work**	CUM	745	0.215935280
C011	Supplying **dry lean concrete** of required thickness of **grade M15** with stone aggregate 20 mm nominal size for **Road Work.**	CUM	900	0.223991499
	TOTAL	CUM	3754	

CONTENT

1.00.00	SCOPE
1.01.00	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. Special requirements for structures such as reinforced concrete chimney, cooling towers, etc. have been covered under the respective specifications. Those specifications shall be used in conjunction with this specification.
1.02.00	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 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. However, should the list be not exhaustive and does not cover any aspect of the work, then relevant Indian and, in its absence, relevant International code shall apply
2.00.00	General
2.01.00	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) Submit for approval detailed schemes of all operations required for executing the work, e.g. Material handling, Concrete mixing, Placement of concrete, services, Approaches, etc. c) Design and submit for approval concrete mix designs required to be adopted on the job. d) Furnish samples and submit for approval results of tests of various properties of the following :

	i) The various ingredients of concrete ii) Concrete e) 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 specifications. f) 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.
2.02.00	**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
2.03.00	**Information to be submitted by the Tenderer**
2.03.01	**With Tender**
	The following technical information's 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.
2.03.02	**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 for Installation & Commissioning of the RMC plant:** Within 15 days of the award of contract, the contractor shall submit a Master Programme for Installation & Commissioning of the RMC plant. **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

	c) Design Mix Design mix as per Clauses 2.01.00 (c) & 3.04.00 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) Test Reports for Cement & admixtures. e) Inspection Reports Inspection Reports in respect of any item of work as may be desired by the Engineer as per this specification. f) Test Reports Reports of tests of various materials and concrete as required under Clause 4.00.00 for Sampling & Testing of this specification g) Any other data which may be required as per this specification.
2.04.00	Conformity with Design Once 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 as per requirement, Making test samples, curing, protection and testing of concrete will be as approved or directed by the Engineer
2.05.00	Materials to be used
2.05.01	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.
2.05.02	Cement Ordinary Portland cement of grade-43 as per IS:269-2015 / fly ash based Portland Pozzolana cement conforming to IS:1489 (Part-1) shall preferably be used in reinforced / plain cement concrete works for all areas other than for the critical structures identified below. However, other types of cement such as ordinary Portland cement conforming to IS:269, Portland slag cement conforming to IS:455 respectively can be used under special circumstances. Cement used in all concrete

	mixes shall be in general of grade 33/43 unless design requires a higher grade. Ordinary Portland cement shall be used for following structure. a) Spring supporting decks of all machine foundations. b) Structures requiring grade of concrete of M30 and above. In special cases, Rapid Hardening Portland Cement, Low Heat Cement, Sulphate resistant cement, high strength Ordinary Portland Cement etc. may be permitted or directed to be used by the Engineer.
2.05.03	**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. Coarse aggregates consisting of hard, strong and durable pieces of crushed stone and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles etc. and any other material liable to affect the strength, durability or appearance of concrete. Aggregates other than crushed stone conforming to the provisions of specification may be used if permitted by the Engineer. Washing of aggregates by approved means shall be carried out, if desired by the Engineer. Grading of coarse aggregates shall generally conform to IS: 383 and shall be such as to produce a dense concrete of the specified proportions and strength and of consistency that will work readily into position without segregation. 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 are 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. Sand shall be hard, durables, clean and free from adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrities, alkalis, salts, coal, mica or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of concrete or to cause corrosions to any metal in contact with such concrete
2.05.04	**Water** Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, soluble silts or other deleterious substances which may cause corrosion, discolouration, efflorescence etc. 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. 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.
2.05.05	**Admixture** Only admixtures 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 IS-9103 and may be one of the followings: a) Accelerating admixture b) Retarding admixture

	c) Water reducing admixture d) Air entraining admixture e) Water proofing admixture The contractor shall inform the Engineer about the type of admixture which he is planning to use in different areas within the scope of work for the approval of the Engineer. The admixture shall be of proven make and from a reputed manufacturer. It should not have any adverse effect on strength, durability of concrete and reinforcement. Super plasticizers conforming to IS: 9103 or ASTMC-494 shall only be used as admixture having the above properties either individually or in a combination as per the direction of the Engineer.
2.06.00	Storage of Materials
2.06.01	General All materials shall be stored so 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 the cost incurred thereof shall be realised from the Contractor's dues. The Contractor shall maintain up-to-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to IS: 4082.
2.06.02	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-ventilated warehouses 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.
2.06.03	Aggregates

	Aggregates shall be stored on raised surface constructed by providing planks or steel plates or on concrete or brick masonry pavement. Each size shall be kept separated with wooden or steel or concrete or masonry bulkheads 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 aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.
2.07.00	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 affects 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. e) Grades of Concrete: Usage and mix design, testing of all properties. f) Batching & Mixing: Types and capacity of plant, concrete mixers and transportation equipment.
3.00.00	Installation All installation requirements shall be in accordance with IS: 456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not cover all the aspects to the full satisfaction of the Engineer.
3.01.00	Washing and Screening of Aggregates Washing and screening of coarse and fine aggregates to remove fines, dirt, or other deleterious materials shall be carried out by approved means as desired by the Engineer.

3.02.00	**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 including plasticisers of approved make may be used with the Engineer's approval 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 owner 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.
3.03.00	**Grades of Concrete** Concrete shall be in one of the grades designated in IS: 456. Grade of concrete to be used in different parts of work shall be as shown on the drawing. In case of liquid retaining structures, IS: 3370 will be followed. Minimum cement content shall be as per IS: 456.
3.04.00	**Proportioning and Works Control**
3.04.01	**General** “Design Mix Concrete” and “Nominal Mix Design” is defined as follows for use in this specification: a) Proportioning of ingredients of concrete made with preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete". b) Proportioning of ingredients of concrete made 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 M-15 or lower only 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 IS: 456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.04.02	**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) The finished concrete should have adequate durability in all condition, to withstand satisfactorily the weather and other destruction agencies, which it is expected to be subjected to in actual service. e) The mix design shall have required workability and characteristic strength as per IS: 456. The quantity of cement, aggregates, and admixtures shall be determined by mass. The requirement of adequate structural strength is catered for by the choice of proper grade of concrete in structural design. The Contractor will strictly abide by the same in his design of concrete mix installation. 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.
3.05.00	**Strength Requirements** The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland Blast furnace slag cement is used, shall be as per IS:456. All other relevant clauses of IS:456 shall also apply.
3.06.00	**Minimum Cement Content** The minimum cement content for each grade of concrete shall be as per IS:456. Contractor has to consider actual environmental exposure condition at site. Based on various tests results and as per Engineer, the environment condition

	shall be adopted for which minimum cement content shall be considered. No extra payment shall be made on account of any variation in environment condition. a) Sufficient number of trial mixes (to be decided by the Engineer) will be taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted. b) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The Contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456. c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.
3.07.00	**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.
3.07.01	**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, the maximum water-cement ratio for different grades of concrete is specified in Table-5 of IS: 456 and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per IS: 456.
3.07.02	**Durability Requirement**

	Tables 4 & 5 of IS: 456 give 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 criteria, the former should 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. Trial mix shall be carried out accordingly. 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.
3.08.00	**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:

TABLE-V

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 equipments, roads
Low	25	50	Uncongested wide and shallow R.C.C. structures
Medium	50	100	Deep but wide RCC structures with congestion of reinforcement and inserts

	High	100	150	Very narrow and deep RCC 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. No extra payment will be made for this additional cement. The workability of concrete shall be checked at frequent intervals by slump tests.			
3.09.00	**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
	Lean concrete	40 mm

	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. 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.
3.09.01	Temperature control of concrete in top decks of machine foundations as extra payable over RCC item of BOQ: The temperature of fresh concrete shall not exceed 23°C when placed. A suitable measuring device for measuring the temperature of concrete as approved by the Engineer shall be used. For maintaining the limiting temperature of the 23°C, crushed ice shall be used as mixing water. The ice shall be formed of water conforming IS: 456. The Contractor shall establish the quantity of crushed ice to be mixed in order to achieve the limiting temperature of 23°C.
3.09.02	Base raft of Turbo Generator foundations and top decks of all machine foundations shall be cast in a continuous operation without any construction joint.
3.10.00	Mixing of Concrete Ingredients of the concrete mix shall be measured by weight. Concrete shall always be mixed in mechanical mixer. 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 at no extra cost to the Owner 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. Batching Plant shall conform to IS: 4925. The measuring gauges of batching plant shall be periodically calibrated for which the contractor shall provide standard weights. The accuracy of all gauges shall be within limits prescribed by the Engineer. When hand mixing is permitted by the Engineer, for unimportant out of the way locations in small quantities, 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 at no extra cost to the owner.
3.17.00	Cold Weather Concreting When conditions are such that the ambient temperature may be expected to be 5°C or below during the placing and curing period, the work shall conform to the requirement of IS: 456 and IS: 7861.
	3.18.00 Hot Weather Concreting When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS: 7861 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 38°C while placing. Positive temperature control by pre-cooling, post cooling or any other method, if required, will have to be done by the contractor at no extra cost.
3.19.00	Concreting under water When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of IS: 456.
4.00.00	SAMPLING AND TESTING
4.01.00	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 teat results in triplicate within 3 (three) days after completion of the test.
4.02.00	**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 as per guidelines of IS: 269. Soundness Tests may also be required to be carried out if required by the Engineer. The Contractor shall carry out the tests without any expense to BHEL. 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 Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the BHEL 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.
4.03.00	**Aggregates** The contractor shall carry out any or all the tests on 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
4.04.00	**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 whenever directed by the Engineer. The acceptance criteria will be as per IS: 456
4.05.00	**Admixture**
4.05.01	**Air Entraining Agents** Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder 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 that, 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.
4.05.02	**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.
4.06.00	**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 IS: 456. To control the consistency of concrete from every mixing plant, slump tests 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 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 at his own cost. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.
5.00.00	**ACCEPTANCE CRITERIA**
5.01.00	**Standard Deviation** Standard deviation shall be based on test results and determination of Standard deviation shall conform to IS: 456.
5.02.00	**Acceptance Criteria** The strength requirements and acceptance criteria shall conform to IS: 456.
5.03.00	**Inspection and Core Tests** Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to IS: 456.
5.04.00	**Load Test**

	Load tests of structural members as per IS:456 may be required by the Engineer, when the strength of test specimen results falls below the required strength. If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL. 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. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor. 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, free of charge by the Contractor to the satisfaction of the Engineer.
6.00.00	**Laboratory and Field Testing**
6.01.00	The field laboratory for QA and QC activities shall be constructed and set-up by the Contractor in line with the indicative field QA&QC laboratory set-up enclosed at Annexure-I. The Laboratory building shall be constructed and installed with the adequate facilities to meet the requirement of envisaged test setup. Temperature and humidity controls shall be available wherever necessary during testing of samples. The quality plan shall identify the testing equipment / instrument, which the Contractor shall deploy and equip the field quality laboratory for meeting the field quality plan requirements. The Contractor shall furnish a comprehensive list of testing equipment / instrument required to meet the planned/scheduled tests for the execution of works for OWNER acceptance/ approval. The Contractor shall mobilize the requisite laboratory equipment and QA&QC manpower at least 15 days prior to the planned test activity as per the schedule of tests.
6.02.00	All equipment and instruments in the field shall be calibrated before the commencement of tests and then at regular intervals, as per the manufacturer's recommendation and as directed by the OWNER. The calibration certificates shall specify the fitness of the equipment and instruments within the limit of tolerance for use. Contractor shall arrange for calibration of equipment and instruments by an NABL / NPL accredited agency and the calibration report shall be submitted to OWNER.
6.03.00	The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute. This includes all IITs, NCB, CSMRS, reputed government /

	autonomous laboratories / organizations, NITs and other reputed testing laboratories. The test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by OWNER engineer. The test report along with the recommendations shall be obtained from the laboratories without delay and submitted to OWNER.	
6.04.00	Based on the schedule of work agreed with the engineer-in-charge and the approved FQP, the Contractor shall prepare a schedule of tests and submit them to the engineer-in-charge and organize to carry out the tests as scheduled /agreed.	
7.00.00	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 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: 269	Indian Standard Specification for Ordinary Portland Cement
	IS: 383	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
	IS: 455	Indian Standard Specification for Portland Slag Cement
	IS: 456	Indian Standard Code of Practice for Plain and Reinforced Concrete
	IS: 516	Indian Standard Specification for Methods of Test for Strength of Concrete
	IS: 1200	Indian Standard Specification for Method of (Part-II) Measurement Cement Concrete Works
	IS: 1489	Indian Standard Specification for Portland - Pozzolona Cement - Part 1 & 2
	IS: 1791	Indian Standard Specification for Batch Type Concrete Mixers
	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: 2514	Indian Standard Specification for Concrete Vibrating Tables

	IS: 2645	Integral Cement water proofing compound
	IS: 2722	Indian Standard Specification for Portable Swing Weigh Batchers for Concrete (Single and Double Bucket type)
	IS: 2770	Indian Standard Specification for Method of Testing Bond in Reinforced Concrete. Part - 1: Pull out Test
	IS: 3025	Indian Standard Specification for Methods of Sampling and Test (Physical and Chemical) for Water & waste water - Part - 1 to 37
	IS: 3550	Indian Standard Specification for Method of Test for Routine Control for Water used in Industry
	IS: 3812	Indian Standard Specification for Fly Ash for Use as Pozzolana & 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: 4634	Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixers
	IS: 4925	Indian Standard Specification for Concrete Batching and Mixing Plant
	IS: 4926	Indian Standard Specification for Ready Mixed Concrete
	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: 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 Super sulphated Cement
	IS: 6925	Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures
	IS: 7320	Indian Standard Specification for Concrete Slump Test Apparatus

	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: 8142	Indian Standard Specification for Determining Setting time of Concrete by Penetration Resistance
	IS: 9103	Indian Standard Specification for Admixtures for Concrete.
	IS: 10262	Recommended Guideline for concrete Mix Design
	IS: 12330	Indian standard specification for sulphate resting Portland cement
	IS: 12600	Indian standard specification for low heat Portland cement

Annexure-I

INDICATIVE LIST OF BOUGHT OUT ITEMS FOR READY MIX CONCRETE WORKS

Sl. No	Bought out Item	Proposed Make	Proposed list of Manufacturers
1	Cement		
2	Construction Chemicals admixtures, waterproofing, accelerators,		
3	Any other specific high value and critical bought out Item required, meeting the specification requirements		

Note: The Bidders are required to indicate the list of proposed manufacturers/ sub-vendors for each of the BOI in their Bid proposal, which shall be discussed for finalization at post bid stage

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Annexure-II		
LIST OF RMC FIELD QUALITY ASSURANCE LABORATORY APPARATUS		
SL NO	DESCRIPTION	QUANTITY
1	Cube moulds - 150 mm (ISI marked)	144
2	Cube moulds - 70.6 mm	18
3	Cube testing machine with two dial gauge and brick plate attachment	2 sets of 2000 kN capacity each
4	Digital thermometer - 200°C	6
5	Electrical oven	1
6	IS sieve set along with sieve shaker – 75 µ, 150 µ, 300 µ, 600 µ, 1.18 mm, 2.36 mm, 4.75 mm, 6.3 mm, 10 mm, 12.5 mm, 16 mm, 20 mm, 22.4 mm, 25 mm, 31.5 mm, 40 mm, 50 mm, 53 mm, 63 mm, 80 mm, 90 mm, 120 mm, 125 mm, pan	1 Set for Sand & 1 set for coarse aggregate
7	Measuring cylinder (glass) 50 ml, 200 ml, 500 ml	2 each
8	Physical balance Digital 10 kg capacity L.C. – 1 gm	1
9	Platform balance – Digital: 200 kg capacity	1
10	Pycnometer	2
11	Slump cone with tamping rod	4
12	Specific gravity bottle – 50 ml	2
13	Air entrainment meter capacity – 0.005 cum	2
14	English type trowel	4
15	Impact testing machine	1
16	Le-Chatelier apparatus with water bath	2
17	Measuring cylinder (plastic) 50 ml, 100 ml, 200 ml, 500 ml	1
18	pH meter	1
19	Screw gauge	2
20	Spatula	4
21	Standard sand grade 1, 2, 3 500 kg	each

22	Stop watch - Digital	1
23	Thermometer ordinary 50°C	5
24	Vernier calipers - Digital	1
25	Vicat apparatus	2
26	Weigh Boxes	4
27	Cylindrical measures: - capacity 0.01 cum, Dia (I) – 250 mm, Height – 280 mm, (I) with tamping rod as per IS 1199.	1
28	Rapid Curing Water Tank (IS: 1199)	1
29	Flow Table for self compacting Concrete	1

Maharatna Company	**TECHNICAL SPECIFICATION FOR READY MIX CEMENT CONCRETE**	PROJECT: 4 x 250 MW BRBCL Nabinagar TPP, Bihar.

INDICATIVE QUALITY PLAN

SUPPLIERS NAME AND ADDRESS		FIELD QUALITY PLAN					PROJECT:	NORTH KARANPURA STPP (3X660 MW)			
BHEL, PS:ER, KOLKATA		ITEM : Civil Work of FGD, GHP & LHP		QP NO. : PP-18-02-NKP-QLY-UT-QA-102			PACKAGE:	FGD SYSTEM PKG			
		SUB-SYSTEM : GEOTECH INVESTIGATION, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		REV. NO. : 0			CONTRACT NO.	4410-109			
				DATE : 30/11/2018			MAIN CONTRACTOR	BHEL, PS:ER, KOLKATA			
				PAGE : 02 OF 24							
Sl. No	Activity and operation	Characteristics / Instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	10	11
1	GENERAL REQUIREMENTS										
A		Setting up of Field QA&QC laboratory	As agreed / required	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings		SR	√	Lab shall be setup by BHEL / BHEL sub-vendor with minimum equipments as per Annex-I
B		Availability of requisite laboratory set up and equipment in good working condition well before commencement of concerned activity	As agreed / required	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings		SR	√	
C		Sampling for testing of building materials, concrete mix design etc.	As agreed / required	B	Physical	Once per each source	Tech Specs and Const. Drawings		SR/TR	√	Test report along with the recommendations from specialist agency to be submitted to NTPC.
D		Submission of schedule of tests to be done monthly / quarterly and maintenance of the same on a computer connected to LAN of NTPC for monitoring		A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings		SR	√	
E		Stacking and storage of construction materials and components at site	As per IS:4082	B	Physical	Random	Tech Specs and Const. Drawings and IS: 4082		SR	√	
F		All bought out items to be procured from the approved vendor and on approval of Quality plans by NTPC as per Inspection Category		B	Verification of TC and/or Testing	100%	NTPC Tech. Spec. /BOQ		SR/LB	√	The TC submitted should bear proper identification or correlation with the batch of material supplied and same shall be brought out in the challan / consignment note.
G		Submission of list of Bought out items and their vendors for each of the bought out item identified for approval within the period agreed in LoA		A	Physical	One time	NTPC Tech. Spec. /BOQ		SR/LB		To be submitted to NTPC for approval with a copy to site.
3.0	MATERIALS										
3.1	CEMENT										
		Retesting of cement	as per IS:4031	A	Testing	At Random	As per relevant IS Codes		Test Report / LB	√	Each consignment of cement shall be duly correlated with manufacturers TC. In case the cement is supplied by the contractor one sample from each lot shall be tested for setting time and compressive strength. Acceptance norms shall be as per relevant IS. If cement is stored more than 90 days in godown of contractor same shall be retested for comp. Strength & setting time.

Maharatna Company	**TECHNICAL SPECIFICATION FOR READY MIX CEMENT CONCRETE**	PROJECT: 4 x 250 MW BRBCL Nabinagar TPP, Bihar.

SUPPLIERS NAME AND ADDRESS		FIELD QUALITY PLAN					PROJECT:	NORTH KARANPURA STPP (3X660 MW)			
BHEL, PS:ER, KOLKATA		ITEM : Civil Work of FGD, GHP & LHP		QP NO. : PP-18-02-NKP-CLY-UT-QA-102			PACKAGE:	FGD SYSTEM PKG			
		SUB-SYSTEM : GEOTECH INVESTIGATION, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		REV. NO. : 0			CONTRACT NO.	4410-109			
				DATE : 30/11/2018			MAIN CONTRACTOR	BHEL, PS:ER, KOLKATA			
				PAGE : 02 OF 24							
Sl. No	Activity and operation	Characteristics / Instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	0*	10
3.2	Coarse Aggregate	Moisture content	as per IS:2386	B	Physical	Once for each stack of 100 Cu.M. or part there of	IS : 456 IS : 383/Tech Spec		SR/LB	√	during monsoon when this has to be done every day before start of concreting
ii		Specific gravity, water absorption	IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS:456 IS:383/Tech Spec		SR/LB/ Test Report	√	
iii		Sieve analysis, flakiness index, elongation index,	IS:2386	B	Physical	One per 100 cum., or part there of	IS: 2386 Part-I, IS:383/Tech Spec		SR/LB	√	
iv		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)	IS:2386	A	Physical	Once per source/ on every change of source	IS: 2386 Part-II, IS:383/Tech Spec		SR/LB/ Test Report	√	
v		Soundness	IS:2386	A	Physical	-do-	IS: 2386 Part-V, IS:383		SR/LB/ Test Report	√	
vi		Alkali aggregate reactivity		A	Physical	-do-	IS: 2386 (Part-VII), IS:383 /Tech Spec/ASTM C-1260 / ASTM 1293		SR/LB/ Test Report	√	The aggregate type (deleterious/innocious result should be supported by petrographic examination
vii		Petrographic examination	IS:2386 Pt VIII	A	Physical	-do-	IS: 2386 Part VIII, IS:383 /Tech Spec		SR/LB/ Test Report	√	
viii		Crushing value abrasion value and impact value	IS:2386	A	Physical	-do-	IS:383, IS-2386 Part IV/Tech Spec		SR/LB/ Test Report	√	
3.3	Fine Aggregate										
i		Moisture content, water absorption	balance , oven etc	B	Physical	To be done every day before start of	IS: 2386 Part-III, IS:383		SR/LB/ TR	√	
ii		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)	IS:2386	B	Physical	Once per source& for on every change of source	IS: 2386 Part-II, IS:383		SR/LB/ TR	√	
iii		All other tests similar to coarse aggregates as mentioned above.					IS-2386, IS-383		SR/ LB/ TR	√	except test for flakiness index,elongation index, abrasion value, impact value
3.4	Water										
i		Complete Testing as per IS:456-2000	Buret, conical flask, pipette etc	B	Testing	One per 3 month for each source.	IS:456-2000		SR/LB/ TR	√	

Maharatna Company	**TECHNICAL SPECIFICATION FOR READY MIX CEMENT CONCRETE**	PROJECT: 4 x 250 MW BRBCL Nabinagar TPP, Bihar.

SUPPLIERS NAME AND ADDRESS		FIELD QUALITY PLAN						PROJECT:	NORTH KARANPURA STPP (3X660 MW)			
BHEL, PS:ER, KOLKATA		ITEM : Civil Work of FGD, GHP & LHP		QP NO. : PP-18-02-NKP-QLY-UT-QA-102				PACKAGE:	FGD SYSTEM PKG			
		SUB-SYSTEM : GEOTECH INVESTIGATION, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		REV. NO. : 0				CONTRACT NO.	4410-109			
				DATE : 30/11/2018				MAIN CONTRACTOR	BHEL, PS:ER, KOLKATA			
				PAGE : 02 OF 24								
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks	
1	2	3		4	5	6	7	8	9	D*	10	
3.5	CONCRETE											
i	Concrete Mix Proportioning	Design Mix Concrete	As agreed / required	A	Testing	Once per source & for on every change of source for each grade of concrete (above grade M15)	IS 456		Test Report	√	Mix Design to be vetted by any NTPC approved institute / IITs / NITs	
ii		4 Trial mixes to ascertain the workability and cube strength	As agreed / required	A	Physical	One for each mix proportion	NTPC tech specification		SR/LB	√		
iii		Crushing strength (works Tests cubes)	IS:516	A	Physical	One set of 6 cubes per 50 CuM or part thereof for each grade of concrete per shift whichever is earlier	IS:516, IS:456, NTPC Tech. Spec.		SR/LB / Test Report	√	Min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days remaining 3 shall be for 28 days comp. Strength.	
iv		Workability - slump test	IS:1199	B	Physical	At the time of concrete pouring at site every two hrs	IS:456 / NTPC Tech. Spec.		SR/LB/ TR	√		
v		Water content		B	Physical	Once per shift	As per approved design mix.		SR/LB	√	At batching plant	
3.5.1	Admixtures for Concrete	Type of admixture	As per IS:9103	A	EIC-FQA/NTPC Approved source and review of MTC/ test reports	For each lot received at site	Designed mix and IS:9103		Test Report	√	Admixture of appd. Brand and tested quality shall be used (each lot of admixture will included with brochure in which the type of admixture and its properties shall be clearly indicated)	
		Suitability	As per IS:9103	B	Physical	For each lot received at site	Designed mix and IS:9103		SR/LB/ TR	√	Relative density, pH and slump retention on each batch / lot of admixture and to compare these properties with MTC.	

LEGENDS :
* Records identified with tick (√) shall be essentially included by supplier in QA documentaion
# Class A : Critical, Class B : Major, Class C : Minor
Class A checks shall be witnessed by NTPC FQE, Class B checks shall be witnessed by NTPC site Engineer/Supervisor, Class C checks shall be witnessed by BHEL Site engineer
SR - Site Register, TR- Test Report, IR - Inspection Report, MTC - Manufacturer's Test Certificate

Providing Ready Mix Concrete

for 4x250 MW

BRBCL Nabinagar FGD Project , Bihar

Bharat Heavy Electricals Limited
(A Govt. of India Undertaking)
Power Sector– Eastern Region
Plot–DJ9/1, Sector-II, Salt Lake
Kolkata-700091

CONTENTS

The Special Conditions of Contract (SCC) inscribed hereunder shall be read and construed along with General Conditions of Contract (GCC, Supply) and in case of any conflict or inconsistency, the provision of the Special Conditions of Contract, shall prevail.

1.0	PROJECT SYNOPSIS AND GENERAL INFORMATION
1.1	BRBCL is setting up a coal based 4x250 MW Thermal Power Project at Nabinagar, Dist: Aurangabad, Bihar. 1. OWNER : BHARTIYA RAIL BIJLEE COMPANY LIMITED (BRBCL) 2. PROJECT TITLE : NABINAGAR THERMAL POWER PROJECT 3. PROJECT RATING : 4X250 MW 4. LOCATION : NABINAGAR, DIST-AURANGABAD , BIHAR 5. NEAREST RLY STN : DEHRI-ON-SON (30 KM FROM PROJ ECT LOCATION) 6.NEAREST PORT : PARADIP 7. NEAREST AIRPORT : GAYA (100 KM FROM PROJECT LOCATION) 8. ROAD APPROACH : NH-2 (25 KM FROM PROJECT LOCATION 9. LATTITIDE : 24°42´30´´ N 10. LONGITUDE : 84°05´36´´ E 11. AVG ELAVATION : 138 MTR. 12. AVG TEMP : 40-50°C DURING SUMMER 13. AVG RAINFALL : 50-75 CM
2.0	SCOPE OF THE CONTRACT
2.1	The scope of work includes the followings: 1. Procurement, Supply, storing, of approved quality aggregates, admixtures etc. for ready mix concrete of various grades as per details given in BOQ or elsewhere in the contract document. 2. Production of ready mix concrete in computerized automatic batching plant of required capacity as per quality norms and as per Field Quality Plan (FQP) approved by Customer. 3. Conducting various tests in established ready mix concrete testing Laboratory at site as per FQP. 4. Supply of ready mix concrete at batching plant in transit mixers placed by respective vendors of BHEL.
2.2	Approved Mix designs are attached (M20, M25, M30, M35, DLC,PQC or as required grade) for all concreting as Annexure-I.II,III, IV & V.Any other design mix required for supply of concrete is to established by the agency as per FQP/Technical Specifications.
2.3	The work to be performed under this specification consists of providing all labour, materials, consumables, equipment, temporary works, temporary storage sheds for contractors own use, temporary colony for labour and staff, temporary site offices, constructional plant's transportation / handling and all incidental items not shown or specified but reasonably implied or necessary for the completion of subject scope, all in strict accordance with the specifications including revisions and amendments thereto as may be required during the execution of work.

2.4	Minimum Two-month stock of raw material including admixture are to be maintained all time at batching plant. Maximum daily requirement would be 100 cum. Approximate 450 – 500 Cum of ready-mix concrete monthly may have to be supplied during peak period i.e. except rainy season as per requirement of BHEL. In rainy season the approximate quantity shall be 250 – 300 cum monthly. Separate shed for storage of cement and admixture is to be made.
2.5	SANITARY
	The Contractor shall furnish and maintain sanitary facilities for the use of all personnel engaged in the Work under this Contract. These facilities shall be subject to the approval by the Employer.
2.6	The scope shall also include testing of material & ready mix concrete in laboratory with necessary equipment for conducting relevant tests as required. Instruments used in Lab shall have valid calibration certificate from authorized agency.
2.7	All quality standards & other technical requirements shall be strictly adhered to. The Bidder shall fully apprise himself regarding prevailing conditions at the site, climatic conditions including monsoon pattern, soil conditions, local conditions and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically mentioned in the specifications.
2.8	All works under this specification, unless specified otherwise, shall conform to the latest revision of Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not covered specifically by customer Specification, any other IS standard practice as may be specified by the Engineer shall be followed.
3.0	SITE VISIT
3.1	Contractor should visit site and acquire full knowledge & information about site conditions prevailing at site and in and around the plant premises together with all the statutory, obligatory, mandatory requirements of various authorities before submission of the bid in line with the above, site visit confirmation will be required to be submitted by the bidder with the technical bid.
4.0	OPEN SPACE FOR OFFICE & STORAGE
4.1	Open spaces for material storage yard & construction of temporary site office (bunk office) may be allocated as made available by the customer / BHEL free of cost. Contractor has to make his own arrangements for labour colony including Electricity and water for the labour colony outside the plant premises.
4.2	Construction of necessary stores and storage of materials shall be in contractor's scope. BHEL shall provide available space as received from customer on mutually agreed basis. Security of stores & work place shall be in Contractor's scope.
4.3	REMOVAL OF TEMPORARY FACILITIES
	When the Work is completed all such temporary structures and facilities shall be removed from the Site and the area shall be restored to its original condition.
5.0	WATER
5.1	Water for construction & drinking water inside the project premises shall be arranged by contractor.
5.2	Further necessary network for construction & drinking water system shall be done by the bidder at his own cost.
5.3	Contractor should arrange for water for labour colony of their own.
5.4	BHEL shall not be responsible for any inconvenience or delay caused due to any interruption of water supply and the contractor shall claim no compensation for delay in work for such interruption. Contractor may make standby arrangement for water at their own cost.
5.5	Contractor will have to arrange for storage of water to meet the day-to-day requirement.
5.6	The availability of water (construction as well as drinking) may be limited. Contractor shall ensure that no water is wasted. In this regard the contractor shall take all necessary measure towards preservation of water.
6.0	ELECTRICITY
6.1	BHEL shall provide construction power free of charge at 415V level at one point. Contractor has to

	make their own distribution arrangement to draw electricity. Overall area illumination will be provided by BHEL. However, for night working contractor should arrange illumination as and when required by them.
6.2	The bidder shall have to provide earth leakage circuit breaker at each point wherever human operated electrical drives/ T&Ps are deployed.
6.3	The power supply will be from the available grid. BHEL shall not be responsible for any inconvenience or delay caused due to any interruption of power supply/ variation in voltage level and no compensation for delay in work can be claimed by the contractor due to such non-supply on the grounds of idle labour, machinery or any other grounds.
6.4	Bidder will have to arrange sufficient illumination at their own work areas.
6.5	The contractor should ensure that the work in critical areas is not held up in the event of power breakdown. In the event of breakdown in the electric supply, if the progress of work is hampered, it will be the responsibility of the contractor to step up the progress of work after restoration of electric supply so that overall progress of work is not affected.
6.6	The contractor shall have to make arrangement at their own cost for illumination that will be required in the working area for execution of the work & safety of workmen.
6.7	Contractor shall make arrangement of electricity of their own for labour colony.
7.0	MATERIAL SUPPLY
7.1	SUPPLY OF MATERIALS – All requisite approved quality materials viz. cement, aggregates, sand, admixtures and consumables (like gas, electrodes etc. and other materials required for the work) shall be supplied by the contractor in time during execution. BHEL shall not supply any materials for this work.
7.1.1	Cement shall be as per Technical specification and description mentioned in the respective items of BOQ.
7.1.2	Test certificates in respect of Cement for each consignment to be furnished and also to be tested as per FQP before use. The contractor shall submit the consumption statement of cement used in the works along with bill.
8.0	INSPECTION, TESTING AND INSPECTION CERTIFICATES
8.1	The engineer, his duly authorized representative and / or an outside inspection agency acting on behalf of BHEL / owner shall have access at all reasonable times to inspect & examine the materials & workmanship of the works during its manufacture and if part of the works is being manufactured or assembled on other premises or works, the vendor shall obtain for the engineer and for their duly authorized representative permission to inspect as if the works were manufactured or assembled on vendor's own premises or works. Necessary arrangement for carrying out inspection including supply of labour, IMTEs, area illumination and scaffolding, if required will be vendor's responsibility and same has to be carried out within the quoted price.
8.2	Before any materials, leaves the place of manufacture, BHEL shall be given the option of witnessing inspections & tests for compliance with specifications & related standards. The vendor shall give the engineer / inspector 15 days written notice of any material being ready for testing. Such test shall be to the vendor's account except for the expenses of the inspector. The engineer / inspector, unless the inspection is waived will attend such tests within 15 days of the date on which the equipment is notified as being ready for test / inspection, failing which the vendor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports.
8.3	In all cases where the vendor provides the tests at the premises of the vendor or any sub-vendor, the vendor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the engineer/ inspector to carry out effectively such tests on the equipment in accordance with the contract and shall give facilities to the engineer/ inspector to accomplish testing.

9.0	INSURANCE
9.1	BHEL shall arrange comprehensive MCE (marine cum erection) Insurance Policy for total project supply & services including balance of plant package covering transit risks & loss, destruction or damage during handling at Site, Storage, civil works, erection, testing and commissioning up to trial operation completion of unit including theft, sabotage, fire, lightning and other natural calamities.
9.2	Contractor shall report to BHEL in writing any damages to equipment/components on receipt, storing, and during withdrawal of the materials from stores, in transit to site and unloading at place of work and during erection and commissioning till trial operation completion including handing over. The above report shall be as prescribed by BHEL site management. Any consequential loss arising out of non-compliance of this stipulation will be borne by contractor.
9.3	The contractor will take necessary precautions/ due care to protect the material at Project site, while in his custody from any damage/ loss till the same is handed over to BHEL/ customer at Project site. For lodging/ processing of insurance claim the contractor will submit necessary documents. BHEL will reserve the right to recover the loss from the contractor as detailed below in case the damage/loss is due to negligence/ carelessness on the part of the contractor. In case of theft of material under contractor's custody, the same shall be reported to police by the contractor immediately and copy of FIR and subsequently police investigation report shall be submitted to BHEL/ customer for taking up with insurance. However, this will not relieve the contractor of his contractual obligation for the materials in his custody.
9.4	In case the damage/loss/theft of materials are attributable to negligence/failure in discharging the duties and obligations of the contractor, the expenses incurred for repair/replacement of such components in excess of the amount realized from the underwriters, limited to Normal Excess (Deductible Franchise) shall be recovered from the contractor.
9.5	Other conditions of Insurance shall be as per relevant clause of GCC/SCC.
10.0	DEVIATIONS/ CLARIFICATIONS
	Normally no deviation with respect to tender is acceptable to BHEL. However, in case of unavoidable circumstances, the bidder may submit their query for seeking clarifications of BHEL as per modality stipulated in NIT or may submit the same along with his offer as per prescribed schedule/ format without any ambiguity. Any assumptions, presumptions, deviations etc. indicated or implied anywhere by the bidder except those indicated in the deviation schedule/ format will not be recognized and will not form a part of consideration / offer. In the absence of such filled-up schedule / format it will be understood and agreed that the bidder's offer is based on strict conformance to the specification and no negotiation would be allowed in this regard. BHEL reserve the right not to recognize any/ all deviations submitted after opening of the bid.
11.0	DEWATERING
	Contractor shall ensure at all times that his work area & approach / access roads are free from accumulation of water, so that the materials are safe and the operation of plant / progressive delivery schedule are not affected. No separate claim in this regard shall be admitted by BHEL. No separate payments for dewatering of subsoil, surface water or catchments water, if required, at any time during execution of the work including monsoon period shall be considered by BHEL.
12.0	TIME SCHEDULE/ COMPLETION PERIOD
	1. The Ready Mix Ready mix concrete (RMC) are likely to be required in stages for a period of 10 (Ten) months. Successful bidder, in consultation with site In-charge can be allowed for reduction of T&P, manpower deployed, after completion of major civil works. Contract period will be 10 (Ten) months from the date of start of work, as

	certified by Construction Manager, BRBCL FGD site. 2. Mobilization at site shall be done within 15 days from date of written intimation from BHEL. The exact date of start of work shall be reckoned based on certificate of Construction Manager, BHEL. 3. Weekly & daily requirement of RMC shall be finalized with designated representative of BHEL suitably and production/supply to be made accordingly. Records of such requirements shall be properly maintained. 4. The scope of work under this contract is deemed to be completed only when so certified by the site engineer of BHEL. The decision of BHEL in this regard shall be final and binding on you.
13.0	PRICE BID, CONTRACT PRICE & EVALUATION OF PRE-QUALIFICATION CRITERIA
	Bidders should quote prices in INR as per format, Volume-III provided in the tender. Bids shall be evaluated based on grand total price quoted.
14.0	TERMS OF PAYMENT
14.1	The contractor shall submit his running bill (RA bill) once in a month at the end of each month in line with payment terms / billing schedule indicated below. The RA bill complete in all respects accompanied by BHEL engineers certified / measurement sheet, jointly signed, will be paid after passing of the bill subject to completeness & correctness. The measurement will be taken as specified in terms & conditions of contract and certified by the BHEL engineer of actual work. However, no extra payment shall be made in the event of delay in release of payment. 95% pro-rata monthly RA payment shall be considered for payment based on monthly work completion certificate to be issued by BHEL engineer as per approved BBU/Price Schedule. The payment shall be released within 30 days from the date of receipt of complete invoice along with all necessary documents including Engineering Certificate.
14.2	Out of above 95%, 3% of gross bill amount shall be paid in the following manner on certification by BHEL engineer after compliance of each of following activity in each month. In case of non-fulfilment of respective activity by contractor in each month, no payment shall be made by BHEL against corresponding activity and no claim of bidder at a later date, whatsoever, in this regard shall be entertained by BHEL.
14.2.1	0.7 % shall be paid on compliance of housekeeping of contractor's working area and store/ office areas.
14.2.2	0.3 % shall be paid on compliance of general illumination of contractor's working area and stores, office area.
14.2.3	0.2 % shall be paid on compliance of applicable OHSAS requirement as per guidelines of BHEL/ PSER and as specified in the tender.
14.2.4	0.3 % shall be paid on compliance of applicable safety requirement as per guidelines of BHEL/ PSER and as specified in the tender.
14.2.5	1.5% shall be paid on submission of soft & hard copies of MSQR (Monthly Site Quality Report) related to all Field Quality activities which have to carry out at site as per approved FQP.
14.3	Balance 5% shall be paid after completion of warranty period of 3 months from the date of completion of work and handing over back of site / land to BHEL / NTPC.
14.4	Contractor shall make their own arrangement for making payment of impending labour wages and other dues in the meanwhile.
14.5	Contractor has to submit entry gate pass for cement and admixture required for the work to BHEL. Contractor have to submit entry gate pass along with royalty paid certificate for Fine & coarse aggregate required for the work to BHEL. In absence of the above their corresponding RA bills shall not be processed.

14.6	Subject to any deduction which BHEL may be authorized to make under the contract, the contractor shall on the certification of the BHEL engineer at site, be entitled to payment explained hereunder.
14.7	The bills will be sent to BHEL, Site Finance for scrutiny and payment will be made after processing / verification only.
14.8	The measurement will be taken by BHEL engineer as per relevant clause of specification and IS standard and certify regarding actual work executed in measurement book and bills for work. However, no additional payment shall be made in the event of delay in release of payment beyond the stated period.
14.9	All admissible recovery / adjustment, etc. shall be made from interim payable amount.
14.10	BHEL site at its discretion may split up percentage break up and effect payment to suit the site condition, cash flow requirement, according to the progress of work.
14.11	Payment shall be made as per order from BHEL site office The quoted / accepted price shall remain Firm throughout the contract period Including extension period, if any. However, price variation shall be paid / recovered as per relevant clause.
14.12	Applicable GST shall be released to you upon compliance of following:
14.12.1	You declaring such Invoice in your IFF/GSTR-1; and the same should be available to BHEL in FORM GSTR-2B electronically through the common portal.
14.12.2	Receipt of Goods / services and Tax Invoice by BHEL.
14.12.3	Confirmation of payment of GST thereon by you on GSTN Portal; and confirmation of payment of such GST to the Government through filing of GSTR-3B of corresponding month/quarter.
14.12.4	Above is subject to receipt of goods / service and tax invoice thereof along with you declaring invoice in your return and paying GST within timeline prescribed for availing ITC by BHEL.
15.0	TAXES, DUTIES ETC
15.1	Bidder's quoted/ accepted rates/ price shall be inclusive of all taxes including GST, Charges, Royalties, any State or Central Levy and other taxes for materials if any obtained for the work and for execution of the contract. Any increase of above at any stage during execution of contract, including extension of the contract, shall have to be borne by successful bidder contractor. However, any increase of GST subsequent to due date of offer submission as per NIT & TCN, by statutory authority during contract period (including extension, if the same is not attributable to you), shall be reimbursed by BHEL on production of relevant supporting document to the satisfaction of BHEL. Benefit of any decrease of taxes including GST, Charges, Royalties, any State or Central Levy and other taxes for materials if any obtained for the work and for execution of the contract; subsequent to due date of offer submission as per NIT & TCN, by statutory authority shall be passed on to BHEL.
15.2	DELETED
15.3	Successful bidder shall furnish proof of GST registration with GSTN Portal covering the services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by successful bidder on BHEL for this project / work.
15.4	Since GST on output will be paid by BHEL separately as enumerated above, bidder's your quoted rates / price should be after considering the Input Credit under GST law at bidder's end.

15.5	TDS under Income Tax Act shall be deducted as per prevailing IT rules from the bills.
15.6	TDS under GST shall be deducted as per prevailing GST rules from the bills.
15.07.01	You may collect TCS under section 206C(1H) of Income Tax Act, 1961 if applicable.
15.07.02	In case, you collect TCS under section 206C(1H) of Income Tax Act, 1961, following compliance is required.
15.07.02.01	TAN and PAN of vendor should appear in all invoices/claims. Copy of TAN /TCS registration is to be submitted.
15.07.02.02	Amount of TCS and Assessable value on which TCS has been calculated should be specified clearly in the invoice.
15.07.02.03	You shall be required to submit certificate of TCS in Form no. 27D within 15 days from the due date for furnishing the statement of tax collected at the source.
15.07.03	In case, you do not collect TCS under section 206C(1H) of Income Tax Act, 1961, following declaration is to be submitted along with each invoice: - "I/We hereby declare that I/We are not required to collect TCS under section 206C(1H) of Income Tax Act, 1961, on this bill.
15.07.04	In event of failure to comply with the provisions of the Act, or proper certificate not issued, or if tax collected but not remitted to the Government, or for any other reason and thereby causing loss to BHEL, the same shall be recoverable from the vendor with applicable interest.
15.07.05	You shall comply with all statutory amendment/ notifications in this respect.
15.08	Bidder shall note that GST Tax Invoice complying with GST Invoice Rules (Section 31 of GST Act & Rules referred thereunder) wherein the 'Bill To' details shall encompass following. BHEL GSTN – Refer attached GSTN code table of BHEL. Name - BHARAT HEAVY ELECTRICALS LIMITED Address - Shall be intimated later. Specific details of BHEL GSTN, Name and Address as stated above, shall be specified project specific orders.
15.09	Successful bidder to intimate immediately on the day of removal of goods (in case of any supply of goods) to BHEL along with all relevant details and send a scanned copy of Tax Invoice to BHEL through following communication mode for enabling BHEL to meet its GST related compliances. Portal address and Email address – Shall be intimated later. Specific details of above shall be intimated to successful bidder by BHEL at appropriate juncture.
15.10	In case of delay in submission of above-mentioned documents on the date of despatch, BHEL may incur penalty/ interest for not adhering to Invoicing Rules under GST Law. The same will be liable to be recovered from successful bidder, in case such delay is not attributable to BHEL.
15.11	In case of raising any Supplementary Tax Invoice (Debit / Credit Note), successful

	bidder shall issue the same containing all the details as referred to in Section 34 read with Section 31 of GST Act & Rules referred there under			
15.12	Successful bidder shall comply with the Time Limit prescribed under the GST Law and rules thereof for raising of the Tax Invoice. If any supply of goods is applicable, successful bidder shall also ensure prompt delivery of goods after despatch.			
15.13	Bidder shall note that in case GST credit is delayed / denied to BHEL due to delayed / non-receipt of goods and/or Tax Invoice or expiry of the timeline prescribed in GST Law for availing such ITC, or any other reasons, not attributable to BHEL, GST amount shall be recoverable from successful bidder along with interest levied/ leviable on BHEL, as the case may be.			
15.14	Successful bidder shall upload the invoices raised on BHEL in GSTR-1 within the prescribed time as given in the GST Act, and the same is available to BHEL in FORM GSTR-2A/2B electronically through the common portal. Bidder shall note that in case of delay in declaring such invoice in your return and GST credit availed by BHEL is denied or reversed subsequently as per GST Law, GST amount paid by BHEL towards such ITC reversal as per GST law shall be recoverable from the successful bidder along with interest levied / leviable on BHEL.			
15.15	Successful bidder to arrange for e-waybill for any movement of goods for the execution of the contract. Successful bidder has to make their own arrangement at their cost for completing the formalities, if required, with Issuing Authorities, for bringing materials, plants & machinery at site for execution of the works under this contract, Road Permit / Way Bill, if required, shall be arranged by successful bidder and BHEL will not supply any Road Permit/ Way Bill for this purpose.			
15.16	Any new taxes & duties, if imposed subsequent to due date of offer submission as per NIT & TCN, by statutory authority during contract period (including extension, if the same is not attributable to bidder, shall be reimbursed by BHEL on production of relevant supporting document to the satisfaction of BHEL. However, you shall obtain prior approval from BHEL before depositing new taxes and duties.			
15.17	Benefits and / or abolition of all existing taxes must be passed on to BHEL against new taxes, if any, proposed to be introduced at a later date.			
16.0	PRICE VARIATION CLAUSE/ ESCALATION			
16.1	ESCALATION / PRICE VARIATION CLAUSE shall be applicable as detailed below:			
16.1.1	In order to take care of variation in cost of execution of work on either side, due to variation in the index of Cement, Aggregate & Diesel, Price Variation Formula as described herein shall be applicable			
16.1.2	85% component of Contract Value shall be permitted to be adjusted for variation in various relevant indices during execution of work. The remaining 15% shall be treated as fixed component.			
16.1.3	SL NO	CATEGORY	INDEX	COMPONENT (K)
	i)	Cement	Monthly index numbers for ORDINARY PORTLAND CEMENT as per Office of the economic Adviser. (website: http://eaindustry.nic.in/home.asp)	45
	ii)	Aggregates	Monthly index numbers for STONE, CHIP as per Office of	35

			the economic Adviser. (website: http://eaindustry.nic.in/home.asp)	
	iii)	Diesel	Monthly index numbers for HSD as per Office of the economic Adviser. (website: http://eaindustry.nic.in/home.asp)	5
16.1.4	Payment / recovery due to variation in index shall be determined on the basis of the following notional formula without any initial absorption, in respect of the identified components viz Cement, Aggregate & Diesel. P = K x R x (Xn - Xo) / Xo Where P = Amount to be paid / recovered due to variation in the Index for Cement, Aggregates & diesel. K = Percentage component applicable for Cement, Aggregate & Diesel. R = Value of work done for the billing month Xn = Revised Index / price for Cement, Aggregates & diesel for the billing month under consideration. Xo = Index / price for Cement, Aggregates & diesel as on the Base date.			
16.1.5	Base date shall be calendar month of the date of LOI.			
16.1.6	PVC shall not be payable for the Supplementary / Additional Items, Extra works executed on man day rates basis.			
16.1.7	You shall furnish necessary monthly indices for Cement, Aggregate & Diesel from the relevant websites along with your Bills.			
16.1.8	You will be required to raise the bills for price variation payments on a monthly basis along with the running bills irrespective of the fact whether any increase / decrease in the index for relevant categories has taken place or not. In case there is delay in publication of bulletins (final figure), the provisional values as published can be considered for payments and arrears shall be paid / recovered on getting the final values.			
16.1.9	PVC shall be applicable for the entire original contract period plus the extended period. However, the Total Quantum of Price Variation amount payable/ recoverable shall be regulated as follows:			
16.1.10	For the portion of backlog attributable to you, the PVC will be based on the average of the indices for the period of the original contract period.			
16.1.11	For the period of Force Majeure, the PVC will be limited to the indices applicable at the beginning of the force majeure period.			
16.1.12	For the portion of backlog attributable to BHEL, the PVC will be as per the indices applicable for the respective months.			
16.1.13	The total amount of PVC shall be limited to 10% of executed contract value. Executed contract value for this purpose is exclusive of PVC, ORC, Supplementary / Additional Items, Extra works executed on man day rates basis.			
17.0	PROJECT MANAGEMENT/ CONSTRUCTION MANAGEMENT			
	To meet the need of construction management at site, contractor shall provide the following services within quoted / accepted rates.			
17.1	PLANNING & MONITORING			
17.1.1	The bidder shall prepare a detail supply schedule (L-3) as per requirement given in this document. This network must conform to the overall supply schedule. The bidder should also ensure monitoring of these activities at least weekly basis to start with and on daily basis whenever required by BHEL.			

17.1.2	DELETED	
17.1.3	The contractor's site office must have facilities of communications like Fax, E-mail, and telephone with STD facility within a month from LOI.	
17.2	PROGRESS REPORTING	
17.2.1	The bidder shall submit monthly progress reports for work force, materials, consumables (cement, aggregates, admixtures etc.) and other as per pro-forma considered necessary by BHEL. In case of any failure on contractor's part to comply with this, BHEL may at its discretion, consider to withhold part payment against their RA bills.	
17.2.2	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 program and the slippages do not accumulate and effect the overall program.	
17.2.3	The daily work force reports shall clearly indicate the work force deployed, category-wise specifying also the activities in which they are engaged.	
17.2.4	Weekly progress review meetings will be held at site during which actual progress during the week vis-à-vis scheduled program shall be discussed or actions to be taken for achieving targets. For discussions, the contractor shall present program of subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement.	
17.2.5	Periodic progress reviews on the entire activities of execution in respect of supply of ready mix concrete will be held once in a month at Kolkata / site. These meetings will be attended by reasonably higher officials of the contractor and will be used as a forum for discussing all areas where progress needs to be speeded up. The contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.	
17.2.6	During the contract / extended contract period contractor shall take an average ten colour digital photograph (soft copy) / slides each month (not less than two per week) of the works during progress. In case of failure in providing such photograph in each month, an amount of Rs. 5000/- per month shall be deducted from contractor's RA bill.	
17.3	SITE ORGANIZATION	
17.3.1	The contractor shall maintain a site organization of adequate strength in respect of manpower, construction machinery and other implements at all time for smooth execution of the contract headed by a competent construction manager for site operations with sufficient level of authority to take site decisions. The vendor will submit organization chart (showing the name of SITE-IN-CHARGE) with individual bio-data indicating various levels of experts to be posted for supervision and execution, quality, material management, planning, safety, etc. The organization shall be reinforced from time to time, as required to make up slippage (if any) from the schedule without any commercial implication to BHEL. The organization chart is to be submitted within 10 days from the date of LOI.	
17.3.2	Following (minimum) engineering manpower with power plant construction background to be deployed at site by the successful vendor for their day to day supervision etc.	
17.3.2.1	Qualified safety officers (exclusive for safety supervision).	One No.
17.3.2.2	Quality Engineer & Quality Assistant	One no Engineer (Minimum 5 years' Experience) One Quality assistants (min. Diploma In Civil Engineering)
17.3.2.3	Deputation of above man-power shall be jointly decided at site in line with requirement.	
17.3.2.4	Engineer / supervisor for other functions like store & purchase, material management, fin, administration etc. are to be provided as per site requirement and not considered above.	

17.3.2.5	In the event of non-deputation of engineer/ supervisor by the bidder as per above agreed schedule, BHEL shall reserve the right to deduct Rs. 55000/- per man-month for engineer, Rs. 45000/- per man-month for the supervisor / safety officer / Assistant from RA bills. Further induction of manpower regarding site supervisor & site engineer will be decided at site as per requirement without any financial implication.
17.3.2.6	BHEL reserves the right to reject or approve the list of personnel proposed by the contractor. The persons whose bio-data have been approved by BHEL will have to be posted at site and deviation in this regard will not be permitted unless specific & reasonable justification is made.
17.3.2.7	In addition to above, a well experienced qualified engineer to be designated, as 'Project Co-coordinator', shall be deployed by the contractor. Such engineer shall have adequate exposure on the job and shall remain fully involved in all planning activities, guidance etc. to contractor's own team during the complete execution period of contract.
17.3.2.8	The contractor should also submit to BHEL for approval a list of T&Ps along with their fitness certificates. The tools & tackles shall not be removed from site without written permission of BHEL.
17.3.2.9	Parallel working of all installed batching plants is envisaged. Hence every batching plant should have independent Batching Plant operator, Transit mixer operator and adequate supporting staff round the clock to cater all the batching plants as per requirement. However, with prior intimation routine maintenance shall be allowed phase wise.
18.0	QUALITY ASSURANCE & QUALITY CONTROL
18.1	INSPECTION & FIELD QUALITY ASSURANCE
18.1.1	Contractor shall carry out all activities conforming to the approved Field Quality Plan (FQP) & technical instructions as revised from time to time. 'Total Quality' shall be the watchword of the work and contractor shall strive to achieve the quality standards, procedures laid down by BHEL. He shall follow all the instructions as per BHEL drawings and quality standards. Contractor shall provide the services of quality assurance engineer as per the relevant clauses.
18.1.2	Preparation of quality assurance log sheets and protocols with customer / consultants / statutory authority, welding logs, NDE records, testing & calibration records and other quality control and quality assurance documentation as per BHEL engineer's instructions, is within the scope of work / specification. These records shall be submitted to BHEL / customer for approval from time to time.
18.1.3	The protocols between contractor and customer / BHEL shall be made for correctness of foundations, materials, procedures, at each stage of installation, generally as per the requirement of customer / BHEL. This is necessary to ensure elimination of errors and to avoid accumulation and multiplication of errors.
18.1.4	A daily log book (with proper indexing) should be maintained by every supervisor / engineer of contractor, for respective area of work, on the job for detailing and incorporating alignment/ clearance / centering / levelling readings and inspection details of various equipment, etc. This log book shall be always accessible to BHEL engineers. High pressure welding (as applicable under the scope of this contract) details like serial number of weld joints, welders name, date of welding, details of repair, heat treatment etc. will be documented in welding log as per BHEL Engineer's instructions. Record of radiography (as applicable under the scope of this contract) containing details like serial number of weld joints, date of radiography, repairs, if any, re-shots etc shall also be maintained as per BHEL Engineer's instructions. Record of heat treatments (as applicable under the scope of this contract) performed shall be maintained as prescribed by BHEL.
18.1.5	The performance of welders (as applicable under the scope of this contract) will be reviewed from time

	to time as per the BHEL standards. Welders' performance record shall be furnished periodically for scrutiny of BHEL's Engineer. Corrective action as informed by BHEL shall be taken in respect of those welders not conforming to these standards. This may include removal/ discontinuance of concerned welder(s). Contractor shall arrange for the alternate welders immediately.
18.1.6	Only welders duly authorized by BHEL / customer / consultant after welder qualification test as per ASME Sec-Ix / AWS D1.1 (as applicable) shall be engaged on the work. All the welders shall carry identity cards as per the proforma prescribed by BHEL / Customer / Consultant.
18.1.7	Any re-laying or re-termination of cables / re-erection of instruments / recalibration of instruments etc. required due to contractor's mistake and found at any stage inspection, shall be carried out by the contractor at no extra cost. Repair / rectification procedure to be adopted to make any job acceptable shall be subject to the approval of BHEL.
18.1.8	Weekly Quality Review Meeting at site shall be organized by BHEL to discuss quality issues and next weeks inspection plans. Site in-charge of the contractor along with QAEs of the contractor must be present in the meeting with closure report of the issues raised by BHEL in the previous meetings.
18.2	**REQUIREMENT OF ISO 9001**
18.2.1	BHEL: PSER is accredited with ISO 9001 certification and as such this work is subject to various audits to meet ISO 9001 requirements.
18.2.2	The basic philosophy of the Quality Management System under ISO 9001 is to define the organizational responsibility, work as per documented procedures, verify the output with respect to acceptance norms, identify the non-conforming product / procedure and take corrective action for removal of non-conformance specifying the steps for avoiding recurrence of such non-conformities, & maintain the relevant quality records. The non-conformities are to be identified through the conduct of periodical audit of implementation of quality systems at various locations/stages of work. Suppliers / vendors of various products / services contributing in the work are also considered as part of the quality management system. As such the contractor is expected not only to conform to the quality management system of BHEL but also it is desirable that they themselves are accredited under any quality management system standard.
18.2.3	BHEL reserves the right to carry out quarterly quality audits and quality surveillance of the systems and procedures of contractor's quality management. Contractor shall provide all necessary assistance to enable BHEL to carry out such audit & surveillance.
18.2.4	Quality audits / approval of the results of test & inspection will not prejudice the right of BHEL to reject an equipment service not giving desired performance and shall not in no way limit the liabilities and responsibilities of the contractor in earning satisfactory performances of equipment / service as per specification.
18.3	**MMEs / MMRs**
18.3.1	Contractor shall ensure deployment of reliable and calibrated MMEs (Measuring and Monitoring Equipment). The MMEs shall have test / calibration certificates from authorized / Government approved / Accredited agencies traceable to National / International Standards. Re-testing / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL

	Engineer within the contract price. The contractor will also have alternate arrangements for such MMEs so that work does not suffer when the particular equipment / instrument is sent for calibration. Also if any MMEs 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 MME and retake the readings at Contractor's cost.
18.3.2	Contractor shall provide all the Measuring Monitoring Equipment (MMEs) required for completion of the work satisfactorily. These MMEs shall be of brand, quality and accuracy specified by BHEL Engineer and should have necessary calibration and other certificates as per the requirement of BHEL Engineer. Decision of BHEL Engineer regarding acceptance or otherwise of the measuring instruments / gauges / tools for the work under this specification, is final and binding on the contractor. BHEL shall give an indicative list of MMEs required for this work else where in this contract and to be made available by the contractor. The list will be reviewed by BHEL site as per the requirement of approved FQPs and the contractor shall meet any augmentation needed wherever required.
18.3.3	It is the responsibility of the contractor to prove the accuracy of the testing / measuring / calibrating equipment brought by him based on the periodicity of calibration as called for in the BHEL's quality assurance standards/BHEL Engineer's instructions.
18.3.4	Re-work necessitated on account of use of invalid MMEs shall be entirely to the contractor's account. He shall be responsible to take all corrective actions, including resource augmentation if any, as specified by BHEL to make-up for the loss of time.
18.3.5	In the courses of erection, it may become necessary to carry repeated checks of the work with instruments recently calibrated, re-calibrated. BHEL may counter / finally check the measurements with their own MMEs. Contractor shall render all assistance in conduct of such counter / final measurements.
18.4	**INSPECTION BY TS / FES / QA ENGINEERS OF BHEL UNITS / ENGINEERING CENTRES**
18.4.1	Apart from day-to-day inspection by BHEL Engineers stationed at Site and Customer's Engineers, stage inspection of equipment under erection and commissioning at various stages may also be conducted by teams of Engineers from Field Engineering Services of BHEL's Manufacturing Units, Quality Assurance teams from Field Quality Assurance, Unit/Factory Quality Assurance and Commissioning Engineers from Technical Services etc. Contractor shall arrange all labour, tools and tackles etc along with proper access for such stage inspections free of cost.
18.4.2	Any modifications suggested by BHEL FES and QA Engineers' team shall be carried out. Claims of contractor, if any, shall be dealt as per applicable clause of the contract, and provided such modifications have not arisen for reasons attributable to the contractor.
18.5	CONFORMANCE TO THE STATUTORY REQUIREMENTS (AS APPLICABLE UNDER THE SCOPE OF THE CONTRACT)

18.5.1	The work to be executed under these specifications has to be offered for inspection, at appropriate stages of work completion, to various statutory authorities for compliance with applicable regulations.The work related statutory inspections, though not limited to, are as under: 1) Factory Inspector, Labour Commissioner, PF Commissioner and other authorities connected to this project work. The scope includes getting the approvals from the statutory authorities, which includes arranging for inspection visits of statutory authority periodically as per BHEL Engineer's instructions, arranging materials for ground inspection, taking rub outs for stamping of the pressure parts / pipes to be offered for inspection, submitting co-related inspection reports, documents, radiographs etc and following up the matter with them. Contractor shall also make all arrangements for offering the Products / Systems for inspection at location, as applicable, to the concerned authority.			
18.5.2	DELETED			
18.5.3	DELETED			
18.5.4	DELETED			
18.6	DELETED			
18.7	PENALTIES ON VENDORS / SUB-CONTRACTORS AGAINST NON-COMPLIANCE OF QUALITY NORMS			
Sl. No.	**Nature of Non-compliance**	**Penalty for Domestic Project**	**Penalty for Export Project**	**Remarks**
GENERAL				
18.7.1	Unavailability of QAE deployment schedule (duly approved by BHEL Site) matching with manpower requirement of approved L2 schedule	0.10%	0.10%	Against each RA bill
18.7.2	Unavailability of required number of QAE with proper experience & NDT certification as per the requirement of the Contract	Rs.1,000.00	$16.00	Per person per day
18.7.3	Not attending quality meeting of BHEL by nominated member of vendor / sub-contractor	Rs.2,000.00	$32.00	Per meeting
CALIBRATION				
18.7.4	Use of MMEs without valid calibration certificate	Rs.1,000.00	$16.00	Per equipment per instance
18.7.5	Use of NDT equipment, welding equipment without having valid calibration certificate / condition not as per requirement	Rs. 1,000.00	$16.00	Per equipment per instance

PROTOCOLS & LOG SHEETS				
18.7.20	Delay in preparation of Protocols / Logsheets as per approved FQP within 3 days of completion of checks.	Rs. 200.00	$3.00	Per protocol per day delay
18.7.21	Delay in offering inspection of Bought-out Items / Consumables / Aggregates (for items which need site inspection as per approved QP) within 3 days of receipt of material at site	1% of the item value of the LOT	1% of the item value of the LOT	per item per day delay after receipt of material
18.7.22	Delay in submission of required documents (viz. Invoice, Inspection Release Note, COC, MDCC, MTC as the case may be) of Bought-out Items (shop inspection items / consumables) within 3 days of receipt of material at site.	1% of the item value of the LOT	1% of the item value of the LOT	per item per day delay after receipt of material

NOTE:

Any non-conformity requiring dismantling / rework, attributable to vendor / sub-contractor, shall be penalised at a rate mentioned above or cost to BHEL, whichever is higher.

19.0	DELETED
20.0	DELETED
21.0	HEALTH, SAFETY & ENVIRONMENT
21.1	Bidder has to follow HSE norms at project site during execution of entire contract period as per Annexure-A.
22.0	DELETED
23.0	INTEREST BEARING RECOVERABLE ADVANCE/ MOBILISATION ADVANCE
	Not applicable for this tender
24.0	OVER RUN CHARGES
	Not applicable in this tender.
25.0	LIQUIDATED DAMAGES
25.1	Since time is the main essence of the contract, the mobilization by bidder is to be made within the time limit prescribed in relevant clause of the tender. In case contractor fails to mobilize within the period specified in the contract, BHEL will reserves the right to levy liquidated damages at the rate of 0.5% (half percent) of the awarded contract value delayed for each week of delay or part thereof without prejudice to any other relief or compensation due to BHEL under any other conditions of the order subject to a maximum limit of 10% of total contract value. In case of delay in mobilization of bidder, for reasons not attributable to BHEL, the `Liquidated Damages' clause shall be strictly enforced, unless extension of delivery date is granted through an amendment to the work/ purchase order.
25.2	COMPENSATION FOR NON-PERFORMANCE
25.2.1	In the event of failure to meet the daily /weekly/monthly targets of RMC supply, BHEL reserves the right to arrange the required quantity of RMC from alternative sources. Any additional cost incurred in this arrangement, along with a 5 % overhead charge, shall be recovered from the running bills of the bidder.
26.0	GUARANTEE / WARRANTY
26.1	The contractor will be responsible for the quality of ready mix concrete supplied, quality of materials.

	In case the ready mix concrete fail to give the required strength, the cost of re-test, demolition & other cost / charges shall be recovered from the vendor. Decision of Engineer in this regard is final & binding on the vendor.
26.2	Guarantee / warranty period shall be 3 months from the date of supply of last lot of ready mix concrete & submission of accepted test results of ready mix concrete specimens. Commencement of guarantee period shall be from the date completion of work under this contract as certified by BHEL.
27.0	EXTENSION OF TIME FOR COMPLETION
27.1	If the completion of work as detailed in the scope of work gets delayed beyond the contract / completion period due to reasons not attributable to contractor, the contractor shall make request for an extension of the contract and BHEL at its discretion may extend the contract. However such extension shall not entitle the vendor for price revision or price compensation as this being FIRM price contract.
27.2	However, if any 'Time extension' is granted to the contractor to facilitate continuation of work and completion of contract, due to backlog attributable to the contractor alone, then it shall be without prejudice to the rights of BHEL to impose penalty / LD for the delays attributable to the contractor, in addition to any other actions BHEL may wish to take at the risk and cost of contractor.
27.3	A joint program shall be drawn for the balance amount of work to be completed during the period of 'Time Extension', along with matching resources to be deployed by the contractor as per specified format. Review of the programme and record of shortfall shall be done.
27.4	During the period of 'Time extension', contractor shall maintain their resources as per mutually agreed program
27.5	At the end of total work completion as certified by BHEL engineer, and upon analysis of the total delay, the portion of time extensions attributable to (i) Contractor, (ii) Force majeure conditions, and (iii) BHEL, shall be worked out and shall be considered to be exhausted in the same order. The total period of time extensions shall be the sum of (i), (ii) and (iii) above and shall be equal to period between the scheduled date of completion and the actual date of completion of contract. LD shall be imposed/ levied for the portion of time extensions attributable solely to contractor after adjusting delay attributable to BHEL& Force majeure and recoverable from the dues payable to the contractor.
28.0	PERFORMANCE BOND
	Performance bond is not applicable.
29.0	CERTIFICATE TOWARDS COMPLETION
	The work under the scope of the contractor shall be deemed to have been completed in all respects only when so certified by BHEL / owner. The decision of BHEL in this regard shall be final and binding on the contractor.
30.0	SPLITTING OF THE CONTRACT
	Not Applicable
31.0	CIVIL LABORATORY
31.1	Vendor shall arrange quality laboratory for a period of 10 months or extended period.
31.2	Ready mix concrete Cubes shall be taken at site as per FQP / instruction of BHEL and the same shall be tested at Site / Govt. approved laboratory / Institution if required at your own cost.
31.3	Other than above mentioned test, any testing required to be carried out at site as per FQP / joint discussion at site and technical specification have to be arranged by you for all the works at your own cost
32.0	CONSTRUCTION SCHEDULE
32.1	Entire work shall be carried out in accordance with the broad supply schedule given below, within the stipulated period. Within 30 days of LOI, the contractor shall discuss with BHEL site engineer & furnish detail construction schedule (L-3/ L-4) indicating all major activities and get it approved from BHEL engineer. This schedule will undergo review and based on progress vis-à-vis project

	requirement, contractor shall have to submit revised schedule for approval of BHEL.		
32.1.1	Sl no.	Major Milestone	Time from date of intimation from BHEL
	1	Report to Construction Manager / BHEL Site	07 days
	2	Completion of Installation of 1st Batching Plant/SML	15 days
	3	Start of production of Ready mix concrete	15 days
32.2	Approved design mix will be provided by BHEL.		
32.3	The contractor shall plan his work in such a manner so as to meet the overall project schedule, in consultation with BHEL/ NTPC engineer		
32.4	Contractor shall submit daily work program based on above construction schedule. Deferment of above schedule is not acceptable. Contractor will adhere to schedule and resource planning to be augmented to ensure completion as per schedule.		
32.5	Periodic progress reviews on the entire activities of execution in respect of supply & works in scope of contractor will be held once in a month at Kolkata / site. These meetings will be attended by reasonably higher officials of the contractor and will be used as a forum for discussing all areas where progress needs to be speeded up. The contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.		
32.6	Above schedule is indicative. The contractor shall plan his work in such a manner so as to meet the overall project schedule, in consultation with BHEL/BIFCL Engineer.		
33.0	MATERIAL HANDLING		
33.1	No material is envisaged to be issued by BHEL in this contract.		
33.2	However, all the materials (to be supplied by you as envisaged & cement) are to be handled by you and you will be solely responsible for safe custody of the same.		
34.0	TOOLS & PLANTS (TO BE PROVIDED BY CONTRACTOR)		
34.1	Tentative list of T&P to be deployed by contractor for successful completion of work is detailed below. It may be noted that the list is not exhaustive and is only for general guidance. The contractor is required to provide all necessary T&P measuring (calibrated) instruments & handing equipment to maintain work progress for timely completion of total work as per contract. In case of project requirement, some activities may have to pre-pone, in such cases the contractor may have to deploy additional T&P. Quoted rate shall be inclusive of such emerging requirements. However, contractor shall submit deployment plan of all T&P along with tender bid.		
34.2	Following Major T&Ps to be deployed by contractor within the indicated time from date of LOI / hand over of site which is applicable.		
	Major T&P items		Time from date of intimation from BHEL
34.2.1	1 No. 40'0" x 8'0" and 1 Nos. 20'0" x 8'0" for office Porta Cabin or equivalent.		Within 10 days
34.2.2	1 Nos. Pay loader-with minimum capacity of 1.2 Cum		Within 10 days
34.2.3	Total 15 Cum/Hr. capacity of Automatic Batching Plant with Printing facility with required Silo for storing of Cement to be commissioned at Site.		Within 10 days
34.2.4	1 Nos. DG set 125KVA (if Bathing plant Set up)		Within 10 days
34.2.5	Vendor shall arrange quality laboratory, Equipment & Instrument as per Annexure - A		Within 10 days
34.2.6	Ready mix concrete compressive strength testing moulds– 24 Nos.		Within 10 days
34.2.7	1 no drinking water tank – 1000 lit.		Within 10 days
34.2.8	1 Nos. self-priming water pump 5HP (diesel / electric)		Within 15 days
34.2.9	2 Nos. dumper		Within 10 days

34.2.10	2 Nos. Welding rectifier	As per requirement
34.2.11	Portable fire extinguishers as below: Soda acid – 2 sets. Dry chemical powder – 2 sets CO2 – 2 sets. Water & sand bucket (4 buckets in one stand) – 2 sets. Fire hose with nozzle (50 M length) – 2 sets	Within 10 days
34.3	In the event of any failure on the part of the contractor to deploy T & P to sustain desired work progress, BHEL may at his discretion also terminate the contract on this ground and take out any or whole amount of the contract from the scope of the contractor. In the event of failure of contractor to deploy necessary and sufficient T&P/ IMTEs to maintain work progress, BHEL will be at liberty to arrange the same at the risk & cost of contractor including transportation cost of same from any of BHEL site/ other agency & charges as applicable shall be deducted from contractor's RA bill. Decision of BHEL in this regard will be final & binding on contractor.	
34.4	Batching Plant shall not be more than 1 year old. All the batching plants shall maintain adequate spares to cater immediate day to day maintenance.	
34.5	T&P shown in the above-mentioned list are tentative based on planned progress requirement, construction schedule and material availability at site. It is to be reviewed and mutually agreed with CM, BHEL site periodically from time to time for mobilization of major T&Ps, and the same have to be adhered to. No change will be permitted without written approval of Construction Manager, BHEL site. Further requirement will be reviewed time to time at site and contractor will provide additional T&P/equipment to ensure completion of entire work within schedule time without any financial implication to BHEL. All other T&Ps shall be provided by the contractor without any extra cost to BHEL. Vendor will give advance intimation & certification regarding capacity etc. prior to dispatch of heavy equipment.	
34.6	All T&P and all 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.	
34.7	In the event of non-mobilization of any T&P by the successful bidder and as a result progress of work suffered, BHEL reserves the right to deduct suitable amount from the dues of the bidder, with assigning reasons thereof on market Rate.	
35.0	OTHER TERMS	
35.1	All other term & conditions of this specification shall be governed by the pertinent provisions of GCC and other volumes of this tender, as applicable.	

ANNEXURE- A
LIST OF EQUIPMENTS FOR CIVIL SITE LABORATORY

SL NO.	NAME OF TEST	NAME OF EQUIPMENT	SIZE OF EQIPMENT	IS REF.
1	Initial & final setting time, Consistency of cement	Vicat Apparatus with desk pot	Standard	IS 5513
2	Abrasion value test	Los Angles Abrasion testing machine	Standard	IS 2386
3	Aggregate Impact value test	Aggregate Impact value testing machine.	Standard	IS 9377
4	Aggregate crushing value test	Crushing value apparatus	Standard	IS 2386
5	Flakiness index	Thickness gauge for measuring flakiness index.	Standard	IS 2386
6	Elongation Index	Elongation gauge	Standard	IS 2386
7	Bulk density, voids and bulking apparatus	Measuring cylinders	3, 5,10 & 15 liters cylinders	
8	Ready mix concrete Compressive test	Digital Compressive Testing Machine.	2000KN capacity	IS 2505
9	Cement cube casting	Cube mould	70.6 x 70.6 x 70.6 mm, 09 Nos. minimum	IS 10086
10	Ready mix concrete Cube Testing	Ready mix concrete Cube Mould	150x150x150mm, minimum 24 Nos.	IS 10086
11	Workability of ready mix concrete	Slump cone	Standard, at least 02 nos	IS 456
12	Specific gravity of aggregates	Pycnometer	Standard, at least 01 nos	IS 383
13	Course aggregate Sieve analysis (Ready mix concrete & Road Works)	Sieve set	450mm dia GI Frames Size: 125 mm, 90 mm, 75 mm, 63 mm, 53 mm, 40 mm, 20 mm, 16 mm, 12.5 mm, 10 mm, 4.75 mm, Pan and cover (1 Sets)	IS 383
14	Fine aggregate sieve analysis	Sieve set	200 mm dia Brass sieves; Size 4.75 mm, 2.36 mm, 1.18 mm 600 micron, 300 micron, 150 micron, 75 micron, 75 micron, Pan and cover (1 Sets)	IS 383
15	Silt content check	Sand silt content beaker	Standard	

Process Control Accessories				
Sl	Description of Equipment	Specification	Size / No.	
1	Hot air oven	Temperature range 50° C to 300° C	600 x 600 x 600 mm (min. size)	
2	Electronic balance	600g x 0.01g, 10Kg and 50 kg	1 nos.	
3	Physical balance	5 kg capacity	Loose weights up to 5 kg	
4	Thermometer	Temperature 0°C to 50°C	1 No. Digital	
5	Measuring jars	100ml, 200ml, 500ml & 1000 ml	1 nos. set of each size	
6	Gauging trowel	100mm & 200 mm with wooden handle	2 nos.	
7	Spatula	100mm & 200 mm with long blade wooden handle	1 nos. each size	
8	Stainless steel scoop	2 kg and 5 kg	1 nos. each	
9	Digital pH meter	0.1 least count	01 nos.	
10	GI tray	600 x 450 x 50 mm, 450 x 300 x 40 mm, 300 x 250 x 40 mm	01 nos. each	
11	Electric mortar mixer	0.25 CUM capacity.	01 no	

(ISO 9001 : 2015)

Centre for Construction Development & Research
National Council for Cement and Building Materials
(Under the Administrative Control Ministry of Commerce & Industry, Govt. of India)
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राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद्
(भारत सरकार के वाणिज्य एवं उद्योग मंत्रालय के प्रशासनिक नियंत्रण)
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By Speed Post/Email

Ref: CDR/SP-6439
19 December 2022

Sh. Rahul Sharma
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(Through: Head of Centre – CDR)

Sub: Evaluation of Materials & Concrete Mix Design for Civil Work of FGD System at 4x250 MW BRBCL Nabinagar FGD System.

Ref:
1. **Your Letter ref. BRBCL/FQA/2022/BHEL/SHIVALIK-Design Mix M-30 dated 20.06.2022**
2. **Email received from M/s Shivalik Buildtech dated 22.06.2022**
3. **Our Letter ref. CDR/SP-0 dated 24.06.2022 and CDR/SP-0 dated 06.07.2022**
4. **Your email dated 11.07.2022**

We are pleased to enclose herewith the **FINAL REPORT** covering the entire scope of work

Thanking you

Yours faithfully
National Council for Cement and Building Materials

Suresh Kumar
Manager & PL-CON

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Evaluation of Materials & Concrete Mix Design for Civil Work of FGD System at 4x250 MW BRBCL Nabinagar FGD System

FOR

BHARTIYA RAIL BIJLEE COMPANY LIMITED

CDR/SP-6439
DECEMBER 2022
FINAL REPORT

Centre for Construction Development and Research
NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
34 Km Stone, Delhi-Mathura Road, NH-2, Ballabgarh – 121 004, Haryana

Evaluation of Materials & Concrete Mix Design for Civil Work of FGD System at 4x250 MW BRBCL Nabinagar FGD System

FOR

BHARTIYA RAIL BIJLEE COMPANY LIMITED

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NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
34 Km Stone, Delhi-Mathura Road, NH-2, Ballabgarh – 121 004 (Haryana)

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CONTENTS

CONCLUSIONS AND RECOMMENDATIONS

1.0 TESTS ON CEMENT SAMPLES

The cement samples PPC (Brand: Ultratech and Double Bull) were tested for various physical and chemical properties and the test results are presented in Table I and Table II respectively. On perusal of test results, it is seen that the available physical and chemical test results of PPC (Brand: Ultratech and Double Bull) conform to the various requirements of IS: 1489 Part-1. However, the value of insoluble residue for PPC should be checked at your end using manufacturer's certificate.

2.0 PHYSICAL TESTS ON COARSE AGGREGATE

On perusal of the test results of 10-20 mm coarse aggregate, it is seen that:

i) The available test results of 10-20 mm coarse aggregate sample provided by the sponsor meets the various physical requirements of IS: 383-2016 except combined elongation and flakiness index. The test results are presented in Table III-A and III-B.

ii) **The combined elongation and flakiness index of this coarse aggregates fraction is 46.7%. As per IS 383: 2016 – "The combined flakiness and elongation index shall not exceed 40 percent for uncrushed or crushed aggregate. However, the engineer-in-charge at his discretion may relax the limit keeping in view the requirement, and availability of aggregates and performance based on tests on concrete."**

On perusal of test results of 4.75-10 mm coarse aggregate, it is seen that the sieve analysis of this coarse aggregates fraction conforms to the grading requirement of IS: 383-2016 for single sized aggregate of nominal size.

3.0 PHYSICAL TESTS ON FINE AGGREGATE (NATURAL)

The fine aggregate sample provided by the sponsor meets the above-mentioned physical requirements of IS: 383-2016 & conforms to grading Zone II. The test results are given in Table IV-A & IV-B.

4.0 ACCELERATED MORTAR BAR TEST

(a) Coarse aggregate: The expansion of this coarse aggregate sample at 16 days after casting, i.e., **0.02%** is less than 0.1%. Therefore, this coarse aggregate sample can be classified as **innocuous** as per ASTM C-1260 and is suitable for making concrete.

The test result is given in Table V.

(b) Fine aggregate The expansion of this fine aggregate sample at 16 days after casting i.e. **0.03%** is less than 0.1%. Therefore, this fine aggregate sample can be classified as **innocuous** as per ASTM C-1260 and is suitable for making concrete.

The test result is given in Table V.

5.0 PETROGRAPHIC AND MINEROLOGICAL ANALYSIS

5.1 Coarse aggregate 10-20 mm

The petrographic and mineralogical analysis of the coarse aggregate sample was carried out as per IS 2386 part VIII. This is a composite sample of Granite and Biotite-Granite and the detailed report is enclosed as Annexure I.

5.1.1 Coarse aggregate 10-20 mm- Granite

This is a coarse grained textured partially weathered random sample of Granite. The strained quartz percentage and their UEA are within permissible limits. Feldspar grains are partially fractured, shattered and altered. The quality of the coarse aggregate is fair. The mineralogical structural textural features of the coarse aggregate suggest carrying out further test to ensure that the coarse aggregate is not reactive.

5.1.2 Coarse aggregate 10-20 mm – Biotite-Granite

This is a medium to coarse grained textured partially weathered random sample of Biotite-Granite. The strained quartz percentage and their UEA are within permissible limits. Feldspar grains are partially fractured, shattered and altered. The quality of the coarse

aggregate is fair. The mineralogical structural textural features of the coarse aggregate suggest carrying out further test to ensure that the coarse aggregate is not reactive.

5.2 Fine Aggregate

The petrographic and mineralogical analysis of the fine aggregate sample was carried out as per IS 2386 part VIII. The detailed report is enclosed as Annexure I.

This is a fine grained textured random sample of the fine aggregate. The strained quartz percentage and their UEA are within permissible limits. Feldspar grains are partially shattered and fractured. Mica grains are partially iron leached. The quality of the fine aggregate is fair.

Mica content: 3 % (% by weight).

5.0 TESTS ON WATER SAMPLE

Water sample provided by the sponsor was tested for various parameters of IS 456:2000 and meets the requirements of IS 456:2000. The results are given in Table VI.

6.0 CONCRETE MIX DESIGN

Final recommendations for Concrete Mix Design based on 28 days' compressive strength, are enclosed as Annexure -II.

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1.0 INTRODUCTION:

The sponsor Bhartiya Rail Bijlee Company Limited requested National Council for Cement and Building Materials (NCB) to take up the Evaluation of Material and Concrete Mix Design for the civil work of FGD System at 4x250 MW BRBCL Nabinagar FGD, vide their letter ref. BRBCL/FQA/2022/BHEL/SHIVALIK-Design Mix M-30 dated 20/06/2022. Subsequently NCB submitted its revised proposal vide its letter ref no. CDR/SP-0 dated 06th July 2022 and BRBCL accepted the proposal vide their email dated 11th July 2022. The scope of work is given below:

1.1 SCOPE OF WORK

A. Evaluation of Cement Sample (Physical and Chemical Parameters)

i) To carry out different physical tests on **two cement samples (Brands: PPC Ultratech, PPC Double Bull)** i.e., specific gravity, Blaine's fineness, initial and final setting time, soundness, compressive strength at 3, 7 and 28 days as per IS 4031 and drying shrinkage.

ii) To carry out chemical analysis of the cement sample as per IS: 4032, including the total alkali content of the cements (Na_2O equivalent).

iii) To prepare a report based on test results of **i)** and **ii)** above and to advise regarding suitability of cement.

B. Evaluation of Aggregates (Physical Parameters)

i) To carry out different tests on **one coarse aggregate sample** i.e. specific gravity, water absorption, sieve analysis, deleterious material (except coal & lignite), soundness, crushing value, impact value, combined flakiness & elongation index and abrasion value as per IS 2386.

ii) To carry out different tests on **one fine aggregate sample** i.e., specific gravity, sieve analysis, water absorption, soundness, deleterious material (except coal & lignite), silt content (materials finer than 75 micron-wet sieving), clay lumps, organic impurities and mica content as per IS:2386.

iii) To prepare a report based on test results of **i)** and **ii)** above and to advise regarding suitability of coarse and fine aggregates.

C. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity

i) Evaluation shall be carried out for one coarse aggregate* and one fine aggregate sample.

ii) The study shall include Petrographic and Mineralogical analysis of one fine aggregate sample and one coarse aggregate sample as per IS: 2386 Part VIII. Mineralogical details shall be analyzed covering the absence/presence of reactive aggregates prone to Alkali-Silica reaction.

iii) To carry out Accelerated Mortar bar test on one fine aggregate sample and one coarse aggregate sample as per ASTM C 1260.

iv) Analysis and interpretation of test results of ii) & iii) above.

v) Preparation of testing and evaluation report covering suitability of the aggregates.

* Only one fraction of coarse aggregate will be taken assuming that different size fractions are from the same source.

D. Evaluation of Water Sample

To carry out different physical and chemical tests on **one water sample** as per IS: 456 and IS: 3025.

E. Concrete Mix Designs

The following design mixes will be carried out at our laboratories:

Sl. No	Grade of Concrete	Slump	Exposure Condition as per Table 5 of IS 456:2000	Restriction on Min cement content and Max W/C ratio	Admixture use (Y/N)	Type & Brand of Cement	Admixture Brand
1.	M30	80-120 mm	Moderate	As per IS 456: 2000	Yes	PPC Ultratech	Chryso Delta G6143
2.	M30					PPC Double Bull	

2.0 SAMPLES RECEIVED

Please note that the following materials have been provided by the sponsor for material evaluation and concrete mix designs on 25.06.2022

Sl. No.	Material description received on 25.06.2022	Quantity (Approx)	Source/Brand
1.	Cement	04 bags	Ultratech PPC, Week No.20
2.	Cement	04 bags	Double Bull PPC, Week No.20
3.	Coarse Aggregates (20mm)	100 kg	Not mentioned in letter
4.	Coarse Aggregates (10mm)	100 kg	Not mentioned in letter
5.	Fine Aggregate	100 kg	Not mentioned in letter
6.	Chemical Admixture	05 kg	Chryso Delta G6143
7.	Water	40 litres	Not mentioned in letter

3.0 TESTS ON CEMENT SAMPLES

The cement samples PPC (Brand: Ultratech and Double Bull) were tested for various physical and chemical properties and the test results are presented in Table I and Table II respectively. On perusal of test results, it is seen that the available physical and chemical test results of PPC (Brand: Ultratech and Double Bull) conform to the various requirements of IS: 1489 Part-1.

However, the value of insoluble residue for PPC should be checked at your end using manufacturer's certificate.

4.0 PHYSICAL TESTS ON COARSE AGGREGATES (Received on 25.06.2022)

4.1 Coarse Aggregate (10-20 mm): The following tests were conducted on this coarse aggregate sample as per IS: 2386-1963.

a) Specific Gravity

b) Water Absorption

c) Sieve Analysis

d) Impact Value

e) Abrasion value

f) Crushing Value

g) Combined Elongation & Flakiness Index

h) Deleterious Materials

i) Soundness

On perusal of the test results of 10-20 mm coarse aggregate, it is seen that:

i) The available test results of 10-20 mm coarse aggregate sample provided by the sponsor meets the various physical requirements of IS: 383-2016 except combined elongation and flakiness index. The test results are presented in Table III-A and III-B.

ii) **The combined elongation and flakiness index of this coarse aggregates fraction is 46.7%. As per IS 383: 2016 – "The combined flakiness and elongation index shall not exceed 40 percent for uncrushed or crushed aggregate. However, the engineer-in-charge at his discretion may relax the limit keeping in view the requirement, and availability of aggregates and performance based on tests on concrete."**

4.2 Coarse Aggregate (4.75-10mm): On perusal of test results, it is seen that the sieve analysis of this coarse aggregates fraction conforms to the grading requirements of IS: 383-2016 for single sized aggregate of nominal size.

The test results are presented in Table III-C.

5.0 PHYSICAL TESTS ON FINE AGGREGATE (NATURAL)

The following tests were conducted on one fine aggregate sample as per IS: 2386-1963.

a) Specific Gravity

b) Water Absorption

c) Material finer than 75-micron

d) Organic impurities

e) Sieve Analysis

f) Deleterious material

g) Soundness

On perusal of the available test results, it is seen that:

The fine aggregate sample provided by the sponsor meets the above-mentioned physical requirements of IS: 383-2016 & conforms to grading Zone II. The test results are given in Table IV-A & IV-B.

6.0 ACCELERATED MORTAR BAR TEST

Accelerated mortar bar test as per ASTM C-1260 was carried out on one coarse aggregate sample and one fine aggregate sample.

The accelerated mortar-bar test consists of preparing mortar-bar in the same way as for conventional tests as per IS: 2386 (Part VII) i.e., by proportioning one part of Ordinary Portland Cement (OPC) to 2.25 parts of graded aggregates by mass, a fixed water to cement ratio i.e., 0.47. The sample after 24-hours was de-moulded and then cured in hot water at 80°C for 24-hours. Finally, the specimen is stored in 1N NaOH solutions at 80°C for 14 days. The length change observations are to be taken in hot condition i.e., within 15±5 seconds after taking out from the solution. The samples are stored in plastic containers and the use of glass or metal container for this purpose is not recommended as the same get corroded by NaOH solution. As per ASTM criteria, the aggregate showing expansions less than 0.10% at 16 days after casting are classified as innocuous, whereas the aggregates showing more than 0.20% expansion are classified as potentially reactive. For aggregates showing expansion between 0.10% and 0.20%, the results are to be supported by other test.

(a) Coarse aggregate: The expansion of this coarse aggregate sample at 16 days after casting i.e. **0.02%** is less than 0.1%. Therefore, this coarse aggregate sample can be classified as **innocuous** as per ASTM C-1260 and is suitable for making concrete. The test result is given in Table V.

(b) Fine aggregate The expansion of this fine aggregate sample at 16 days after casting i.e. **0.03%** is less than 0.1%. Therefore, this fine aggregate sample can be classified as **innocuous** as per ASTM C-1260 and is suitable for making concrete. The test result is given in Table V.

7.0 PETROGRAPHIC AND MINEROLOGICAL ANALYSIS

7.1 Coarse aggregate 10-20 mm

The petrographic and mineralogical analysis of the coarse aggregate sample was carried out as per IS 2386 part VIII. This is a composite sample of Granite and Biotite-Granite and the detailed report is enclosed as Annexure I.

7.1.1 Coarse aggregate 10-20 mm- Granite

This is a coarse grained textured partially weathered random sample of Granite. The strained quartz percentage and their UEA are within permissible limits. Feldspar grains are partially fractured, shattered and altered. The quality of the coarse aggregate is fair. The mineralogical structural textural features of the coarse aggregate suggest carrying out further test to ensure that the coarse aggregate is not reactive.

7.1.2 Coarse aggregate 10-20 mm – Biotite-Granite

This is a medium to coarse grained textured partially weathered random sample of Biotite-Granite. The strained quartz percentage and their UEA are within permissible limits. Feldspar grains are partially fractured, shattered and altered. The quality of the coarse aggregate is fair. The mineralogical structural textural features of the coarse aggregate suggest carrying out further test to ensure that the coarse aggregate is not reactive.

7.2 Fine Aggregate

The petrographic and mineralogical analysis of the fine aggregate sample was carried out as per IS 2386 part VIII. The detailed report is enclosed as Annexure I.

This is a fine grained textured random sample of the fine aggregate. The strained quartz percentage and their UEA are within permissible limits. Feldspar grains are partially shattered and fractured. Mica grains are partially iron leached. The quality of the fine aggregate is fair.

Mica content: 3 % (% by weight).

8.0 WATER SAMPLE

Water sample provided by the sponsor was tested for various parameters of IS 456:2000 and meets the requirements of IS 456:2000. The results are given in Table VI.

9.0 CONCRETE MIX DESIGN

Final recommendations for Concrete Mix Design based on 28 days' compressive strength, are enclosed as Annexure -II.

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TABLE I
TEST RESULTS OF CEMENT SAMPLE
CEMENT (PPC) ULTRATECH

Sl No.	Properties	Results Obtained	Permissible limits as per IS: 1489 Part-1
(A) Physical Analysis:			
1	Blaine's fineness, m^2/kg	345	300.0 (Min.)
2	Compressive strength, N/mm^2		
	3 days	29.0	16.0 (Min.)
	7 days	38.0	22.0 (Min.)
	28 days	51.5	33.0 (Min.)
3	Specific Gravity	2.82	--
4	Soundness		
	Autoclave, %	0.03	0.8 (max)
	Le Chatelier Exp. (mm)	1.0	10.0 (max)
5	Setting time, minutes		
	Initial	185	30.0 (Min.)
	Final	260	600.0 (Max)
6	Drying Shrinkage (%)	0.04	0.15 (Max)
(B) Chemical analysis, %			
1	Loss of Ignition (LOI)	2.33	5.0 (Max)
2	Silica (SiO_2)	33.47	--
3	Iron oxide (Fe_2O_3)	4.74	--
4	Aluminium oxide (Al_2O_3)	11.03	--
5	Calcium oxide (CaO)	41.58	--
6	Magnesium oxide (MgO)	3.42	6.0 (Max)
7	Sulphate (SO_3)	1.78	3.5 (Max)
8	Alkalies:		
	Na_2O	0.28	--
	K_2O	0.83	--
	Eq. as Na_2O	0.83	--
9	Insoluble residue	31.14	--
10	Chloride	0.014	0.1 (Max)

TABLE II
TEST RESULTS OF CEMENT SAMPLE
CEMENT (PPC) DOUBLE BULL

Sl No.	Properties	Results Obtained	Permissible limits as per IS: 1489 Part-1
(A) Physical Analysis:			
1	Blaine's fineness, m^2/kg	338	300.0 (Min.)
2	Compressive strength, N/mm^2		
	3 days	21.0	16.0 (Min.)
	7 days	27.0	22.0 (Min.)
	28 days	41.5	33.0 (Min.)
3	Specific Gravity	2.76	--
4	Soundness		
	Autoclave, %	0.05	0.8 (max)
	Le Chatelier Exp. (mm)	1.0	10.0 (max)
5	Setting time, minutes		
	Initial	160	30.0 (Min.)
	Final	230	600.0 (Max)
6	Drying Shrinkage (%)	0.05	0.15 (Max)
(B) Chemical analysis, %			
1	Loss of Ignition (LOI)	2.96	5.0 (Max)
2	Silica (SiO_2)	34.27	--
3	Iron oxide (Fe_2O_3)	4.42	--
4	Aluminium oxide (Al_2O_3)	12.17	--
5	Calcium oxide (CaO)	38.28	--
6	Magnesium oxide (MgO)	4.68	6.0 (Max)
7	Sulphate (SO_3)	1.75	3.5 (Max)
8	Alkalies:		
	Na_2O	0.29	--
	K_2O	0.86	--
	Eq. as Na_2O	0.86	--
9	Insoluble residue	34.65	--
10	Chloride	0.018	0.1 (Max)

TABLE III-A
PHYSICAL TEST RESULTS OF COARSE AGGREGATE SAMPLE (Received on 25.06.2022)

Sl No.	Test Carried out	Result Obtained	Permissible Limits as Per IS: 383-2016
1	Specific gravity	2.71	--
2	Water absorption (%)	0.23	--
3	Abrasion Value %	31	For aggregates to be used in concrete for wearing surfaces: 30% (Max) For aggregates to be used in concrete other than for wearing surfaces: 50%(Max)
4	Crushing value/Ten percent fines value %	29	For aggregates to be used in concrete for wearing surfaces:30% (Max) For aggregates to be used in concrete other than for wearing surfaces: In case the aggregate crushing value exceeds 30%, then the test for 'ten percent fines' should be conducted and the minimum load for ten percent fine should be 50kN
5	Impact value %	29	For aggregates to be used in concrete for wearing surfaces:30% (Max) For aggregates to be used in concrete other than for wearing surfaces:45%(Max)
6	Combined Flakiness and Elongation index % (20 mm)	46.7*	40% (Max.)
7	Soundness Na_2SO_4 % (20 mm)	0.19	12.00% (Max.)
8	Total Deleterious content % (20 mm) (Except Coal & Lignite)	0.11	2.00 %(Max.) for crushed coarse aggregate

*See section 4.1 of the report

TABLE III-B
SIEVE ANALYSIS OF COARSE AGGREGATE (10-20 mm)

Sieve Size (mm)	Sieve analysis of Coarse aggregates (% Passing)	Percentage Passing for Single-Sized Aggregate of Nominal Size as Per IS: 383-2016
40.0	100	100
20.0	92	85-100
10.0	04	0-20
4.75	0	0-5

TABLE III-C
TEST RESULTS OF 4.75-10 mm SIZE COARSE AGGREGATE SAMPLE

Sieve Size (mm)	Sieve analysis of Coarse aggregates (% Passing)	Required Percentage Passing for Single-Sized Aggregate of Nominal Size as Per IS: 383-2016
12.5	100	100
10.0	91	85-100
4.75	04	0-20
2.36	0	0-5

TABLE IV-A
PHYSICAL TEST RESULTS OF FINE AGGREGATE SAMPLE-1 (Natural)

Sl No.	Test Carried out	Result Obtained	Permissible Limits as Per IS: 383
1.	Specific gravity	2.64	--
2.	Water absorption, %	0.75	--
3.	Material finer than 75-micron, %	0.82	3.0
4.	Clay Lumps, %	0.0	1
5.	Total deleterious material, % (except coal & lignite)	0.82	5
6.	Soundness Na_2SO_4 %	1.23	10 (Max.)
7.	Organic Impurities	nil	--

TABLE IV-B
SIEVE ANALYSIS OF FINE AGGREGATE SAMPLE

Sieve Size	Percentage Passing	Percentage Passing for Grading Zone II as per IS: 383-2016 Table 9
10 mm	97*	100
4.75 mm	94	90-100
2.36 mm	90	75-100
1.18 mm	79	55-90
600 micron	50	35-59
300 micron	20	8-30
150 micron	03	0-10
Zone as per IS: 383-2016	Zone II	

*Within 5% deviation at individual sieve as per IS383-2016
Cumulative amount of deviation on all sieves is less than 10%

TABLE V
ACCELERATED MORTAR BAR TEST (ASTM C1260)

S.No.	Sample Type	1N NaOH 80^0C 16 Day Expansion %	Remarks
1	Coarse Aggregate	0.02	innocuous
2	Fine Aggregate	0.03	innocuous

TABLE VI
RESULTS OF WATER SAMPLE

SI No.	Properties	Results	Permissible Limits as per IS 456: 2000 Max.
1	pH	8.55	>6
2	Sulphate (SO_3), mg/l	24	400
3	Chlorides (Cl), mg/l	20	500 (for RCC work) & 2000 (for concrete not containing embedded steel)
4	Total dissolved solids (TDS), mg/l :		
	Inorganic matter (fixed residue), mg/l	164	3000
	Organic matter (volatile residue), mg/l	38	200
	Suspended matter, mg/l	12	2000
5	Alkalinity: 0.02 N H_2SO_4 used to neutralize 100 ml sample, ml	13.55	25
6	Acidity : 0.02 N NaOH used to neutralize 100 ml sample, ml	0.00	5

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CDR, SP-6439 (OM REPORT)

CA20/046/I: Granite-This is a coarse grained textured, partially weathered, random sample of the Granite. The major mineral constituents are quartz, plagioclase-feldspar and orthoclase-feldspar. Accessory minerals are biotite, microcline-feldspar, muscovite, and iron oxide. Subhedral to anhedral quartz grains with sharp grain margins are well graded and homogeneously distributed. Grain size of quartz varies from 82 µm to 1968 µm with an average of 1027µm. Majority of quartz grains are in the size range of 900 µm to 1300 µm. The strained quartz percentage is about 16% and their undulatory extinction angle (UEA) varies from 14° to 16°. Prismatic plagioclase grains with both broken and sharp grain margin are also uniformly distributed in the sample. The grains of plagioclase are partially shattered and fractured. Subhedral orthoclase grains with rounded grain margins are uniformly distributed in the rock. Orthoclase phenocrysts are partially fractured, shattered and altered. Few orthoclase grains are altered up to kaolinite stage. Prismatic to lath shaped biotite grains with smooth grain margins are partially iron leached. Few biotite grains are highly iron leached. Tabular microcline grains with sharp grain margins are partially fractured and shattered. Needle shaped muscovite grains are mostly present as inclusion in the quartz and orthoclase grains. Subhedral iron oxide grains with sharp grain margins are randomly disseminated in the sample.

(a) Trade Group: Granite (Igneous Rock)
(b) Petrological name: Granite
(c) Particle shape: Irregular
(d) Surface texture: Crystalline

Recommendation: - This is a coarse grained textured partially weathered random sample of Granite. The strained quartz percentage and their UEA are within permissible limits. Feldspar grains are partially fractured, shattered and altered. The quality of the coarse aggregate is fair. The mineralogical structural textural features of the coarse aggregate suggest carrying out further test to ensure that the coarse aggregate is not reactive.

CA20/046/II: Biotite-Granite-This is a medium to coarse grained textured, partially weathered, random sample of the Biotite-granite. The major mineral constituents are Quartz, orthoclase-feldspar, biotite and plagioclase-feldspar. Accessory minerals are microcline-feldspar, and iron oxide. Subhedral quartz grains with sharp grain margins are well graded and homogeneously distributed. Grain size of quartz varies from 61 µm to 1421 µm with an average of 827µm. Majority of quartz grains are in the size range of 700 µm to 1050 µm. The strained quartz percentage is about 14% and their undulatory extinction angle (UEA) varies from 13^0 to 15^0.Subhedral to anhedral orthoclase grains with rounded grain margins are also uniformly distributed in the rock. Orthoclase grains are partially fractured, shattered and altered. Graphic texture is also observed in few orthoclase grains. Perthitic and anti-perthitic intergrowth are also noticed in the feldspar crystals. Lath to prismatic plagioclase grains with sharp grain margin are also observed uniformly developed in the sample and these grains are both partially and highly iron leached. Prismatic plagioclase grains with fractured margins are also

homogeneously noticed in the sample. Tabular microcline grains with sharp margins are fresh in nature. Subhedral to anhedral iron oxide grains with corroded margins are partially brittle.

(a) Trade Group: Granite (Igneous Rock)
(b) Petrological name: Biotite Granite
(c) Particle shape: Irregular
(d) Surface texture: Crystalline

Recommendation: - This is a medium to coarse grained textured partially weathered random sample of Biotite-Granite. The strained quartz percentage and their UEA are within permissible limits. Feldspar grains are partially fractured, shattered and altered. The quality of the coarse aggregate is fair. The mineralogical structural textural features of the coarse aggregate suggest carrying out further test to ensure that the coarse aggregate is not reactive.

Table-1: Modal Composition of The Coarse Aggregates (Results In %)

Sl No.	Sample No.	Rock Type	MINERALS						
			Quartz	Muscovite	Orthoclase-Feldspar	Plagioclase-Feldspar	Microcline-feldspar	Biotite	Iron oxide
1	**CA20/046/I**	**Granite**	35	2	19	33	4	5	2
2	**CA20/046/II**	**Biotite Granite**	34	-	28	15	4	18	1

FA/046, Fine Aggregate: This is a fine-grained random sample of the fine aggregate. The minerals present in order of abundance are quartz, orthoclase-feldspar, biotite, plagioclase-feldspar, microcline- feldspar, muscovite, hornblende, garnet, tourmaline and iron oxide. Subhedral to anhedral quartz grains with angular grain margins are well graded and homogeneously distributed. Grain size of quartz varies from 13 μm to 261 μm with an average of 147 μm. Majority of quartz grains are in the size range of 80 μm to 180 μm. The strained quartz percentage is about 10% and their undulatory extinction angle (UEA) varies from 11^0 to 13^0. Subhedral orthoclase with corroded margins are partially fractured and shattered. Prismatic to lath shaped biotite grains are partially iron leached with uniform distribution. Prismatic plagioclase-feldspar and tabular microcline grains with corroded margins are partially shattered and fractured. Prismatic hornblende grains are fresh. Lath to needle shaped muscovite with sharp grain margins are randomly distributed in the sample. Subhedral garnet grains are partially fractured. Lath shaped tourmaline grains are randomly distributed in the

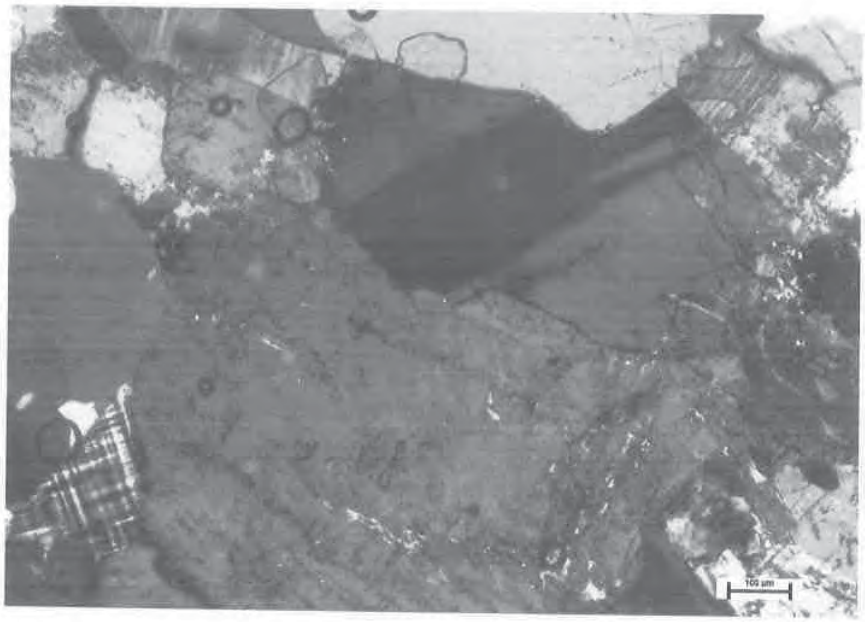
sample. Subhedral to anhedral iron oxide grains with rounded grain margins are uniformly distributed in the sample.

Recommendations: This is a fine grained textured random sample of the fine aggregate. The strained quartz percentage and their UEA are within permissible limits. Feldspar grains are partially shattered and fractured. Mica grains are partially iron leached. The quality of the fine aggregate is fair.

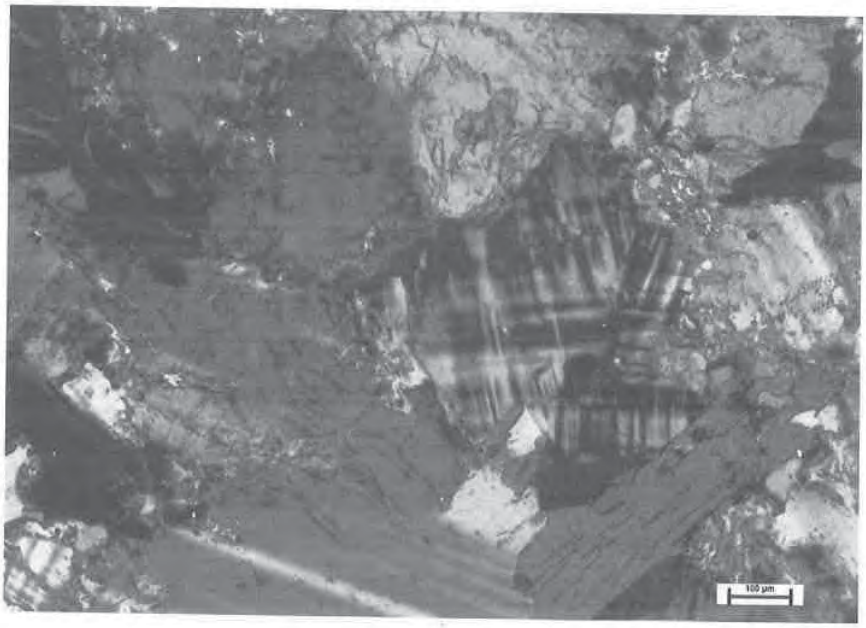
TABLE-2: MODAL COMPOSITION OF THE FINE AGGREGATE (Results in %)

Sample No.	Type	MINERALS PRESENT									
		Quartz	Orthoclase-feldspar	Plagioclase-feldspar	Biotite	Microcline-feldspar	Hornblende	Muscovite	garnet	Tourmaline	Iron oxide
FA/046	Fine Aggregate	54	11	7	9	5	3	4	3	2	2

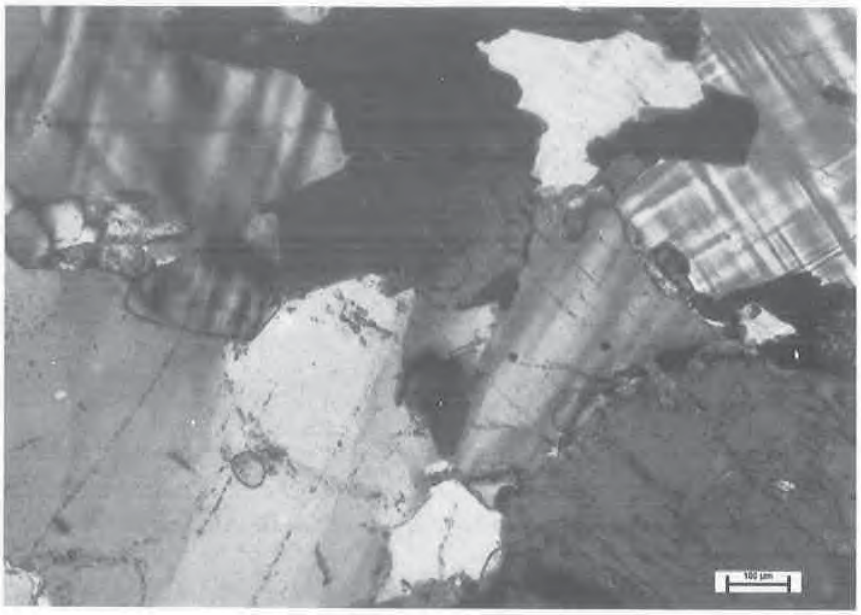
Mica content: 3 % (% by weight)



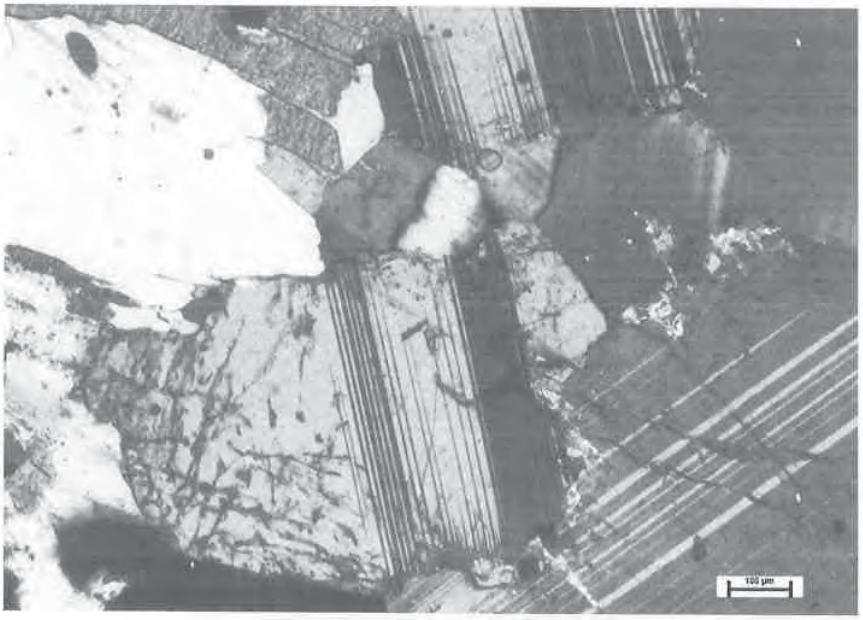
CA/20/046/I (plate-1): Distribution of quartz, plagioclase-feldspar, orthoclase-feldspar, biotite, microcline-feldspar, muscovite, and iron oxide in the sample. (5x, x-nicols)



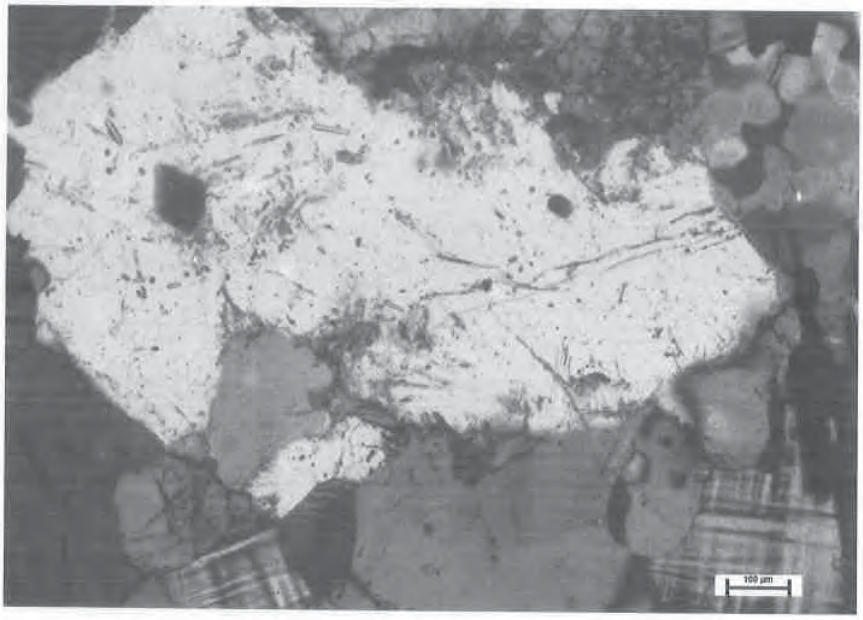
CA/20/046/I (plate-2): Distribution of quartz, plagioclase-feldspar, orthoclase-feldspar, biotite, microcline-feldspar, muscovite, and iron oxide in the sample. (5x, x-nicols)



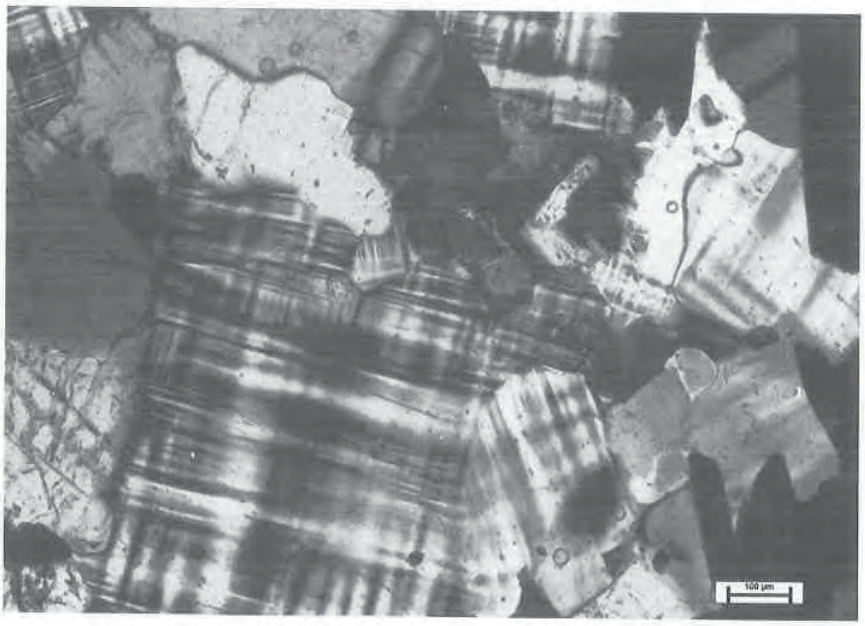
CA/20/046/I (plate-3): Distribution of quartz, plagioclase-feldspar, orthoclase-feldspar, biotite, microcline-feldspar, muscovite, and iron oxide in the sample. (5x, x-nicols)



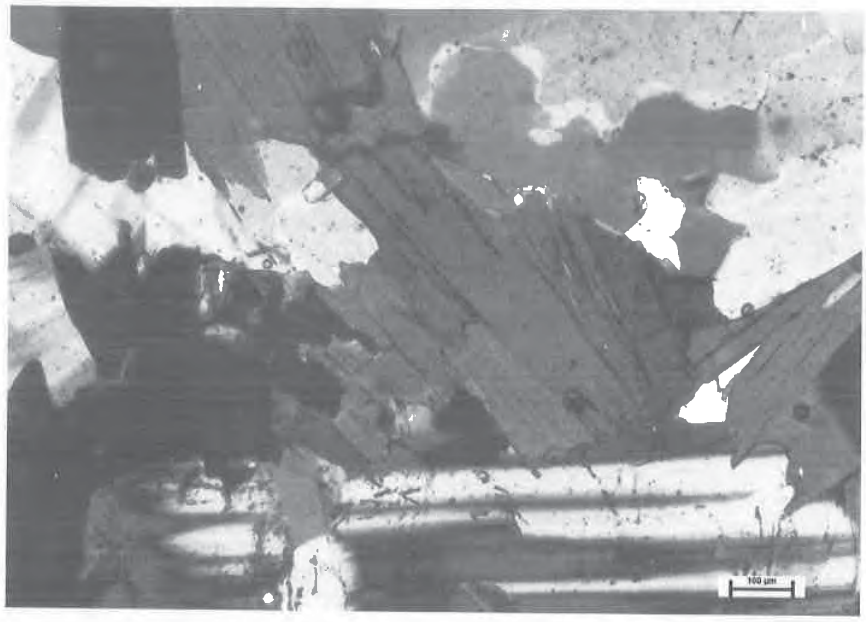
CA/20/046/I (plate-4): Distribution of quartz, plagioclase-feldspar, orthoclase-feldspar, biotite, microcline-feldspar, muscovite, and iron oxide in the sample. (5x, x-nicols)



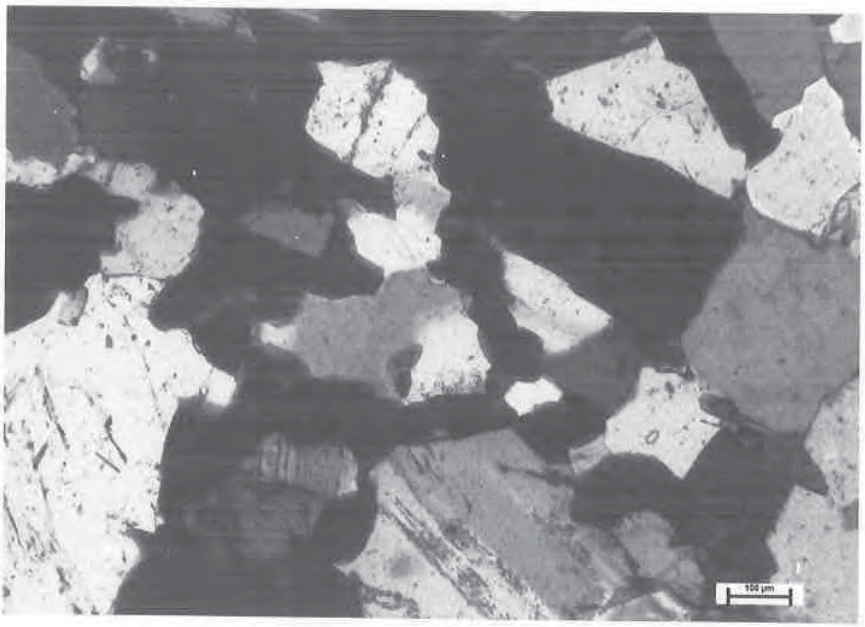
CA/20/046/II (plate-1): Distribution of Quartz, orthoclase-feldspar, biotite, plagioclase-feldspar, microcline-feldspar, and iron oxide in the sample. (5x, x-nicols)



CA/20/046/II (plate-2): Distribution of Quartz, orthoclase-feldspar, biotite, plagioclase-feldspar, microcline-feldspar, and iron oxide in the sample. (5x, x-nicols)

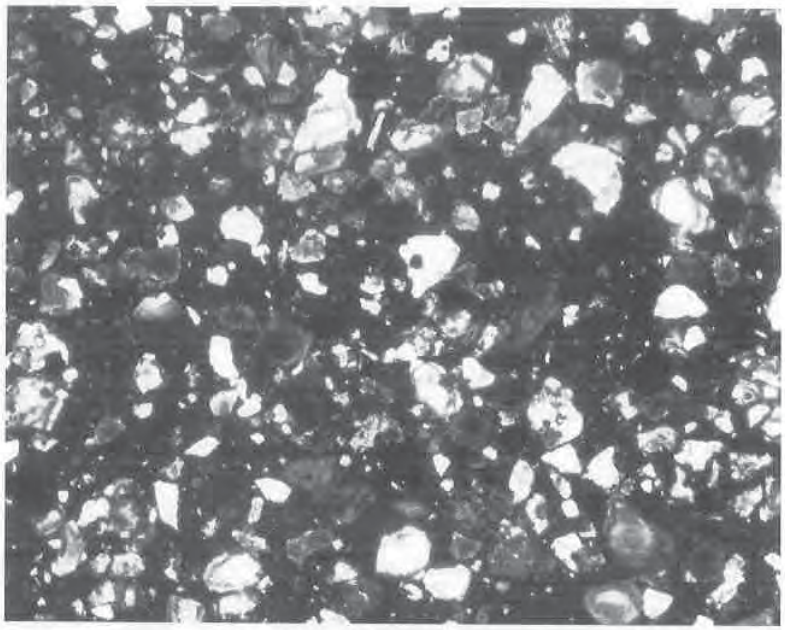


CA/20/046/II (plate-3): Distribution of Quartz, orthoclase-feldspar, biotite, plagioclase-feldspar, microcline-feldspar, and iron oxide in the sample. (5x, x-nicols)

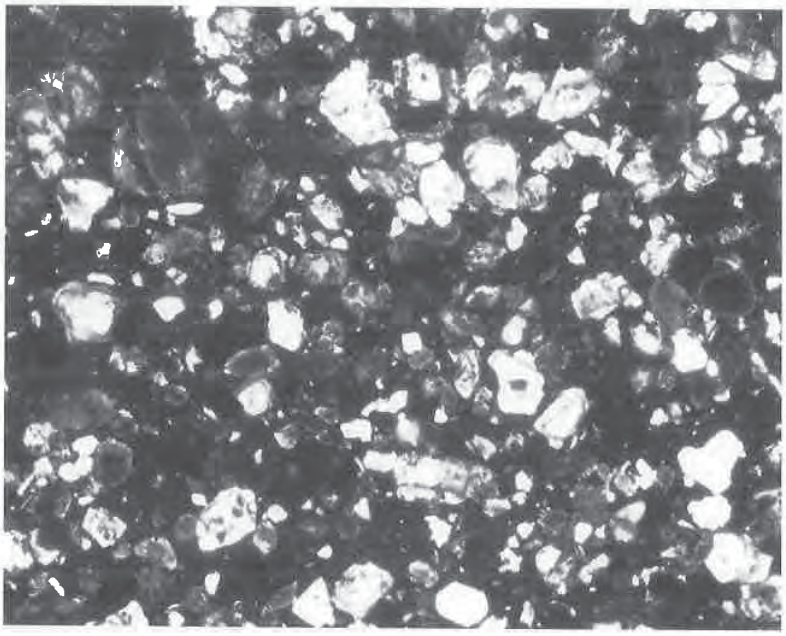


CA/20/046/II (plate-4): Distribution of Quartz, orthoclase-feldspar, biotite, plagioclase-feldspar, microcline-feldspar, and iron oxide in the sample. (5x, x-nicols)

Microphotographs of SP-6439



FA/046(plate-1): Distribution of mineral grains in the sample. (5x, x-nicols)



FA/046(plate-2): Distribution of mineral grains in thc sample. (5x, x-nicols)

ANNEXURE-II

MIX DESIGN FOR M30 GRADE WITH PPC ULTRATECH
RESULTS BASED ON 28 DAYS' COMPRESSIVE STRENGTH

Name of work : Evaluation of Materials & Concrete Mix Design for Civil Work of FGD System at 4x250 MW BRBCL Nabinagar FGD System.

1.0 DATA PROVIDED BY SPONSOR

Ref:
1. **Your Letter ref. BRBCL/FQA/2022/BHEL/SHIVALIK-Design Mix M-30 dated 20.06.2022**
2. **Email received from M/s Shivalik Buildtech dated 22.06.2022**
3. **Our Letter ref. CDR/SP-0 dated 24.06.2022 and CDR/SP-0 dated 06.07.2022**
4. **Your email dated 11.07.2022**

Sponsor	:	Bhartiya Rail Bijlee Company Ltd.
Grade of Concrete	:	M30
Type of Cement	:	PPC
Grade of Cement	:	--
Brand of Cement	:	Ultratech
Workability of Concrete (Slump in mm)	:	80-120 mm
Retention Time	:	Not Provided by Sponsor
Min. Cement Content	:	As per IS: 456
Max. Water Cement Ratio	:	As per IS: 456
Exposure Condition	:	Moderate
Source of Coarse Aggregate	:	Not Provided by Sponsor
Max. Nominal Size of Aggregate	:	20 mm
Source of Fine Aggregate	:	Not Provided by Sponsor
Brand name of Chemical Admixture	:	Chryso Delta G6143

ANNEXURE-II

2.0 TESTS ON CONCRETE MAKING MATERIALS

2.1 Cement PPC (Ultratech)

The test results of PPC cement (UltraTech) are given in Table I.

2.2 Coarse Aggregate (tested as per IS: 2386-1963)

The test results of Coarse Aggregate (20 mm and 10 mm) are given in Table III-A, III-B and III-C.

2.2.A Combined Grading of Coarse Aggregate

Sieve Size (mm)	*Percentage Passing*		*Combined Grading Achieved* 60% Fraction-I + 40%Fraction-II	*Required combined grading as per Table-7, IS: 383-2016*
	Fraction-I (10-20 mm)	*Fraction-II (<10mm)*		
40.0	100.00	100.00	100	100
20.0	92.00	100.00	95.20	90-100
10.0	4.00	91.00	38.80	25-55
4.75	0.00	4.00	1.60	0-10

Note: To satisfy the combined grading limit of IS: 383-2016 for 20mm MSA, the following proportions of different size fractions was used.

Fraction- I (10-20mm) : 60 %
Fraction -II (Below 10 mm) : 40%

2.3 Fine Aggregate, (As Per IS: 2386-1963)

The test results of Fine aggregate (natural) are given in Table- IV-A & IV-B

On perusal of test results it is seen that the result of grading of fine aggregate conforms to grading zone II as per IS: 383-2016.The sample of fine aggregate is also satisfactory with respect to permissible silt content by wet sieving method.

3.0 CONCRETE MIX DESIGN

3.1 Target Mean Strength

Grade of Concrete	Standard Deviation as per IS:456-2000 (N/mm^2)	Target mean Strength (N/mm^2)
M30	5.0	38.25

3.2 Trials – The details of trials for the concrete mix design are given in Table 1

ANNEXURE-II

4.0 FINAL RECOMMENDATIONS FOR THE CONCRETE MIX DESIGN

4.1 **Grade of Concrete:** M30; **Exposure Condition:** Moderate; **Workability:** 80-120 mm slump; **Cement:** PPC (Ultratech); **Minimum cement content:** As per IS:456, **Maximum Water Cement Ratio:** As per IS:456; **Chemical Admixture**: Chryso Delta G6143

The final recommendations for M30 grade of concrete for the target average 28-day compressive strength of 38.25 N/mm^2 are given below on the basis of data generated from Table 1.

Mix Constituents (kg/m^3)	For One Cubic Meter (kg/m^3)
Cement (PPC: Ultratech)	400
Water	160
Fine Aggregate (Natural)	750
Coarse Aggregate 10-20 mm (60%)	651
Coarse Aggregate <10 mm (40%)	434
Chemical Admixture (Chryso delta G6143) @ 0.90% by wt. of cement	3.60
Water – Cement Ratio	**0.400**

NOTES:

1. The mix design trials were carried out in NCB laboratory at temperature of (27±2) ^{0}C and relative humidity of more than 65%. If the workability achieved at site is slightly less or more than required workability due to temperature variation, the dose of chemical admixture can be adjusted slightly to achieve the desirable workability keeping the w/c same as recommended and site trials should be conducted to check the workability and strength.
2. The mix design is based on saturated surface dry condition of coarse and fine aggregate. If dry aggregates are used, the amount of mixing water should by increased by an amount equal to the moisture likely to be absorbed by the aggregates. If wet aggregates are used, necessary adjustment should be made on the mixing water and aggregate depending upon the amount of free (surface) moisture present.
3. It will be advisable to check the silt content of sand at frequent intervals during the supply, if the silt content in sand is higher than the permissible limit as per IS: 383, the sand may require washing.
4. Results given above refer only to the sample supplied.
5. The above tentative mix design can be adopted at site after carrying out trials as usual.
6. This report is being issued on the specific understanding that NCB will not in any way be involved in any action following the interpretation of the above results.

ANNEXURE-II

MIX DESIGN FOR M30 GRADE WITH PPC DOUBLE BULL RESULTS BASED 28 DAYS' COMPRESSIVE STRENGTH

Name of work : Evaluation of Materials & Concrete Mix Design for Civil Work of FGD System at 4x250 MW BRBCL Nabinagar FGD System.

1.0 DATA PROVIDED BY SPONSOR

Ref:
1. **Your Letter ref. BRBCL/FQA/2022/BHEL/SHIVALIK-Design Mix M-30 dated 20.06.2022**
2. **Email received from M/s Shivalik Buildtech dated 22.06.2022**
3. **Our Letter ref. CDR/SP-0 dated 24.06.2022 and CDR/SP-0 dated 06.07.2022**
4. **Your email dated 11.07.2022**

Sponsor	:	Bhartiya Rail Bijlee Company Ltd.
Grade of Concrete	:	M30
Type of Cement	:	PPC
Grade of Cement	:	--
Brand of Cement	:	Double Bull
Workability of Concrete	:	80-120 mm
Retention Time	:	Not Provided by Sponsor
Min. Cement Content	:	As per IS: 456
Max. Water Cement Ratio	:	As per IS: 456
Exposure Condition	:	Moderate
Source of Coarse Aggregate	:	Not Provided by Sponsor
Max. Nominal Size of Aggregate	:	20 mm
Source of Fine Aggregate	:	Not Provided by Sponsor
Brand name of Chemical Admixture	:	Chryso Delta G6143

ANNEXURE-II

2.0 TESTS ON CONCRETE MAKING MATERIALS

2.1 Cement PPC (Double Bull)

The test results of PPC cement (Double Bull) are given in Table II.

2.2 Coarse Aggregate (tested as per IS: 2386-1963)

The test results of Coarse Aggregate (20 mm and 10 mm) are given in Table III-A, III-B and III-C.

2.2.A Combined Grading of Coarse Aggregate

Sieve Size (mm)	*Percentage Passing*		*Combined Grading Achieved* 60% Fraction-I + 40%Fraction-II	*Required combined grading as per Table-7, IS: 383-2016*
	Fraction-I (10-20 mm)	*Fraction-II (<10mm)*		
40.0	100.00	100.00	100	100
20.0	92.00	100.00	95.20	90-100
10.0	4.00	91.00	38.80	25-55
4.75	0.00	4.00	1.60	0-10

Note: To satisfy the combined grading limit of IS: 383-2016 for 20mm MSA, the following proportions of different size fractions was used.

Fraction- I (10-20mm) : 60 %
Fraction -II (Below 10 mm) : 40%

2.3 Fine Aggregate, (As Per IS: 2386-1963)

The test results of Fine aggregate (natural) are given in Table- IV-A & IV-B

On perusal of test results it is seen that the result of grading of fine aggregate conforms to grading zone II as per IS: 383-2016.The sample of fine aggregate is also satisfactory with respect to permissible silt content by wet sieving method.

3.0 CONCRETE MIX DESIGN

3.1 Target Mean Strength

Grade of Concrete	Standard Deviation as per IS:456-2000 (N/mm^2)	Target mean Strength (N/mm^2)
M30	5.0	38.25

3.2 Trials – The details of trials for the concrete mix design are given in Table 2.

ANNEXURE-II

4.0 FINAL RECOMMENDATIONS FOR THE CONCRETE MIX DESIGN

4.1 **Grade of Concrete:** M30; **Exposure Condition:** Moderate; **Workability:** 80-120 mm slump; **Cement:** PPC (Double Bull); **Minimum cement content:** As per IS:456, **Maximum Water Cement Ratio:** As per IS:456; **Chemical Admixture**: Chryso Delta G6143

The final recommendations for M30 grade of concrete for the target average 28-day compressive strength of 38.25 N/mm^2 are given below on the basis of data generated from Table 2 & Figure 1.

Mix Constituents (kg/m^3)	For One Cubic Meter (kg/m^3)
Cement (PPC: Double Bull)	410
Water	160
Fine Aggregate (Natural)	743
Coarse Aggregate 10-20 mm (60%)	645
Coarse Aggregate <10 mm (40%)	430
Chemical Admixture (Chryso delta G6143) @ 0.90% by wt. of cement	3.69
Water – Cement Ratio	**0.390**

NOTES:

1. The mix design trials were carried out in NCB laboratory at temperature of (27±2) ^{0}C and relative humidity of more than 65%. If the workability achieved at site is slightly less or more than required workability due to temperature variation, the dose of chemical admixture can be adjusted slightly to achieve the desirable workability keeping the w/c same as recommended and site trials should be conducted to check the workability and strength.
2. The mix design is based on saturated surface dry condition of coarse and fine aggregate. If dry aggregates are used, the amount of mixing water should by increased by an amount equal to the moisture likely to be absorbed by the aggregates. If wet aggregates are used, necessary adjustment should be made on the mixing water and aggregate depending upon the amount of free (surface) moisture present.
3. It will be advisable to check the silt content of sand at frequent intervals during the supply, if the silt content in sand is higher than the permissible limit as per IS: 383, the sand may require washing.
4. Results given above refer only to the sample supplied.
5. The above tentative mix design can be adopted at site after carrying out trials as usual.
6. This report is being issued on the specific understanding that NCB will not in any way be involved in any action following the interpretation of the above results.

MIX DESIGN REPORT

Table-1: Mix Design Trials

Project No			SP 6439 046 Ultratech		
1.1: Accelerated Curing Method (ACT)			NCB Method		
Sl No	**Particulars**		**Trial-1**	**Trial-2**	**Trial-3**
1.	Free water-cement ratio		0.450	**0.400**	0.380
2.	Cement Content (kg/m^3)		355	**400**	421
3.	Water Content (kg/m^3)		160	**160**	160
4.	Dose of admixture (% by wt. of cement)		0.90	**0.90**	0.90
5.	Fine Aggregate as % of total aggregate by absolute volume		42.0	**41.5**	41.0
6.	Slump (mm)		110	**115**	110
7.	Compressive Strength (N/mm^2) by ACT	Expected 28 days	25.24	**30.06**	32.59
			32.89	**38.79**	41.88
Interim Optimum mix			**Trial-2**		
Note: Expected 28 day's age compressive strength based on ACT is calculated as follows a. NCB Method (PPC): $R_{28} = 2.024 + 1.223 * R_a$					
1.2: Normal Curing Method					
1	Compressive Strength (N/mm^2)	28 days	33.18	**39.11**	42.02
Final Optimum mix			**Trial-2**		

Prepared by 10/10/2022

Checked by
Engineer/Scientist

07/10/22

MIX DESIGN REPORT

Table-2: Mix Design Trials

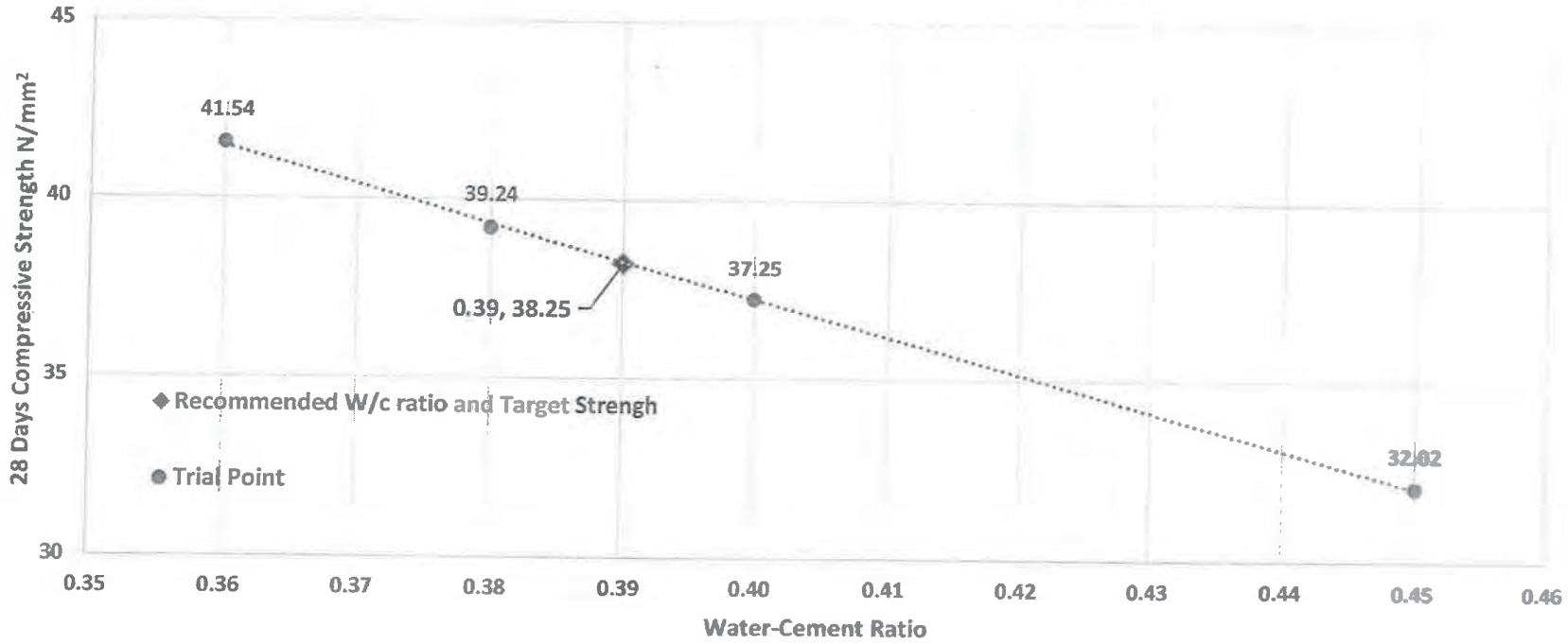
Project No			SP_6439_046_Double Bull			
1.1: Accelerated Curing Method (ACT)			NCB Method			
SI No	**Particulars**		**Trial-1**	**Trial-2**	**Trial-3**	**Trial-4**
1.	Free water-cement ratio		0.450	0.400	0.380	0.360
2.	Cement Content (kg/m^3)		355	400	421	444
3.	Water Content (kg/m^3)		160	160	160	160
4.	Dose of admixture (% by wt. of cement)		0.90	0.90	0.90	0.90
5.	Fine Aggregate as % of total aggregate by absolute volume		42.0	41.5	41.0	40.0
6.	Slump (mm)		110	115	120	110
7.	Compressive Strength (N/mm^2) by ACT	Expected 28 days	24.33	29.09	30.72	32.05
			31.78	37.60	39.59	41.22
Interim Optimum mix			**As Per fig-1**			
Note: Expected 28 day's age compressive strength based on ACT is calculated as follows a. NCB Method (PPC): $R_{28}=2.024+1.223*R_a$						
1.2: Normal Curing Method						
1	Compressive Strength (N/mm^2)	28 days	32.02	37.25	39.24	41.54
Final Optimum mix			**As Per fig-1**			

Prepared by 10/10/2022

11/10/22
Checked by
Engineer/Scientist

07/10/22

Fig. 1: Water-Cement Ratio v/s 28 Days Compressive Strength of Concrete



07/10/22

VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY,

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विश्वेश्वरय्या राष्ट्रीय प्रोद्योगिकी संस्थान,
नागपुर (भारत)

DEPARTMENT OF CIVIL ENGINEERING

Ref : CT 3204/CE 5718
Date: 16-11-2021

To
Shri Rahul Sharma
Sr. Mgr (FES & FQA)
(FQA Representativ of NTPC)
Bhartiya Rail Bijlee Company Ltd.
NTPC Limited, Nabinagar.

Subject : Evaluation of Materials and Concrete Mix Design M-35 Chimney Shell
Name of Work: FLUE GAS DESULPHARIZATION (FGD) PACKAGE to M/s BHARAT HEAVY ELECTRICALS LIMITED (BHEL) AT BRBCL NABINAGAR pakage for BRBCL Nabinagar TPP(4x250MW) to M/s BHEL vide our Contract No. CS-0270-109(1A)-2-SC-COA-BRBCL/19-20/1819 Dated: 14/08/2019 (PO No.-5500036627).
Through: M/s Bygging India Limited
Ref: BRBCL/FQA/2021/BHEL/BYGGING-M-35 Design Mix Dated:- 26-08-2021

1 DESIGN STIPULATES

Sr. No	Design stipulation	M 35
1	Characteristic strength:	35 MPa
2	Assumed target strength at 28 Days:	43.3 MPa
3	Degree of control: Assumed standard deviation	5
4	Minimum Cement Content Required	430 kg
5	Retention time (minutes):	90 min
6	Slump required (mm):	Above 150 mm
7	Cement Type	OPC 43 Grade
8	Type of Exposure:	Severe
9	Maximum Water-Cement Ratio	0.45
10	Nominal size of Coarse Aggregate	20 mm

2 Summary of received materials

Sr. No	Material	Source	Make	Type/ Product	Testing to the IS Codes
1	20 mm	Chattarpur	——	Coarse Aggregate	IS 2386 & IS 383
2	10 mm	Chattarpur	——	Coarse Aggregate	IS 2386 & IS 383
3	River Sand	Sone River, Majhiawan	------	Fine Aggregate	IS 2386 & IS 383
4	Cement	------	JK Lakshmi	OPC 43 Grade (W-29,Y-21)	IS 269:2015
5	Cement	------	Ultratech	OPC 43 Grade (W-29,Y-21)	IS 269:2015
6	Admixture	------	Fosroc	Auramix- 400 (QCDA-1390)	IS 9103:1999
7	Retarder	------	Fosroc	Conplast-R (QCDA-1285)	IS 9103:1999
8	Water	Bore Well Near Batching Area	------	——	IS 456:2000

Remarks: All the Samples are Collected & Sealed jointly (by NTPC/BRBCL CCD,FQA Deptt. and Contractors Representative) is being sent for testing

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

3A Physical Properties

Sr. No	Particulars	Observed Value	Limiting Value
1	Cement Brand	JK Lakshmi OPC 43	
2	Normal Consistency	31.0%	
3	Setting time : Initial	80 Minutes	Greater than 30 min
4	Setting time : Final	385 Minutes	Less than 600 min
5	Soundness by LeChatelier,s method	2 mm	10 mm (Max)
6	Blain Air Permeability	289 Sqm/kg	225 sqm/ kg min. for OPC

3B Mechanical Properties

Sr. No	Date of		Crushing Load in KN	Comp str.	Avg Compressive strength	Requirement	Limiting Value
	Casting	Testing					
1	28-09-21	01-10-21	132	26.40	26.67 MPa	3 days	>23 Mpa
2	"	"	138	27.60			
3	"	"	130	26.00			
4	"	05-10-21	180	36.00	36.40 MPa	7 days	>33 Mpa
5	"	"	184	36.80			
6	"	"	182	36.40			
7	"	26-10-21	260	52.00	52.13 MPa	28 days	>43 Mpa & <58 Mpa
8	"	"	258	51.60			
9	"	"	264	52.80			

3C Chemical Analysis of Cement

Sr. No	Particulars	Observed Value	Limiting Value (IS 269-2015)
1	Ratio of % lime to % of Silica, alumina and iron oxide	0.70%	0.66-1.02
2	Ratio of % of Alumina to % of Iron Oxide	1.45%	Not less than 0.66
3	Insoluble residue % by mass	4.48%	5 (Max)
4	Calcium Oxide	50.55%	
5	Silica	21.81%	
6	Magnesia , % by Mass	2.28%	6 (Max)
7	Chloride content	0.09%	0.1 (Max)
8	Iron Oxide	4.83%	
9	Aluminium Oxide	7.01%	
10	Total Sulphur	4.04%	3.5% (Max)
11	Loss of Ignition	4.91%	5 (Max)

Hence, Physical & Chemical properties of cement are satisfactory as per Code.

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

4A Physical Properties

Sr. No	Particulars	Observed Value	Limiting Value
1	Cement Brand	Ultratech OPC 43	
2	Normal Consistency	31.0%	
3	Setting time : Initial	85 Minutes	Greater than 30 min
4	Setting time . Final	390 Minutes	Less than 600 min
5	Soundness by LeChatelier,s method	2 mm	10 mm (Max)
6	Blain Air Permeability	293 Sqm/kg	225 sqm/ kg min. for OPC

4B Mechanical Properties

Sr. No	Date of		Crushing Load in KN	Comp str.	Avg Compressive strength	Requirement	Limiting Value
	Casting	Testing					
1	28-09-21	01-10-21	130	26.00	25.87 MPa	3 days	>23 Mpa
2	"	"	128	25.60			
3	"	"	130	26.00			
4	"	05-10-21	178	35.60	35.73 MPa	7 days	>33 Mpa
5	"	"	180	36.00			
6	"	"	178	35.60			
7	"	26-10-21	262	52.40	52.40 MPa	28 days	>43 Mpa & <58 Mpa
8	"	"	264	52.80			
9	"	"	260	52.00			

4C Chemical Analysis of Cement

Sr. No	Particulars	Observed Value	Limiting Value (IS 269-2015)
1	Ratio of % lime to % of Silica, alumina and iron oxide	0.70%	0.66-1.02
2	Ratio of % of Alumina to % of Iron Oxide	1.69%	Not less than 0.66
3	Insoluble residue % by mass	4.34%	5 (Max)
4	Calcium Oxide	52.99%	
5	Silica	23.22%	
6	Magnesia , % by Mass	1.09%	6 (Max)
7	Chloride content	0.08%	0.1 (Max)
8	Iron Oxide	3.89%	
9	Aluminium Oxide	6.57%	
10	Total Sulphur	3.11%	3.5% (Max)
11	Loss of Ignition	4.71%	5 (Max)

Hence, Physical & Chemical properties of cement are satisfactory as per Code.

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

5 Evaluation of Admixture

5A Chemical Properties of Admixture **Fosroc** **Auramix- 400 (QCDA-1390)**

Sr. No	Particulars	Observed Value	Limiting Value as per IS 9103: 1999
1	Relative Density	1.098	± 0.02 of the value stated by the manufacturer
2	pH	6.92	Min 6.00
3	Dry Material Content	44.09	± 5% of the value stated by the manufacturer
4	Chloride Content	0.025	Within 10% of the values or within 0.2% whichever is greater as stated by the manufacturer

*** Hence, Admixture is found Satisfactory as per IS 9103: 1999

5B Chemical Properties of Admixture **Fosroc** **Conplast-R (QCDA-1285)**

Sr. No	Particulars	Observed Value	Limiting Value as per IS 9103: 1999
1	Relative Density	1.065	± 0.02 of the value stated by the manufacturer
2	pH	7.02	Min 6.00
3	Dry Material Content	15.27	± 5% of the value stated by the manufacturer
4	Chloride Content	0.023	Within 10% of the values or within 0.2% whichever is greater as stated by the manufacturer

*** Hence, Admixture is found Satisfactory as per IS 9103: 1999

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

6A PHYSICAL PROPERTIES OF FINE AND COARSE AGGREAGATE

Sr. No	Physical Properties	River Sand	10 mm	20 mm	Permissible Limit as Per IS 383:2016
1	Specific Gravity(Apparent)	2.74	2.81	2.82	
2	Water Absorption %	0.95%	1.01%	0.81%	
3	Crushing Value %	NA	28.66%	25.31%	30 (For wearing Surf) 45 (For non-wearing)
4	Impact Value %	NA	12.71%	15.67%	30 (For wearing Surf) 45 (For non-wearing)
5	Abrasion Value %	NA	23.95%	21.02%	30 (For wearing Surf) 50 (For non-wearing)
6	Combined Flackiness and Elongation Index %	NA	24.99%	28.07%	< 40 % For Crushed and Un-Crushed Aggregates
7	Organic Impurities	Nil	—		< 1.0% (coal and lignite)
8	Total Deleterious material % except coal & lignite	Nil	—		< 1.0%
9	Material fines than 75um	5.19%	—		—
10	Silt/Clay Content	0.22%	—		—

Remarks: Based on tests Conducted, Sample Confirm to IS IS 383:2016, Certified that the above material confirm to the specification.

6B SIEVE ANALYSIS OF COARSE AND FINE AGGREGATES

Table : Sieve Analysis (Avg. sample test) **20 mm**

Sieve Size (mm)	Mass retained (gm)	% Retained	% Retained Accum.	% Passing	Specified Limits (IS 383)
40	0.0	0.00	0.00	100.00	100
20	98.0	4.90	4.90	95.10	85-100
16	576.0	28.80	33.70	66.30	
12.5	798.0	39.90	73.60	26.40	
10	395.0	19.75	93.35	6.65	0-20
4.75	133.0	6.65	100.00	0.00	0-5
2.36	0.0	0.00	100.00	0.00	-
1.18	0.0	0.00	100.00	0.00	
0.60	0.0	0.00	100.00	0.00	
0.30	0.0	0.00	100.00	0.00	
0.15	0.0	0.00	100.00	0.00	
TOTAL	2000.0	FM	8.06	Remark:	Accepted

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

Table : Sieve Analysis (Avg. sample test) 10 mm

Sieve Size (mm)	Mass retained (gm)	% Retained	% Retained Accum.	% Passing	Specified Limits (IS 383)
16	0.0	0.00	0.00	100.00	
12.5	0.0	0.00	0.00	100.00	100.00
10	136.0	6.80	6.80	93.20	85-100
4.75	1506.0	75.30	82.10	17.90	0-20
2.36	358.0	17.90	100.00	0.00	0-5
1.18	0.0	0.00	100.00	0.00	
0.6	0.0	0.00	100.00	0.00	
0.3	0.0	0.00	100.00	0.00	
0.15	0.0	0.00	100.00	0.00	
TOTAL	2000.0	FM	5.89	Remark:	Accepted

Table : Sieve Analysis (Avg. sample test) River Sand

Sieve Size (mm)	Mass retained (gm)	% Retained	% Retained Accum.	% Passing	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10	0.0	0.00	0.00	100.00	100	100	100	100
4.75	7.0	0.35	0.35	99.65	90-100	90-100	90-100	95-100
2.36	36.0	1.80	2.15	97.85	65-95	75-100	85-100	95-100
1.18	210.0	10.50	12.65	87.35	30-70	55-90	75-100	90-100
0.600	487.0	24.35	37.00	63.00	15-34	35-59	60-79	80-100
0.300	969.0	48.45	85.45	14.55	5-20	8-30	12-40	15-50
0.150	246.0	12.30	97.75	2.25	0-10	0-10	0-10	0-15
Pass	45.0	2.25	100.00	0.00				
TOTAL	2000	FM	2.35	Remark:	Sand Confirm to Zone-III			

7 EVALUATION OF AGGREGATES FOR PETROGRAPHIC AND POTENTIAL ALKALI-AGGREGATE REACTIVITY

OBSERVED RESULTS AS PER IS 383

Sr. No	Physical Properties	River Sand	10 mm	20 mm	Permissible Limit as Per IS 383:2016
1	Soundness % ($MgSO_4$)	2.24%	3.56%		12% (When tested with $MgSO_4$)
2	Alkali aggregate reaction test	0.037%	0.044%		< 0.1 % after 14 cycles

*** Hence, Aggregate such as River Sand, 10mm & 20mm is suitable for Construction purpose as per IS 383:2016

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

7A OBSERVED RESULTS AS PER IS 2386 Part-VIII, 1963 RA 2016, (Method-I)

Sample Coarse aggregate 10 mm Aggregate

Sr. No.	Name of Test	Test Results
1	Type and Size of Specimen	10 mm Aggregate
2	Rock Type/Description	Igneous hard
3	Rock Name	Andesitic
4	**Physical Properties:**	
	a) Grain Size	Coarse Grained
	b) Texture	Phaneritic
	c) Porosity	Dense and Non-porous
	d) Shape	Angular to sub-angular
5	**Physical Qualities**	Satisfactory Aggregate Particles
6	**Chemical Properties:**	
	a) Solubility	Insoluble
	b) Reactivity	Non-reactive
7	**Chemical Qualities**	Innocuous Aggregate Particles (Alkali Agg React 0.044%)
8	Mineral Composition (Lithology)	Principle essential Minerals: Amphibole Plagioclase feldspar Secondary minerals: Pyroxene Biotite, etc.
9	Structural Description, Weathering Condition	Fresh and Strong (Hardness = 7),unweathered
10	Remarks, if any	Suitable to be used as construction material

7B Sample Coarse aggregate 20 mm Aggregate

Sr. No.	Name of Test	Test Results
1	Type and Size of Specimen	20 mm Aggregate
2	Rock Type/Description	Igneous hard
3	Rock Name	Andesitic
4	**Physical Properties:**	
	a) Grain Size	Coarse Grained
	b) Texture	Phaneritic
	c) Porosity	Dense and Non-porous
	d) Shape	Angular to sub-angular
5	**Physical Qualities**	Satisfactory Aggregate Particles
6	**Chemical Properties:**	
	a) Solubility	Insoluble
	b) Reactivity	Non-reactive
7	**Chemical Qualities**	Innocuous Aggregate Particles (Alkali Agg React 0.044%)
8	Mineral Composition (Lithology)	Principle essential Minerals: Amphibole Plagioclase feldspar Secondary minerals: Pyroxene Biotite, etc.
9	Structural Description, Weathering Condition	Fresh and Strong (Hardness = 7),unweathered
10	Remarks, if any	Suitable to be used as construction material

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

7C Sample **Fine Aggregate** **River Sand**

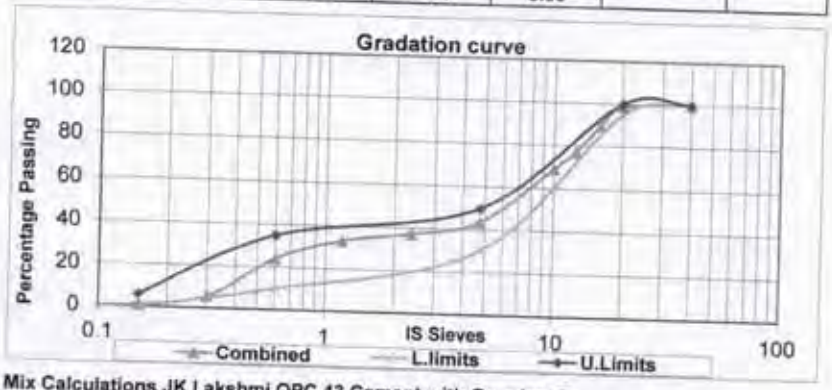
Sr. No.	Name of Test	Test Results
1	Type and Size of Specimen	River Sand
2	Rock Type/Description	Igneous hard
3	Rock Name	Granitic
4	**Physical Properties:**	
	a) Grain Size	Fine to Coarse Grained
	b) Shape	Rounded
5	**Physical Qualities**	Satisfactory Aggregate Particles
6	**Chemical Properties:**	
	a) Solubility	Insoluble
	b) Reactivity	Non-reactive
7	**Chemical Qualities**	Innocuous Aggregate Particles (Alkali Agg React 0.037%)
8	Mineral Composition (Lithology)	Principle essential Minerals: calcic Plagioclase, feldspar and quartz Secondary minerals: Mica, pyroxenes etc.
9	Structural Description, Weathering Condition	Fresh and Strong (Hardness = 7),unweathered
10	Remarks, if any	Suitable to be used as construction material

*** **Hence Fine Aggregate and Coarse Aggregates Samples are found to be satisfactory for potential alkali aggregate reactivity and petrographic analysis**

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

8 MIX DESIGN FOR RCC CONCRETE

Is Sieves Size		20 mm	10 mm	River Sand	Combined	L.limits	U.Limits
Sieve	% tage	62.00%		38.00%			
		31.00%	31.00%	38.00%	100.00		
40	mm	100.00	100.00	100.00	100.00	100	100
20	mm	95.10	100.00	100.00	98.48	95	100
16	mm	66.30	100.00	100.00	89.55		
12.5	mm	26.40	100.00	100.00	77.18		
10	mm	6.65	93.20	100.00	68.95		
4.75	mm	0.00	17.90	99.65	43.42	30	50
2.36	mm	0.00	0.00	97.85	37.18		
1.18	mm	0.00	0.00	87.35	33.19		
0.6	mm	0.00	0.00	63.00	23.94	10	35
0.3	mm	0.00	0.00	14.55	5.53		
0.15	mm	0.00	0.00	2.25	0.86	0	6
0.075	mm	0.00	0.00	0.00	0.00		



8A Concrete Mix Calculations JK Lakshmi OPC 43 Cement with Conplast R

Ingredients	Proportion	Sp. Gr.	Water Absorption	Volume in cum	Trial 1	Trial 2
Cementious Content					430 kg	450 kg
JK Lakshmi OPC 43	100.0%	2.9		0.148	430 kg	450 kg
Plastisizer	0.45%	1.2		0.002	1.94	2.03
Retarder	0.20%	1.2		0.001	0.86	0.90
W/C					0.37	0.36
Free Water					160 kg	160 kg
Water Absorption					17.25 kg	17.06 kg
Total Water		1.0		0.177	177 kg	177 kg
Aggregates (Dry condition)		1864 kg				
River sand	38.0%	2.740	0.95%	0.259	708 kg	708 kg
10 mm	31.0%	2.810	1.01%	0.206	578 kg	568 kg
20 mm	31.0%	2.820	0.81%	0.205	578 kg	568 kg
Density (Th.) in Kg/ Cum		2470		0.997	2471 kg	2471 kg
Slump Observed			Initial		180-200 mm	
Slump Observed			Retention	90 min	150 mm above	

Remark: i) Initial Setting of the Concrete is Observed Upto 8 hours.
ii) After 8 hours no impression of Penetratometer have been seen. Hence, Its advice to add the Retarder (Conplast-R) as per the Site Requirement.
iii) As per the site Requirement, If the change in setting time is required so it is proposed that the dose of retarder (Conplast-R) to be Increased or Decreased at site depend upon trial mix carried out at site.

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

8B CUBE TESTING RESULTS

Table : Cube Testing results Size of Cube : (150 x 150 x 150 mm)

Trial Composition	Date of		Weight of Cube	Compressive Load	Compressive Strength	Average Compresive Stregnth	Duration	Remarks
	Casting	Testing	(Kg)	(KN)	(inMPa)			
430 kg	27-09-21	04-10-21	8.382 kg	858 KN	38.13 MPa	36.89 MPa	7 days	JK Lakshmi OPC 43
	------	------	8.427 kg	797 KN	35.42 MPa			
	------	------	8.471 kg	835 KN	37.11 MPa			
	------	25-10-21	8.513 kg	996 KN	44.27 MPa	44.53 MPa	28 days	
	------	------	8.339 kg	1012 KN	44.98 MPa			
	------	------	8.736 kg	998 KN	44.36 MPa			
450 kg	27-09-21	04-10-21	8.279 kg	910 KN	40.44 MPa	40.86 MPa	7 days	
	------	------	8.271 kg	916 KN	40.71 MPa			
	------	------	8.219 kg	932 KN	41.42 MPa			
	------	25-10-21	8.253 kg	1041 KN	46.27 MPa	46.39 MPa	28 days	
	------	------	8.325 kg	1047 KN	46.53 MPa			
	------	------	8.269 kg	1043 KN	46.36 MPa			

Cement Content	Observed Strength in 7 days	Observed Strength in 28 days
	Compressive Strength	Compressive Strength
430 kg	36.89 MPa	44.53 MPa
450 kg	40.86 MPa	46.39 MPa

CC= Cement Content

CS= Compressive Strength

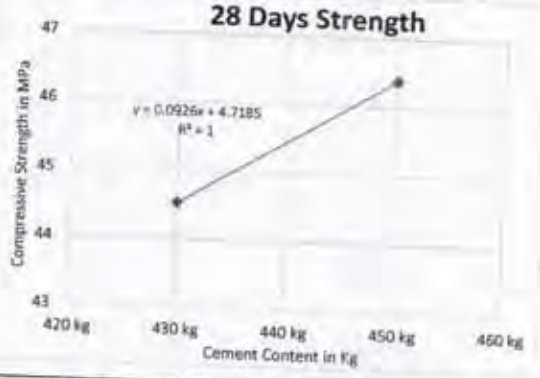


Table : Proposed Cement Content

Grade	Target strength		Cement Content	Remark	
	28 days	7 days	CC= (CS+4.7185)/0.0926	Proposed Cementious Content	Remark
M 35	43.3 MPa	30 MPa	416 kg	Say 430 kg	Min. Cement Content as per reff letter 430 kg

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

9A Concrete Mix Calculations Ultratech OPC 43 Cement with Conplast R

Ingredients	Proportion	Sp. Gr.	Water Absorption	Volume in cum	Trial 1	Trial 2
Cementious Content					430 kg	450 kg
Ultratech OPC 43	100.0%	2.9		0.148	430 kg	450 kg
Plastisizer	0.45%	1.2		0.002	1.94	2.03
Retarder	0.20%	1.2		0.001	0.86	0.90
W/C					0.37	0.36
Free Water					160 kg	160 kg
Water Absorption					17.25 kg	17.06 kg
Total Water		1.0		0.177	177 kg	177 kg
Aggregates (Dry condition)		1864 kg				
River sand	38.0%	2.740	0.95%	0.259	708 kg	708 kg
10 mm	31.0%	2.810	1.01%	0.206	578 kg	568 kg
20 mm	31.0%	2.820	0.81%	0.205	578 kg	568 kg
Density (Th.) in Kg/ Cum		2470		0.997	2471 kg	2471 kg
Slump Observed			Initial		180-200 mm	
Slump Observed			Retention	90 min	150 mm above	

Remark: i) Initial Setting of the Concrete is Observed Upto 8 hours.
ii) After 8 hours no impression of Penetratometer have been seen. Hence, Its advice to add the Retarder (Conplast-R) as per the Site Requirement.
iii) As per the site Requirement, If the change in setting time is required so it is proposed that the dose of retarder (Conplast-R) to be Increased or Decreased at site depend upon trial mix carried out at site.

9B CUBE TESTING RESULTS

Table : Cube Testing results Size of Cube : (150 x 150 x 150 mm)

Trial Composition	Date of		Weight of Cube	Compressive Load	Compressive Strength	Average Compresive Stregnth	Duration	Remarks
	Casting	Testing	(Kg)	(KN)	(inMPa)			
430 kg	27-09-21	04-10-21	8.479 kg	954 KN	42.40 MPa	43.81 MPa	7 days	Ultratech OPC 43
	------	------	8.347 kg	1004 KN	44.62 MPa			
	------	------	8.574 kg	999 KN	44.40 MPa			
	------	25-10-21	8.476 kg	1141 KN	50.71 MPa	51.01 MPa	28 days	
	------	------	8.351 kg	1168 KN	51.91 MPa			
	------	------	8.388 kg	1134 KN	50.40 MPa			
450 kg	27-09-21	04-10-21	8.462 kg	1103 KN	49.02 MPa	49.17 MPa	7 days	
	------	------	8.453 kg	1123 KN	49.91 MPa			
	------	------	8.513 kg	1093 KN	48.58 MPa			
	------	25-10-21	8.308 kg	1280 KN	56.89 MPa	56.00 MPa	28 days	
	------	------	8.469 kg	1210 KN	53.78 MPa			
	------	------	8.492 kg	1290 KN	57.33 MPa			

Cement Content	Observed Strength in 7 days	Observed Strength in 28 days
	Compressive Strength	Compressive Strength
430 kg	43.81 MPa	51.01 MPa
450 kg	49.17 MPa	56.00 MPa

CC= Cement Content
CS= Compressive Strength

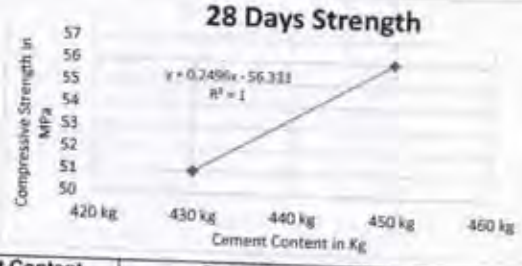


Table : Proposed Cement Content

Grade	Target strength		Cement Content	Remark	Remark
	28 days	7 days	CC= (CS+56.333)/0.2496	Proposed Cementious Content	
M 35	43.3 MPa	30 MPa	399 kg	Say 430 kg	Min. Cement Content as per ref letter 430 kg

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

10A Concrete Mix Calculations JK Lakshmi OPC 43 Cement without Conplast R

Ingredients	Proportion	Sp. Gr.	Water Absorption	Volume in cum	Trial 1	Trial 2
Cementious Content					430 kg	450 kg
JK Lakshmi OPC 43	100.0%	2.9		0.148	430 kg	450 kg
Plastisizer	0.45%	1.2		0.002	1.94	2.03
W/C					0.37	0.36
Free Water					160 kg	160 kg
Water Absorption					17.25 kg	17.06 kg
Total Water		1.0		0.177	177 kg	177 kg
Aggregates (Dry condition)		1864 kg				
River sand	38.0%	2.740	0.95%	0.259	708 kg	708 kg
10 mm	31.0%	2.810	1.01%	0.206	578 kg	568 kg
20 mm	31.0%	2.620	0.81%	0.205	578 kg	568 kg
Density (Th.) in Kg/ Cum		2470		0.996	2471 kg	2471 kg
Slump Observed			Initial		180-200 mm	
Slump Observed			Retention	90 min	150 mm above	

Remark: i) Initial Setting of the Concrete is Observed Upto 6 hours
ii) After 6 hours no impression of Penetratometer have been seen. Hence, Its advice to add the Retarder (Conplast-R) if more retardation is required as per the Site Requirement.

10B CUBE TESTING RESULTS

Table : Cube Testing results Size of Cube : (150 x 150 x 150 mm)

Trial Composition	Date of		Weight of Cube	Compressive Load	Compressive Strength	Average Compresive Stregnth	Duration	Remarks
	Casting	Testing	(Kg)	(KN)	(inMPa)			
430 kg	29-09-21	06-10-21	8.300 kg	724 KN	32.18 MPa	35.32 MPa	7 days	JK Lakshmi OPC 43
	------	------	8.219 kg	890 KN	39.56 MPa			
	------	------	8.446 kg	770 KN	34.22 MPa			
	------	27-10-21	8.162 kg	1016 KN	45.16 MPa	44.99 MPa	28 days	
	------	------	8.290 kg	1009 KN	44.84 MPa			
	------	------	8.323 kg	1012 KN	44.98 MPa			
450 kg	29-09-21	06-10-21	8.429 kg	919 KN	40.84 MPa	41.73 MPa	7 days	
	------	------	8.281 kg	974 KN	43.29 MPa			
	------	------	8.371 kg	924 KN	41.07 MPa			
	------	27-10-21	8.361 kg	1089 KN	48.40 MPa	49.01 MPa	28 days	
	------	------	8.490 kg	1096 KN	48.71 MPa			
	------	------	8.535 kg	1123 KN	49.91 MPa			

Cement Content	Observed Strength in 7 days	Observed Strength in 28 days
	Compressive Strength	Compressive Strength
430 kg	35.32 MPa	44.99 MPa
450 kg	41.73 MPa	49.01 MPa

CC= Cement Content
CS= Compressive Strength

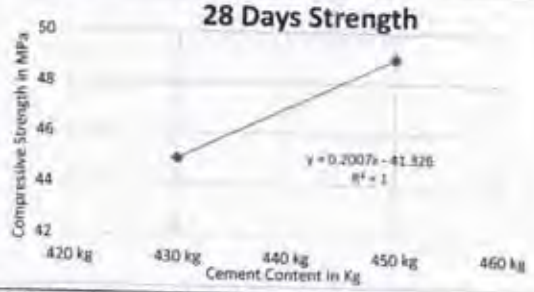


Table : Proposed Cement Content

Grade	Target strength		Cement Content	Remark	
	28 days	7 days	CC= (CS+41.326)/0.2007	Proposed Cementious Content	Remark
M 35	43.3 MPa	30 MPa	421 kg	Say 430 kg	Min. Cement Content as per reff letter 430 kg

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

11A Concrete Mix Calculations Ultratech OPC 43 Cement without Conplast R

Ingredients	Proportion	Sp. Gr.	Water Absorption	Volume in cum	Trial 1	Trial 2
Cementious Content					430 kg	450 kg
JK Lakshmi OPC 43	100.0%	2.9		0.148	430 kg	450 kg
Plastisizer	0.45%	1.2		0.002	1.94	2.03
W/C					0.37	0.36
Free Water					160 kg	160 kg
Water Absorption					17.25 kg	17.06 kg
Total Water		1.0		0.177	177 kg	177 kg
Aggregates (Dry condition)		1864 kg				
River sand	38.0%	2.740	0.95%	0.259	708 kg	708 kg
10 mm	31.0%	2.810	1.01%	0.206	578 kg	568 kg
20 mm	31.0%	2.820	0.81%	0.205	578 kg	568 kg
Density (Th.) in Kg/ Cum		**2470**		0.996	2471 kg	2471 kg
Slump Observed			Initial		180-200 mm	
Slump Observed			Retention	90 min	150 mm above	

Remark: i) Initial Setting of the Concrete is Observed Upto 6 hours.
ii) After 6 hours no impression of Penetratometer have been seen. Hence, Its advice to add the Retarder (Conplast-R) if more retardation is required as per the Site Requirement.

11B CUBE TESTING RESULTS

Table : Cube Testing results Size of Cube : (150 x 150 x 150 mm)

Trial Composition	Date of		Weight of Cube	Compressive Load	Compressive Strength	Average Compresive Stregnth	Duration	Remarks
	Casting	Testing	(Kg)	(KN)	(inMPa)			
430 kg	29-09-21	06-10-21	8.479 kg	954 KN	42.40 MPa	43.81 MPa	7 days	Ultratech OPC 43
	------	------	8.347 kg	1004 KN	44.62 MPa			
	------	------	8.574 kg	999 KN	44.40 MPa			
	------	27-10-21	8.476 kg	1241 KN	55.16 MPa	53.97 MPa	28 days	
	------	------	8.351 kg	1168 KN	51.91 MPa			
	------	------	8.388 kg	1234 KN	54.84 MPa			
450 kg	29-09-21	06-10-21	8.462 kg	1103 KN	49.02 MPa	49.17 MPa	7 days	
	------	------	8.453 kg	1123 KN	49.91 MPa			
	------	------	8.513 kg	1093 KN	48.58 MPa			
	------	27-10-21	8.308 kg	1280 KN	56.89 MPa	57.48 MPa	28 days	
	------	------	8.469 kg	1310 KN	58.22 MPa			
	------	------	8.492 kg	1290 KN	57.33 MPa			

Cement Content	Observed Strength in 7 days	Observed Strength in 28 days
	Compressive Strength	Compressive Strength
430 kg	43.81 MPa	53.97 MPa
450 kg	49.17 MPa	57.48 MPa

CC= Cement Content
CS= Compressive Strength

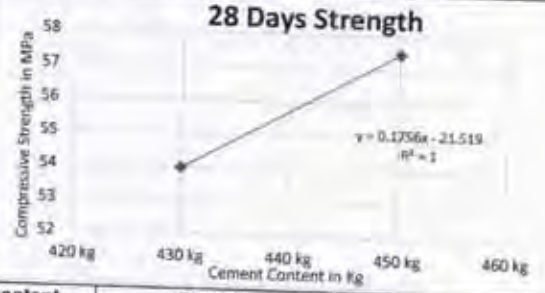


Table : Proposed Cement Content

Grade	Target strength		Cement Content	Remark	
	28 days	7 days	CC= (CS+21.519)/0.1756	Proposed Cementious Content	Remark
M 35	43.3 MPa	30 MPa	369 kg	Say 430 kg	Min. Cement Content as per reff letter 430 kg

(Dr. S.P. Wanjari)
Test I/c (Concrete Technology Laboratory)

12 PROPOSED MIX PROPORTIONS

12A Proposed Mix Design with JK Lakshmi OPC 43 with Conplast R

Ingredients	Proportion	M 35	Source
Type of Concrete		Chimney Shell	
Cementious Content		430 kg	
Cement	100.0%	430 kg	Lakshmi OPC 43
Plastisizer	0.45%	1.94 kg	Fosroc (Auramix-400)
Plastisizer	0.20%	.86 kg	Fosroc (Conplast-R)
W/C		0.37	
Free Water		160 kg	
Water Absorption		17 kg	
Total Water		177 kg	
Aggregates (Dry condition)			
River Sand	38.0%	708 kg	Sone River, Majhiawan
10 mm	31.0%	578 kg	Chattarpur
20 mm	31.0%	578 kg	Chattarpur
Density (Th.) in Kg/ Cum		2471 kg	
Observed Slump (mm)		180-200 mm	Initial
Observed Slump (mm)		150 above	Retention 90 minutes
Type of Exposure:		Severe	

12B Proposed Mix Design with Ultratech OPC 43 with Conplast R

Ingredients	Proportion	M 35	Source
Type of Concrete		Chimney Shell	
Cementious Content		430 kg	
Cement	100.0%	430 kg	Ultratech OPC 43
Plastisizer	0.45%	1.94 kg	Fosroc (Auramix-400)
Plastisizer	0.20%	.86 kg	Fosroc (Conplast-R)
W/C		0.37	
Free Water		160 kg	
Water Absorption		17 kg	
Total Water		177 kg	
Aggregates (Dry condition)			
River Sand	38.0%	708 kg	Sone River, Majhiawan
10 mm	31.0%	578 kg	Chattarpur
20 mm	31.0%	578 kg	Chattarpur
Density (Th.) in Kg/ Cum		2471 kg	
Observed Slump (mm)		180-200 mm	Initial
Observed Slump (mm)		150 above	Retention 90 minutes
Type of Exposure:		Severe	

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

12C Proposed Mix Design with JK Lakshmi OPC 43 without Conplast R

Ingredients	Proportion	M 35	Source
Type of Concrete		Chimney Shell	
Cementious Content		430 kg	
Cement	100.0%	430 kg	JK Lakshmi OPC 43
Plastisizer	0.45%	1.94 kg	Fosroc (Auramix-400)
W/C		0.37	
Free Water		160 kg	
Water Absorption		17 kg	
Total Water		177 kg	
Aggregates (Dry condition)			
River Sand	38.0%	708 kg	Sone River, Majhiawan
10 mm	31.0%	578 kg	Chattarpur
20 mm	31.0%	578 kg	Chattarpur
Density (Th.) in Kg/ Cum		2471 kg	
Observed Slump (mm)		180-200 mm	Initial
Observed Slump (mm)		150 above	Retention 90 minutes
Type of Exposure:		Severe	

12D Proposed Mix Design with Ultratech OPC 43 without Conplast R

Ingredients	Proportion	M 35	Source
Type of Concrete		Chimney Shell	
Cementious Content		430 kg	
Cement	100.0%	430 kg	Ultratech OPC 43
Plastisizer	0.45%	1.94 kg	Fosroc (Auramix-400)
W/C		0.37	
Free Water		160 kg	
Water Absorption		17 kg	
Total Water		177 kg	
Aggregates (Dry condition)			
River Sand	38.0%	708 kg	Sone River, Majhiawan
10 mm	31.0%	578 kg	Chattarpur
20 mm	31.0%	578 kg	Chattarpur
Density (Th.) in Kg/ Cum		2471 kg	
Observed Slump (mm)		180-200 mm	Initial
Observed Slump (mm)		150 mm above	Retention 90 minutes
Type of Exposure:		Severe	

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

13 MIX DESIGN RECCOMMENDATION

1 Mix Design proportions has been proposed in section 12 based on 28 Days strength.

2 It is suggested not to change either grade or brand of Admixture as well as Cement. If the grade, or brand of cement or admixture is changed then it should be Varified for 7 days before doing Concrete.

3 The mix design is based on saturated surface dry condition of coarse and fine aggregate. If dry aggregates are used, the amount of water absorption to be added in to mix. If wet aggregates are used, necessary water reduction adjustment should be made on water absorption given in the Design mix.

4 If the workability achieved at site is lesser or higher than required workability due to temperature variation, the dose of admixture can be increased or decreased with out disturbing water content designed for the mix. In no case, dosages of admixture should not disturb final setting time of Concrete. Fresh trial may be conducted at site to check workability and strength.

5 This report is released after verifying 28 Days strength criterion. Hence after the receipt of this report, it is suggested that party should immediately take out a batch load, check the slump required and cast the cube on site to verify strength at 7 & 28 days. If any discrepancy is noticed/ observed, then the same please communicated to us immediately, within a period of 1½ month so as to take corrective action if any. Any communication in this regard received later than period mentioned earlier shall not be entertained.

6 The given mix design report relates to the samples of materials such as Cement, Admixture, aggregates supplied to this laboratory. However to if you want to achieve minimum cement content as per contracts or IS Specification, It is necessary to change Cement or very high water reduction concrete superplastisizer (ISI mark) in Consultant with VNIT Nagpur, we request you prior intimation to be given to the test I/c before release of final report by VNIT Nagpur. This statement only for the situation when contractors send some materials, which results in increased in project cost due to addition of cement.

7 The Cement shall be used in Fresh state.

8 The percentage of coarse and fine aggretage may be changed upto 2 to 3 % as per the materials gradation at site (for same source only).

9 As per the site Requirement. If the change in setting time is required so it is proposed that the dose of retarder (Conplast-R) to be Increased or Decreased at site depend upon trial mix carried out at site.

Limitations of the report: The given mix design report pertains to normal working conditions of concreting and not for hot weather /cold weather conditions of concreting.& this report should not be treated as universal.

References: I.S.10262-2009, IS 1489 (P-1):2015 for PPC , IS 269.2015 for OPC cement. IS 456 -2000, SP 231 Book on Concrete Technology by: Author Prof. Shetty, Book on Concrete Technology by: Author Prof. Gambhir.

16/11/21

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16.11.21

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17.11.21

(Dr. (Smt.) M.A. Chaudhari)
Dean (R&C)

Terms and Conditions

1 Laboratories at VNIT Nagpur are not NABL accredited.
2 The tests are performed with the test facilities and resources available and accessible to VNIT Nagpur.
3 The test report relates only to the samples supplied by the agency and VNIT will not be responsible for any errors arising due to reasons beyond control of VNIT.
4 VNIT Nagpur is not responsible for any damage, in whatever manner, occurring to any one because of the test results/certification.
5 VNIT Nagpur is not responsible for non functioning of the equipment (fully or partly) on the field for whatever reasons.
6 All the test reports/certificate are valid for a period one year from the date of issue unless otherwise specified and are exclusively for the internal use of the agency which has asked to carry out testing/certification.
7 Any dispute arising out of the contract between agency and VNIT is subject to the jurisdiction of Bombay High Court, Nagpur Bench.
8 VNIT, Nagpur is authorized to carry out testing/certification as per GFR. No.1088/(2512)/Udyog-6dated January 2, 1992.

Final Report

(Dr. S.P.Wanjari)
Test I/c (Concrete Technology Laboratory)

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National Council for Cement and Building Materials
(Under the Administrative Control of Ministry of Commerce & Industry, Govt. of India)
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राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद्
(भारत सरकार के वाणिज्य एवं उद्योग मंत्रालय के प्रशासनिक नियंत्रणाधीन)
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(ISO 9001 : 2015)

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By Speed Post/Email

Ref: CDR/SP-6068
11 January 2021

Sh. Rahul Sharma
Sr Manager (FES&FQA)
Bhartiya Rail Bijlee Company Ltd
Mobile: 9416212682
E mail ID- rahulsharma04@ntpc.co.in

Sub: Evaluation of materials & Concrete Mix Design for Ready mix cement concrete for civil works of FGD system at 4x250 MW BRBCL Nabinagar FGD system, Bihar

Ref: 1. Your letter Ref No. BRBCL/FQA/2020/BHEL/SHIVALIK- Design Mix
2. Your Email dated
3. Our report ref. CDR/SP-6068 dated 09.12.2020

Dear Sir,

We are pleased to enclose herewith the **INTERIM REPORT-II** covering Interim recommendation for M25A20 and M35A20 grade of concrete with PPC

Thanking you

Yours faithfully
National Council for Cement and Building Materials

Suresh Kumar
Manager-CDR

11/01/2021

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Evaluation of materials & Concrete Mix Design for Ready mix cement concrete for civil works of FGD system at 4x250 MW BRBCL Nabinagar FGD system, Bihar

FOR

Bhartiya Rail Bijlee Company Ltd

CDR/SP-6068
JANUARY 2021
INTERIM REPORT-II

Centre for Construction Development and Research
NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
34 Km Stone, Delhi-Mathura Road, NH-2, Ballabgarh – 121 004 (Haryana)

Prepared and checked By **Megha Kalra (Team Leader)**	(Signature)
Approved By **Suresh Kumar (Manager-CDR)**	(Signature) 11/01/2021

Electronic File Ref: **CDR-2/F:/Report/SP-6068-11012021**	**Report No. NCB/CDR-3160** **Version: Interim Report-II**	**No. of Pages/Appendices** **08/10**

MIX DESIGN FOR M30 GRADE
RESULTS BASED ON ACCELERATED TEST METHOD

Name of work : Evaluation of materials & Concrete Mix Design for Ready mix cement concrete for civil works of FGD system at 4x250 MW BRBCL Nabinagar FGD system, Bihar

1.0 DATA PROVIDED BY SPONSOR

Your letter ref: BRBCL/FQA/2020/BHEL/SHIVALIK-Design mix dated 05.09.2020

Sponsor	:	BRBCL, Nabinagar
Grade of Concrete	:	M25
Type of Cement	:	PPC
Grade of Cement	:	--
Brand of Cement	:	JK Lakshmi
Workability of Concrete	:	80-120 mm
Retention Time	:	90 mins
Min. Cement Content	:	As per IS: 456
Max. Cement Content	:	As per IS: 456
Max. Water Cement Ratio	:	As per IS: 456
Exposure Condition	:	Moderate
Source of Coarse Aggregate	:	Chattarpur, Dist. Palamau, Jharkhand
Min. Nominal Size of Aggregate	:	20 mm
Source of Fine Aggregate	:	Sone River, Majhiawan Ghat, Bihar
Brand name of Chemical Admixture	:	Chryso Delta G6143

2.0 TESTS ON CONCRETE MAKING MATERIALS

2.1 Cement PPC (JK Lakshmi)

The test results of PPC cement are given in Table 1A.

2.2 Coarse Aggregate (tested as per IS: 2386-1963)

The test results of Coarse Aggregate (20 mm and 10 mm) are given in Table- 2A and 2B.

2.2.A Combined Grading of Coarse Aggregate

Sieve Size (mm)	*Percentage Passing*		*Combined Grading Achieved* 60% Fraction-I + 40%Fraction-II	*Required combined grading as per Table-7, IS: 383-2016*
	Fraction-I (10-20 mm)	*Fraction-II (<10mm)*		
40.0	100.00	100.00	100	100
20.0	100.0	100.00	100	90-100
10.0	19.0	93.0	48.6	25-55
4.75	1.0	16.0	7	0-10

Note: To satisfy the combined grading limit of IS: 383-2016 for 20mm MSA, the following proportions of different size fractions was used.

Fraction- I (10-20mm) : 60%
Fraction -II (Below 10 mm) : 40 %

2.3 Fine Aggregate, (As Per IS: 2386-1963)

The test results of Fine aggregate (natural) are given in Table- 3A & 3B

On perusal of test results it is seen that the result of grading of fine aggregate conforms to grading zone III as per IS: 383-2016.The sample of fine aggregate is also satisfactory with respect to permissible silt content by wet sieving method.

3.0 CONCRETE MIX DESIGN

3.1 Target Mean Strength

Grade of Concrete	Standard Deviation as per IS:456-2000 (N/mm^2)	Target mean Strength (N/mm^2)
M25	4.0	31.60

3.2 Trials – The details of trials for the concrete mix design are given in Table 4

4.0 INTERIM RECOMMENDATIONS FOR THE CONCRETE MIX DESIGN

4.1 M25A20 Grade with Chemical admixture, Exposure Condition: Moderate, Workability: 80-120 mm slump, Maximum W/C Ratio: As per IS 456, Cement PPC (JK Lakshmi), Minimum cement content: As per IS 456

The interim recommendations for M25A20 grade of concrete for the target average 28-day compressive strength of 31.60 N/mm^2 are given below on the basis of data generated from Table 4

Mix Constituents (kg)	For One Cubic Meter
Cement (PPC)	354
Water	168
Fine Aggregate (Natural)	718
Coarse Aggregate 10-20 mm (60%)	728
Coarse Aggregate <10 mm (40%)	485
Chemical Admixture (Chryso Delta G6143) @ 1.00% by wt. of cementitious material	3.5
Water – Cementitious Ratio	**0.475**

NOTES:

1. The mix design trials were carried out in NCB laboratory at temperature of $(27^0 \pm 2^0)$C and relative humidity of more than 65%. If the workability achieved at site is less than required workability due to temperature variation, the dose of chemical admixture can be increased slightly and site trials should be conducted to check the workability and strength. If the workability achieved is more than required, water content should be adjusted.
2. The mix design is based on saturated surface dry condition of coarse and fine aggregate. If dry aggregates are used, the amount of mixing water should by increased by an amount equal to the moisture likely to be absorbed by the aggregates. If wet aggregates are used, necessary adjustment should be made on the mixing water and aggregate depending upon the amount of free (surface) moisture present.
3. It will be advisable to check the silt content of sand at frequent intervals during the supply, if the silt content in sand is higher than the permissible limit as per IS: 383, the sand may require washing.
4. Results given above refer only to the sample supplied.
5. The above tentative mix design can be adopted at site after carrying out trials as usual.
6. This report is being issued on the specific understanding that NCB will not in any way be involved in any action following the interpretation of the above results.

11/01/2021

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
(Under Administrative Control of Ministry of Commerce and Industry, Govt. of India)
34 KM Stone, Delhi-Mathura Road, Ballabgarh-121004 (HR.)

MIX DESIGN FOR M30 GRADE
RESULTS BASED ON ACCELERATED TEST METHOD

Name of work : Evaluation of materials & Concrete Mix Design for Ready mix cement concrete for civil works of FGD system at 4x250 MW BRBCL Nabinagar FGD system, Bihar

1.0 DATA PROVIDED BY SPONSOR

Your letter ref: BRBCL/FQA/2020/BHEL/SHIVALIK-Design mix dated 05.09.2020

Sponsor	:	BRBCL, Nabinagar
Grade of Concrete	:	M35
Type of Cement	:	PPC
Grade of Cement	:	--
Brand of Cement	:	JK Lakshmi
Workability of Concrete	:	80-120 mm
Retention Time	:	90 mins
Min. Cement Content	:	As per IS: 456
Max. Cement Content	:	As per IS: 456
Max. Water Cement Ratio	:	As per IS: 456
Exposure Condition	:	Moderate
Source of Coarse Aggregate	:	Chattarpur, Dist. Palamau, Jharkhand
Min. Nominal Size of Aggregate	:	20 mm
Source of Fine Aggregate	:	Sone River, Majhiawan Ghat, Bihar
Brand name of Chemical Admixture	:	Chryso Delta G6143

2.0 TESTS ON CONCRETE MAKING MATERIALS

2.1 Cement PPC (JK Lakshmi)

The test results of PPC cement are given in Table 1A.

2.2 Coarse Aggregate (tested as per IS: 2386-1963)

The test results of Coarse Aggregate (20 mm and 10 mm) are given in Table- 2A and 2B.

2.2.A Combined Grading of Coarse Aggregate

Sieve Size (mm)	*Percentage Passing*		*Combined Grading Achieved* 60% Fraction-I + 40%Fraction-II	*Required combined grading as per Table-7, IS: 383-2016*
	Fraction-I (10-20 mm)	*Fraction-II (<10mm)*		
40.0	100.00	100.00	100	100
20.0	100.0	100.00	100	90-100
10.0	19.0	93.0	48.6	25-55
4.75	1.0	16.0	7	0-10

Note: To satisfy the combined grading limit of IS: 383-2016 for 20mm MSA, the following proportions of different size fractions was used.

Fraction- I (10-20mm) : 60%
Fraction -II (Below 10 mm) : 40 %

2.3 Fine Aggregate, (As Per IS: 2386-1963)

The test results of Fine aggregate (natural) are given in Table- 3A & 3B

On perusal of test results it is seen that the result of grading of fine aggregate conforms to grading zone III as per IS: 383-2016.The sample of fine aggregate is also satisfactory with respect to permissible silt content by wet sieving method.

3.0 CONCRETE MIX DESIGN

3.1 Target Mean Strength

Grade of Concrete	Standard Deviation as per IS:456-2000 (N/mm^2)	Target mean Strength (N/mm^2)
M35	5.0	43.25

3.2 Trials – The details of trials for the concrete mix design are given in Table 4

4.0 INTERIM RECOMMENDATIONS FOR THE CONCRETE MIX DESIGN

4.1 M35A20 Grade with Chemical admixture, Exposure Condition: Moderate, Workability: 80-120 mm slump, Maximum W/C Ratio: As per IS 456, Cement PPC (JK Lakshmi), Minimum cement content: As per IS 456

The interim recommendations for M35A20 grade of concrete for the target average 28-day compressive strength of 43.25 N/mm^2 are given below on the basis of data generated from Table 4

Mix Constituents (kg)	For One Cubic Meter
Cement (PPC)	442
Water	168
Fine Aggregate (Natural)	616
Coarse Aggregate 10-20 mm (60%)	741
Coarse Aggregate <10 mm (40%)	494
Chemical Admixture (Chryso Delta G6143) @ 1.00% by wt. of cementitious material	4.40
Water – Cementitious Ratio	**0.380**

NOTES:

1. The mix design trials were carried out in NCB laboratory at temperature of $(27^0 \pm 2^0)$C and relative humidity of more than 65%. If the workability achieved at site is less than required workability due to temperature variation, the dose of chemical admixture can be increased slightly and site trials should be conducted to check the workability and strength. If the workability achieved is more than required, water content should be adjusted.
2. The mix design is based on saturated surface dry condition of coarse and fine aggregate. If dry aggregates are used, the amount of mixing water should by increased by an amount equal to the moisture likely to be absorbed by the aggregates. If wet aggregates are used, necessary adjustment should be made on the mixing water and aggregate depending upon the amount of free (surface) moisture present.
3. It will be advisable to check the silt content of sand at frequent intervals during the supply, if the silt content in sand is higher than the permissible limit as per IS: 383, the sand may require washing.
4. Results given above refer only to the sample supplied.
5. The above tentative mix design can be adopted at site after carrying out trials as usual.
6. This report is being issued on the specific understanding that NCB will not in any way be involved in any action following the interpretation of the above results.

11/01/2021

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
(Under Administrative Control of Ministry of Commerce and Industry, Govt. of India)
34 KM Stone, Delhi-Mathura Road, Ballabgarh-121004 (HR)

TABLE 1A
TEST RESULTS OF CEMENT SAMPLE
CEMENT (PPC) J K Lakshmi

Sl No.	Properties	Results Obtained	Permissible limits as per IS: 1489 Part-1
(A) Physical Analysis:			
1	Blain's fineness, m^2/kg	337	300.0 (Min.)
2	Setting time, minutes		
	Initial	170	30.0 (Min.)
	Final	240	600.0 (Max)
3	Compressive strength, N/mm^2		
	3 days	23.0	16.0 (Min.)
	7 days	31.5	22.0 (Min.)
	28 days	40.5	33.0 (Min.)
4	Soundness		
	Autoclave, %	0.07	0.8 (max)
	Le Chatelier Exp. (mm)	1.5	10.0 (max)
5	Specific Gravity	2.92	--
6	Drying shrinkage	0.04	
(B) Chemical analysis, %			
1	Loss of Ignition (LOI)	3.19	5.0 (Max)
2	Silica (SiO_2)	26.19	--
3	Iron oxide (Fe_2O_3)	2.47	--
4	Aluminium oxide (Al_2O_3)	9.39	--
5	Calcium oxide (CaO)	48.81	--
6	Magnesium oxide (MgO)	5.53	6.0 (Max)
7	Sulphate (SO_3)	2.60	3.5 (Max)
8	Alkalies:		
	Na_2O	0.26	--
	K_2O	0.85	--
	Eq. as Na_2O	0.82	*
9	Insoluble residue	7.88	--
10	Chloride	0.014	0.1 (Max)

TABLE 2A
PHYSICAL TEST RESULTS OF COARSE AGGREGATE SAMPLE
Source- Chatarpur (Jharkhand)

Sl No.	Test Carried out		Result Obtained	Permissible Limits as Per IS: 383-2016
1	Specific gravity		2.85	--
2	Water absorption (%)		0.41	--
3	Abrasion Value %		37	For wearing surface:30% (Max) For non-wearing:50%(Max)
4	Crushing value/Ten percent fines value %		28	For wearing surface:30% (Max) For non-wearing: In case the aggregate crushing value exceeds 30%, then the test for 'ten percent fines' should be conducted and the minimum load for ten percent fine should be 50kN
5	Impact value %		24	For wearing surface:30% (Max) For non-wearing:45%(Max)
6	Combined Flakiness and Elongation index %	20 mm	41.5	40% (Max.)
		10 mm	45.8	
7	Soundness Na_2SO_4 %		0.13	12.00% (Max.)
8	Total Deleterious content % (except coal and lignite)		0.10	2.00 %(Max.) for crushed coarse aggregate

TABLE 2B
SIEVE ANALYSIS OF COARSE AGGREGATE (20 mm & 10mm)

Sieve Size (mm)	Sieve analysis of Coarse aggregates	
	Fraction-I (20 mm down)	*Fraction-II (10 mm down)*
40.0	100	--
20.0	100	--
12.5	--	100
10.0	19	93
4.75	1	16
2.36	--	1

TABLE 3A
PHYSICAL TEST RESULTS OF FINE AGGREGATE SAMPLE (Natural)
Source- Sone River

Sl No.	Test Carried out	Result Obtained	Permissible Limits as Per IS: 383
1.	Specific gravity	2.64	--
2.	Water absorption, %	0.56	--
3.	Material finer than 75-micron, %	0.58	3.0
4.	Clay Lumps, %	0.1	1
5.	Total deleterious material, % (except coal & lignite)	0.68	5
6.	Soundness Na_2SO_4 %	2.36	10 (Max.)
7.	Organic Impurities	nil	--

TABLE 3B
SIEVE ANALYSIS OF FINE AGGREGATE SAMPLE

Sieve Size	Percentage Passing	Percentage Passing for Grading Zone II as per IS: 383-2016 Table 9
10 mm	99	100
4.75 mm	98	90-100
2.36 mm	97	85-100
1.18 mm	92	75-100
600 micron	72	60-79
300 micron	29	12-40
150 micron	3	0-10
Zone as per IS: 383-2016	Zone III	

NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS

Centre for Construction Development & Research

Concrete Section

Concrete Mix Design Trials

TABLE 4

S. No.	Free Water-Cement Ratio	Mix Constituents			Fine Aggregate as % of Total Aggregate by Absolute Volume	Workability of concrete obtained in terms of Slump at 90 min (mm)	Accelerated strength as per NCB method (N/mm^2)	Expected 28-day compressive strength as per NCB Method (N/mm^2)
		Cement Content (Kg/m^3)	Water Content (Kg/m^3)	Dose of admixture (% by Wt. of Cement)				
M25A20, M35A20, Workability:80-120 mm slump at 90 min, Exposure condition: Moderate, Maximum W/c ratio: as per IS 456, Minimum cement content (Kg/cum):As per IS 456,**Cement :PPC (JK Lakshmi)**								
1.	0.500	300	150	1.00	42.0	00	Mix rejected	
2.	0.500	320	160	1.00	42.0	40	Mix rejected	
3.	0.500	330	165	1.00	41.0	75	Mix rejected	
4.	0.500	336	168	1.00	40.0	85	22.34	29.35
5.	**0.475**	**354**	**168**	**1.00**	**39.0**	**100**	**24.61**	**32.12**
6.	0.450	373	168	1.00	38.0	85	26.69	34.67
7.	0.425	395	168	1.00	37.0	95	30.06	38.79
8.	0.400	420	168	1.00	36.0	90	31.85	40.98
9.	**0.380**	**442**	**168**	**1.00**	**35.0**	**100**	**34.28**	**43.95**
10.	0.360	467	168	1.00	34.0	95	36.18	46.27

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Ref. No. IIT(BHU)/CE/Transportation/Consultancy/AM/2024-2025/1520 **Date**: 22/07/2024

Report: Design of Dry Lean Concrete (DLC) [Revised]

Tested for:	Mr. Manish Ojha (Sr. Assistant Engineer (FQA) Bhartiya Rail Bijlee Comany Ltd. Nabinagar, District-Aurangabad (Bihar) 824303 (Kumar Piyush Construction Private Limited)
Ref.	Ref Letter: BRBCL/FQA/TP/2024/16 (Date: 13/04/2024)
Sample Details (Received on 16/04/2024)	Cement (Shree Cement, OPC): 2 bags, Sand: 300 kg, Aggregates (20 mm: 250 kg, 10 mm: 250 kg), Water: 100 liter
Scope of Work	**Mixed Design** of Dry Lean Concrete (M10, designed as per IRC SP 049, 2014)

Combined Gradation as per MORTH Table 600-3

Size (mm)	20 mm	10 mm	Sand	Combined Achieved	Lower Limit	Upper Limit
26.50	100.0	100.0	100.0	100.0	100	100
19.00	73.3	100.0	100.0	89.7	75	95
9.50	0.8	88.5	100.0	58.5	50	70
4.75	0.0	2.4	100.0	34.8	30	55
2.36	0.0	0.0	94.4	32.2	17	42
0.60	0.0	0.0	64.2	21.9	8	22
0.30	0.0	0.0	24.0	8.2	7	17
0.15	0.0	0.0	5.0	1.7	2	12
0.075	0.0	0.0	0.8	0.3	0	10
Mix %	**38.7**	**27.2**	**34.1**			

AM

Material Properties

Material	Specific Gravity	Impact Value (%)	Water Absorption (%)
Cement	3.15	--	--
Water	1	--	--
Coarse Aggregate, 20 mm	2.689	13.20	0.301
Coarse Aggregate, 10 mm	2.680	15.54	0.351
Fine Aggregate, Sand	2.579	--	1.407

Cubes were cast for water contents of 5.0%, 5.5%, 6.0%, 6.5% and 7.0% by weight of the DLC materials. The optimum water content was found to be **5.5%** while the density was estimated to be **2.424 g/cc**. Compaction of the mix was done using vibratory hammer. The 7 day strength of the cube was 19.17 Mpa. The following is the job mix formula that could be targeted in the field.

Job Mix Formula

Item	(kg per m^3)
Cement (M10)	160
Water (5.5 %)	579
Coarse Aggregate, 20 mm	3803
Coarse Aggregate, 10 mm	2671
Fine Aggregate, Sand	3352
(Aggregate/Cement) Ratio = 14	

Note:

- Test results are based on the material/samples provided by the client.
- Material was supplied to the Laboratory in sealed condition.
- DLC design is subjected to vibratory compaction. Proper quality control measures and curing must is requried to achieve the desired strength values of DLC.
- Any clarification on the report should reach within one month from the date of the test report.

Abhisek Mudgal 22/7/24

Dr. Abhisek Mudgal
Project Consultant
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Ref. No. IIT(BHU)/CE/Transportation/Consultancy/AM/2024-2025/ 1036 **Date**: 21/06/2024

TEST CERTIFICATE for Mixed Design of PQC

Tested for:	Mr. Manish Ojha (Sr. Assistant Engineer (FQA) Bhartiya Rail Bijlee Comany Ltd. Nabinagar, District-Aurangabad (Bihar) 824303 (Kumar Piyush Construction Private Limited)
Ref.	Ref Letter: BRBCL/FQA/TP/2024/17 (Date: 13/04/2024)
Sample Details (Received on 16/04/2024)	Cement (Shree Cement, OPC): 2 bags, Sand: 300 kg, Aggregates (20 mm: 250 kg, 10 mm: 250 kg), Chemical Admixture (Chryso Delta CG143): 20 kg Water: 100 liter
Scope of Work	**Mixed Design** of Pavement Quality Concrete (M35, designed as per IRC 44-2017)

Combined Gradation as per MORTH 600

Size (mm)	20 mm	10 mm	Sand	Combined Achieved	Lower Limit	Upper Limit
26.50	100	100	100	100	100	100
19.00	78	100	100	92.3	90	100
9.50	0.8	89.9	100	63.5	48	78
4.75	0	3.55	97	45.9	30	58
0.60	0	0	24	11.2	8	35
0.15	0	0	4.8	2.2	0	12
0.075	0	0	0.8	0.4	0	2
Pan	0	0	0	0	0	0
Mix %	**34.9**	**18.5**	**46.6**			

AM

Job Mix Formula and Specific Gravity

Material	Job Mix Formula		Specific Gravity
	Weight Ratio	Weight (Kg) in 1 m^3	
Cement	1	391	3.15
Water	0.436	171	1
Coarse Aggregate, 20 mm	3.172	1240	2.689
Coarse Aggregate, 10 mm	1.674	655	2.680
Fine Aggregate, Sand	1.551	606	2.579
Chemical Admixture (0.6% by weight of cement)	0.006	2.35	1.075

Other Material Properties

Material	Coarse Aggregate, 20 mm	Coarse Aggregate, 10 mm	Fine Aggregate, Sand (Sone River)
Impact Value (%)	13.2	15.54	--
Los Angeles Value (%)	17.5	19.5	--
Crushing Value (%)	15.68	18.22	--
Water Absorption (%)	0.3	0.35	1.41
Deleterious Material (%)	--	--	0
Silt Content (%)	--	--	0.2
Soundness (%)	--	--	1.41
Flakiness (%)	13.00%	15.00%	--
Elongation (%)	15.00%	16.00%	--

Test Results

Parameter	Value
Target Compressive Strength (N/mm²)	43.25
Achieved Slump (mm)	85
7-days Compressive Strength in Lab (N/mm²) [29-05-2024]	43.41
28-days Compressive Strength in Lab (N/mm²) [20-06-2024]	49.87

Note:

- Test results are based on the material/samples provided by the client.
- Material was supplied to the Laboratory in sealed condition.
- DLC design is subjected to vibratory compaction. Proper quality control measures and curing must is requried to achieve the desired strength values of PQC and DLC.
- Any clarification on the report should reach within one month from the date of the test report.

Dr. Abhisek Mudgal
Project Consultant

Dr. ABHISEK MUDGAL
Assistant Professor
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Indian Institute of Technology
(BHU), Varan... 005

ANNEXURE-A

1.0 MANDATORY/GENERAL HSE COMPLIANCE OBLIGATIONS:

a. CONTRACTOR HAS TO ENSURE THAT THEIR DEPLOYED PERSONNEL/MANPOWER SHALL FOLLOW AND COMPLY WITH, DURING THEIR ENTIRE PERIOD OF DEPLOYMENT AT THE SITE WHILE SUPPLYING AND INSTALLATION OF MATERIAL, ALL EXTANT HSE RULES & REGULATIONS AT THE PROJECT SITE AS IS APPLICABLE FOR GENERAL WORKPLACE SAFETY, PERSONAL SAFETY AS WELL AS MANDATORY FOR SAFE EXECUTION OF THEIR WORK & DISCHARGING THEIR PRESCRIBED ROLES.

b. THE PERSONNEL/MANPOWER OF THE CONTRACTOR (BIDDER/VENDOR/AGENCY) DEPLOYED AT THE SITE SHALL BE GUIDED BY & SHALL BE ACCOUNTABLE TO THE BHEL SITE HSE MANAGEMENT FOR ALL MATTERS PERTAINING TO HEALTH, SAFETY & ENVIRONMENT DURING THE ENTIRE TENURE OF DEPLOYMENT. THEY SHALL CONDUCT THEMSELVES IN LINE WITH BHEL SAFETY CULTURE.

c. THE CONTRACTOR (BIDDER/VENDOR/AGENCY) SHALL ENSURE THAT THEIR PERSONNEL/MANPOWER DEPLOYED AT THE SITE, BESIDES BEING QUALIFIED FOR THE PRESCRIBED JOB, ARE PHYSICALLY AND MENTALLY SOUND TO EXECUTE THE SAME.

d. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR (BIDDER/VENDOR/AGENCY) TO ENSURE THAT THEIR PERSONNEL/MANPOWER DEPLOYED AT THE SITE POSSESS AND USE AT WORK ALL STANDARD QUALITY PPES AS ARE MANDATORY TO EXECUTE THEIR PRESCRIBED JOB SAFELY INCLUDING BASIC PPES LIKE SAFETY SHOES AND SAFETY HELMET.

e. THE PERSONNEL/MANPOWER OF THE CONTRACTOR (BIDDER/VENDOR/AGENCY) DEPLOYED AT THE SITE SHALL BE RESPONSIBLE & HELD ACCOUNTABLE FOR THE SAFETY OF SELF, OF OTHERS, OF MATERIAL/ASSET AND OF THE ENVIRONMENT. ACCORDINGLY, THE BIDDER/VENDOR/AGENCY SHALL ENSURE THAT THEIR PERSONNEL/MANPOWER DEPLOYED AT THE SITE SHALL NOT INDULGE IN ANY ACT OF COMMISSION OR OMISSION THAT WOULD JEOPARDISE THE SAFETY OF MAN, MATERIAL OR ENVIRONMENT.

f. IN CASE ANY TYPE OF INCIDENT OCCURS DUE TO NEGLIGENCE AND/OR NON-OBSERVANCE OR NON-COMPLANCE OF NECESSARY HSE RULES/REGULATIONS/GUIDELINES/THER PRECAUTIONS BY THE PERSONNEL/MANPOWER OF THE BIDDER/VENDOR/AGENCY CAUSING INJURY OR ILL-HEALTH TO ANY OTHER PERSON(S)/PUBLIC, TO PROPERTY OR ENVIRONMENT, THE CONTRACTOR (BIDDER/VENDOR/AGENCY) SHALL HAVE TO PAY NECESSARY COMPENSATION AND OTHER EXPENSES, AS DECIDED BY COMPETENT AUTHORITIES.

g. IN CASE ANY TYPE OF DAMAGE OCCURS TO THE PROPERTY/ASSET AND PERSONNEL OF BHEL, CUSTOMER, GOVERNMENT OR ANY THIRD PARTY DUE TO NEGLIGENCE AND/OR NON-OBSERVANCE OR NON-COMPLANCE OF NECESSARY HSE RULES, REGULATIONS OR GUIDELINES AS WELL AS OTHER PRECAUTIONS BY THE PERSONNEL/MANPOWER OF THE BIDDER/VENDOR/AGENCY AND IF BHEL IS UNABLE TO RECOVER IN FULL, THE COST FROM THE INSURANCE COMPANY, THE BALANCE WILL BE RECOVERED FROM THE CONTRACTOR'S (BIDDER/VENDOR/AGENCY) BILL.

h. **AMENDMENTS/MODIFICATIONS, ADDITIONS, REVISIONS ETC. TO THE EXTANT RULES, REGULATIONS & GUIDELINES AS INCLUDED IN THE PRESENT DOCUMENT OR THE APEX DOCUMENT (HSEP:14, REV.02 DATED 21.12.2022) OR ANY OTHER RELATED DOCUMENT ISSUED BY BHEL, CUSTOMER (BRBCL, NABINAGAR) OR ANY STATUTORY BODY AT ANY LATER DATE DURING THE COURSE OF EXECUTION OF THE JOB TO ENSURE OCCUPATIONAL SAFETY SHOULD ALSO BE COMPLIED WITH BY** THE CONTRACTOR (BIDDER/VENDOR/AGENCY).

2.0. IN ORDER TO ENSURE APPROPRIATE & EFFECTIVE HSE COMPLIANCE (BOTH GENERAL & JOB-SPECIFIC) AND SAFE EXECUTION OF THEIR STIPULATED JOB THE BIDDER/VENDOR/AGENCY, BESIDES CONFORMING TO THE PROVISIONS OF CLAUSE 1.0 ABOVE, SHOULD ALSO ACQUAINT THEMSELVES & COMPLY WITH THE PROVISIONS &

GUIDELINES HELD IN VARIOUS SECTIONS OF BHEL APEX SAFETY DOCUMENT i.e. **HSE PLAN FOR SITE OPERATIONS BY SUBCONTRACTORS (HSEP 14 REV.02 DTD. 21.12.2022)** THAT ARE RELEVANT TO THEIR JOB. AN OVERVIEW OF SOME OF THE MAJOR HSE PROVISIONS THAT SHOULD BE COMPLIED WITH ARE MENTIONED BELOW.

Sl. No.	Clause Reference	Subject	Document Reference
1	Clause 4 (Section-A/Page No. 06-08)	Critical Requirements w.r.t. Equipment & PPEs	HSEP 14 REV.02 DTD. 21.12.2022 (HSE Plan for Site Operations by Subcontractors)
2	Clause 5 (Section-A/Page No. 08-10)	HSE Personnel to be provided solely by the Subcontractor	
3	Clause 12 (Section-A/Page No. 13-16)	HSE Penalties	
4	Clause 6.1 (Section-B/Page No. 27)	Hazard Analysis & Risk Assessment (HIRA), Method Statement (MS) & Job Safety Analysis (JSA)	
5	Clause 9 (Section-B/Page No. 29-31)	Provision of Personal Protective Equipment (PPEs)	
6	Clause 10 (Section-B/Page No. 31-34)	Arrangement of infrastructure- 10.1 Drinking Water 10.5 Medical Facilities/First Aid Box/ Health Check-up 10.9 Illumination	
7	Clause 13.3/Annexure-I (Section-B/Page No. 31-34)	Activity-specific Precautions/Controls- 3.3 Batching Plant Operation 3.4 Mobile Plant 3.6 Concrete Mixers	
8	HSECHK/15	Format-Inspection of Batching Plant	Placed as FORMAT A
9	HSEOCP:36	Operational Control Procedure-Batching Plant	Placed as FORMAT B
10	HSEP:12-F19	Work Permit-Concrete Batching Plant Operation & Maintenance	Placed as FORMAT C

	BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR HEAD QUARTER INSPECTION OF BATCHING PLANT	Checklist No. HSECHK/15 Revision No. 01 Date: 22-04-2022

S. No	Inspection Details	Y/N	Remarks
	Operational and maintenance safety points		
1	Batching plant operator is trained and having adequate experience		
2	Details of authorized operator displayed at plant		
3	Limit switch is provided (and in working condition) for cleaning and maintenance work		
4	Emergency stop buttons available, effective and clearly labelled?		
5	Are the openings where there is free fall hazard covered or fenced securely by railing, toe guards etc?		
6	Are the moving parts and point of operation of concrete pump, compressor adequately guarded?		
7	All the conveyors are adequately guarded and pull-guard switch provided if applicable		
8	Electrical & mechanical isolation with airline drain done before cleaning /maintenance of mixer or discharge chute		
9	Work platforms protected by adequate hand rails (minimum height 1.0 meter)		
10	All the chain block/lifting machines, compressors, chains, ropes of conveyor or bucket elevator inspected by competent third party? Test certificate with identity No. available		
11	Additional holding arrangements for mixing compartment opening lid provided (other than single chain block)		
12	Screw conveyor casing for unloading cement from silo is without any cracks, joints clamped properly		
13	Ladder / staircase provided for grinding compartment and other platforms is secured properly		
14	Hazardous chemicals (admixtures) stored at isolated location, with proper warning signs, spill control measures, MSDS displayed		
15	All pressure gauges are working, calibrated and max. pressure displayed		
16	LOTO system implemented		
	General Safety Points		
17	Safe Operating Procedure (SOP) or OCP available and displayed		
18	Backhoe loader / JCB for feeding aggregates is provided with a. main horn / reverse horn operated by competent driver valid statutory documents of the vehicle		
19	Periodic Medical examination done for all labours		
20	Adequate Portable Fire extinguishers available and periodically inspected		
21	First aid kit available and displayed		
22	Operating manual available at plant		
23	Adequate illumination provided at night		
24	All emergency indicators light in operation		
25	Warning signs displayed		
26	Proper Housekeeping practices are followed at the work area		
27	Unintended visitors to work area not allowed. (display to be made)		
28	Adequate personal protective equipment is worn by the workers.		
29	Periodic water sprinkling for dust suppression		
30	Are the operators for concrete mixture and other machines having moving parts aware of the danger of working with loose clothing?		

31	Adequate rain protection measure done for DG set, compressor and other installations		
32	Unauthorized equipment modification without OEM concurrence		
	General Electrical safety points		
33	Are all connections made by using appropriate plugs, receptacles or enclosures? Are fuses provided?		
34	Single line diagram of electrical cable routing, danger sign at power source displayed		
35	ELCB /RCCB/MCB to all power sources.		
36	No joints / Multiple joints of electrical (industrial socket should be used for joints in case)		
37	Whether all electric equipments / installations have been provided with double earthing?		
	During periodic calibration of the plant		
38	Electrical & mechanical isolation with airline drain done before calibration		
39	All the guards removed during calibration are replaced and fixed properly		
	During cement feeding to Silo (unloading of cement bulker)		
40	Rotating parts of Cement feeding pump is guarded properly		
41	Pressure gauge is provided, working and max. pressure displayed		
42	Safety valve /pressure relief valve and Non-return valve available and working		
43	Screw pump hose casing is provided without any cracks, joints clamped properly		

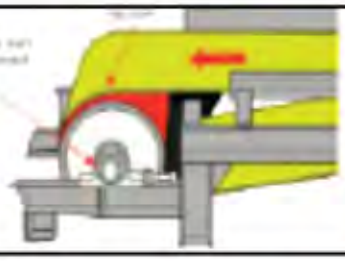
Inspection Area/Agency		
Inspected by (Name & Sign)		Inspected Date: Agency:

बी एच ई एल BHEL	**OPERATIONAL CONTROL PROCEDURE**	**Doc. No.: HSEOCP:36** **Rev. No.: 03** **Rev. Date: 22/04/2022**
OCP No. : 36	**BATCHING**	Page 1 of 8

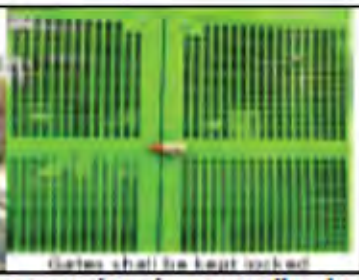
Purpose	To ensure safety of men & equipment involved in batching operation and obviate undesirable effects on environment.	**Scope**	PS Regions
Responsibility	Concerned HOS / Safety co-ordinator		
Performance criteria	Number of unsafe incidents reported		

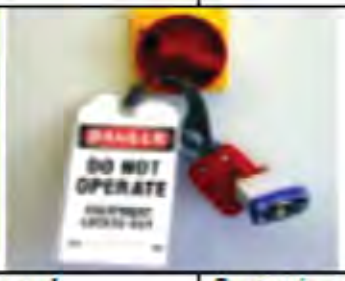
PPEs Used					
	Insulated rubber gloves		Appropriate Insulated rubber footwear		Good safety helmet secured with chin strap
	Respiratory protection				

Procedures and Controls		
S. No.	Activity	Responsibility
General		
1.	Ensure that only experienced operators run the batching machine.	Supervisor
2.	Avoid prolonged exposure/inhalation of dust or cement powder. Ensure respiratory masks are provided to all involved in carrying cement / sand	Supervisor
3.	Follow the maximum weight limit for men and women workers engaged in lifting the mixed concrete	Supervisor
4	Follow instructions on electrical safety like ELCB operated equipment, proper cable termination with plugs, use of 24V hand lamps. etc.	Supervisor
5	Adequate safety measures (including job-instructions) are taken for the workmen pouring aggregates and cement in the batching machine	Supervisor
Safety Features of Batching Plant		
6	Ensure the availability of external electric motovibrators in the feeding hopper of batching plant to reduce human intervention in clearing jammed sand	Supervisor
7	Ensure all applicable safety devices like pull-chord on both the sides of conveyor for stopping the conveyor in emergency., all limit switches, emergency push buttons, safety interlocks etc. are working	Supervisor
	 	
8	Ensure conveyor belt/rotating parts are guarded properly.	Supervisor



Operation		
9	Ensure that manufacturer's operating manual is available and understood by the operating staff	Supervisor
10	Ensure operating staff is skilled and able to understand operating instructions (generally) in English	Supervisor
11	Ensure operating staff understands each other and communicates in a common language	Supervisor
12	Avoid sending personnel inside the plant for cleaning. In case necessary, same should be carried out rarely. In that case, ensure that a written Lockout Tag-out procedure is in place if cleaning of equipment is required from inside, and precautions in S. No. 13 below are ensured	Supervisor





13. Precautions to be ensured in case mixer is manually cleaned a. Never remove Limit Switch installed on the mixer door b. Never modify or bypass or remove anything from machine circuit particularly mixer door limit switch & emergency switch. In case of any defects in Limit Switch operation, promptly attend to it for proper functioning c. Put a visual indication like "MEN AT WORK", "MACHINE UNDER SERVICE", "DO NOT START" etc. to warn and prevent against unintended restart d. Especially when chipping and cleaning is carried out inside the mixer by manual intervention, it is extremely necessary that the machine is locked out for the mixer motor. For that, it is strongly recommended to keep the emergency switch pushed, panel to be shut off and main switch of the panel to be locked e. Put a Tag Notice Board: "MIXER UNDER CLEANING. DO NOT START" f. Before restarting the machine, ensure that no one is working inside the mixer. This is must for the safety of the person g. Never allow anyone to take a shortcut to start the mixer motor. Never	Supervisor & Operator

	tamper the wiring in order to start the mixer. Take precautions to safeguard the personnel first and then carry out the necessary servicing h. Carry out regular cleaning of mixer by water to avoid the need for chipping	
	 Red Emergency stop Button	
14.	Curing water tanks at ground level shall be hard barricaded to prevent personal falls.	Supervisor
	 Curing Tank	
15.	Prohibition of cell phones: Prevent use of cell phone at all critical activities. Do identify critical activities and communicate the same. Maintain signage's at prominent places of workplace.	Supervisor
		

HSEP-12-F19

CONCRETE BATCHING PLANT OPERATION & MAINTANANCE PERMIT

Permit No. & Date	
Project & Unit:	Emergency Contact Nos:

Exact Location of Work: _____

Nature / Description of Work: _____

Duration of Work Execution *: From Date: _____ to Date: _____ Daily from _____ hrs. to _____ hrs.

Name of Agency Performing the Work: _____

Name of Agency's Site Engineer (Permit Requesting Authority): _____ Sign: _____

Name of Agency's Package In-charge: _____ Sign: _____ Date: _____

The above described work will be done under all the safety precautions mentioned on this permit to work as under during the currency of the Permit.

No.	Item	Yes	Not required / Remarks
1.	All workers on job are competent and medically fit (No Height Phobia) for working at height		
2.	Batching plant operator is trained and having adequate experience and displayed		
3.	Emergency stop buttons available, effective and clearly labelled?		
4.	All the conveyors are adequately guarded and pull-guard switch provided if applicable		
5.	All the chain block/lifting machines, compressors, chains, ropes of conveyor or bucket elevator inspected by competent third party? Test certificate with identity No. available		
6.	Work platforms protected by adequate hand rails (minimum height 1.0 meter)		
7.	Valid PV Test certificate of compressor is available & displayed.		
8.	Elect Compressor MOTOR is powered through RCCB		
9.	Proper Housekeeping practices are followed at the work area		
10.	Limit switch is provided (and in working condition) for cleaning and maintenance work		
11.	Are the openings where there is free fall hazard covered or fenced securely by railing, toe guards etc?		
12.	Are the moving parts and point of operation of concrete pump, compressor adequately guarded?		
13.	Fire Extinguisher is available		
14.	Additional holding arrangements for mixing compartment opening lid provided (other than single chain block)		
15.	Competent Supervisor and Safety Officer are available during operation		
16.	Emergency response team & Medical Facilities available		
17.	Work hazards are identified, controlled and communicated to the worker in daily Safety Pep talk		
18.	Hazardous chemicals (admixtures) stored at isolated location, with proper warning signs,, MSDS displayed		
19.	Method Statements/ Job Safety Analyses attached. SOP/OCP available and displayed		
20.	Inspection of Batching Plant done frequently as per BHEL INSPECTION CHECKLIST		
21.	List of Other Permits Required for the Activity (Attached):		
22.	Toolbox Talk Records with (preferably) list of workers involved in the Permit Activity (to be attached)		

The conditions mentioned in the above checklist are sufficient for safe completion of this activity. These have been checked and found complied before issuing the Permit, and shall be monitored and ensured throughout the currency of this Permit.

A. Permit Requester / Receiver (Agency):

Site Engineer:	Site HSE Officer:
Signature:	Signature:
Name: Designation:	Name: Designation:

B. Permit Issuer (BHEL):

Site Engineer / Authorized Representative:	Site HSE Officer / Authorized Representative:
Signature:	Signature:
Name: Designation:	Name: Designation:

C. Package-in-charge (BHEL):

Signature:

Name: Designation:

Original: Permittee ( ) 2nd Copy: Agency Deptt. HOS ( ) 3rd Copy: BHEL Site HSE ( )

(* Permit valid for 14 days as per overleaf format)

P.T.O.

(To be printed on both sides of an A4 Sheet)

Permit No. & Date:

All parameters from S.No. 1 to 23 on Page 1 of this Permit are to be checked physically. In case any deviation is observed, same is to be rectified, only then work is to be started

Daily Work Area Condition Endorsement

Day	Date	Remarks (if any) & Signature with Date & Time				
		Agency Site Engineer	Agency HSE Officer	BHEL Site Engineer *	BHEL HSE Officer *	Remarks
2						
3						
4						
5						
6						
7						

Permit Extension Beyond Initially Requested Hours

Sl. No.	Extension Period		Remarks	Signature with Date & Time			
	From..... (Date, Time)	To..... (Date, Time)		Agency Site Engineer	Agency HSE Officer	BHEL Site Engineer *	BHEL HSE Officer*
1							
2							
3							
4							
5							
6							
7							

Permit Closure After Work Completion

Permit is here by returned after completing the job, ensuring safe removal of men and material and proper housekeeping of the Area.

Reason for Closure: Job complete ( ) Permit Validity Over ( )

Agency

Site Engineer	Site HSE Officer
Signature:	Signature:
Name:	Name:

BHEL

Verified as above and Permit is Closed In case job not complete, New Permit No. Issued:

Site HSE Officer*	Site Engineer*
Signature:	Signature:
Name:	Name:

(* or authorized representative duly concurred by Region HSE)

Bharat Heavy Electricals Ltd.
(A Govt. of India Undertaking)
Power Sector – Management Services

Ref: PSHQ-HSE/ HSEP14 /Rev02 Date: 13th Jan' 2023

Sub: Release of revised HSE Tender Specifications (HSEP14-Rev02) for Subcontracting of Installation works at Power Sector Regions

The HSE tender specification (Rev 01) issued vide IOM dtd. 20.1.2020 were taken up for review under the present scenario. The same were reviewed in line with customer specifications, learnings from incidents and site inputs.

The Revised HSE Tender Specification i.e. HSEP14 Rev. 02 proposed by PSHQ-HSE department, duly endorsed by HSE and SCT Heads of PS-Regions, PSHQ-MSX and approved by Heads of PS-Regions, is hereby released for implementation for all future tenders w.e.f. 17.01.2023

The document shall be applicable to all tenders floated by PS-Regions.

The specification is also being uploaded on PSHQ-HSE portal.

13/01/23

(Asim Mishra)
AGM (PSHQ-MSX)

Encl.: HSEP14 Rev. 02

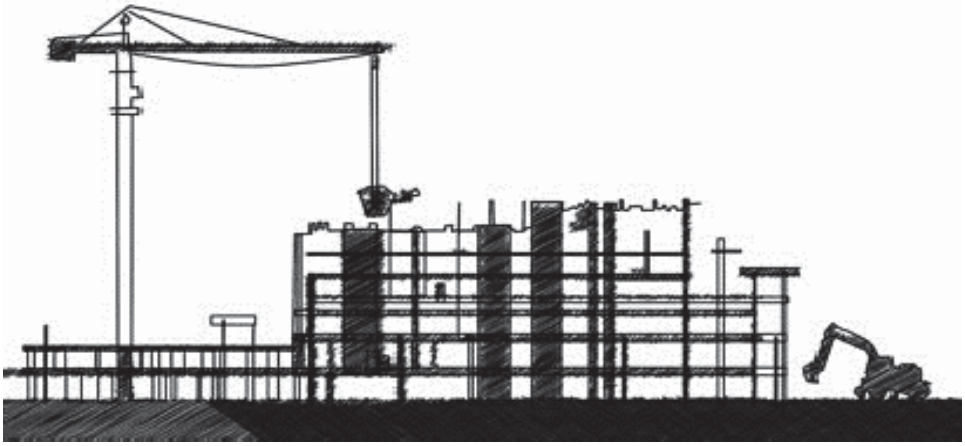
Distribution:
SCT Heads of PS-Regions
HSE Heads of PS- Regions
Project Heads of PS Regions
Head - Corp HSE

For kind information please:

GM (I/C)/(PSNR), ED/(PSER), GM (I/C)/(PSWR), ED/(PSSR)
GM (I/C)/ (PSHQ)
ED (HR & CC), Corporate Office.
SA to Director (Power)

HSEP14

Health, Safety & Environment Plan for Site Operations by Subcontractors



Bharat Heavy Electricals Limited, Power Sector
Regd. Office: BHEL House, Siri Fort, New Delhi – 110049, www.bhel.com

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SECTION A

CRITICAL RESOURCES FOR HSE IMPLEMENTATION

1. SHARING OF OPERATING COSTS OF FACILITIES

TABLE A.1

SN	FACILITY
1	Ambulance with 24 hr. First Aid Trained Driver (Specs in Annexure A)
2	Operation of Medical center, Nurses, Medical Consumables etc. (Specs in Annexure A)
3	Training Center Consumables
4	Water sprinkling for dust suppression
	(Others:)

Note:

i. Responsibility of operation of above facilities shall rest with BHEL
ii. Operating cost of the above shall be deducted from subcontractors on 'proportional to contract' value basis. Sample deduction table enclosed as Annexure A.1
iii. "Contract value" defined above & subsequently in the document shall be considered as "Awarded contract value".
iv. No overhead cost/ enabling cost of BHEL shall be levied on the contractors for common facilities.
v. These running costs shall be recovered from all the available subcontractors at site for the complete operational duration of the site
vi. No overheads shall be charged on shared operating costs

2. RESOURCES TO BE PROVIDED SOLELY BY THE SUBCONTRACTOR

TABLE A.2

SN	ITEM	SPECIFICATIONS
1.	HSE DISPLAYS, Posters and signage	Annexure B
2.	HSE Tools/ Equipment/ Devices	Annexure C
3.	Rest Sheds for Workers	Annexure D
4.	Labor Colony	Annexure E
5.	Toilets (Latrines & Urinals) - in Site and Labor Colony	Annexure F
6.	Fire Extinguishers	Annexure G

Note:

In case subcontractor fails to provide the required resources, same will be procured and deployed by BHEL with applicable overhead on total procurement cost

3. ESTABLISHMENT OF COMMON FACILITIES

In green field projects BHEL shall arrange and provide the following facilities which shall be used by all subcontractors for their employees and workers. These shall be

i. Medical Centre
ii. Safety park with facilities of audio-visual training & vertigo test center.
iii. No cost shall be deducted from the subcontractors for the structure part only.
iv. The running cost with basic inputs already mentioned at Point 1 above shall be shared by all contractors.
v. The sub-contractors shall be required to ensure participation in trainings, medical checkup and vertigo test as per the guidelines laid in this document and required as per statutory HSE requirements.

vi. However, in projects where in these facilities are not provided by BHEL, subcontractors shall ensure the training, medical/ vertigo test of all workers at site in consultation and guidance of BHEL HSE team at site in line with provisions of this document.

vii. The overall onus of compliance to HSE practices pertaining to training, medical checkup including vertigo test shall lie on the subcontractor only.

4. CRITICAL REQUIREMENTS W.R.T. EQUIPMENT & PPES

i. Conventional Hydra crane with carriage in front shall not be permitted. Pick & carry tyre mounted Front Cabin mobile crane (FX or TRX/ NextGen series of 'ESCORT" or equivalent make) shall only be permitted.

ii. Any Heavy equipment (cranes, winch machines, etc.) shall be deployed only after pre-safety Inspection by safety dept. Valid AMCs/ Fitness/ other statutory clearances as per local rules shall be required to be submitted before mobilizing the equipment at site.

iii. All other Hand tools and power tools should not be older than 5 years.

iv. For Chimney passenger lift, winch to have double drum rope for passenger and double safety devices must be used. Winch should not more than 3 years old and winch rope must be inspected with valid certificate from competent authority within 6 months and should meet the IS standard 9507 provision of OLR and push back button arrangement or dead man switch.

v. Gate pass for all the lifting T&Ps and construction machinery/ equipment shall be made after obtaining written acceptance (Pre-entry Safety Clearance) from BHEL Site Safety Department after physical verification and checking all requisite documents/ compliance to Safety norms

vi. All motor vehicles should have valid registration certificate, insurance, Pollution under control (PUC) and fitness certificate as per Motor Vehicle Act 2020. The certificates should be pasted in the glass from inside.

vii. PPEs shall be from reputed manufactures viz. 3M, Udyogi, Karam, Frontier, Freedom, Honeywell, Liberty, Bata, Nomex, Acme, Unicare, Life Gear or equivalent. In case Subcontractor recommends any other name the same can be approved at site level by the Construction manager & Site HSE

viii. For height work, where fall could result in death or disability, a secondary means of fall protection (Safety Net, Retractable Fall Arrestor etc.) shall be mandatorily provided by the subcontractor, failing which, a penalty of INR 10000 per case will be imposed. In addition, there should be constant supervision for such critical height work. Any non-erection activities at height eg. Housekeeping etc. shall also fall under the category of height work

ix. **Scaffold Tagging**

Scaffolds being erected, modified or dismantled must be tagged as suitable for use. Tagging shall be done with standard tag holder. Scaffolding tag should be certified by scaffolding inspector having valid certificate.

- **GREEN** scaffold tag- shall be fixed when scaffold is complete and safe for use, signed and dated by the scaffolding competent person daily.
- **RED** scaffold tag – to be fixed if scaffold is in some way defective and cannot be used or is still under erection.
- **YELLOW** scaffold tag – to be fixed if scaffold is in under construction/ maintenance.

FIG. A.4.1 SAMPLE SCAFFOLD TAGS AND TAG HOLDER

x. **T&P Color Coding:**

a. Inspections and tests shall be documented by means of color coding which shall verify that inspections or testing are current and that all receptacles, portable Power tools, Lifting Tools & Tackles have been inspected and tested as required. The color codes used on the project shall be:

GREEN	BLUE	YELLOW	PURPLE
January	April	July	October
February	May	August	November
March	June	September	December

TABLE. A.4.2: T&P COLOR CODES

b. The cycle of colors shall be Quarterly as a minimum or as decided by BHEL. The color code tape / Sticker shall be clearly visible to designate the period for which the inspections and tests were conducted.

c. Following the initial inspection, the equipment must be color-coded quarterly as per color-coding instructions that will be issued by the subcontractor.

d. Fire extinguisher with the current month color-coding inspection sticker must be provided and secured in the platform.

e. All slings shall be regularly inspected in accordance with the requirement of the project for frequent and periodic inspections and discard immediately if they fail to meet the minimum requirements of the project.

f. The Subcontractor's HSE Officer shall ensure that all PPE is inspected prior to its issue. He is to ensure all subcontractor personnel are using safe and proper PPE equipment.

inspections on the PPE shall be carried out and personnel not adhering to those inspections shall be removed immediately from the site.

g. A Ten (10) day interval period shall be given into each monthly color code change. During this Ten (10) day period either color shall be acceptable.

xi. **T&P Tagging:**

All deployed Wire Rope Slings, Chain Pulley Blocks, Hooks, slings etc. shall be Tagged using aluminum or any other metal tag with punching.

5. HSE PERSONNEL TO BE PROVIDED SOLELY BY THE SUBCONTRACTOR

5.1. NUMBERS OF HSE PERSONNEL (APPLICABLE FOR EACH WORK SHIFT)

Number of HSE Officers and Supervisors shall be in proportion to number of workers as per Table A.6 below

TABLE A.5

No. of Workers	No. of HSE Supervisors	No. of HSE Officers
Up to 100	1	1
101 to 250	2	1
251 to 500	4	1
501 to 1000	6	2
1000 to 2000	6+ One additional supervisor up to every additional 250 workers	3
2000-3000	10+ One additional supervisor up to every additional 250 workers	4
3000-4000	14+ One additional supervisor up to every additional 250 workers	5

5.1.1. DEPLOYMENT PLAN

i. Above requirement is for every shift for each unit.

ii. The dynamic deployment plan of Safety manpower at various locations containing names, areas, time periods, shifts etc. shall be submitted to BHEL for approval by subcontractor

iii. BHEL may modify the deployment plan based on nature and volume of jobs, Risks and hazards associated etc.

iv. For less than 20 workers HSE Officer is not mandatory. In case the number of workers exceed 20 for 3 consecutive months, HSE Officer is to be engaged. The HSE Officer shall be deployed for a minimum period of 6 months even if the number of workers fall below 20 in any month subsequent to deployment. If within that 6-month period, the number of workers is more than 20 for at least 3 months, the deployment duration of HSE Officer will extend further 6 months after completion of previous 6-month period.

v. For Site Material Management/ Handling (Loading/ Unloading) contracts, 1 no. HSE Officer shall be required irrespective of the total manpower deployed.

vi. HSE Officers/Supervisors of all the vendors may be required to report directly to BHEL HSE Officer at site & shall comprise as a total team for handling all HSE issues. However, each safety officer/ agency shall be individually responsible for the safe execution of work in their respective areas.

5.2. Qualification & Experience Requirements Of HSE Personnel

5.2.1. HSE Officer

First HSE Officer to be mandatorily as per Option I as under and shall be designated Senior HSE Officer. In case of non-availability of HSE Officers with Option I configuration, the subsequent HSE Officers can be as per Option II below with recorded reasons and approval of Site Construction Manager of BHEL. All these deviations should be reported to Region HSE and PSHQ HSE.

A. Option I

i. possesses a recognized degree in any branch of engineering or technology or architecture and had a practical experience of working in a building or other construction work in a supervisory capacity for a period of not less than two years or possesses a recognized diploma in any branch of engineering or technology and has had practical experience of building or other construction work in a supervisory capacity for a period of not less than five years;

ii. possesses a recognized degree or diploma in industrial safety with at least one paper in construction safety (as an elective subject/ part thereof);

iii. has adequate knowledge of the language spoken by majority of building workers from the construction site in which he is to be appointed.

B. Option II:

Graduation Degree in Science with Physics & Chemistry and degree or diploma in Industrial Safety (All Degrees/ Diploma from any Indian institutes recognized by AICTE or State Council of Technical Education of any Indian State) with practical experience of working in a building, plant or other construction works (as HSE Officer, in line with Indian Factories Act, 1958 or BOCW Act, 1996) for a period of not less than five years

Note:

i. HSE Officer as per Option II shall be valid only on availability of Senior HSE Officer as per Option I at site.

ii. In case of resignation of the Senior HSE Officer, the same has to be replaced within 15 days else all subsequent HSE Officers as per Option II (in case of multiple HSE Officers with a single agency) shall not be considered as valid.

iii. The penalty shall be deducted considering non-availability of any HSE Officer at site.

5.2.2. HSE Supervisor: Either of X or Y below

X. Recognized Degree in any branch of Engineering OR Diploma in any branch of engineering with at least one-year construction experience

OR

Y. A recognized graduation Degree in Science (with Physics & Chemistry) or a recognized diploma in Engg. or Tech.

Additional requirements for option (Y) above

i. Trained in fire-fighting as well as in safety / occupational health related subjects, with:
ii. Minimum Two years of practical experience in construction work environment or in the field of safety and

Note:

i. Option a above is by default, b is under special approval from Site HSE & Construction manager
ii. In both cases the candidate should possess requisite skills to deal with construction & fire safety related day-to-day issues.

5.3. HSE In-Charge

In case there is more than one HSE Officer with any subcontractor, one of them, who is senior most by experience & meets qualification as per option 1 as mentioned in clause 2.1 A above (in HSE discipline), may be designated as HSE In-charge who will be the nodal point of contact on HSE matters.

5.4. Supporting Staff To HSE Team

i. Supporting Staff shall include scaffolders, scaffolding inspectors, riggers, skilled and unskilled manpower
ii. Subcontractor shall provide adequate number of workers as and when required, in order to attend and comply to Safety observations raised by BHEL/ Customer.

5.5. Availability And Penalty For Non-Deployment

i. The subcontractor shall submit the certificates of qualification & experience of HSE manpower before deployment for BHEL to assess suitability as per requirement detailed in this document
ii. In case of rejection, subcontractor shall arrange additional candidates and submit resume to BHEL. Penalties will be applicable during the period of non-deployment in such cases as well.
iii. Subcontractor shall ensure physical availability of safety personnel at the place of specific work locations.
iv. The Subcontractor shall deploy the HSE Officers as per the site's requirement. Non-deployment shall lead to stoppage of the work and final decision shall rest with Site HSE & Construction manager.
v. The Subcontractor shall prepare an organization chart identifying the areas of operations, responsibilities and reporting structure of all safety personnel for each shift and submit the same to BHEL.
vi. The subcontractor shall deploy sufficient HSE Officers, supervisors, as per numbers & qualifications mandated in this Section since mobilization of first batch of manpower and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty at following rates:

Non-deployment of HSE Officer – Rs. 75,000 per man-month
Non-deployment of HSE Supervisor – Rs. 50,000 per man-month

vii. Penalty shall be collected for the period of non-availability of safety personnel after allowing a grace period of 15 days for finding a replacement. The same shall be deducted on pro-rata basis till the required manpower is deployed.

viii. In case of abnormal delay & frequent rejections of candidates proposed by the subcontractor, BHEL shall exercise the right to deploy the safety manpower & deduct the amount from subcontractor's running bill with applicable overheads. In such cases also, the provision of logistics, transportation, food and other logistical support to the HSE personnel shall be in the scope of subcontractor in addition to the salary. After deployment of manpower by BHEL, the penalty for non-deployment specified above shall not be applicable.

6. COMPETENCY OF OPERATORS/ DRIVERS OF CRANE, WINCH, LIFTING/ CONSTRUCTION EQUIPMENT ETC.

i. The Operators/ Drivers of crane, winch, construction/ lifting equipment etc. shall be experienced and have valid driving license for the class of vehicle / machinery as applicable (like Crane/ Forklift/ Rig, Construction equipment driving license etc.).

ii. Minimum HMV driving license is required for all heavy equipment/ heavy vehicle (trailer/ Hyva /dumper /TM) operators at site.

iii. The subcontractor shall certify competence of these persons in writing as and when they are posted at site.

iv. Crane, Winch, Construction & lifting equipment operator should have certificate on subject course or experience certificate in employer letterhead.

v. Where state is providing license for operating crane, tractor and other construction vehicles, same to be ensured.

Note: In case the statutory requirements i.e. State or Central Acts and / or Rules as applicable like the Building and Other Construction Workers' Regulation of Employment and Conditions of Service- Act,1996 or State Rules (wherever notified), the Factories Act, 1948 or Rules (wherever notified), etc. are more stringent than above, the same shall be followed.

7. In case of any stringent requirement of BHEL's customer over and above the specifications mentioned in current document, the same shall also be required to be complied at site by subcontractor.

8. REFERENCES

The Safety Rules for Construction & Erection as outlined hereunder, while setting out a broad parameter of safety norms, are not exhaustive. The subcontractor and his agencies are advised to refer to the following statutory provisions as amended from time to time for details and strict compliance therewith.

8.1. FOR GREENFIELD PROJECTS

a) Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996 (briefly referred to as BOCW Act),
b) Building and other construction workers (regulation of employment and conditions of service) Central Rules, 1998 (briefly referred to as BOCW Rules) as adopted by the various State Governments,

8.2. For Expansion, Modification, Alteration And, Or Construction Activity Within An Existing Plant Operating As Per Approved Site Plan Under The Factories Act

a) Factories Act, 1948,
b) Factories Rules, as adopted by the various State Governments
c) BOCW Act
d) BOCW Rules
e) In case a new act/ statutory guideline/ modification/ consolidation of acts is implemented the same shall be required to be adhered by the subcontractor.
f) The latest amendment of the above-mentioned acts/ rules shall be followed at site.

9. BHEL POWER SECTOR HSE MANAGEMENT SYSTEM

The Systems and procedures of BHEL Power Sector HSE Management System shall be implemented by the subcontractor, including:

- HSE Procedure for Register of OHS Hazards and Risks
- HSE Procedure for Register of Environmental Aspects and Impacts
- HSE Procedure for Register of Regulations
- HSE Procedure for Training and Awareness
- HSE Procedure for Emergency Preparedness and Response Plan
- HSE Procedure for Permit to Work
- HSE Inspection and Other Formats

Note:

i. BHEL reserves the right to revise/ update these systems and procedure as per requirement to address any changing HSE needs

ii. BHEL will provide hard / soft copies of applicable HSE Procedures, Work Permits, Operational Control Procedures, Inspection/ Other Formats etc. that are necessary for ensuring safe work to the successful bidder at Site. It is the responsibility of the subcontractor to ensure availability of these documents before commencing work at site.

iii. The subcontractor can get soft copies of these documents from respective Region SCT/ HSE for reference. The signed hard copies of the same shall not be required to be submitted along with tender document

iv. Subcontractor shall use the Digital (Web & App-Based) HSE management Software Systems provided by BHEL whenever provided. In case not provided, hard copy systems will continue to be used. All information technology resources (Computers, mobile phones, mobile data, internet access etc.) for the use of such systems shall be ensured by the subcontractor.

10. CLEARANCE OF MONTHLY RUNNING BILLS SUBJECT TO SAFETY COMPLIANCE

i. The monthly running Bills of the subcontractor shall be released subject to compliance to HSE requirements as per checklist in Annexure H
ii. BHEL site HSE Head and Package In-charge shall be authorized to issue the clearance
iii. Site Construction Manager of BHEL shall be the final authority on the matter.

11. HSE PERFORMANCE EVALUATION

i. Subcontractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site.
ii. The HSE evaluation shall be based on HSE Performance Evaluation System of BHEL covering the contractual, statutory and regulatory requirements of HSE.
iii. BHEL shall reserve the right to use these performance scores for evaluating bidder's capacity for future tenders
iv. If safety record of the subcontractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the subcontractor may be considered by BHEL after completion of the job, provided the execution performance is satisfactory.

12. HSE PENALTIES

i. Nonconformity of safety rules and safety appliances will be viewed seriously and BHEL has right to impose fines on the subcontractor for every instance of violation noticed.
ii. As per contractual provision HSE penalties shall be imposed on subcontractors for non-compliance on HSE requirement as per following format.
iii. Following are the applicable penalties for various Safety violations:

Sub: MEMO for Penalty for non-compliances in Safety

Following lapse (tick marked) was observed and penalty (in Rs.) is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

S. No	Nature of Non - Compliance	Penalty (in INR)	Remarks
A. System Violations			
1	Working without valid Work Permit/ HIRA/ Method Statement / JSA	2000	Per case
2	Controls as per Work Permit/ HIRA/MS/JSA not ensured	2000	Per case
3	Reported Safety Violations Not Closed within Stipulated Time	1000-10000	Per case
4	Absence of required Subcontractor Officials (Site Head, HS Head) in Safety Reviews/Meetings	5000	Per case
5	Not providing required PPEs (Safety Harness, Lifeline, Safety Net, Fall arrestor, Safety Helmet, Gloves, Shoes etc.) for the work by subcontractor	2000	Per case
B. Competency/ Training/ Induction Violations			

1	Incompetent personnel deployed for specialized jobs like height work, hot work, rigging, vehicle operation etc. (without valid license/ certificate etc.)	3000	Per case
2	Work without induction training & medical check	2000	Per case
3	Height Work without Vertigo Test and height work training	2000	Per case
C. PPE Violations – Height Work			
1	Not wearing/ hooking Double Lanyard Safety Harness while working at height (> 1.2 meters) or not anchoring to lifeline	1000	Per case
2	Not Providing Lifeline for height work	3000	
3	Unsafe platforms – without Top, Mid Rails and Toe-Guards for Height Work	3000	
4	Not providing secondary means of fall protection for height work (Safety Nets, Retractable Fall Arrestors etc.)	3000	Per case
D. PPE Violations – General			
1	Not wearing safety helmet	1000	Per case
2	Wearing of helmets without chin straps	1000	Per case
3	Not Wearing safety shoes	500	Per case
4	Not wearing gloves	500	Per case
6	Not using grinding goggles/ face shield during grinding/ cutting	2000	Per case
E. Electrical Safety Violations			
1	Broken/ exposed wires/ cables	2000	Per case per day
2	Electrical plug not used for connection/ hand machines	1000	Per case per day
3	Not using proper ELCBs for electrical equipment	2000	Per case per day
4	Improper earthing of welding & Other electrical machines (Lack of double earthing, improper/ untested earth pit etc.)	2000	Per case per day
5	Not using 24 V supply for lighting in confined spaces	2000	Per case
6	Cables haphazard/ blocking way/ not organized properly	1000	Per case per day
F. Lifting & Rigging Violations			
1	Using Sling/ Chain Pulley Block and other Small T&Ps without proper, traceable Tag and Test Certificate	2000	Per T&P per day
2	Using damaged slings or not slinging properly	2000	Per T&P per day
3	Use of lifting equipment without having valid Test certificate	5000	Per equipment per seven days
4	Lifting hooks used without latches	2000	Per hook per day
5	Not effectively barricading area below lifting activity	5000	Per case
6	Using untrained/ unqualified rigger	5000	Per case
G. Housekeeping			
1	Non-removal of scrap from platforms	5000	Per Event Per location per 7 days
2	Not conducting scheduled housekeeping drives	5000	Per drive
H. Hot Work Safety Violations			
1	Gas cutting without flash back arrestor at both ends	5000	Per machine per incidence
2	Gas cutting at height without fire blanket	2000	Per event

3	Not keeping gas cylinders vertically	2000	Per event
4	Lifting cylinders without cage or rolling of cylinders	2000	Per incidence
5	Leakage in gas cylinder	2000	Per incidence
I. Vehicle Safety/ Operation			
1	Not having valid driving license for the type of vehicle/ T&P	2000	Per driver per incidence
2	Two-wheeler entry in construction area	2000	Per vehicle
3	Using Hydra for material movement at site in unsafe manner	2000	Per case
4	Using Two Hydra in Tandem for material movement without proper precautions as per OCP	2000	Per case
5	Vehicles, Hydras, Cranes, Dumpers and Earth Movers not having automatic back horns linked to gear	2000	Per Equipment per day
6	Not providing proper hard barricades around excavations/ unpermitted areas	5000	Per location per day
7	Not using guide rope while transporting material using Hydra or Cranes	2000	Per event
8	Over speeding	5000	Per case
9	Using Conventional Hydra crane	50000	Per day /crane
J. Accidents/ Incidents/ Near Misses			
1	Non-reporting of Near Miss/ Incident	20000	Per case
2	Major Accident – Worker unable to resume work within 48 hrs	100000	Per incident
3	Fatal Accident	500000	Per incident
K. Miscellaneous			
1.	Not providing the facility (drinking water, rest shed, labor colony etc. as per the specifications/ requirement)	5000	Per month per violation
2.	Not nominating the required number of workers for training as per plan	5000	Per incidence
3.	Lack of proper arrangement for disposal of sewage/ waste water/ effluents etc.	10000	Per incidence

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.):

_____
_____
_____

Penalty Amount:

1. Rate as per above chart
2. No. of Persons/ machine/ event/ labor
3. No. of times the same error is repeated: Repetition factor
4. Total Penalty= 1. X 2. X 3. =

Witnessed by:

(Sub- Subcontractor representative) (BHEL representative)

Signature _____

_____

Name _____

_____

Distribution: 1 Copy: to Sub- subcontractor Site In-charge,
1 Copy to Site Construction Manager (BHEL)
1 Copy to Site Finance

Note:

i. In case the amount of penalty imposed by BHEL's Client on BHEL for Safety violation/ incident due to or in the area of the subcontractor is more than those indicated above, same shall be imposed back-to-back on the subcontractor. However, in case such an amount is less than the specified above, penalty amount indicated above shall be imposed on the subcontractor.

ii. For same violation only one penalty (higher of the two mentioned below) shall be applicable
   a. Penalty imposed by BHEL's Customer over BHEL.
   b. Penalty as indicated in current document.

iii. For repeated violation for the same equipment/ location, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

iv. For repeated fatal incident in the same Unit incremental penalty shall be imposed: The subcontractor will pay 2 times the previously paid penalty in case there is repeated major/ fatal incident under the same subcontractor for the same package in the same unit.

v. Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above.

vi. If principal customer/statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the subcontractor the same shall be passed on to them.

vii. The penalty amount shall be recovered by BHEL Finance department from subcontractors from the RA/Final bill.

13. PUNITIVE ACTIONS FOR "CRITICAL SAFETY VIOLATIONS":

"Critical Safety Violations" include:

i. Not wearing required PPEs when provided and not following safe work procedure

ii. Taking unnecessary risks especially in height work, hot work, radiation work, lifting activity

iii. Coming to work under influence of sedatives like alcohol, drugs etc.

iv. Coming to work without ID Card/ Gate Pass (if provided)

v. Intimidating/ threatening at work

vi. Using cell phones during height work, hot work, lifting activity, driving.

In case any worker carries out any of the critical safety violations as above, BHEL reserves the right to enforce punitive action in following manner:

First Offence:	1 Punch on Gate Pass/ Induction Card/ ID Card etc. and 1-hour HSE Training. With one day off from duty
Second Offence:	2 Punches and 2-hours HSE Training with one day off from duty

Third Offence:	3 Punches and the worker will be dismissed. Gate pass to be confiscated

In case any employee of subcontractor carries out any of the critical safety violations as above, subcontractor Site In-charge shall issue warning letter to concerned employee with copy to BHEL

Note:

i. For above violations, guilt of the worker/ employee has to be established through appropriate evidences and records maintained.

ii. If worker/ employee has not been given the required PPEs and safety equipment by the agency and/or not facilitated by the agency to follow safety rules, he/ she will not be considered liable but the agency will be penalized as per penalty provision in this document. In such cases, the subcontractor shall not pass the penalty over to the worker/ employee through wage deduction etc.

iii. These critical safety violations and their consequences shall be shared with all workers and employees during induction and other training programs/ meetings, toolbox talks etc.

iv. Gate Pass shall have provision of Tagging as indicated above

v. The appellate authority (only for final dismissal) in this case shall be the BHEL Site In-charge whose decision shall be final on the matter and binding on all parties.

14. LEGAL IMPLICATIONS

Any legal Costs incurred by BHEL, on account of accidents taking place in the activities of the subcontractor, shall be debited to the subcontractor on actual cost basis.

For any accident occurring at site to any worker/ employee of the subcontractor leading to legal implications to BHEL Employee/ Management shall be safeguarded by BHEL legal department. All legal expenses incurred by BHEL on this account shall be recovered from the subcontractor. The accident also includes fire, loss of property or life at site.

15. HSE REVIEW MEETING

i. Subcontractor Site In-charge and HSE In-charge shall attend the HSE Review Meeting as and when called by BHEL.

The indicative agenda points are given below:

a) Implementation of earlier MOM points
b) Compliance Status of HSE Observations
c) Incidents & Near Misses, their Root Causes and Actions Taken
d) HSE performance review
e) HSE inspection findings
f) HSE audit and CAPA
g) HSE training
h) Health check-up camp
i) HSE planning for the erection and commissioning and installation activities in the coming month

j) HSE reward and promotional activities

ii. MOM on the discussion along with HSE observations will be circulated to the subcontractor for action.

iii. The subcontractor shall close the observations to the satisfaction of BHEL within stipulated time frame

16. OTHER REQUIREMENTS

i. If the subcontractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps and the cost shall be debited to the subcontractor with applicable overheads.

ii. If the subcontractor succeeds in carrying out its job in time without any fatal or disabling injury incident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the subcontractor suitably for the performance.

iii. In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.

iv. The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.

v. The subcontractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.

vi. The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.

vii. BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the subcontractor shall adhere to such instructions.

viii. BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

17. MEMORANDUM OF UNDERSTANDING:

After award of work, subcontractors are required to enter into a memorandum of understanding as given below:

Memorandum of Understanding

BHEL, Power Sector Region is committed to Health, Safety and Environment Policy (HSE Policy).

M/s……..do hereby also commit to comply with the same HSE Policy while executing the Contract Number _____

M/s……..have gone through and understood all the HSE requirements of the contract including HSE manpower, tools & equipment, systems & procedures, and agree to fulfill the same as a minimum. Any additional resources and support required for ensuring fulfillment of HSE Objectives shall be provided by subcontractor at no extra cost.

M/s…….. agree that in case they fail to comply to the HSE requirements as stipulated in the contract, BHEL shall have the right to implement the same and the cost shall be recovered from the subcontractor with applicable overheads.

M/s…….. shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be imbibed in all workers and supervisors for compliance.

In addition to this, M/s……..shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.

M/s……..shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.

M/s…….. agree that the subcontractor shall seek HSE clearance as per BHEL format before each RA bill as mentioned in clause no. 9. The penalty amounts for not providing Safety manpower and various Safety violations have also been reviewed and agreed.

M/s…….. agree to share the HSE Costs (running costs) of common facilities created by BHEL on proportional to contract value basis as calculated at Site by BHEL.

Signed by authorized representative of M/s ----------

Name :

Place & Date:

SECTION B

OPERATIONAL REQUIREMENTS

1. PURPOSE:

1.1. The purpose of this HSE Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during installation and servicing of industrial projects and power plants.

1.2. This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents in complementary manner.

1.3. Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy wherein the relevant statutory guidelines supersedes this document, the same shall be followed.

1.4. In case there's any specific HSE requirement from BHEL's Client, not explicitly indicated in this document the same shall be required to be fulfilled as per the decision of BHEL Site construction manager.

2. SCOPE:

The document is applicable to BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations

3. OBJECTIVES AND TARGETS:

i. To achieve "Zero Incident at Site"
ii. 100% compliance to all legal/statutory requirements related to EHS.
iii. 100% Health, Safety and Environmental Induction training attendance for all workers.
iv. 100% High Risk activities to be carried out only after approved Method Statement, HIRA / Aspect-Impact / JSA / OCP and Permit to Work are implemented.
v. 100% PPEs compliance in high and medium risk activities.
vi. 100% incident reporting, recording and reviewing for corrective actions.
vii. Regular Safety Reviews to assess HSE program compliance and closure of any recognized gaps to improve safety management and incident prevention
viii. Prevent injury and ill health of all workers at site ('Workers' refers to all personnel including managerial, supervisory, professional, technical, clerical and other workers including contract laborers)
ix. Prevent pollution to environment
x. Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
xi. Ensure protection of environment of the work site.
xii. Comply at all times with the relevant statutory and contractual HSE requirements.
xiii. Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
xiv. Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.

xv. Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
xvi. Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
xvii. Establish effective communication on HSE matters with all relevant parties involved in the Project works.
xviii. Ensure that all work planning considers all persons that may be affected by the work.
xix. Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
xx. Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
xxi. Ensure continual improvements in HSE performance.
xxii. Ensure conservation of resources and reduction of wastage.
xxiii. Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
xxiv. Ensure timely implementation of correction, corrective action and preventive action. The subcontractor shall also comply with HSE Targets stipulated by BHEL from time to time.

4. BHEL HEALTH, SAFETY & ENVIRONMENT POLICY:

In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, subcontractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

Chairman & Managing Directo

5. Illustrative Responsibilities of Subcontractor Employees

5.1 HSE - A Line Responsibility

i. HSE is a “Line Responsibility”.
ii. The term "Line" includes management, Executives, Supervisors, Foremen, and Workers who are part of the workforce. Line is to be fully involved in HSE Planning & Implementation with the aid and advice of HSE organization.
iii. “Line”, having control of resources and manpower is responsible for overall implementation of HSE Systems and closure of HSE observations.

5.2 Site In -Charge:

i. Shall sign Memorandum of Understanding (MoU)
ii. Shall ensure availability of all necessary resources required for implementation of HSE at Site
iii. Shall engage qualified HSE Officer(s) and supervisors (s)
iv. Shall adhere to the rules and regulations mentioned in this code, practice very strictly in area of work in consultation with concerned engineer and the safety coordinator.
v. Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
vi. Shall not engage any employee below 18 years.
vii. Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job.
viii. Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
ix. Shall ensure closure of all HSE non-conformities reported by BHEL or observed during internal inspection by providing appropriate resources in a timely manner.
x. Shall ensure the implementation of provisions of applicable acts and rules pertaining to HSE.
xi. Shall ensure availability of updated (Hazard Identification and Risk Assessment) Register for the area of activity
xii. Shall ensure availability of Method Statements & Job Safety Analysis for all hazardous activities
xiii. Shall ensure necessary controls to minimize risk in all applicable hazardous activities including Height Work, Hot Work, Lifting & Rigging, Confined Space, Maintenance, excavation, Radiography, Loading/ Unloading, Drilling/ Blasting etc.
xiv. Shall ensure implementation of HSE requirements mentioned in this document and as specified in the BHEL HSE management System including training, inspection, awareness, reporting etc.
xv. Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
xvi. Shall ensure a secondary means of fall protection (Safety Net, Retractable Fall Arrestor etc.) for preventing fall from height
xvii. Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.

xviii. Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
xix. Shall ensure that Horseplay is strictly forbidden.
xx. Shall ensure that adequate illumination is arranged during night work.
xxi. Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
xxii. Shall ensure display of adequate signage/posters on HSE.
xxiii. Shall ensure that mobile phone is not used by workers while working.
xxiv. Shall ensure conductance of HSE audit, mock drill, medical camps, induction training and training on HSE at site.
xxv. Shall ensure full co-operation during HSE audits.
xxvi. Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
xxvii. Shall ensure good housekeeping.
xxviii. Shall ensure adequate valid fire extinguishers are provided at the work site.
xxix. Shall ensure availability of sufficient number of toilets (preferably bio-toilets) /restrooms and adequate drinking water at work site and labor colony.
xxx. Shall ensure adequate emergency preparedness.
xxxi. Shall be member of site HSE committee and attend all meetings of the committee
xxxii. Power source for hand lamps shall be maximum of 24 v.
xxxiii. Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available
xxxiv. To record all incidents including near miss and report to BHEL and to ensure analysis & corrective actions for the same
xxxv. Shall conduct weekly Safety Walks in the work area and record the findings.
xxxvi. Construction of Canteen at Site, Office Infrastructure: Printer, PC, Fire Extinguishers etc.
xxxvii. Shall analysis HSE Performance regularly in work area and take steps to improve the same
xxxviii. Shall ensure stoppage of work in case of unacceptable Safety hazards

5.3 HSE OFFICER:

i. Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
ii. Facilitate inclusion of safety elements into Work Method Statement and creation of Job Safety Analysis (JSA)
iii. (HSE Head) To prepare deployment plan of HSE personnel for all shifts, so as to ensure constant supervision of all areas. The plan to be submitted to BHEL
iv. Highlight the requirements of safety through Tool-box / other meetings.
v. Help concerned HOS to prepare Job Specific instructions/ JSA for critical jobs.
vi. Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
vii. Advice & co-ordinate for implementation of HSE Systems & Procedures.
viii. To stop work in case of any critical safety violation until the violation is cleared
ix. Convene HSE meeting & minute the proceeding for circulation & follow-up acti

x. Plan procurement of PPE & Safety devices and inspect their healthiness.
xi. Report to BHEL on all matters pertaining to status of safety and promotional program at site level.
xii. Facilitate administration of First Aid
xiii. Facilitate screening of workmen and safety induction.
xiv. Conduct fire Drill and facilitate emergency preparedness
xv. Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
xvi. Apprise BHEL on safety related problems.
xvii. Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
xviii. Recommend to Site In charge, immediate discontinuance of work until rectification, of such situations warranting immediate action in view of imminent danger to life or property or environment.
xix. To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
xx. Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
xxi. Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters.

5.4 HSE SUPERVISOR:

i. All requirements as per 5.1
ii. To monitor allotted area for Safety violations, take required action and inform the concerned Safety Supervisor / Officer
iii. To assist HSE Officer

5.5 PACKAGE IN-CHARGES, ENGINEERS & ALL EMPLOYEES:

i. To be aware of, get involved in and ensure implementation of all HSE related Systems and Procedures including but not limited to:
   a. BHEL HSE Management System including HSE Procedures and OCPs, HIRA, JSA etc.
   b. Work Permit System
   c. Emergency Preparedness Response Plans
   d. Contractual HSE requirements
   e. Legal Requirements
   f. Penalty System
   g. Training requirements
ii. To ensure that the persons engaged in respective area follow the safety rules like using appropriate PPEs.
iii. To develop Method Statements and ensure availability of Job Safety Analysis for all activities in scope
iv. To ensure that the reported HSE non-conformities in the work area are resolved immediately before resuming work
v. To record all incidents including near miss and report to BHEL.

vi. To adopt safe working practices at all times and act as role model for Safety
vii. To take immediate corrective action actions in case any non-conformity is observed on product / process / system with respect to Occupational Health, Safety and Environment.
viii. In case any particular activity / work has extremely high consequential risk or high environmental impact, same shall be brought to the notice of BHEL Package In-charge before starting the work.
ix. To interfere/ stop work as & when identified unsafe.
x. To maintain & promote improved level of house-keeping all the time at site.
xi. To support/co-operate with audit team members as & when safety audits are carried out.
xii. To involve in investigation, if any incident occurs in his work area.
xiii. To participate in safety promotional programs
xiv. To attend the safety committee meeting, if member/invitee
xv. To ensure that only fit T&Ps and qualified persons are engaged for all activities.
xvi. Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
xvii. Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
xviii. Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent authorities.

6. HSE Planning by Subcontractor:

6.1 Hazard Analysis & Risk Assessment (HIRA), Method Statement (MS) & Job Safety Analysis (JSA):

i. Subcontractor shall identify all OHS Hazards and Risks applicable to all activities in scope and plan & implement the required control measures. HIRA Register shall be maintained.
ii. Subcontractor shall develop Method Statements & Job Safety Analysis documents for all hazardous activities in scope and ensure the required control measures. Job Safety Analysis is to be attached along with any Work Permit request

6.2 Register of Regulations:

Subcontractor shall prepare a register of applicable rules and regulations in the scope and plan to ensure compliance.

HIRA Register, Method Statements, Job Safety Analysis and Register of Regulations are dynamic documents and shall be revised (as applicable):

i. At fixed frequency of 3 months
ii. Addition/ deletion/ modification of a process/ activity
iii. After an accident/ incident
iv. After any change in applicable rules/ regulations/ laws.

6.3 Monthly HSE Plan covering the following as a minimum shall be prepared and submitted to BHEL for approval:

i. HSE Trainings covering all activities/ hazards/ workers

ii. HSE Inspection Plan covering all areas/ activities/ equipment/ hazards

iii. HSE Activities: Safety walks, Awards, housekeeping, reviews etc.

Note: Online/ App-based system shall be used for HSE Planning and Implementation/ Update whenever provided by BHEL otherwise Hard-copy based system shall continue

6.4 Monthly HSE Planning & Review of HSE Activities along with BHEL:

Monthly planning and review of HSE activities shall be carried out by subcontractor as per provided **format** jointly along with BHEL

7. Mobilization Of Machinery/Equipment/Tools By Subcontractor:

i. Subcontractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the subcontractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.

ii. As a measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and complies with legislative and owner requirement, inspection shall be arranged by in-house competent authority for acceptance as applicable. Inspection by Third Party competent person shall be arranged:
   a. Before first time use at site
   b. After carrying out any modification
   c. After repairs subsequent to involvement in any accident/ incident

iii. As a further measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and comply with legislative and owner requirement, inspection as per provided format shall be arranged by in-house expert / competent authority (preferable) for acceptance. The equipment considered for this purpose shall include all those in the T&P list in the tender document.

8. Mobilization of Manpower by Subcontractor:

i. As a measure to ensure that manpower being mobilized to the construction site is fit and competent for safe working, screening arrangement shall be made by the sub-subcontractor to ensure competency and fitness through following measures:

a) **Medical Checkup:** Examination of medical fitness shall be conducted through qualified medical professional for all workers to be deployed as per provided **format**. For height workers, vertigo (height phobia) test to be carried out as qualification criteria as per Annexure K and recorded in provided **format**.

b) **Induction Training**: Induction training of all workers to be ensured as per **provided procedure and format**. Training evaluation to be carried out and training to be repeated if not passed

c) Only on successfully meeting above criteria, permanent gate passes to be issued

ii. The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.

iii. The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.

iv. Ensure that the regulatory requirements of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.

v. Appropriate accommodation to be arranged for all workmen in hygienic condition.

vi. Cost of contractual, statutory and regulatory requirements like Training, medical checks, PPEs etc. shall not be transferred to the workers and such activities shall be considered as part of the job.

9. Provision of Personal Protective Equipment (PPEs):

i. Personnel Protective Equipment (PPEs), shall be provided by the subcontractor to all workers as per requirement of the job.

ii. The choice of PPEs to ensure multiple (at least more than 1) means of protection against any hazard. All applicable safety precautions for a job shall be ensured notwithstanding the duration or perceived importance of the task.

iii. The applicability of PPEs shall be as per the concept of Hierarchy of controls, i.e.:

iv. Elimination->Substitution->EngineeringControls->AdministrativeControls-PPEs

v. Relying solely on PPEs without ensuring necessary controls to be strictly avoided.

vi. The following matrix recommends usage of minimum PPEs against the respective job.

Activity	Type of Protection						Remarks, if any
	Hand	Eye	Ear	Body	Respiratory	Others	
Gas Welding & Cutting	LG	WG	-	LA	*SCBA/ OLBA	-	* for confined space
Electric Arc Welding	LG	HMWS	-	LA	*SCBA/ OLBA	-	* for confined space
Rigging	CG	SG	-				--
Working at Height	-	SG	-	DLFBH	-	*FAS	* for vertical columns
Grinding & Chipping	CG	FS / SG	-	LA	-	-	--
Working in High Noise	-	-	EP / EM	-	-	-	--
Handling of Cement Concrete	RG	SG	-	-	DM	-	

Blasting	CG	SG	EP*	-	-	-	* at noise area
Excavation	CG	SG	-	-	DM	-	*Gum boot in place of Safety shoe for foot
Chemical Handling	PVCG	CSG	-	PVCA	-	-	*Full body rubber suit with hood
Electrical and C&I	ERG*	SG	-	-	-	-	*For high voltages
Sand/shot blasting	CG	-	EP/ EM	CA	SAMH	-	

ABBREVIATIONS: FS: Face Shield, CSG: Chemical splash goggles, HMWS: Helmet mounted welder's shield, GB: gum boot, DLFBH: Double lanyard full body harness, SG: Safety goggles, DM: Dust mask, SAMH L Supplied air mask/hood, EP/EM: Ear plug/Ear Muff, CG: Cotton hand gloves, LG: Leather hand gloves, LA: Leather apron, RG: Rubber gloves, PVCG: PVC Gloves, PVCA: PVC Apron, SCBA: Self-contained breathing apparatus, WG: Welding goggles, ERG: Electrical Rubber Gloves. OLBA: Online breathing apparatus

The list is not exhaustive. Additional PPEs to ensure Safe Work may need to be deployed as per the requirement of the task at no additional cost.

vii. The PPEs shall conform to the relevant standards as below (illustrative list) and bear ISI mark.

RELEVANT IS-CODES FOR PERSONAL PROTECTION

PPEs	IS Codes
Industrial Safety Helmets.	IS: 2925 – 1984
Rubber gloves for electrical purposes.	IS: 4770 – 1968
Industrial Safety Gloves (Leather &Cotton Gloves).	IS: 6994 – 1973 (Part-I)
Leather safety boots and shoes.	IS: 1989 – 1986 (Part-I-II)
Industrial and Safety rubber knee boots.	IS: 5557 – 1969
Code of practice for selections care and repair of Safety footwear.	IS: 6519 – 1971
Leather Safety footwear having direct molding sole.	IS: 11226 – 1985
Eye protectors.	IS: 5983 – 1978
Ear protectors.	IS: 9167 – 1979
Eye & Face protection during welding	IS: 1179-1967
Industrial Safety Belts and Harness	IS: 3521 – 1983
Guide for selection of industrial Safety equipment for body protection	IS:8519 -1977
Respiratory Protective Devices	IS:9473-2002,14166-1994,14746-1999

viii. Where workers are employed in sewers and manholes, which are in use, the subcontractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent incident to the public

ix. All the personnel and visitors shall mandatorily use safety helmet (with company logo), safety shoe and reflective vests, in addition to any other PPEs as deemed appropriate for the area of work/ visit.

x. Following Color scheme for Helmets shall be followed:
   a. Workmen: Yellow
   b. Safety staff: Green or white with green band
   c. Electrician: Red
   d. Others including visitors: White
   e. For height workers, special marking on helmets besides indication on Gate Pass/ ID Card

xi. The subcontractor shall maintain register for issue and receipt of PPEs.

xii. All the PPEs shall be checked for quality before issue and the same shall be periodically re-checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be replaced.

xiii. The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.

xiv. The body harnesses shall be serial numbered.

10. ARRANGEMENT OF INFRASTRUCTURE:

10.1 DRINKING WATER:

i. Drinking water shall be provided and maintained at suitable places at different elevations such that minimum quantity of 5 liters is available for each worker during the day.

ii. Drinking water tank shall be so installed so as to be available within 200 meters of each working area

iii. Container should be labeled as “Drinking Water” in languages understood by the workers

iv. Cleaning of the container shall be ensured at least once in a week. Mild cleaning detergents as used for cleaning vessels shall be applied and scrubbers (3M or equivalent) shall be used for removing scales and deposits on the inside surface. The tank shall be thoroughly cleaned with potable water only before it is refilled (also applicable to labor colony).

v. Suitability of water source for drinking to be tested as per IS10500 at least once in six months.

10.2 WASHING FACILITIES:

i. In every workplace, adequate and suitable facilities for washing shall be provided and maintained.

ii. Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition and dully illuminated for night use.

iii. Water suitable for washing and not for drinking shall be clearly indicated as “Not for Drinking” in language understood by workers.

iv. Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

10.3 Latrines and Urinals:

i. Latrines and urinals shall be provided in every work place as indicated in Section A
ii. Urinals shall also be provided at different elevations.
iii. They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
iv. Separate facilities shall be provided for the use of male and female worker if any.

10.4 Provision of Rest Sheds for Workers During Rest Period:

Proper Rest Shed (s) with shelter shall be provided for rest during break so as to accommodate all workers as indicated in Section A

10.5 Medical Facilities:

10.5.1 General

i. Provision of Medical Center, Ambulance etc. shall be as per Section A of this document
ii. Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste – Management and Handling Rules, 1998)
iii. Every injury shall be treated, recorded and reported.
iv. All First Aid injuries shall be recorded as per provided Format
v. List of qualified first aiders and their contact numbers to be displayed at conspicuous places.

10.5.2 First Aider/ First Aid Box

i. The first aider along with facilities should be available at a point nearest to the work location wherein majority of the workers are working.
ii. The subcontractor shall provide necessary first aid facilities as per schedule III of BOCW. At every work place first aid facilities shall be provided and maintained.
iii. The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
iv. The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time.
v. The first aid box shall be distinctly marked with a Green Cross on white background.
vi. Details of contents of first aid box is given in Annexure J
vii. A slip of contents shall be pasted on the First Aid Box with following details
viii. Monthly inspection of First Aid Box shall be carried out by the owner as per provided format
ix. The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

10.5.3 Health Check Up

The persons engaged at the site shall undergo health check-up as per provided format before induction. In addition, the persons engaged in the following works shall undergo health check-up at least once in a year:

i. Height workers
ii. Drivers/crane operators/riggers
iii. Confined space workers
iv. Shot/sand blaster
v. Welding and NDE personnel

10.5.4 Height Phobia/ Vertigo Test:

i. The persons engaged in working at heights (above 2 meters) to be assessed for Vertigo and associated conditions and recorded as per provided format. Suggested Vertigo Test Procedure is given in Annexure K
ii. Such workers are to be allowed only on successful completion of test, otherwise shall be allocated ground-based jobs.
iii. IDs / Height passes shall be issued to such workers, besides special markings on helmets for easy identification.

10.5.5 Provision of Canteen Facility:

i. Canteen facilities shall be provided for the workmen of the project inside the project site where worker strength is 250 or more.
ii. Proper cleaning and hygienic condition shall be maintained.
iii. Proper care should be taken to prevent biological contamination.
iv. Adequate drinking water should be available at canteen.
v. Fire extinguisher shall be provided inside canteen.
vi. Regular health check-up and medication to the canteen workers shall be ensured as per applicable regulations.
vii. Canteen waste to be disposed of in hygienic manner

10.6 Provision of Accommodation/Labor Colony for workforce:

i. Proper accommodation for workforce to be provided in line with minimum requirements indicated in Section A
ii. Labor colony shall be inspected each week by HSE Officer and report submitted to BHEL as per provided format

10.7 Pest Control:

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labor colony and stores.

10.8 Scrapyard:

i. In consultation with customer, scrapyard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
ii. Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

10.9 ILLUMINATION:

i. The subcontractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations at dark places and during night hours at the work spot as well as at the pre-assembly area.
ii. Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
iii. Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
iv. Emergency lighting provision for night work shall be made to minimize danger in case of main supply failure.
v. Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II).

SUITABLE ILLUMINATION LEVELS FOR VARIOUS AREAS SHALL BE DECIDED BASED ON BROAD GUIDELINES INDICATED BELOW:

S. No.	Location	Lux Level (lumens/sqm)
A.	**Construction Site**	
1	Outdoor areas like store yards, entrance and exit roads	20
2	Platforms	50
3	Entrances, corridors and stairs	100
4	General illumination of work area	150
5	Rough work like fabrication, assembly of major items	150
6	Medium work like assembly of small machined parts	300
7	Fine work like precision assembly, precision measurements etc.	700
8	Sheet metal works	200
9	Electrical and instrument labs	450
B.	**Office**	
1	Outdoor area like entrance and exit roads	20
2	Entrance halls	150
3	Corridors and lift cars	70
4	Lift landing	150
5	Stairs	100
6	Office rooms, conference rooms, library reading tables	300
7	Drawing table	450
8	Manual telephone exchange	200

vi. Illuminations shall be inspected on weekly basis as per provided **format** using a calibrated lux meter.

11. HSE TRAINING & AWARENESS:

11.1 TRAINING PLAN:

i. All training programs to be carried out in a planned manner. Monthly/ Annual Training Calendar to be submitted to BHEL for approval and shall cover HSE Training requirements of all activities, workers, hazards applicable to the area(s) of work.
ii. Subcontractor shall nominate workers as per the schedule of specific training plan, failing which, penalty shall be imposed.
iii. Training records of all workers along with attendance, signatures, faculty details etc. shall be maintained in soft/ hard copy as per provided **formats**.
iv. Each labor should undergo at least 0.5% of total man-hours worked in HSE training.

11.2 HSE INDUCTION TRAINING

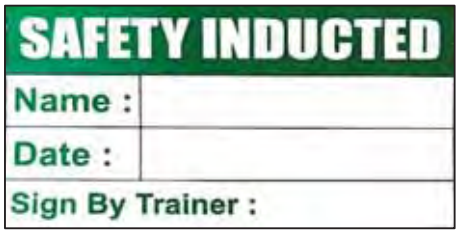
i. All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.
ii. The induction training shall be imparted through audio-visual medium (Classroom specialized training), and shall be minimum of 1 Complete Day.
iii. Evaluation to be carried out after training and training shall be repeated in case of failure.
iv. Safety Induction Card shall be printed by Subcontractor and provided to all trained workers. A Safety induction book shall also be printed and issued to each worker after induction training (Format for the same may be provided by BHEL).
v. Induction training subjects shall include but not limited to:

   a. Briefing of the Project details.
   b. Safety objectives and targets.
   c. Site HSE rules.
   d. Critical Safety Violations and consequences
   e. Site HSE hazards and aspects.
   f. First aid facility.
   g. Emergency Contact No.
   h. Incident & Near Miss reporting.
   i. Fire prevention and emergency response.
   j. Rules to be followed in the labor colony (if applicable)
   k. Accident case studies

vi. General:

   a. Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
   b. They must arrive fully dressed in safety wear & gear to attend the induction.
   c. Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.

d. On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form to declare that he had understood the content and shall abide to follow and comply with safe work practices.
e. They may only then be qualified to be issued with a personal I.D. card, for access to the work site subject to clearing the medical fitness test.



ABOVE STICKER SHALL BE PASTED ON HELMET OF WORKERS AFTER SAFETY INDUCTION TRAINING

11.3 JOB-SPECIFIC SKILL BASED HSE TRAINING

The contracting agency shall also impart job specific skill-based safety training to all its employees (Minimum one day) on various related safety topics using internal/external safety professionals/consultants as per the matrix given below. Record of such trainings and attendance particulars shall be maintained in a register for ready reference to statutory authorities/engineer-in charge as per provided format.

TRAINING MATRIX

Name of topic	Executives	Supervisors	Skilled Workmen	Other Workers
Safety Induction	Y	Y	Y	Y
Accident_ Causes, factors, cost	Y	Y	Y	-
Industrial hazards & Accident Prevention	Y	Y	Y	-
Investigating, reporting, records	Y	Y	-	-
Personal Protective Equipment	-	Y	Y	Y
Construction Safety & Role of Supervisory personnel	-	Y	-	-
Permit to Work (PTW)	-	Y	Y	y
Statutory Provisions (BOCW Act/Rules, Factories Act 1948 etc.)	Y	Y	y	y
Material handling	-	y	Y	Y
Emergency Management	Y	Y	Y	-
Electrical Safety	-	Y	Y	-
Fire safety	Y	Y	Y	Y
First Aid & CPR (cardio pulmonary resuscitation)	-	Y	Y	Y (Selected)
Safety in Welding & Cutting	-	-	Y	-
Safety Audit	Y	Y	-	-
Safety in Lifting Tools & Tackles	-	Y	Y	y

Safety in Working at height	-	Y	Y	Y
Safety in Confined space work	-	Y	Y	Y
Defensive Driving	-	Y*	Y*	Y*

*for construction vehicle operators, helpers & crane operators

Y=YES

Note:

i. Subcontractor shall prepare a training plan/ matrix covering all hazards and implement the same after approval of BHEL.
ii. It is to be ensured that every worker undergoes Job-Specific training once every 3 months.
iii. Records of training programmes along with attendance shall be maintained by the subcontractor
iv. Each worker to be issued a Card indicating the types of trainings undergone.

11.4 HSE TOOL-BOX TALK:

i. HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work and shall be randomly attended by subcontractor engineers/ officials. The agenda shall consist of the following:

   a. Details of the job being intended for immediate execution.
   b. The relevant hazards and risks involved in executing the job and their control and mitigating measures.
   c. Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
   d. Recent non-compliances observed.
   e. Appreciation of good work done by any person.
   f. Any doubt clearing session at the end.

ii. Tool box talk to be conducted before start of work in every shift.
iii. During toolbox talk, visual check-up of workers regarding health, any signs of fatigue, intoxication etc. shall be conducted and any suspected workers to be acted upon.
iv. Record of Tool box talk shall be maintained as per provided **format**

11.5 TRAINING ON HEIGHT WORK:

i. Training on height work shall be imparted to all workers working at height by in-house/external faculty at least once every 3 months.
ii. For Height Workers Separate pass shall be provided by the subcontractor.
iii. The training shall be of minimum 2-hour duration, through audio-visual medium and followed by evaluation. In case of poor scoring, training shall be repeated.
iv. The training shall include following topics:

   a. Proper use of PPEs – safety harness, lanyard, fall arrester, retractable fall arrester, life line, safety nets etc.
   b. Provision of secondary means of fall protection

c. Safe climbing through monkey ladders.
d. Inspection of PPEs.
e. Medical fitness requirements.
f. Mock drill on rescue at height.
g. Dos & Don'ts during height work.
h. Accident case Studies

11.6 Re-Induction Training

The induction training shall be repeated for every worker after at least 1 year and shall be a pre-requisite for renewal of Gate Pass/ ID card.

11.7 Penalty Training

The personnel involved in Safety Violations/ Incidents shall mandatorily undertake penalty training pertaining to the violation/ incident. Penalty training shall be at least half-day duration.

11.8 HSE Promotion-Signage, Posters, Competition, Awards etc.:

i. HSE Displays shall be installed as indicated in Section A
ii. Contracting agencies shall arrange for display of safety hoardings depicting suitable safety cartoons/messages/ cautionary notices at appropriate places of project site to remind the workers to perform their duties safely.
iii. Apart from safety hoardings, each agency should maintain a safety bulletin board at all their work locations. Such safety bulletin boards should depict the activities being planned for the day, good practices, permit details etc.
iv. Safety suggestion boxes shall be kept at each subcontractor's office at site for obtaining safety suggestions from the workers. Best suggestions should be implemented and may be rewarded suitably to encourage the workers for safety.
v. Safety awareness campaigns, competitions, plays, movie shows, songs etc. to be organized for workers at Site and Labor colony from time to time to enhance Safety Awareness

11.9 HSE Rewards & Incentive Scheme

Subcontractor shall implement a reward & incentive scheme for workers & supervisors displaying adherence to safety principles. Such workers shall be felicitated in a monthly function, attended by Subcontractor top management and BHEL representatives. Suitable gift shall be given to such workers for encouragement.

11.10 HSE Awareness Program for Officials:

Subcontractor shall arrange monthly HSE awareness program on different topics including medical awareness for all engineers/ supervisors / officials working at site. This program can be part of progress/ safety review meetings.

12. HSE COMMUNICATION AND PARTICIPATION:

12.1 HSE INCIDENT REPORTING, INVESTIGATION & CORRECTIVE ACTION:

i. All incidents (near misses, property damage, first-aid cases, minor, major and fatal incidents) shall be reported to BHEL as they happen immediately through SMS and Hard/Soft copy as per provided format

ii. All incidents including near miss, minor, major and fatal incidents shall be recorded

iii. All incidents shall be investigated for Root Causes and corrective actions ensured to prevent recurrence shall be implemented.

iv. Work shall be put on hold in the area till corrective actions are verified by BHEL

v. The Root Cause Analyses and Corrective actions taken shall be recorded

12.2 HSE EVENT REPORTING:

i. Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photographs for publication in different in-house magazines

ii. Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

12.3 MONTHLY HSE REPORTING:

i. All routine and non-routine HSE activities shall be reported to BHEL on monthly basis by the subcontractor as per provided format. The reporting medium can be hard/soft as per BHEL requirement.

ii. The period of reporting shall be 25th of the preceding month to 24th of the present month and shall be submitted by the end of the calendar month.

iii. Report shall include good quality images of HSE Activities

12.4 DAILY HSE ACTIVITY REPORTING:

Daily HSE activities shall be reported by subcontractor to BHEL as per provided format

12.5 HSE SUGGESTIONS:

All workers and employees shall be encouraged to provide suggestions for improvement in Health, Safety & Environment performance at site. The suggestions shall be recorded in a “Suggestions Register” as per provided format. Suggestions found suitable for implementation shall be implemented and recognition / reward to be given to the submitter.

Suggestion Register to be placed at Site and Labor Colony and shall be reviewed on periodic basis

12.6 Client Communication:

All HSE related communication from BHEL, customer / external statutory and regulatory agencies to be handled on priority. Same to be recorded and issues to be resolved in expeditious manner

13. Safety During Work Execution:

Safety during work execution shall be ensured by following appropriate Safety Rules, providing adequate resources, deploying competent and trained manpower, regular training & inspection and non-conformity resolution. Main aspects are indicated as under:

13.1 Operational Control Procedures:

In order to reduce the risk associated with hazardous activities, applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions, outcomes of Hazard Analysis & other requirements. This will be done as part of normal scope of work. Illustrative list of reference OCPs is given below.

Table 13.1 Illustrative List of Reference OCPs

No.	Topic	No.	Topic	No.	Topic
0	General Safety	**22**	Steam blowing	**44**	Material preservation
1	Handling of chemicals	**23**	Working in confined area	**45**	Electro-resistance heating
2	Electrical safety	**24**	Operation of passenger lift, material hoists & cages	**46**	Blasting
3	Energy conservation	**25**	Vehicle/ Crane maintenance	**47**	Transformer charging
4	Welding and gas cutting operation	**26**	Radiography	**48**	Handling of battery system
5	Fire safety	**27**	Waste disposal	**49**	DG set
6	Use of hand tools	**28**	Handling & storage of mineral wool	**50**	Sanitary maintenance
7	First aid	**29**	Working at night	**51**	Piling rig operation
8	Food safety at canteen	**30**	Computer operation	**52**	Passivation
9	Use of cranes	**31**	Storage in open yard	**53**	EDTA Cleaning
10	Storage and handling of gas cylinders	**32**	Drilling, reaming and grinding(machining)	**54**	Chemical cleaning of Pre boiler system
11	Manual arc welding	**33**	Stress relieving	**55**	Boiler Light up
12	Use of helmets	**34**	Hydraulic test	**56**	Rolling and Synchronization
13	Good house keeping	**35**	Trial run of rotary equipment	**57**	Loading of Unit

14	Safe excavation	**36**	Batching	**58**	Air compressor
15	Working at height	**37**	Cable laying/tray work	**59**	Hydra Operation
16	Filling of hydrogen in cylinder	**38**	Spray insulation	**60**	Duct Pre-assembly
17	Illumination	**39**	Compressor operation	**61**	Resumption of construction activities after lockdown and prevention of coronavirus infection during site operations
18	Handling and erection of heavy metals	**40**	Gas distribution test		
19	Acid cleaning	**41**	Cleaning of Hot well / Deaerator		
20	Oil flushing	**42**	Electrical maintenance	**61A**	Prevention of Covid-19 infection in labour colony
21	Alkali boil out	**43**	O&M of control of AC plant & system	**62**	Truss/ Structure fit-up and alignment

a. The reference OCPs shall be suitably modified by subcontractor as per specific requirements to control the hazards.

b. In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will prepare and follow those as well.

13.2 WORK PERMIT SYSTEM:

i. The following activities shall be carried out by the subcontractor strictly after obtaining Permit to Work from BHEL
   a) Height working
   b) Hot working
   c) Confined space Work
   d) Excavation more than 2-meter depth
   e) Radiography
   f) Heavy / Complex / Critical Lifting Activity
   g) Night / Holiday Work
   h) Material Loading / Unloading
   i) Grating, Safety Net, Safety Facility Removal
   j) Live Electrical Maintenance etc. - Lockout / Tagout
   k) Beam / truss/ duct/ structure alignment

ii. The Work Permit Formats shall be provided by BHEL at Site. It is the responsibility of the subcontractor to ensure their availability

iii. The above list is not exhaustive. BHEL reserves right to introduce additional Permits or modify requirements for usage of existing Permits. The conditions for using the Permit are specified in the Format (General Requirements).

iv. Where customer is having separate Work Permit System the same shall be followed in conjunction / merged to ensure all activities and checks are covered in all systems.

v. Details of working Group to be attached along with work permit request.

vi. All the Permits along with JSA/HIRA must be initiated by Agency Execution Team
vii. Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
viii. All Permit signatories (including subcontractor's package in-charge and HSE Officer) shall physically visit the work area and check that all the safety control measures necessary for the activity are in place. Only then the permit shall be issued.
ix. Signatory shall physically visit the area of work and ensure all required safeguards before signing the Permit
x. Signatory shall periodically visit the area to confirm the availability of required safeguards throughout the currency of the permit
xi. In case any Permit requirement is not available, work will be stopped till it is made available
xii. Permit holder shall implement and maintain all control measures during the period of permit. The permit will be closed after completion of the work.
xiii. Online Work Permit System shall be used whenever provided by BHEL, otherwise hard copy shall be used

13.3 Activity-Specific Precautions/ Controls

Detailed HSE precautions for various activities undertaken at Site by the subcontractors are specified in **Annexure I**. Same are to be ensured by the Sub-subcontractor while carrying out respective activities at Site

Index of **Annexure I** is given as under

14. ENVIRONMENTAL CONTROL & SOCIAL RESPONSIBILITY

i. Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal subcontractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Banned substances like asbestos and Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.

ii. Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per Material Safety Data Sheet (MSDS).

iii. In the event of any spillage, the principle is to recover as much material as possible before it enters drainage system and to take all possible action to prevent spilled materials from running off the site. The subcontractor shall use appropriate MSDS for clean-up technique

iv. All subcontractors shall be responsible for the cleanliness of their own areas

v. Regular dust suppression using sprinklers shall be carried out in respective area

vi. The subcontractors shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the subcontractor anticipates the generation of excessive noise levels from his operations the subcontractor shall inform to Construction Manager of BHEL accordingly so that reasonable &practicable precautions can be taken to protect other persons who may be affected.

vii. It is imperative on the part of the subcontractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, enhancing good relation with local populace etc.

viii. The subcontractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

15. HOUSEKEEPING

i. Keeping the work area and access roads clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the subcontractor. Such cleanings have to be done by subcontractor within quoted rate, on daily basis.

ii. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from subcontractor's bill. Such decisions of BHEL shall be binding on the subcontractor

iii. Dedicated Housekeeping gangs shall be deployed, who shall be provided all required PPEs and safety training

iv. Mass housekeeping shall be carried out for half a day in a week

v. Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.

vi. All surplus earth and debris are removed/disposed off from the working areas to identified locations.

vii. Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.

viii. All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations.

ix. Sufficient waste bins shall be provided at different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high locations.

x. Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.

xi. Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.

xii. Labor camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.

xiii. Fabricated steel structures, pipes & piping materials shall be stacked properly.

xiv. No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power line.

xv. Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.

16. WASTE MANAGEMENT

i. Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.

ii. Details of E-Waste, Hazardous Waste, biomedical waste etc. and their disposal plan, shall be submitted to BHEL every 6 months as per provided **formats**.

16.1 Bins At Work Place

i. Sufficient rubbish bins shall be provided close to workplaces.
ii. Bins should be painted yellow and numbered.
iii. Sufficient nos. of drip trays shall be provided to collect oil and grease.
iv. Sufficient qty. of broomsticks with handle shall be provided.
v. Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

16.2 Storage And Collection

i. Different types of rubbish/waste should be collected and stored separately.
ii. Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
iii. Rubbish should not be left or allowed to accumulate on construction and other work places.
iv. Do not burn construction rubbish near working site.

16.3 Segregation

i. Earmark the scrap area for different types of waste.
ii. Store wastes away from building.
iii. Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
iv. Clinical and first aid waste stored and incinerated separately.

16.4 Disposal

i. Sufficient containers and scrap disposal area should be allocated.
ii. All scrap bin and containers should be conveniently located.
iii. Provide self-closing containers for flammable/spontaneously combustible material.
iv. Keep drainage channels free from choking.
v. Make schedule for collection and disposal of waste.

16.5 Warning And Signs

i. Appropriate sign to be displayed at scrap storage area
ii. No toxic, corrosive or flammable substance to be discarded into public sewage system.
iii. Waste disposal shall be in accordance with best practice.
iv. Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

17. Traffic Management System

17.1 Safe Workplace Transport System

i. Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.

ii. Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.
iii. For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
iv. Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
v. Speed limits shall be clearly displayed for each kind of vehicle.
vi. Speed ramps preceded by a warning signs or marker are necessary.
vii. The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
viii. Safest route shall be provided between places where vehicles have to call or deliver.
ix. Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse
x. Safe areas shall be provided for loading and unloading.
xi. Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
xii. Ensure road crossings are minimum and clearly signed.
xiii. Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
xiv. Set sensible speed limits which are clearly sign posted.
xv. Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
xvi. Forklift trucks shall not pass over road hump unless of a type capable of doing so.
xvii. Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
xviii. Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

17.2 Traffic Route For Pedestrians

i. Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
ii. Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
iii. Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.

iv. Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
v. Provide high visibility clothing for people permitted in delivery area.

17.3 Work Vehicle

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

i. A high level of stability.
ii. A safe means of access/egress.
iii. Suitable and effective service and parking brakes.
iv. Windscreens with wipers and external mirrors giving optimum all round visibility.
v. Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
vi. Provision of seat belts.
vii. Guards on dangerous parts.
viii. Driver protection - to prevent injury from overturning and from falling objects/materials.
ix. Driver protection from adverse weather.
x. No vehicle shall be parked below HT/LT power lines.
xi. Valid Pollution Under Control certification for all vehicles
xii. Wheel stopper shall be use during the parking of vehicle
xiii. Helper to be deployed in each vehicle as per site requirement.

17.4 Daily Check By Driver

1. There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.

Brakes	Mirrors	Warning signals
Tires	Windscreen waters	Specific safety systems i.e. controls & interlocks
Steering	Wipers	

2. Management should ensure that drivers carry out these checks.

17.5 Transportation Of Personnel And Materials By Vehicles

i. All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.
ii. Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.
iii. All overhangs shall be made clearly visible and restricted to acceptable limits
iv. Load shall be checked before moving off and after traveling a suitable distance.
v. On no account is construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing foreman.

vi. Warning signs shall be displayed during transportation of material.
vii. All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.
viii. Wheel stopper shall be use during the parking of vehicle
ix. Helper to be deployed in each vehicle as per site requirement.

17.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.

18. EMERGENCY PREPAREDNESS AND RESPONSE

i. Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by BHEL
ii. Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
iii. All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures.
iv. Assembly point shall be earmarked and access to the same from different location shall be shown
v. Fire exit shall be identified and pathway shall be clear for emergency escape.
vi. Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
vii. Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
viii. First aid center shall be developed at site with trained medical personnel and ambulance
ix. Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
x. Tie up with fire brigade shall be done in case customer is not having fire station.
xi. Tie up with hospital shall be done in case customer is not having hospital.
xii. Disaster Management group shall be formed at site
xiii. Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL HSE Officer as per prescribed BHEL formats
xiv. Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

19. HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSE requirements. The subcontractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test as applicable, to enable inspection agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

Online/ App-based HSE Inspection system shall be used for inspection whenever provided by BHEL otherwise Hard-copy based system shall continue

	OK	NOT OK
Contractor Name:		
Equipment Identification No :		
Inspection Date :		
Next Inspection Date :		
Inspected By :		

Every Inspected Equipment shall display above sticker

19.1 INSPECTION PLAN

Subcontractor shall prepare an inspection plan covering all areas/ activities/ equipment/ hazards and implement the same after getting approval of BHEL. Responsibility to ensure coverage of all areas/ activities rests with the subcontractor.

All Inspections shall be witnessed by BHEL – only then they shall be considered as valid

19.2 INSPECTION REPORTS

Monthly inspection reports as per plan shall be submitted to BHEL HSE Head

19.3 NON-CONFORMANCES

Any non-conformances identified during inspection observed shall be addressed on priority.

The responsibility of resolution shall rest with the Subcontractor Site In-charge

In case immediate closure of non-conformities is not possible:

a. work to be halted in the area
b. non-conformance to be generated and submitted to responsible person and BHEL
c. non-conformance to be resolved through responsible agency / person

Only after closure of non-conformances, work to be allowed to resume

19.4 DAILY HSE CHECKS

Both the Site Supervisors and HSE Officer of Subcontractor are to conduct daily site Safety inspection around work activities and premises to ensure that work methods and the sites

are maintained to an acceptable standard. The following are to form the common subjects of a daily safety inspection:

i. Personal Safety wears & gear compliance.
ii. Complying with site safety rules and permit-to-work (PTW).
iii. Positions and postures of workers.
iv. Use of tools and equipment etc. by the workers.

The inspection should be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

19.5 Indicative List of Inspections And Periodicities

Indicative list & periodicity of Inspections is given as under. It is the responsibility of the subcontractor to develop an inspection plan covering all areas & activities in the scope.

SL. No.	Format Name	Frequency of check (if applicable)
01	Inspection of First Aid Box	Weekly
02	Inspection of PPE	Weekly
03	Inspection of T&Ps	Monthly
04	Inspection of Cranes	Monthly
05	Inspection of Winches	Monthly
06	Inspection on Height Working	Weekly
07	Inspection on Welding & Gas Cutting	Monthly
08	Inspection on Electrical Installation	Monthly
09	Inspection on Elevator	Weekly
10	Inspection of Excavation	Weekly
11	Inspection of Labor Colony	Monthly
12	Inspection of Illumination Levels	Weekly

The checklists shall be provided by BHEL at Site. It is the responsibility of the subcontractor to ensure their availability before start of work

19.5.1 Inspection Of PPE

i. PPEs shall be inspected by HSE officer at random once in a week as per provided **format** for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
ii. The applicable PPEs for carrying out particular activities are listed below.

19.5.2 Inspection Of Tools & Plants (T&Ps)

i. A master list of T&Ps shall be maintained by each subcontractor in provided **format**.
ii. All T&Ps being used at site shall be inspected by HSE officer once in a month as per provided **format** for its healthiness and maintenance.
iii. The T&Ps which require third party inspection shall be checked for its validity during inspection. The third-party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record.

iv. BHEL shall be given advance intimation of Third-Party Inspection. BHEL shall associate with Inspection as per discretion.
v. The validity of T&P shall be monitored as per provided **format**

19.5.3 Inspection Of Cranes And Winches

i. Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
ii. Cranes and Winches shall be inspected by HSE officer once in a month as per provided **format** for healthiness, maintenance and validity of third-party inspection.
iii. The date of third-party inspection and next due date shall be painted on cranes and winches.
iv. The operators/drivers shall be authorized by sub-subcontractor based on their competency and experience and shall carry the I-card.
v. The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

19.5.4 Inspection Of Height Working

i. Any activity carried out at more than 2 m height is classified as height work.
ii. Inspection of height working shall be conducted daily by Supervisors before start of work to ensure safe working condition including provision of
   a. Fall arrestor
   b. Lifelines – connected to rigid & independent structure
   c. Safety nets deployed below all height work activities
   d. Fencing and barricading
   e. Warning signage
   f. Covering of opening
   g. Proper scaffolding with access and egress.
   h. Illumination
iii. For full duration of height work, constant supervision to be maintained by dedicated HSE personnel
iv. Inspection on height working shall be conducted once in a week by HSE officer as per provided **format**.
v. Medical fitness of height worker shall be ensured.
vi. Height working shall not be allowed during adverse weather.

19.5.5 Inspection Of Welding And Gas Cutting Operation

i. Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
ii. Gas cylinders shall be kept upright.
iii. Use of Flash back arrestor shall be ensured at both ends.

iv. Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per provided **format**.
v. Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
vi. Availability of fire extinguisher at vicinity shall be ensured.

19.5.6 Inspection Of Electrical Installation / Appliances

i. Ensure proper earthing in electrical installation
ii. Use ELCB at electrical booth
iii. Electrical installation shall be properly covered at top where required
iv. Use appropriate PPEs while working
v. Use portable electrical light < 24 V in confined space and potentially wet area.
vi. Inspection shall be carried out as per provided **format**.

19.5.7 Inspection Of Elevator

i. Elevators shall be inspected by concerned supervisors once in a week as per provided **format**
ii. All elevators shall be inspected by competent person and validity shall be ensured.
iii. The date of third-party inspection and next due date shall be painted on elevator.

19.5.8 Inspection Of Excavation

Excavation activities shall be inspected as per provided **format**

19.5.9 Internal/ External HSE Audits/Inspections

i. All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed of by site in a time bound manner and reported back the implementation status.
ii. Corrective action and Preventive action on HSE issues raised by certification body issued by BHEL shall be implemented by site and reported to Site management.

20. Terms and Definitions:

1. **Incident**
   Work- related or natural event(s) in which an injury, or ill health (regardless of severity), damage to property or fatality occurred, or could have occurred.

2. **Near Miss:**
   An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as “Near-Miss”.

3. **Man-Hours Worked:**
   The total number of man hours worked by all employees including subcontractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labors. Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worke

period covered by the number of hours worked per day. The total number of workdays for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

4. **First Aid Cases:**
   First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

5. **Lost Time Injury:**
   Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

6. **Medical Cases:**
   Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

7. **Type of Incidents & Their Reporting:**
   The three categories of Incident are as follows:

8. **Non-Reportable Cases:**
   An incident, where the injured person is given medical help and discharged for work without counting any lost time.

9. **Reportable Cases:**
   In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

10. **Injury Cases:**
    These are covered under the heading of non-reportable cases. In these cases, the incident caused injury to the person, but he still continues his duty.

11. **Total Reportable Frequency Rate**
    Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

    Number of Reportable LTI x 1,000,000/ Total Man Hours Worked

12. **Severity Rate:**
    Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:
    Days lost due to LTI x 1,000,000/ Total Man Hours Worked

13. **Incidence Rate:**
    Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:
    Number of LTIx1000/Average number of manpower deployed

14. HIRA:

Hazard Identification and Risk Assessment (HIRA) is a process of identifying Hazards in work area and then assessing them properly

15. Method Statement:

A method statement is prepared by the Execution/ Engineering Department detailing the steps, equipment, competencies and safety precautions required for carrying out any activity

16. Job Safety Analysis:

A job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job operation. In a JSA, each basic step of the job is to identify potential hazards and to recommend the safest way to do the job. Other terms used to describe this procedure are job hazard analysis (JHA) and job hazard breakdown.

17. Safety Walk:

It's conducted periodically by an official - it's a walk through a portion or whole of a site as a HSE officer who notes down HSE observations, speak to concerned workmen and supervisor on observation, get the same corrected with personal follow up- this sends out a strong message on Management's commitment to safety.

18. Heavy & Complex Lifting:

A heavy and complex lifting activity includes:

1. Lifting above 20 Tons
2. Tandem Lifting using multiple cranes
   Total load exceeding 75% of capacity of crane. Depending up the condition of cranes, hydra cranes, winch machines & other lifting accessories
3. Lift of unusual difficulty or geometry or rigging
4. Lift over operating units
5. Any other lift as decided by site HSE / Erection

19. Safety Committee:

As per the BOCW, Safety Committee shall be constituted if there are more than five hundred or more construction workers are employed at any site. As per the Factories Act, 1948 it is for 250 workers. It shall be represented by equal number of representatives of employer and construction workers.

20. Night Work:

Work conducted after sunset when only a fraction of total manpower is available

ANNEXURE A

Medical Centre & Ambulance

A. Medical Centre

1. Paramedical staff
    a. When < 500 workers, 1 Trained Male Nurse (round the clock deployment)
    b. When >=500 workers*:
        i. Registered Medical Practitioner (Qualified MBBS) to be deployed for at least 8 hours in a day, 5 days per week
        ii. 2 Trained Male Nurses (round the clock deployment)
2. All articles as per Schedule IV of BOCW Central Rules, 1998 to be made available in the Medical Centre (given under for convenience)
3. Basic Facilities/ Requirements to be provided as per location eg. Refrigerator, Air Conditioner, Anti Venom Serums etc.
4. Tie-ups with speciality hospitals to be ensured for referring serious patients

* In case the number of workers is envisaged to exceed 500, a medical practitioner is to be engaged.

SCHEDULE IV (BOCW CENTRAL RULES, 1998) ARTICLES FOR AMBULANCE ROOM
[SEE RULE 226 (C)]

i. A glazed sink with hot and cold water always available.
ii. A table with a smooth top at least 180 cm x 105 cm.
iii. Means for sterilising instruments.
iv. A couch.
v. Two stretchers.
vi. Two buckets or containers with close fitting lids.
vii. Two rubber hot water bags
viii. A kettle and spirit stove or other suitable means of boiling water.
ix. Twelve plain wooden splints 900 cm x 100 cm x 6 cm.
x. Twelve plain wooden splints 350 cm x 75 cm x 6 cm.
xi. Six plain wooden splints 250 cm x 50 cm x 12 cm.
xii. Six woollen blankets.
xiii. Three pairs of artery forceps.
xiv. One bottle of spiritus annemia aremations (120 ml).
xv. Smelling salt (60 gm).
xvi. Two medium size sponges.
xvii. Six hand towels.
xviii. Four kidney trays.
xix. Four cakes of toilet, preferably antiseptic soap.
xx. Two glass tumblers and tow wine glasses.
xxi. Two clinical thermometers.
xxii. Two tea spoons.
xxiii. Two graduated (120 ml) measuring glasses.
xxiv. Two minimum measuring glasses.
xxv. One wash bottle (1000 cc) for washing eyes.
xxvi. one bottle (one litre) carbolic lotion 1 to 20.
xxvii. Three chairs.
xxviii. One screen.
xxix. One electric hand torch.
xxx. Four first-aid boxes or cupboards stocked to the standards prescribed in
xxxi. An adequate supply of tetanus toxide.
xxxii. Injections—morphia, pethidine, atrophine, adrenaline, coramine, novocaine (6 each).
xxxiii. Cramine liquid (60 ml).
xxxiv. Tablets—antihistaminic antispasmodic (25 each).
xxxv. Syringes with needles—2 cc, 5 cc, 10 cc and 500 cc.

xxxvi. Three surgical scissors.
xxxvii. Two needle holders, big and small.
xxxviii. Suturing needles and materials.
xxxix. Three dissecting forceps
xl. Three dressing forceps
xli. Three scalpels.
xlii. One stethoscope and a B. P. apparatus.
xliii. Rubber bandage—pressure bandage.
xliv. Oxygen cylinder with necessary attachments.
xlv. Atropine eye ointments.
xlvi. I. V. Fluids and sets 10 nos.
xlvii. Suitable, foot operated, covered, refuse containers.
xlviii. Adequate number of sterilised, paired, latex hand gloves.

B. Ambulance

1. When number of workers is <500:
   If the distance to a major hospital capable of handling critical injuries expected at Site is <= 50 KM from Site, then 1 BLS (Basic Life Support)/ Type B Ambulance otherwise ALS* (Advanced Life Support)/ Type D Ambulance
2. If no. of workers increases to >2000 workers one additional BLS Ambulance to be deployed
3. Minimum Articles as per Schedule V of BOCW Central Rules to be ensured in each Ambulance. (given under for convenience)

*Final call to be taken at Site in consultation with all the contractors

SCHEDULE V (BOCW CENTRAL RULES, 1998)
CONTENTS OF AMBULANCE VAN OR CARRIAGE
[SEE RULE 227]

The Ambulance Van shall have equipment prescribed as under:

a) General—a portable stretcher with folding and adjusting devices with the Head of the stretcher capable of being tilted upward. Fixed suction unit with equipment. Fixed oxygen supply with equipment. Pillow with case, sheets, blankets, towels, emergency bag, bed pan, urinal glass.
b) Safety Equipment-Flaros with life of three thousand minutes, floor lights, flash lights, fire extinguishers (dry power type), insulated guntlets.
c) Emergency Care Equipment—
   i. **Resuscitation**—Portable suction unit, portable oxygen unit, bag valve mask, hand operated artificial ventilation unit, airways, mouth gag tracheostomy adapters, short spine board, I.V. FLUIDS with administration unit, B. P. manometer cuff stethoscope.
   ii. **Immobilisation**—Long and short padded boards, wire ladder splints, triangular bandage—long and short spine boards.
   iii. **Dressing**-Gauze pads—100 m x 100 mm universal dressing 250 x 1000 mm, roll of aluminium foils—soft roller bandages 150 mm x 5 mm yards adhesive tape in 75 mm roll safety pins, bandage sheets, burn sheets.
   iv. **Poisoning**—Syrup of Ipecac, activated charcoal pre packeted dose, snake bit kit, drinking water.
   v. **Emergency Medicines**—As per requirement (under the advice of construction Medical Officer).

ANNEXURE A.1

Sample calculation for deduction of operational cost of facilities

Annexure A.1

Cost Calculation Methodology of Operation of Facilities (Data is indicative only)

(Period of 48 months is considered - shall be on actual basis)

A. Project Info:

Total time of Project	48 months
Project cost	1000 Crore
No. of packages	10 (A1-A10)

B. Item-wise Calculation:

Item	Nos.	Rate	Unit	Amount
Ambulance with Driver	2		Monthly/Unit	170000
Nurse/First aider	2 X 2 shifts	15000	Per month	30000
Training center one time cost	1	100000	Once	100000
Medical center one time cost	1	200000	Once	200000
Medicines at medical center	1	10000	Monthly	10000
Dust supression water tank	2	2000	Monthly	4000
Doctor	1	70000	Monthly	70000
Cleaning staff	1	12000	Monthly	12000
			Recurring monthly expenditure	296000
			Total one-time expenditure	300000

C. Package-wise Deduction Plan for a period of 48 months

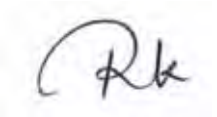
Period (In Months)	6	36	6
	For 1-6 months	For 7-42 months	For 43-48 months
Cost to be incurred from contractors	7%	81%	12%
	1.17% per month	2.25% per month	2.00% per month

D. Calculation For One-Time Running Cost

Packages/ Contracts	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10			
Contract Values (in Thousands)	100000	250000	2000000	200000	500000	1500000	1000000	1000000	250000	200000	7000000		
Share of common facilities one time running cost (in Thousands)	4	11	86	9	21	64	43	43	11	9	Individual Pkg value X Total one time running cost / All Pkg award values		
Timeline of work	1-6	1-8	2-48	6-36	7-15	10-48	6-48	7-40	40-48	41-48			
Month Count of work	6	8	47	31	9	39	43	34	9	8			
Deduction per month (in Thousands)	1	1	2	0	2	2	1	1	1	1	Total of One time Running cost (in thousands)	% deduction share of one time running cost per month	Nos. of active packages in month
Month No.													
1	1	1									2	1%	2
2	1	1	2								4	1%	3
3	1	1	2								4	1%	3
4	1	1	2								4	1%	3
5	1	1	2								4	1%	3
6	1	1	2	0			1				5	2%	5
7		1	2	0	2		1	1			8	3%	6
8		1	2	0	2		1	1			8	3%	6
9			2	0	2		1	1			7	2%	5
10			2	0	2	2	1	1			8	3%	6
11			2	0	2	2	1	1			8	3%	6
12			2	0	2	2	1	1			8	3%	6
13			2	0	2	2	1	1			8	3%	6
14			2	0	2	2	1	1			8	3%	6
15			2	0	2	2	1	1			8	3%	6
16			2	0		2	1	1			6	2%	5
17			2	0		2	1	1			6	2%	5
18			2	0		2	1	1			6	2%	5
19			2	0		2	1	1			6	2%	5
20			2	0		2	1	1			6	2%	5
21			2	0		2	1	1			6	2%	5
22			2	0		2	1	1			6	2%	5
23			2	0		2	1	1			6	2%	5
24			2	0		2	1	1			6	2%	5
25			2	0		2	1	1			6	2%	5
26			2	0		2	1	1			6	2%	5
27			2	0		2	1	1			6	2%	5
28			2	0		2	1	1			6	2%	5
29			2	0		2	1	1			6	2%	5
30			2	0		2	1	1			6	2%	5
31			2	0		2	1	1			6	2%	5
32			2	0		2	1	1			6	2%	5
33			2	0		2	1	1			6	2%	5
34			2	0		2	1	1			6	2%	5
35			2	0		2	1	1			6	2%	5
36			2	0		2	1	1			6	2%	5
37			2			2	1	1			6	2%	4
38			2			2	1	1			6	2%	4
39			2			2	1	1			6	2%	4
40			2			2	1	1	1		7	2%	5
41			2			2	1		1	1	7	2%	5
42			2			2	1		1	1	7	2%	5
43			2			2	1		1	1	7	2%	5
44			2			2	1		1	1	7	2%	5
45			2			2	1		1	1	7	2%	5
46			2			2	1		1	1	7	2%	5
47			2			2	1		1	1	7	2%	5
48			2			2	1		1	1	7	2%	5
Total	4	11	86	9	21	64	43	43	11	9	300	100%	

D. Calculation For Recurring Running Cost

Packages/ Contracts	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10		
Contract Values (in Thousands)	100000	250000	2000000	200000	500000	1500000	1000000	1000000	250000	200000	7000000	
Timeline of work	1-6	1-8	2-48	6-36	7-15	10-48	6-48	7-40	40-48	41-48	Total of Recurring cost (in thousands)	Nos. of active packages in month
	6	8	47	31	9	39	43	34	9	8		
Month No.												
1	85	211									296	2
2	13	31	252								296	3
3	13	31	252								296	3
4	13	31	252								296	3
5	13	31	252								296	3
6	8	21	167	17			83				296	5
7		15	120	12	30		60	60			296	6
8		15	120	12	30		60	60			296	6
9			126	13	31		63	63			296	5
10			95	10	24	72	48	48			296	6
11			95	10	24	72	48	48			296	6
12			95	10	24	72	48	48			296	6
13			95	10	24	72	48	48			296	6
14			95	10	24	72	48	48			296	6
15			95	10	24	72	48	48			296	6
16			104	10		78	52	52			296	5
17			104	10		78	52	52			296	5
18			104	10		78	52	52			296	5
19			104	10		78	52	52			296	5
20			104	10		78	52	52			296	5
21			104	10		78	52	52			296	5
22			104	10		78	52	52			296	5
23			104	10		78	52	52			296	5
24			104	10		78	52	52			296	5
25			104	10		78	52	52			296	5
26			104	10		78	52	52			296	5
27			104	10		78	52	52			296	5
28			104	10		78	52	52			296	5
29			104	10		78	52	52			296	5
30			104	10		78	52	52			296	5
31			104	10		78	52	52			296	5
32			104	10		78	52	52			296	5
33			104	10		78	52	52			296	5
34			104	10		78	52	52			296	5
35			104	10		78	52	52			296	5
36			104	10		78	52	52			296	5
37			108			81	54	54			296	4
38			108			81	54	54			296	4
39			108			81	54	54			296	4
40			103			77	51	51	13		296	5
41			120			90	60		15	12	296	5
42			120			90	60		15	12	296	5
43			120			90	60		15	12	296	5
44			120			90	60		15	12	296	5
45			120			90	60		15	12	296	5
46			120			90	60		15	12	296	5
47			120			90	60		15	12	296	5
48			120			90	60		15	12	296	5
Total	143	388	5676	329	235	3102	2334	1772	132	96	14208	



ANNEXURE B

HSE Displays

A. Types of Displays

1. Based on Content

SN	Type
1.	**HSE Hazards & Precautions** Height Work, Housekeeping, Fire Safety, PPEs, Hot Work, Lifting & Rigging Activity, Site-specific Hazards – eg. for Refineries, Nuclear plants etc.; COVID Precautions; Environment Protection etc.
2.	**Other Displays, Signage etc.** HSE Policy, ISO Certificate, Safety Statistics, Assembly Area Location/ Route, Emergency Contact Numbers, Site Safety Rules & Regulations, Speed Limit, Work in Progress, Lock-Out Tag-Out (LOTO) Boards etc.

2. Based on Mounting

[Type 1]	[Type 2]	[Type 3]
Flex Sign Boards of Wooden Frame – directly mounted on Structures (walls, stairs, railings etc.)	Flex Sign Boards with Wooden Frame – mounted on metallic/ wooden legs – preferably double-sided	Coloured weather-proof Paintings on Walls (after due concurrence of BHEL/ Customer – Type 1 in case of no concurrence/ space)

B. General Requirements:

a. Displays should be weather-proof as per installation location, i.e. rain-proof, wind-proof and sun-proof.
b. Installation location and size to ensure visibility for the intended viewers (workers and moving personnel)
c. Displays to have at least 50% graphical elements preferably (as applicable). Language should be understandable by majority of the workers
d. Displays to be relevant to the hazards in the area
e. Proper installation to ensure boards don't obstruct activities and should not be prone to fall so as to pose danger
f. In case of multiple elevations (eg. Boiler, Power-house etc.), each elevation to have displays for applicable hazards including Height-Work, Housekeeping
g. For temporary work locations, posters/ boards may be erected and shifted after task is over
h. Minimum size of displays should be A1 unless otherwise specified
i. In case of damage, displays shall be reviewed and repaired/ replaced
j. In areas where night work is envisaged, fluorescent displays shall be installed and these should comprise of at least 20-30% of total displays
k. Total Number of displays to be not less than 1 per 10 workers and are to be dynamically updated based on number of workers

C. Area-wise Displays

Below is list of Area-wise displays that are to be installed at Sites (Numbers, locations may be adjusted for specific requirements)

SN	Area	Suggested Subjects	Minimum Size	Minimum Quantity	Locations
1	**Walls/ Foundations/ Cement Structures etc. belonging to the package area**	Safety Hazards Prevention and other HSE Awareness content	**[Type 3]**	As per BHEL assessment from time to time	
2	**Site Interior Roads belonging to the package area**	At least every 20 meters: 1. Speed Limit Indication, Safe Driving board 2. Boards for hazard awareness	1.As needed **[Type 2]** **2.** A1 or equivalent each [**Type 2]**	As indicated	Sides of Roads; Height to ensure good visibility
3	**Specific Package Areas**	**A. Common** At entry to respective Package/ Work Area, each contractor to put up daily updated board with following for each shift: 1. Scope of work and start date 2. Emergency Contact Numbers 3. Emergency Assembly Location, Escape Plan 4. Locations and supervisors of various gangs in the area, 5. Current Work permit Details 6. Safety Supervisor Location assignments - Names, Mobile Nos., Assigned Locations 7. Details (Name, Contact No. etc.) of Package In-charge - Contractor & BHEL 8. Details (Name, Contact No. etc.) of Safety In-charge - Contractor & BHEL 9. LTI Free Man-days & details of last LTI also to be indicated In addition, Area-Specific Displays as indicated in Table 1	**A0** **[Type 2]**	1 per Package Area	Entry/ Ground Level

Table 1

(Area/ Package-wise HSE Display Plan – As applicable)

Prepared By (Subcontractor)				
S. No.	**Area**	**Suggested Minimum No. of Displays & Types**	**Type**	**Numbers Installed**
1	Boiler	3 per working elevation	**[Type 1]**	
2	Powerhouse	5 per elevation	**[Type 1]**	
3	ESP	5 Per Pass	**[Type 1]**	
4	Buildings	5 per elevation	**[Type 1]**	
5	Cooling Tower (NDCT/ IDCT/ ACC)	20 per Structure	**[Type 1]**	
6	Chimney	20 per Structure	**[Type 1]**	
7	Fabrication Yard	10 per Yard	**[Type 2]**	
8	Batching Plant	5 per Plant	**[Type 1]**	
9	Material Storage Yard – Open	20 per Yard	**[Type 2]**	
10	Material Storage Shed – Semi-Closed/ Closed	10 per Shed	**[Type 1]**	
11	Electrical Booths	2 per booth + Line diagram, Emergency contact details	**[Type 1]**	
12	Medical & First Aid Centre	2 per Centre	**[Type 1]**	
13	Rest Shed	2 per Shed	**[Type 1]**	
14	Canteen	2 per Canteen	**[Type 1]**	
15	Drinking Water Area	1 Per Outlet	**[Type 1]**	
16	Washing Water Area	1 Per Outlet	**[Type 1]**	
17	Training Centre	10 per room	**[Type 1/2]**	
18	Assembly Area	5	**[Type 1/2]**	
19	Stairs	1 per landing elevation	**[Type 1]**	
20	Cylinder Storage Area	5 + Signage: Type of Gas, Empty, Filled etc.	**[Type 1/2]**	
21	Labor Colony	Electrical Safety with Distribution Plan/ Line Diagram - 1 COVID Precautions Posters – 5 Safety Awareness Posters – 10 Hygiene awareness posters - 2	**[Type 1]**	
22	Others	As per requirement	**[Type 1/2]**	

Date:

Sign (Contractor) **Sign (BHEL)**

ANNEXURE C

HSE Tools/ Equipment/ Devices

Following equipment conforming to relevant IS/ISO/BS Codes/ Standards in indicated quantities shall be ensured by subcontractor. This list is tentative, not exhaustive. Quantity and date/ period of deployment shall be as per site requirement.

A. HSE Tools/ Equipment/ Devices

SN	Item
1	Lifelines
2	Retractable Fall Arrestors
3	Safety Nets (10m X 5m) fire proof double mesh
4	Sky Climbers
5	Fire Blanket
6	Honey Bee Removal Suit & Kit
7	Scaffolding Pipes
8	Flashback Arrestors
9	Barricading Tape
10	Binoculars
11	Walkie-Talkies
12	LOTO kit
13	24-Volt light
14	Sand Buckets
15	Hard barricading Pipes
16	Standby Fire kits
17	Hand-held Megaphone
18	Small Public Address System
19	Foldable Stretcher
20	Height Rescue Kit (Non-Motorized)
	(Others:)

B. Test & Measurement Devices

SN	Device
1	ELCB Tester
2	Multi meter (Light cables)
3	Earth Resistance Meter
4	Lux Meter
5	Sound Meter
6	Anemometer
7	Breath Analyzer (Alcohol)
8	Multi-gas dozi-meter/ detector
9	Gas leakage detector / alarm
10	Gas monitor (confined space)
11	Radiation meter & Badges
12	Blood Pressure Monitor
13	Fire detectors
14	Hand held signaling light
	(Others:)

ANNEXURE D

Rest Sheds

1. Determining the Number, Sizes and Locations of Rest Shelters

i. **Numbers:**

The number of rest shelters shall be determined based on maximum number of workers at any one time (across all shifts). Formula is:

Wmax = Maximum number of workers at any time in the Site

Space per worker = 1.1 sq meter

Total space required, Tspace = Wmax X 1.1

Based on total space requirement calculated above, the number of rest sheds can be decided according to availability of locations and concentration of workers – so as to ensure the required space.

ii. **Locations:**

The rest sheds should be so located so as to minimize the distance to be travelled by the workers from their locations of work considering all the practical constraints

iii. **Other:**

The Rest shelter should be fenced so that it cannot be used as parking area.

2. Design & Construction of Rest Sheds

a. Permanent/ Long duration Rest Sheds

i. For locations where, permanent rest sheds can be constructed without possibility of removal for relatively long period of time, a semi-closed shed can be constructed covered with tin roof and supported with well-grouted beams. The floor of the shed to be preferably cemented/ solidified.

ii. Adequate structural requirements suitable to the local weather (wind/ rain etc.) to be ensured.

iii. The design of the rest shed to be approved by Civil Engineering Department of BHEL Site before commencing work

b. Temporary/ Movable/ Portable Rest Sheds

i. For locations where, permanent rest sheds cannot be constructed either due to non-availability of permanent location or other reasons, temporary rest shed shall be constructed.

ii. Temporary rest sheds shall comprise of Tent arrangement carried out by professional agencies

3. Amenities in Rest Sheds

a. Essential Amenities

Following amenities shall be essentially ensured in a rest shed:

i. Hygienic environment with regular cleaning and housekeeping (with records)
ii. Adequate illumination
iii. Adequate ventilation/ heating as per weather conditions
iv. Clean Drinking water source
v. Hand Washing area
vi. Toilets & Urinals
vii. Benches/ mats for sitting/ lying
viii. Any other essential requirement deemed necessary by the Site
ix. Dust bins of sufficient quantity/ size that are vacated each day/ as per requirement

b. Additional/ Optional Amenities

Following amenities are optional but are recommended to enhance the level of satisfaction of work force:

i. Hot/ Cold drinks (Tea, Coffee, Glucose etc.) as per requirement
ii. Snacks
iii. Fans/ Coolers/ Heating arrangements as per requirement and weather conditions
iv. A nice, welcoming interior design, music etc.
v. Water cooler

4. Health & Safety Requirements of Rest Sheds

Use of asbestos in construction is banned and shall not be used.
In addition, following essential Safety features shall be ensured in Rest sheds:

i. Availability of Fire extinguishers (preferably CO2 type)
ii. Display of Safety Posters
iii. Pest/ reptile protection
iv. Mosquito prevention measures

5. Note:

Any suitable closed spaces/ newly constructed buildings etc. available at project may also be used for the purpose of rest shed with due concurrence of BHEL

ANNEXURE E

Labor Colony

1. These Guidelines suggest minimum requirements. However, additional requirements based on feasibility and circumstances, while adhering to directions of GOI/District Administration/Local Authority guidelines to be considered
2. Norms for social distancing, training/ awareness, face masks, disinfection, sanitization, gate entry, quarantine, medical, action in case of suspect cases of COVID and other communicable diseases etc. to be followed as per Govt. and BHEL guidelines issued from time to time
3. Labor colony to be developed as close to the Site as possible to avoid lengthy commute
4. A "Suggestion Register" shall be made available at the labor colony for residents. The feedback shall be reviewed on weekly basis and acted upon by concerned Contractor. Same shall be reviewed periodically by authorized BHEL Site Official.
5. Canteens, Latrines & Urinals, Washing Facilities, Creches, Residential Accommodation and other infrastructure/ facilities:
   Numbers/ Quantities and Features of these facilities shall be in line with the following as applicable:

   a. BOCW Act & State Rules
   b. The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act & State Rules
   c. Factories Act & State Rules
   d. Other Relevant Acts & Rules

6. Cleanliness & Hygiene/ Housekeeping:
   a. Regular cleaning of the labor colony to be ensured.
   b. Daily cleaning of Sanitary facilities.
   c. Proper drainage system to prevent water-logging
   d. Regular fogging to prevent spread of mosquitoes
   e. Prevention of foul smell through necessary interventions
   f. Dust suppression as per requirement
   g. Cutting of Grass at regular intervals and other necessary measures to prevent pests & reptiles
   h. Stray animals to be banned from labor colony.
   i. Outside every common facility, eg. Toilet, washroom, food hall/ canteen etc., provision of washbasin with flowing water and soap (preferably liquid soap) to be ensured
7. Power Supply Layout:
   Electrical supply Layout of Labor Colony shall have the provision of Safety devices like MCBs, ELCBs etc. and to be clearly displayed
8. Washing & Drinking Water Availability
   a. Adequate water to be provided in line with: "Estimation of Water Requirements for Drinking and Domestic Use (Source: National Building Code 2016, BIS)"
   b. Drinking water tank to be cleaned every week and sticker for the same pasted on the tank
   c. Drinking water source should be tested as per IS 10500
9. Waste Disposal: Separate bins for dry, wet and biomedical waste to be installed. These bins to be evacuated regularly
10. Training & Awareness/ Displays
    a. HSE Awareness Displays: Posters/ banners/ boards to be displayed in labor colony. Subjects of displays shall be precautions for applicable hazards at work site.
    b. Emergency Contact Numbers including that of Doctor, Hospital, Labor Colony Supervisor, HSE Officials to be displayed prominently

11. Doctor Visits:
    Regular and need-based visits by Doctors to be ensured through tie-ups etc.
12. Inspection & Review: Regular inspection of labor accommodation to be carried out by the Contractor as per prescribed format. Last inspection date, inspector and next due date to be prominently indicated near main gate
13. Provision of a Fair Price shop in the premises to be ensured as per requirement
14. Adequate arrangements to be ensured in case of children/ families

ANNEXURE F

Toilets

Toilets (Latrines and urinals shall be ensured at Site and Labor Colony in accordance with the Inter-State Migrant Workmen Act, 1979 as given below:

LATRINES	URINALS
1. Latrines shall be provided in every establishment on the following scale, namely: - a. Where females are employed, there shall be at least one latrine for every 25 females; b. Where males are employed, there shall be at least one latrine for every 25 males: Provided that where the number of males or females exceeds 190, it shall be sufficient if there is one latrine for 25 males or females, as the case may be, up to the first 100, and one for every 30 thereafter 2. Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.	1. There shall be at least one urinal for male workers up to fifty and one for female up to fifty employed at a time: Provided that where the number of male or female workmen, as the case may be, exceeds 500 it shall be sufficient if there is one urinal for every fifty females up to the first 500 and one for every 100 or part thereof thereafter. 2. The urinals shall be designed and located so as to ensure privacy.

Important:

1. Where workers of both sexes are employed there shall be displayed outside each block of latrine and urinal a notice in the language understood by the majority of the workers 'For Men Only', or For Women Ónly', as the case may be.
2. The notice shall also bear the figure of a man or of a woman, as the case may be.
3. The latrines and urinals shall be conveniently situated and accessible to workers at all times at the establishment.
4. The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.
5. Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the public health authorities.
6. Water shall be provided by the means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.
7. At Site, on ground, Modular Bio-toilets as per industry standard specifications and regular professional cleaning shall be ensured. The toilets should be sufficient in number and easily accessible to workers from every work area
8. At Site, in various elevations, suitable urinals with proper drainage to be ensured at each elevation in line with IS 2064 (1993). Same to be cleaned regularly

ANNEXURE G

Fire Extinguishers

SN	Type of Fire Risk (Class of Fire)	Extinguishing Medium & Relevant INDIAN STANDARD	Scale of Equipment (Minimum recommended)
1.	**CLASS 'A'** Fires involving ordinary combustible materials like wood, paper, textiles, rubber etc. (Ordinary hazard or low fire load)	WATER Soda acid type, water type (gas pressure) and water type (constant air pressure) IS: 934 -1976; IS: 940 -1976; IS: 6234 -1971	For every 600 square meter floor area or part, one 9-litre capacity. Minimum 4 numbers per floor or room; should not be required to travel more than 15 meter to reach any extinguisher.
2.	**CLASS 'A'** (Extra hazard &high fire load)	-do	-do – (Also, consult local fire authority).
3.	**CLASS 'A'** (Special hazards)	-do	-do – Extra provision For every 100 square meter floor area or part, one 4.5 Kg. CO2; minimum 2 numbers per room; should not be required to travel more than 10 meter to reach any extinguisher.
4.	**CLASS 'B'** (Fires in flammable liquids like oils, solvents, petroleum, products, varnishes, paints, etc. where blanketing effect is essential) (Storage and handling in small quantities)	FOAM / CARBON DIOXIDE / DRY CHEMICAL POWDER IS: 933 -1976; IS: 2878 1976; IS: 2171 1976; IS: 4308 -1982	For every 50 square meter floor area or part, 2 numbers 9 -liters foam or 5 kg dry powder; should not be required to travel more than 10 m in the area of storage to reach any extinguisher.
5.	**CLASS 'B'** (Bulk storage other than in tank form))	-do -	-do- (but minimum 3 numbers per room)
6.	**CLASS 'C'** (Fires involving gaseous substances under pressure where it is necessary to dilute the burning gas at a very fast rate with an inert gas or powder) (storage and handling of gas cylinders)	CARBON DIOXIDE / DRY CHEM. POWDER. The best way to extinguish such fire is by stopping the flow of fuel gas to the fire. Container is kept cool with water spray. IS: 2878 1976; IS: 2171 -1976; IS: 4308 -1982	For every 100 square meter floor area or part; 2 numbers, 10 kg powder extinguisher or 6 kg C02; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher.
7.	**CLASS'D'** Fires involving metals like magnesium, aluminum, zinc, potassium etc. where the burning metal is reactive to water and which require special extinguishing media or technique	SPECIAL DAY POWDER IS: 2171 -1976 IS: 4861 -1968	For every 50 square meter floor area or part, 2 nos. 5 kg special dry powder; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher.
8.	**MIXED OCCUPANCY** (electrical); Generators; Transformers; etc.	CARBON DIOXIDE DRY POWDER, IS: 2878 1976; IS: 2171 -1976	For every 100 square meter floor area or part one 10 kg C02. Minimum 2 numbers for every location should not be required to travel more than 10 meter to reach an extinguisher.
Note: Due to peculiarities of the power plant construction sites, there would be locations in the construction areas of Boiler, Turbine, Generator, Transformer, etc. where different types of fire risk (classes of fire) may co-exist. Special care shall be taken while selecting and installing portable fire extinguishers for such locations so that all types of fire risk that may co-exist, are adequately covered. Similar special care shall be taken for storage areas.			

a. All Electrical welding booths shall be equipped with appropriate Fire Extinguisher

b. Appropriate Fire Extinguishers shall be made within easy reach of all welding operations
c. Fire extinguishers shall be regularly tested and last checked date to be indicated on each. Master list shall be prepared with location and details
d. Providing appropriate fire-fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
e. Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labour colony etc. Such fire protection equipment shall be easy and kept open at all times.
f. The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders.
g. All other fire safety measures as laid down in the “codes for fire safety at construction site” issued by safety coordinator of BHEL shall be followed.
h. Non-compliance of the above requirement under fire protection shall in no way relieve the subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
i. Emergency contacts nos. must be displayed at prominent locations
j. Tarpaulin being inflammable should not be used (instead, only non-infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.

ANNEXURE H

HSE Compliance Certificate

Bill Ref no:_____Date:_____

NAME OF THE AGENCY: _____ Work-Area/Package:_____

Sl. No.	Description	Remarks
1	**HOUSE KEEPING**:	
1.1	All working areas at site (specific to the agency) are free from garbage's, scraps & any other undesired non-plant materials. There is no encroachment in safe passage of man, material & T&P to carry out activities safely	
1.2	All the plant materials under the custody of the agency are stacked & stored properly.	
2	**GENERAL ILLUMINATION**:	
2.1	ALL the working areas at site & office of the agency including passages are having proper & sufficient illumination.	
3	**STATUTORY & REGULATORY REQUIREMENT**:	
3.1	Sufficient water for drinking & other purposes and sanitation in work area and labour colony are available.	
3.2	Periodical Medical check-up of workers & staff done regularly & report submitted to BHEL	
3.3	Regular EYE testing is done for Crane operators/Welders and data's are available with agency	
3.4	All the T&P, Cranes etc used by the agency are having proper T.Cs & Fitness certificate available from competent authority.	
4	**SAFETY COMPLIANCE:**	
4.1	Number of Tool box meetings between Safety officers, erection staff & workers of the agency held in this month with location mentioned	
4.2	All precautions & Safety measures including PPE compliances are taken before working at HEIGHT	
4.3	Permit for working at Height is taken & complied accordingly	
4.4	ELCB is used in Construction Power Supply source by the agency & Proper Distribution board and electrical cabling has been used by the agency and regularly checked by electrician & safety officer of the agency	
4.5	Unsafe areas barricaded properly &unsafe opening closed properly	
4.6	Proper Platforms & Hand-rails used In areas earmarked earlier	
4.7	Proper safety signage's, Slogans & Emergency contact phone numbers including FIRE contact nos. are made available by the agency in locations mentioned	
5	Whether any penalty imposed by BHEL towards non-compliance of above points.	

VENDOR'S SIGNATURE	
Erection Engineer	
HSE Officer	
Site-in-Charge	

BHEL'S SIGNATURE	
Erection Engineer	
HSE Officer	
Package-in-Charge	

ANNEXURE I

Activity-Specific Safety Precautions/ Controls

INDEX OF CONTENTS

General

The philosophy of hierarchy of controls as below shall be followed

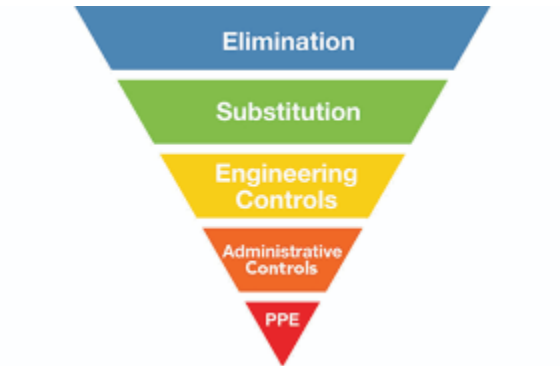


Fig. 1.1

It shall be ensured that there are multiple protections against any accident/ incident. For example, for height work there shall be safe platforms and walkways, Safety Nets and Lifelines for hooking double lanyard Safety harness by workers.

Monitoring and modifying worker behavior shall be part of ensuring safety. All personnel should be competent and trained for the job

Brief Safety guidelines for various hazardous activities are indicated below, besides the mandatory requirements based on Hazard Identification studies, HSE Procedures, Operational Control Procedures, Work Permits, applicable Indian Standard Codes and other provisions detailed in this document. Constant supervision at all times to be maintained by Execution & Safety Team to ensure implementation of these provisions.

1. WORK AT HEIGHT:

a. All work at height above 2 meter above ground level without complete platforms, handrails and other related fall protection shall require a work permit in the prescribed form. This shall require approval by the competent authority. The HSE officer of sub-contractors shall follow the checklist religiously by physically verifying the condition of the work area before recommending for approval.

b. Prior to the start of work at elevation, the HSE Officer involved with the work must meet the work supervisor to review the scope of work, and must review all the possible fall hazards and effective safety responses. The evaluation / analysis must be documented and kept on file and on site by the HSE Officer.

c. Whenever a fall hazard or other exposure exists for working at heights more than 2.0m/6ft, the nature and scope of work will be evaluated for conditions and environmental factors before selecting the appropriate fall protection system (active, passive or a combination of measures, as appropriate).

d. All Engineering and Administrative Controls including barricading, safe platform, Safety Nets etc. shall be made available at work location. Under no circumstances, there shall be total reliance on PPEs only

e. **Safety Nets**

   i. Contractor shall maintain sufficient stock of Safety Nets for deployment

   ii. Safety Nets as per IS: 11057:1984 should be used extensively for prevention / arrest men and materials falling from height.

   iii. The safety nets shall be fire resistant, duly tested and shall be of ISI marked.

iv. Safety Nets shall be deployed below all platforms where height work is envisaged. Duration of work, delay shall be no excuses for non-installation of Safety Net

f. Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
g. Monkey Ladder shall be fitted with cages. Rope ladder should be discouraged.
h. In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
i. In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
j. For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor.
k. The procedures for the safety response to identified fall hazards developed and rescue plans must be reviewed with all individuals exposed to the hazards.
l. The HSE Officer must establish an inspection process of fall protection systems. Some equipment requires documented inspections by its manufacture on a regular schedule. Such equipment must have evidence of the inspection and re-certification process on it. This information must be reviewed before the equipment is actually used. Individuals must visually inspect the fall protection equipment before each use. Failure to complete this inspection process could result in serious injury or death.
m. Immediately remove from service any fall protection equipment that is identified as defective, damaged, or has been subjected to an impact. Damaged fall protective equipment must be destroyed to prevent re-use and not be discarded into trash containers, as the worn or damaged equipment could be unintentionally re-used.
n. Aerial lifting devices, excluding scissor lifts require the use of full body harnesses and lanyards in any elevated position.
o. Where Height related works are applicable then rescue team (consist of 5- 10 person) shall be identified and trained for potential rescue.

1.1 Personnel fall protection system must include:

a. Safety Harness

All height workers must use Full Body Safety harness with double lanyards with shock absorber (only). The primary lanyard is never unhooked until the secondary lanyard is secure. The design of the working platform should be such that under no circumstances, worker should have both lanyards unhooked while at height.

b. Lanyard

i. The type of work and the environment conditions determine lanyard and lifeline selection. If welding, chemical cleaning that may damage lanyards, connectors or lifelines, sandblasting, etc., either protect the components or use more appropriate type of system.
ii. Lanyards and lifelines must incorporate, or be used with, an appropriate deceleration (shock absorbing) device. Deceleration devices include rope grabs, rip-stitch lanyards, specially woven lanyards, tearing, or deforming lanyards, automatic self-retracting lifelines and lanyards which dissipate or limit the energy imposed on the employee during fall arrest.
iii. Once in use, the system's effectiveness is to be monitored. In some cases, a program for cleaning and maintaining the system may be necessary. Lanyard and lifelines must use locking snap hooks only and under

no circumstances must two lanyard snap hooks be connected.

c. Lifeline

All lifelines in general are to be made of min 12mm dia. steel rope (plastic coated) and tied to columns with 3 clamps at each end. Wherever columns are not available to tie the lifelines, the vertical posts as per the design below are to be provided after carrying out drop load test initially. A load of 240kg to be dropped off the mid-point of lifeline in this test.

d. Lifeline Post

DIAGRAM : LIFELINE POST

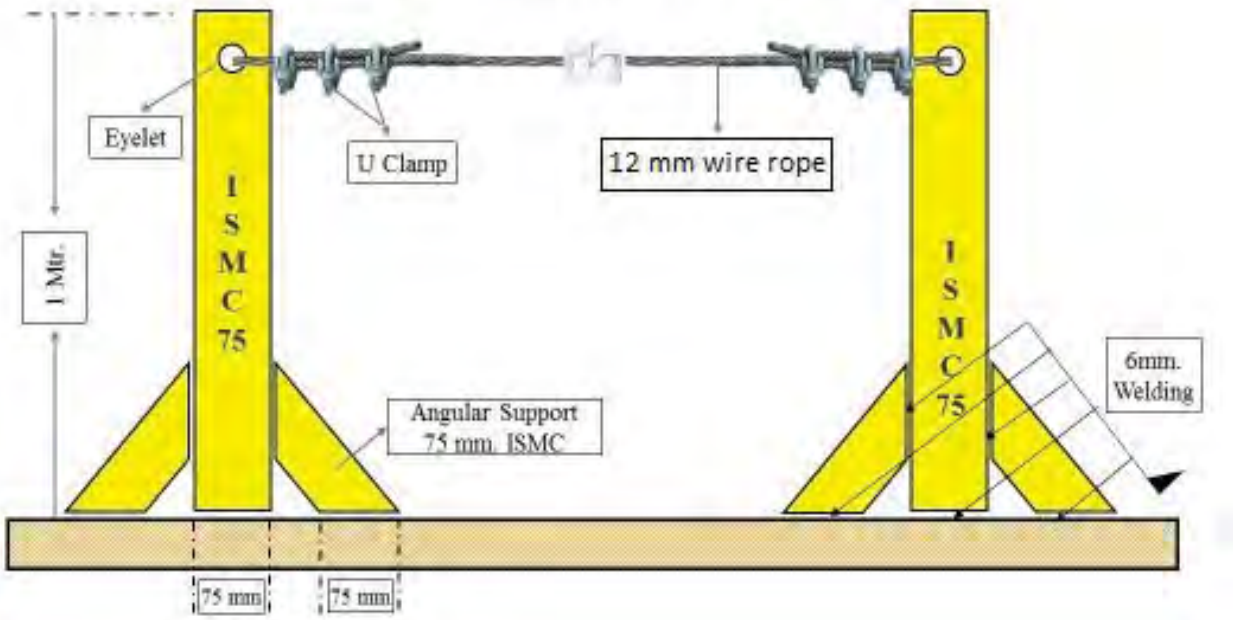


Fig. 2.1 Lifeline Post

i. The support at vertical post shall be fixed at end-to-end (welded/ bolted). The maximum length of one end to another end shall be 6 meters

ii. If the length of a lifeline is more than 6 meters, then intermediate vertical post(s) are to be used. Such intermediate post(s) will act as supports and the lifeline rope should simply pass through the eyelets (holes) of such supports without being anchored

iii. The lifeline need not be wrapped / clamped to any intermediate post

iv. Such intermediate posts must be used at an interval of every 6 meters

v. The post(s) in which the original lifeline is to be installed should be capable of sustaining a tensile stress of 2268 Kgs.

vi. In a horizontal lifeline installation, maximum allowable sagging is 500-600 mm

vii. For a single spun lifeline, no more than 3(Three Nos.) persons are allowed to work; for more than two workers, another lifeline should be installed

viii. Horizontal lifeline should be so installed that it does not impede safe movement of workers

ix. All the installation work must be carried out by competent person with adequate knowledge

1.2 Working Platform

a. Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or

floor level, they shall be closely boarded and shall have adequate width, which shall not be less than 750 mm and be suitably fenced.

b. <u>Precautions against the fall of Materials, Persons and Collapse of Structures:</u>

i. Every opening in the floor or a building or in a working platform shall be suitably barricaded to prevent the fall of persons by providing suitable fencing or railing whose minimum height shall be 90 cm.

ii. Adequate precautions should be taken such as the provision of fencing, or barriers to protect any person who might be injured by the fall of materials, or tools or equipment being raised or lowered. Hard barricading shall be made at such places made of scaffolding pipe & clamps covered with reflective net. Cradle may be used for lifting materials - however this shall be made of MS angles and flats only and duly certified by the HSE officer. Operators may also use designed containers for lifting small tools.

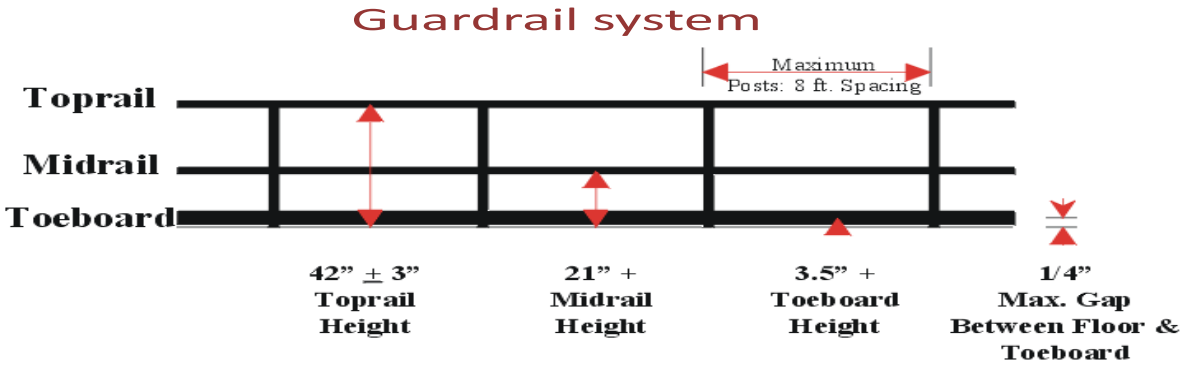
iii. Guardrails (including scaffolding) erected over/adjacent working areas must have the guardrails screened (opening < 0.5), to prevent material from falling outside the platform/decking.

iv. Guardrails must be able to withstand a 200-pound force exerted in any one direction.

v. Where necessary to prevent danger, guys, stays or supports should be used or other effective precautions should be taken to prevent the collapse of structures or parts of structures that are being erected, maintained, repaired, dismantled or demolished.

vi. All openings through which workers are liable to fall should be kept effectively covered or fenced and indicated in the most appropriate manner.

vii. Guardrails and toe-board/barricades and sound platform conforming to IS: 4912-1978 and other Indian laws and regulations as depicted below should be provided.



<u>Fig. 2.2 Guard Rail System</u>

viii. Guardrails shall be provided to protect workers from falling from elevated work places. The rails are generally made of MS pipes of suitable dia. Rebar shall not be used for any handrails, ladder or cover purpose. Wherever the guard-rails and toe-boards cannot be provided:

a. adequate safety nets or safety sheets shall be erected and maintained; or
b. adequate safety harnesses shall be provided and used and / or
c. adequate fall arrestor shall be provided and used.

As mentioned under PPE clause, all these PPEs shall be defect free and regularly inspected for any defect. The full body safety harness shall have double lanyard only with max 1.8m length.

ix. The monkey ladders shall have sufficient fall arrestors. Adequate lifelines of 8mm steel wire rope shall be provided across the work area.

x. The HSE officer shall recommend appropriate PPEs after analyzing hazards and risks involved.

1.3 Scaffolding

All scaffolds shall be conformant to the relevant standards including IS 3696 and IS 4014 as applicable. A sketch of the scaffolds proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use. Only cup lock type scaffoldings will be allowed in site. Where cup lock type scaffolding arrangement is not feasible by the virtue of the location, in that case only pipe and clamp type scaffolding will be allowed.

a. The scaffolding work must be carried out by a competent person, who shall train the scaffold users on safety aspects
b. All scaffolds shall be erected / dismantled by scaffolding crew under direct supervision of competent scaffolding supervisors.
c. All scaffolds shall be capable of supporting 4 times maximum intended load and erected on sound, rigid footing, capable of carrying the maximum intended load without settling or displacement. Bamboo scaffolding is not permitted for use on site.
d. Each employee on the scaffold shall use an approved safety harness attached to an independent lifeline. The lifeline is to be securely attached to substantial members of the structure (not the scaffold itself) or to securely rigged lines, which shall safely suspend a worker in event of a fall.
e. Guard rails and toe boards shall be installed on all open sides and ends of platforms more than (2) meters above ground or floor
f. Scaffold planks must be at least 5 cm x 25 cm (2" x 10") full thickness lumber scaffold grade or better.
g. Scaffold planks shall not span distances greater than 2.5 meters (8 feet).
h. Scaffold planks shall extend over end supports not less than 6 inches nor more than 12 inches and be secured to the scaffold. Scaffolding and accessories with defective parts shall be immediately repaired or replaced.
i. All scaffolding must be a minimum of two planks wide. No one may work from a single plank.
j. Scaffold planks must be inspected before use. Planks that have been damaged must be removed from the site.
k. Access ladders must be provided for each scaffold. Climbing the end frames is prohibited unless the design incorporates an approved ladder.
l. Adequate mudsills or other rigid footing capable of withstanding the maximum intended load must be provided.
m. Scaffolds more the 6 meters (20 feet) in height must be tied to the building or structure at intervals which do not exceed 4 meters (13 feet) vertically and 6 meters (20 feet) horizontally.
n. Do not overload scaffolds. Material should be brought up as needed. Scaffolding must not be loaded in excess of its rated capacity.
o. Barrels, boxes, kegs, blocks or similar unstable object must never be used as work platforms or to support scaffold.
p. Where persons must work under or pass under a scaffold then a 18 gauge wire mesh screen must be installed between the toe board and guard rail.
q. Employees exposed to overhead hazards while working on a scaffold will be protected by 5 cm (2") thick planks.
r. Wooden/bamboo ladders shall not be allowed at any cost. Ladder's rungs shall be fitted /welded

properly. Before every use the rungs should be checked for safe use.

s. Wooden scaffolds shall not be used in areas where fire / fire products are expected

t. Ropes made of jute / Plastic and other fire prone material shall not be used to tie up scaffolding components together

u. The platform should have permanent hand rail and mid rail with Toe board without fail.

v. All platforms are to be tightly planked for the full width of the scaffold, except as may be necessary for entrance openings. Platforms shall be secured in place.

w. On suspension scaffolds designed for a working load of 500 pounds, no more than two workers are permitted to work on the scaffold simultaneously. On suspension scaffolds with a working load of 750 pounds, no more than three workers are permitted on the scaffold simultaneously.

x. Requirements for different types of Scaffolds:

A. Suspended Scaffold

i. Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.

ii. Requirements for use are to be preapproved by HSE Head, under a specific Permit to Work.

B. Rolling Scaffolds

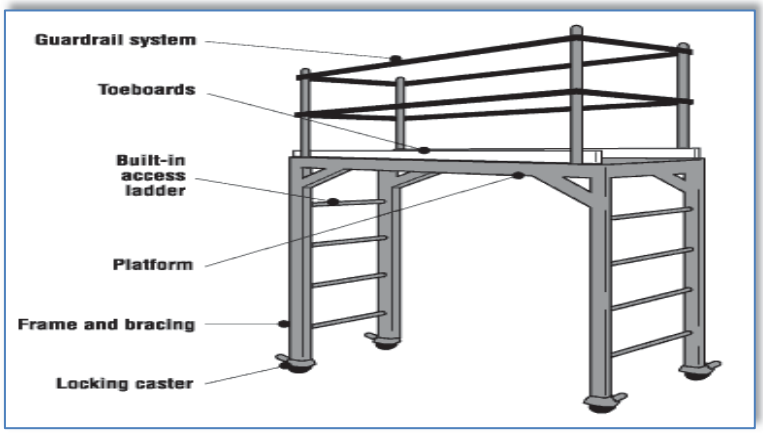
i. The height of rolling scaffolds shall not exceed three times the minimum base dimension.

ii. The minimum base dimension of rolling scaffold will be 1.25 meters (4 feet).

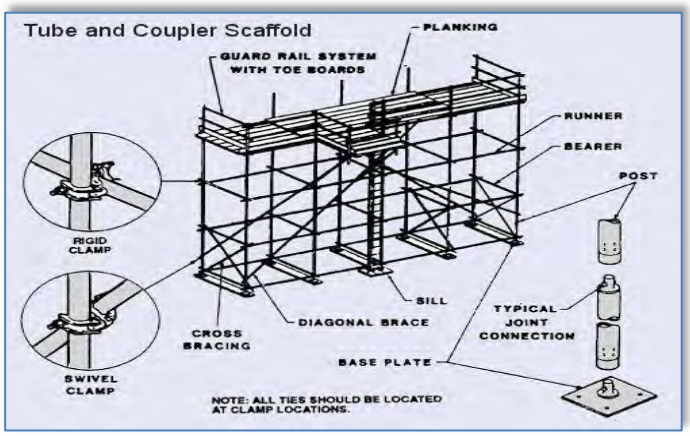
iii. Adequate help must be provided when moving a rolling scaffold.

iv. Secure or remove all loose materials, equipment and tools before moving a rolling scaffold.

v. No one is permitted to ride a rolling scaffold when it is being moved. Castor brakes must be locked-on when the scaffold is not being moved.



Rolling Scaffold



Tube & Coupler Scaffold

Fig. 2.3 Types of Scaffolds

1.4 Ladder Safety

A sketch of the ladders proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use

a. Safe Use of Ladders:

i. Fall protection is required when working on a ladder above 2 meters and when climbing above nearby guardrails.

ii. Ladders must be inspected prior to use and by a competent person quarterly, with documentation.
iii. Use portable ladders for height up to 4 M only
iv. Provide fixed ladders for height above 4 M
v. Place the ladder at an angle of 75 degrees (approx.) from the horizontal (1:4)
vi. Extend ladder at least 1 M above the top landing
vii. Secure top and bottom of the ladder firmly to prevent displacement- anti skid lining at the bottom
viii. Ensure that the width of the ladder is not less than 300 mm and distance between rungs is not more than 300 mm
ix. Provide landings of minimum size 600 x 600 mm at intervals not more than 6 M for fixed ladders. Check the ladders daily for any defects
x. Ensure that the areas around base and top of the ladder are clear. Getting on and off the ladder is more hazardous than using it. Use a mudsill if the ladder is to rest on soft, lose or rough soil
xi. Do not use ladders of conducting material near power lines, and only use ladders near power line or other energize system with exposed parts if they are confirmed locked-out and de-energized.
xii. Stand no higher than the fourth rung from the top for carrying out any job standing on a ladder.
xiii. Never reach out from a ladder to perform work where your belt buckle protrudes past the ladder rung.
xiv. Always face the ladder while climbing up or down
xv. Maintain three-point contact while climbing up or down a ladder i.e. two hands and one foot or two feet and one hand on the ladder at all the times.
xvi. Avoid climbing up or down a ladder while carrying anything in hands. Lift tools, equipment and materials with a rope.
xvii. Work from portable and extension ladders near guardrail where fall expose exists over the guardrail regardless of height, and above 2.0 mtr. heights from the working/walking surface will require the use of personal fall arrest equipment

2. EXCAVATION & CIVIL WORKS

All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

2.1 Excavation

The following safety measures are to be ensured before and during excavation:

a. All Excavation activities more than with depth of 1.22 meter or more shall require and Excavation Work Permit
b. Check for underground utilities like electrical / telephone cables, sewage, water lines and proper care has to be exercised to protect and prevent damage to it.
c. Electrical cables and service lines to be identified using cable detector/locator device before carrying out the excavation work
d. Proper and adequate slope is maintained while excavating
e. Adequate shoring or sheeting is done wherever require to prevent soil sliding
f. Safe access through ladder or steps for exit & entry to excavation
g. No material /excavated soil is kept within one meter from the edge
h. Safe way is planned and provided for movement of HEM /transport equipment near excavation
i. Safety helmet and shoes/gum boots are provided and worn by the workmen at excavation works

j. Dewatering arrangement is made where water seepage is prevailed.
k. Stop blocks are provided to avoid vehicles reversing into the excavated trenches
l. Danger signs /Caution boards are displayed at work spot
m. Hard Barricading is provided at excavated pits. It should be made of scaffolding pipe and clamp with reflective nets.
n. All Excavated area of depth 3mtr or more is to be hard barricaded with pipe.

Soil Type	Height/Depth ratio	Slope Angle
Stable Rock	Vertical	90 deg.
Type A	¾ : 1	53 deg.
Type B	1 : 1	45 deg.
Type C	1½ : 1	34 deg.

Determining Soil Type

Type	Description	Examples
A	Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot or greater.	Clay, silty clay, sandy clay, clay loam and in some cases: silty clay loam and sandy clay loam.
B	Cohesive soils with unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf.	Angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases silty clay loam and sandy clay loam.
C	Cohesive soils with unconfined compressive strength greater than 0.5 tsf or less.	Granular soils such as gravel, sand and loamy sand; submerged soil or soil from which water is freely seeping; submerged rock that is not stable.

Fig. 3.1 Excavation Reference

2.2 Piling

Ensure the following precautionary measures before starting piling works:

a. Inspection of piling equipment by responsible person for its condition before initiating piling operation.
b. Checklist and OCP for piling to be prepared using manufacturer's instructions and used
c. Testing and its certification wire rope, slings, D-shackles, chain pulley blocks using in the process of piling work by competent person
d. Adequate support and secured foundation of the piling equipment to avoid toppling
e. Hoses should be lashed and adequately secured
f. Proper work platform is to be provided on piling frame
g. Safe work procedures and close supervision to prevent unsafe acts of operators/any unsafe conditions that may arise
h. Only experienced and trained operators are engaged for the piling operation
i. Provision of Personal Protective Equipment (PPE) like safety shoes/gumshoes/safety helmet/safety belt etc. and its use by their workmen.
j. Special care and precautions If work is near electrical live cables/ electrical equipment
k. Cordoning of work area to prevent un authorized entry
l. Guarding of revolving parts
m. Specific measures to prevent over turning of pile driver/missing of hammer/ hammer movement out of range

2.3 Batching Plant Operation

Following Safety considerations for batching plant are to be ensured:

1. Modern type batching plant should be used in which all the moving parts are protected and emergency

and safety features are incorporated.

2. Installation of external Electric moto-vibrators in the feeding hopper of all batching plants to reduce human intervention.
3. Installation of safety devices like pull-chord on both the sides of conveyor for stopping the conveyor in emergency
4. Workers carrying cement / sand to be given appropriate PPEs like respiratory masks & gloves.
5. Conveyor belt/rotating parts must be guarded properly.
6. Safety awareness shall be inculcated in workmen about the risk involved in rotating parts.
7. The agency shall ensure to erect the batching plant as per drawing including installation of all safety devices as provided by manufacturer and witnessed by BHEL Engineer in charge before starting of machine in future.
8. Safety audit to also focus on Batching plant.
9. The site shall impose penalty on the agency who has violated the safety norms as per contract.

2.4 Mobile Plant

Mobile plant includes tractors, trailers, dumpers, excavators, bulldozers, road rollers etc. for earthmoving purpose and concrete mixers, concrete transit mixtures, concrete pumps etc for concreting purpose. Due to the very nature of their function and movement in difficult terrains, congested areas, working in tandem with manual work and other operations the danger is inherent.

Automatic reverse camera with reverse horn connected with reverse gear is compulsory for all moving machineries.

Following Safety measures to be ensured for Mobile Plant:

a. Where movement around site is involved, routes should be planned, obstruction free and well maintained
b. Observe specified speed limits
c. Operating personnel should be aware of associated risks and its preventive measures
d. Only experienced, trained and authorized persons with valid license (wherever applicable) should operate the mobile equipment/vehicles
e. Provide and use Warning lights and reverse horn for cautioning the people around
f. Operation should be on level and stable ground with adequate working clearance.
g. Loading of out riggers/stabilizers should be well within safe ground bearing capacity
h. No person should be on equipment or vehicle during loading and unloading of material
i. Operators should be protected by warning barriers or switching off power when working in close proximity of overhead power lines
j. The equipment /vehicles should be well maintained and provided with effective brake system and other safety devices (wherever require)
k. Rotating parts of equipment should be adequately guarded
l. Provide necessary personal protective appliances and ensure its use by the operating personnel Ensure effective measures at source to control harmful emissions, dust, fumes contaminating atmosphere and cause health hazards to the operators and people in the vicinity.
m. No overloading/over stressing of vehicles/plant is allowed
n. Hoses, pipes, receivers, gauges and valves involved in carrying out hydraulic fluid/ compressed air should be checked for leaks and tested prior to operation.

o. Adequate safe clearance for swing and movement is to be judged during operation of Concrete mixer
p. Setting of machines on firm and level ground with wheel locked to prevent movement of machine
q. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket
r. Operator leaving work spot should ensure that the equipment/vehicle is kept in neutral position and place on firm and level ground.
s. The hand brake should be kept in position and block road wheels as additional safety measure
t. Blades/buckets should be kept low while moving
u. The dozer blades should not be used as brakes except in emergency
v. The ground should be examined for its bearing capacity and general safety especially when operating road roller at the edges of slopes, embankments.
w. The roller should not be moved downhill with the engine out of gear
x. If operating near excavations the following precautionary measures are to be ensured
y. Barricading, edge protection to prevent fall of persons/vehicles over running while reversing etc.
z. Suitable support system and adequate allowance to avoid the danger of side collapsing
aa. Experienced signaler /attendant should be always accompanied with operator/driver for proper direction /signal and also to caution others in the working Zone during operation of mobile plant

2.5 Concrete Vibrators

a. Revolving parts/belt drives should be adequately guarded and Vibrating unit shall be completely enclosed and have suitable overload relays and effectively earthed
b. Ensure sufficient length of cable to the Vibrator.
c. Ensure electric starters and other accessories are firmly fixed adequately supported
d. Ensure locking of needle load while inserting needle in to the vibrator,
e. Ensure periodical lubrication and maintenance

2.6 Concrete Mixers

a. Setting of machines on firm and level ground with wheel locked to prevent movement of machine
b. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket

3. WELDING & GAS CUTTING SAFETY (HOT WORK)

a. All Hot Work shall require a Hot Work Permit
b. Inbuilt Voltage Reduction Device (VRD) equipped arc welding machine will only be allowed for work.
c. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced.
d. All safety precautions shall be taken for welding and cutting operations as per IS-818.
e. When possible, items to be welded, cut, heated, etc. shall be moved to a safe location free of combustible or flammable material. If this is not possible, then all combustibles/ flammables that can be removed from the area shall be removed within a 35-foot circumference and a positive means of confining arcs and sparks generated by the process shall be ensured and additional person(s) shall be stationed as fire-watch for the area(s) still exposed, along with obtaining the Hot Work Permit as applicable.
f. Appropriate fire-fighting equipment is to be available in close proximity of any welding and gas cutting operations at all times suitable for the type of Fire.

g. Drums, tanks, and similar containers that have contained flammable or toxic material shall not be welded, cut, or heated until they have been made safe by water filling, thorough cleansing or similar accepted practices. The container shall also be ventilated during the welding, cutting, or heating process.
h. Proper ventilation is required for any welding or torch operations performed in a confined space.
i. Any welding or gas cutting operations performed on metals of toxic compounds or coating such as zinc, stainless steel, lead, cadmium, chromium, and beryllium shall be properly ventilated and/or proper respiratory protection shall be worn by any person that could be exposed to fumes, vapors, and gasses created by the welding and gas cutting processes.
j. Wherever it is practical, all arc welding operations shall be shielded to prevent direct light rays or sparks from contacting persons in the vicinity or from reaching areas normally used to travel through or into the vicinity. Where this is not practical, persons who shall be in the area are to use proper eye and skin protection. Other persons who are not participating in the welding or gas cutting operations are not to be allowed into the hazard zone.
k. Welders and other employees who are exposed to arc welding radiation shall wear suitable clothing and protective apparel to prevent burns and other types of ultraviolet radiation damage to the skin.
l. Arc welding machines shall be shut down when being moved or when they are not in continuous use. Electrode holders left unattended shall have electrodes removed and shall not be left where they might contact employees or conducting objects.
m. Arc welding power supply cable shall be of proper rating and material, e.g. copper.
n. Welders shall guard against allowing materials adjacent to or behind them to reflect radiation back toward them or towards others in the area. Reflected radiation can cause skin burns and eye flash burns.
o. Valve caps shall be in place when cylinders are not in use. Valve caps shall never be used for lifting the cylinder vertically.
p. Torches shall only be lit by approved strikers; never with matches, cigarette lighters, or hot-work.
q. Splatter / Slag Collector:

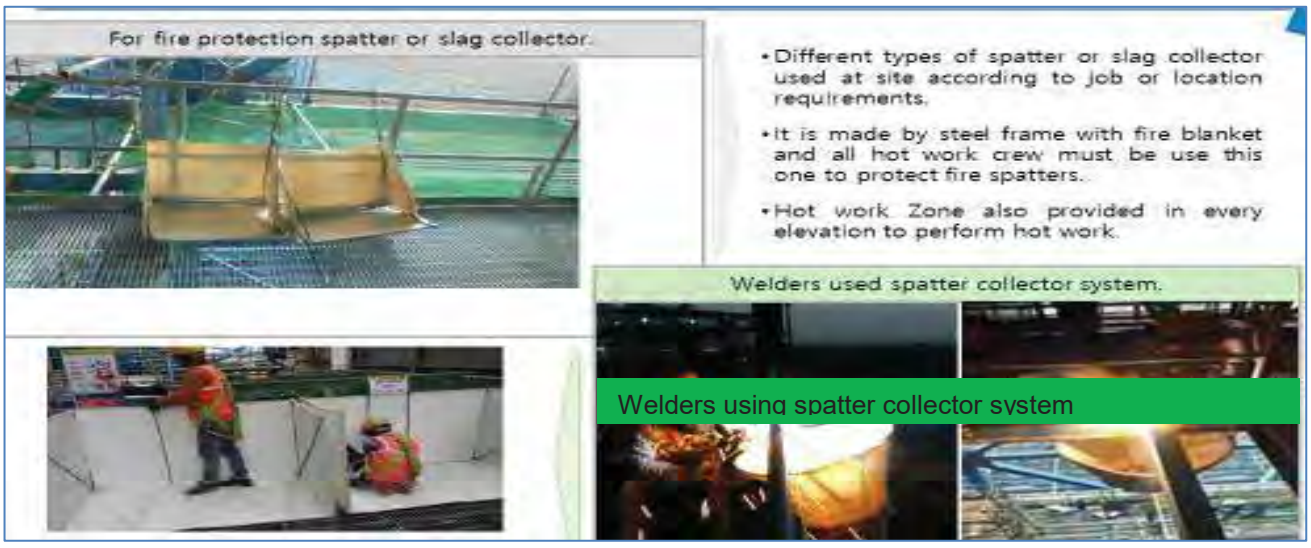


Fig. 4.1 Splatter / Slag Collector

While carrying out job at height, the sparks or molten slag shall be prevented from falling down by putting a fire-resistant (non-asbestos) sheet or patter/ slag collector or even MS Sheet. The passage of falling sparks

or molten slag shall be barricaded till ground floor and any cable/ tubes/ any other objects interfering in the passages hall either be removed or covered with Fire-resistant sheet or MS Sheet.

r. COMPRESSED GAS

i. All cylinder valves shall be closed when any work is finished and when any Cylinders are empty or being moved. Valve protection caps shall be placed and secured properly before gas cylinders are transported, moved or stored.

ii. Compressed gas cylinders shall be secured in an upright position with chain or appropriate means during storage & use. However, a trolley shall be used for transportation.

iii. Compressed gas cylinders shall always be secured from tipping or falling, whether in use, in storage or in transit. The cylinders shall always be secured upright, except during times when actually being hoisted or carried.

iv. When cylinders are transported by powered vehicle they shall be secured in a vertical position.

v. Regulators shall be removed when cylinders are not in use or are in transit, unless the cylinder is firmly secured on a special carrier designed for this purpose.

vi. Gas cylinders are not allowed to be used in man-basket when occupied.

vii. Cylinders containing oxygen or fuel gasses shall not be taken into confined spaces.

viii. Oxygen cylinders shall be stored a minimum of 6 meters from fuel gas cylinders or shall have an approved firewall between them.

ix. All cylinders shall be kept at a safe distance from welding or cutting operations or shielded from arc/ sparks / slag.

x. All cylinders shall be placed where they cannot become part of the electrical circuit.

xi. Oxygen and acetylene shall not be stored together. Oxygen must be separated from acetylene (or ANY fuel gas) or combustible material by at least 20ft or a barrier with a 30-minute fire resistance rating.

xii. All Cylinders should be stored upright in a designated area with labels for the type of gas. All applicable precautions to be ensured during storage

xiii. Oxygen and fuel gas regulators, hoses and associated equipment shall not be altered and shall be in proper working order while in use.

xiv. Compressed air can be extremely dangerous if allowed to penetrate the skin. As such, the use of compressed air to clean off yourself or other workers shall be strictly prohibited.

xv. All gas cylinders shall be stored in upright position. Suitable trolley shall be used for cylinder movement, the design of which shall be submitted to BHEL Engineer for approval.

xvi. No of cylinders shall not exceed the specified quantity as per OCP

xvii. Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.

xviii. All cylinder should be kept only in cylinder trolley.

xix. Cylinder shall be transported in upright vertical position by suitable mean.

4. LIFTING & RIGGING SAFETY

a. All Heavy / Complex Lifting operations as defined in Clause 6.12 shall require a Lifting Work Permit. A written rigging procedure and plan must be prepared for all individual heavy/ complex lifting operations.

b. All the cranes and lifting tools & tackles shall be inspected on daily / weekly basis as well as monthly by expert as per applicable formats.
c. In addition, inspection / certification as mandated by law shall be carried out wherein these shall be tested and certificates of fitness shall be obtained from 3rd party State Govt. approved competent agency before deploying at site and later periodically. BHEL shall be given advance intimation of any such inspections
d. The last date of Third-Party Inspection and the next Due date shall be conspicuously displayed on all cranes. A copy of certificate shall be pasted on operator's cabin of all the lifting equipment.
e. Specifically designed heavy steel plates lifting clamps shall be used for lifting heavy metal sheets. Manmade lifting clamp chapa shall not be used for lifting/shifting of plates.
f. Following requirements shall be mandatorily followed, wherever applicable:
    i. The manufacturer's instruction for maintenance shall also be followed. All safety measures shall be followed.
    ii. All tools tackles, lifting appliances; material-handling equipment etc. used by the subcontractor shall be of safe design and construction.
    iii. The operators, slingers and signalers shall be qualified as per IS 13367 (part-1):2003 "Safe use of cranes- code of practices".
    iv. There shall be a person responsible for co-ordination among cranes where multiple cranes are used, and lifting over load chart of the crane to be avoided.
    v. Mobile phone should be banned for crane operator and lifting operation. Only walkie talkie shall be allowed in rigging/Lifting purpose.
g. Lifts/Movements between 5 Tons and 20 Tons:
    i. Shall include a rigging plan, detailing schematic representation of the handling/lifting operations that must be included on the Method Statement.
    ii. When performing similar lifts of identical items, only one rigging plan need be prepared, provided each of the lifts can be performed in accordance with the rigging plan.
h. Lifts/Movements Less Than 5 Tons:
    i. An equipment rigging plan is not required for lifts less than 5 tons, safety measures are covered in the JSA. This could change as per BHEL requirement

i. Personnel Lifts (Man-Basket / Jhoola):

The design of personnel man basket shall be submitted to BHEL Engineer for approval before use. Relevant permit (Height work & others as applicable) shall be completed prior to lifting any people, along with a rigging plan.

i. A separate Lifeline / fall arrestor anchored to a fixed structure outside of Jhoola shall be provided for the workers inside the basket. All occupants of the basket shall have Safety Harnesses equipped with rope grabs, which are to be hooked to the vertical lifeline.
ii. Man-basket shall be used where access through ladders or scaffolding is not feasible.
iii. Man-baskets shall be designed and engineered by a manufacturer (job made man-baskets are not allowed, unless designed and tested by a certified engineer), and built robust with MS Angles and flats or plates or channels only.
iv. Guard rails top and mid, must be in place and screened-in to avoid material from falling out of

basket. The factor of safety shall be 200%.

v. It shall have a door with double latches and shall open inside. Anchor points shall be identified within the man-basket.

vi. The man-basket shall be thoroughly inspected and load tested and a trial run performed without personnel before being put to job.

vii. It shall be treated as a lifting tool (T&P Item) and shall undergo same certification cycle and inspection as other lifting equipment.

viii. An additional sling of required lifting capacity shall be fixed the man-basket main lifting point and attached to the crane above the ball or block.

ix. While lifting man-basket, the crane shall maintain a uniform speed of lift without any swing.

x. Once man-basket reaches the destination, the lift brakes shall be locked as long as the basket
   a. remains at that point. The same care shall be taken in its descent.

xi. As for hanging man-basket, the same shall be hung off a rigid structure with help U-shaped handle welded to man-basket. This shall be tested once in a year by a competent person.

xii. Use of Rebar steel for making and monkey-ladder must be avoided.

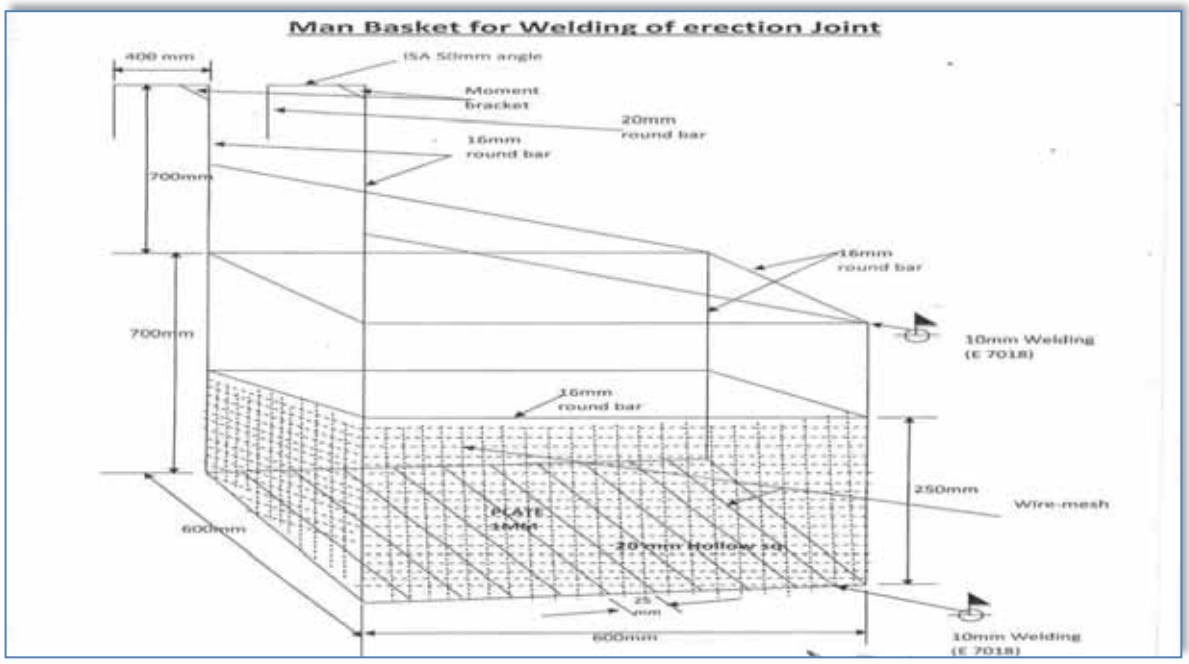


Fig. 5.1 Man Basket for Welding Erection Joint

4.1 Cranes & Hoisting Equipment:

This section provides the guidelines to ensure proper rigging and lifting activities are accomplished safely and in accordance with applicable specifications, codes, and regulations.

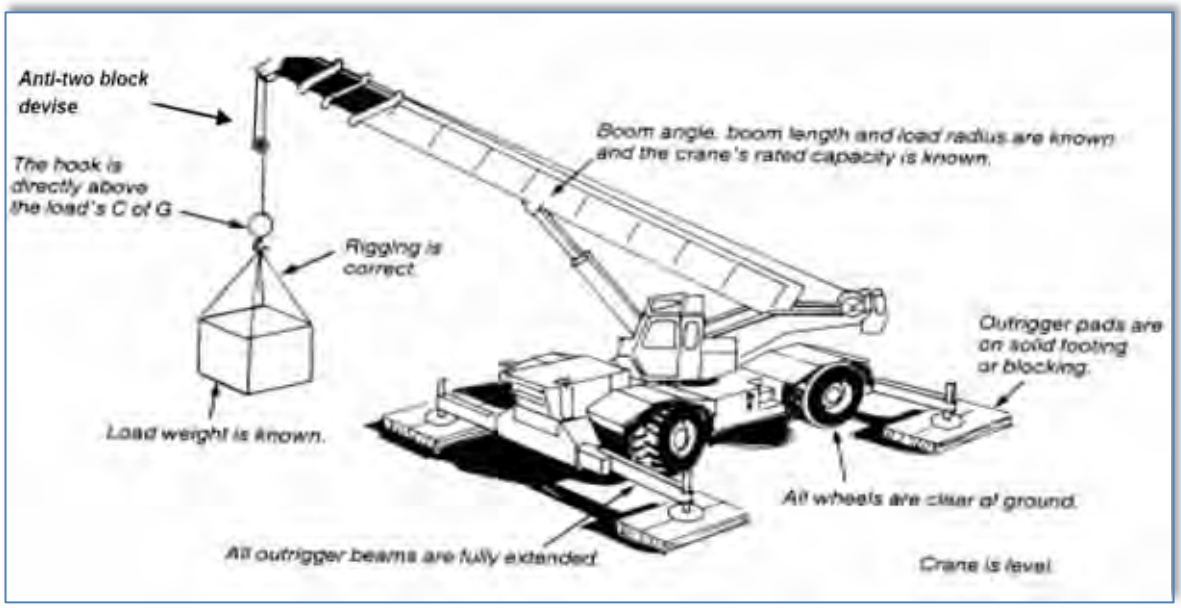


Fig. 5.2 Proper Crane Setup

a. On every crane or piece of hoisting equipment notices of all rated load capacities, recommended operating speeds, and any hazard warnings or special instructions shall be conspicuously posted. All instructions and warning shall be visible from the equipment operator 's station.
b. Cranes shall have an Anti-Two-block safety device installed
c. All mobile cranes shall have overload and backup alarms, load angle indicators and limit switches
d. All areas within swing radius of cranes that are potentially accessible by pedestrian, vehicular, or equipment movement shall be barricaded to prevent anyone or any vehicle or equipment from being struck by the crane or hoisting equipment, or its load(s).
e. No part of the lifting equipment or its load shall be within the distance as specified in the Indian Electricity Act from an energized power line
f. Cranes shall have annual certified third-party inspection and be inspected before use by the operator. Any defects shall be corrected before use. Logs of crane inspection shall be kept with the crane.
g. Make certain that the rigging personnel, material, and equipment have the necessary capabilities for the job and are in safe condition.
h. Communicate with person(s) directly responsible for accomplishing the work and / or work area to establish requirements/responsibilities and make certain that all preparatory work is complete.
i. Mats/Pads must be used on all lifting equipment, equipped with out riggers.
j. Pick and carry must have the load secured to the rig in front.
k. Only BHEL Approved Plate Lifting Spreader Beam configuration shall be used (Sample in Fig. 11.3.5.3)
l. Crane operators must follow the following:
    i. Pass an annual Operator's Physical examination
    ii. Carry a valid training certification card at all time while operating issued by the Govt. or other recognized institute.

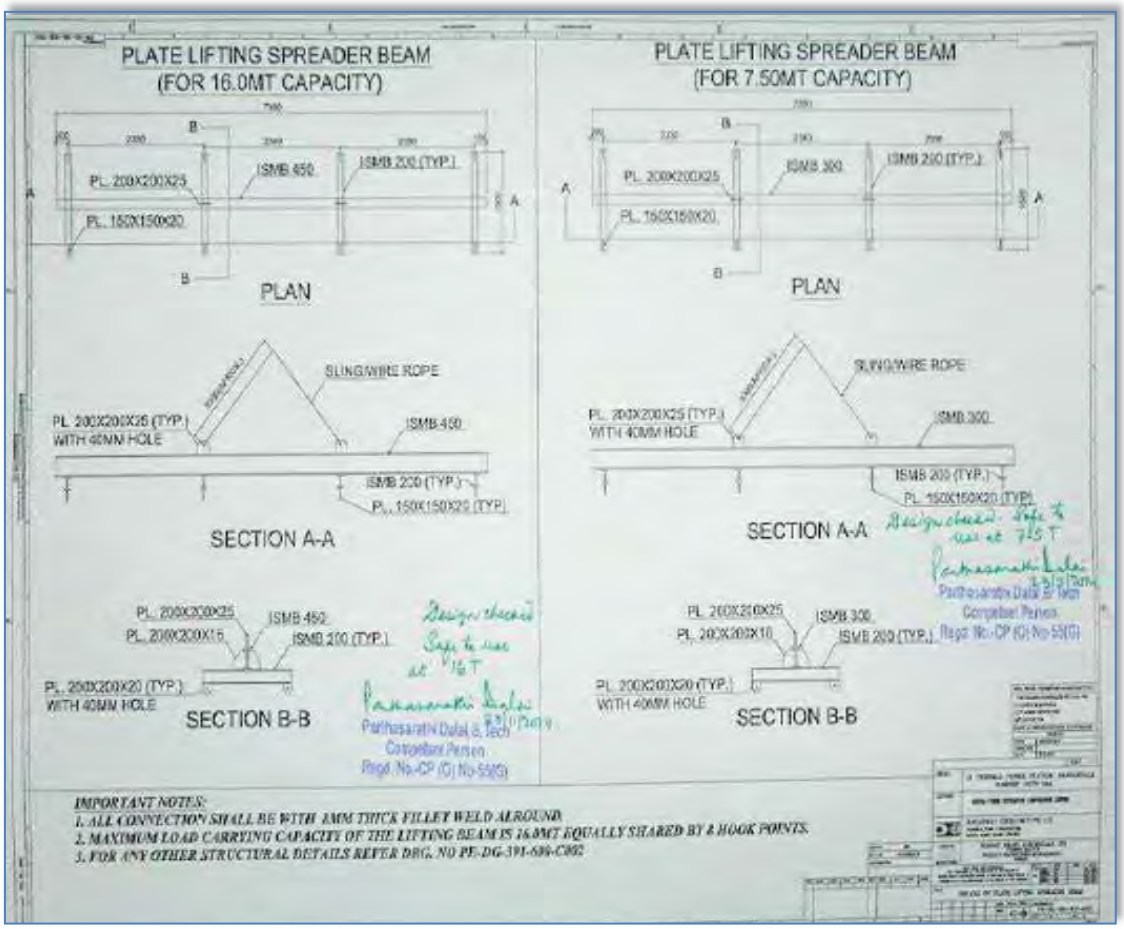


Fig. 5.3 Typical Plate Lifting Spreader Beam Configuration for 7.5 MT and 15 MT Loads

m. Safe Rigging Practices

i. Review the planned operation and requirements with the operator and rigging crew.
ii. Ensure a pre-lift meeting is conducted with crane operator, tagline operator, signal personnel, and Safety Manager.
iii. Designate a qualified person from the rigging crew to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desire clearance by visual means.
iv. Clear the lift area of all unnecessary personnel.
v. Hydras shall only be allowed for loading & unloading works & shall not be allowed to move with load

n. Rules for Safe Rigging

i. Use loops, thimbles and corner pads to prevent damage to slings when used around corners or on cutting edges.
ii. Never allow wire rope to lie on the ground for any length of time or on rusty steel or near solvents, chemicals or corrosive substances.
iii. Slings must not be pulled from between or under loads with load resting on the sling.
iv. Keep all rope away from flame cutting or welding operations.
v. Never use rope as sling material.
vi. Never wrap a wire rope completely around a hook.

vii. Do not bend wire rope near any attached fitting.

viii. The sling must be selected to suite the most heavily loaded leg rather than the total weight when using multi-legged sling to lift loads in which one end is heavier than the other.

ix. When using 3 and 4-legged sling configurations, any two legs must be capable of supporting the entire load.

x. Where possible, wire rope choker hitches must include a shackle with the eye around the shackle pin to prevent breaking wires of the choke. The choker hitch must be “snugged down” prior to lifting, not after tension is applied.

xi. Unless authorized by the hook manufacturer when more than two rope eyes are placed over a hook, install a shackle, pin resting in the hook, and place the rope eyes in the bowl of the shackle.

xii. Properly rig all loads to prevent dislodgment of any part.

xiii. Use guide ropes or tag lines to prevent the rotation or uncontrolled motion of the load when necessary.

xiv. Loads must be safely landed and properly blocked before being unhooked and unslung. Tag lines must not be used in situations that jeopardize the safety of the lift.

xv. Lifting beams must be plainly marked with their weight and designed working load and must only be used in the manner for which they were designed.

xvi. The hoist rope or chain must never be wrapped around the load. The load must be attached to the hook by slings or other rigging devices that are adequate for the load being lifted.

xvii. Multiple part lines must not be twisted around each other.

xviii. The hook must be brought over the center of gravity of load before the lift is started.

xix. If there has been a slack rope condition, determine that the rope is properly seated on the drum and in the sheaves prior to lifting.

xx. Keep hands away from pinch points as the slack is being taken up.

xxi. Leather gloves are recommended when handling wire rope.

xxii. Avoid impact loading caused by sudden jerking when lifting or lowering. Lift the load gradually until the slack is eliminated.

xxiii. Never ride on a load that is suspended.

xxiv. Avoid allowing the load to be carried over the heads of any personnel.

xxv. Never work under a suspended load until the load has been adequately supported from the floor and all conditions have been approved by the supervisor in charge of the operation.

xxvi. Never leave a load suspended unless emergency evacuation is required.

xxvii. Never make temporary repairs to sling.

xxviii. The capacity of a sling is determined by its angle, construction, type of hitch and size.

xxix. Never lift loads with one leg of a multi-leg sling until the unused legs are made secure.

xxx. Never point load a hook unless it is especially designed and rated for such use.

xxxi. Make certain that the load is broken free before lifting and that all legs are taking the load.

xxxii. When using two or more slings on a load make certain all slings are made from the same materials.

xxxiii. Lower the loads on to adequate blocking to prevent damage to the slings.

xxxiv. Materials and equipment being hoisted must be loaded and secured to prevent any movement which could create a hazard in transit.

xxxv. The weight of the hook, load block and any material handling devices must be included when determining crane capacity.

xxxvi. Calculated weights cannot exceed load chart without written approval.

xxxvii. Personnel must be completely clear of loads being picked up or set down by crane. Tag lines will be used to control the loads. Loads must not be touched by hand while placing/ moving.

o. Slings

The following are rules for safe use of synthetic slings:

i. Synthetic slings must be marked to show the rated capacity for each type of hitch and type of web material.

ii. Nylon web slings must not be used where fumes, vapors, sprays or mists or liquids of acids or phenolic are present. Web slings with aluminum fittings must apply in this category.

iii. Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:

a. Acid or caustic burns
b. Melting or charring of any part of the sling surface
c. Snags, punctures, tears or cuts
d. Broken stitches
e. Distortion of fittings
f. Synthetic web slings of polyester or nylon must not be used at or come in contact with temperatures in excess of 82°C
g. Polypropylene web slings must not be used at or come in contact with temperatures in excess of 93°C
h. Insulated hooks must be tested yearly to ensure insulation integrity to at least manufacturer's specifications.

p. Wire Rope Slings must be removed from service and destroyed if any of the following conditions are present:

i. In (10) randomly distributed wires broken in one (1) rope lay, or five (5) broken wires in one (1) strand in one (1) rope lay.
ii. Wear or scraping of one-third the original diameter of outside wires.
iii. Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure such as:
iv. Evidence of heat damage.
v. End attachments that are cracked, deformed worn.
vi. Corrosion of the rope or end attachments.

q. Metal mesh slings must be immediately removed from service if any of the following conditions are present:

i. A broken weld or broken brazed joint along the sling edge.
ii. Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion.
iii. Lack of flexibility due to distortion or corrosion.

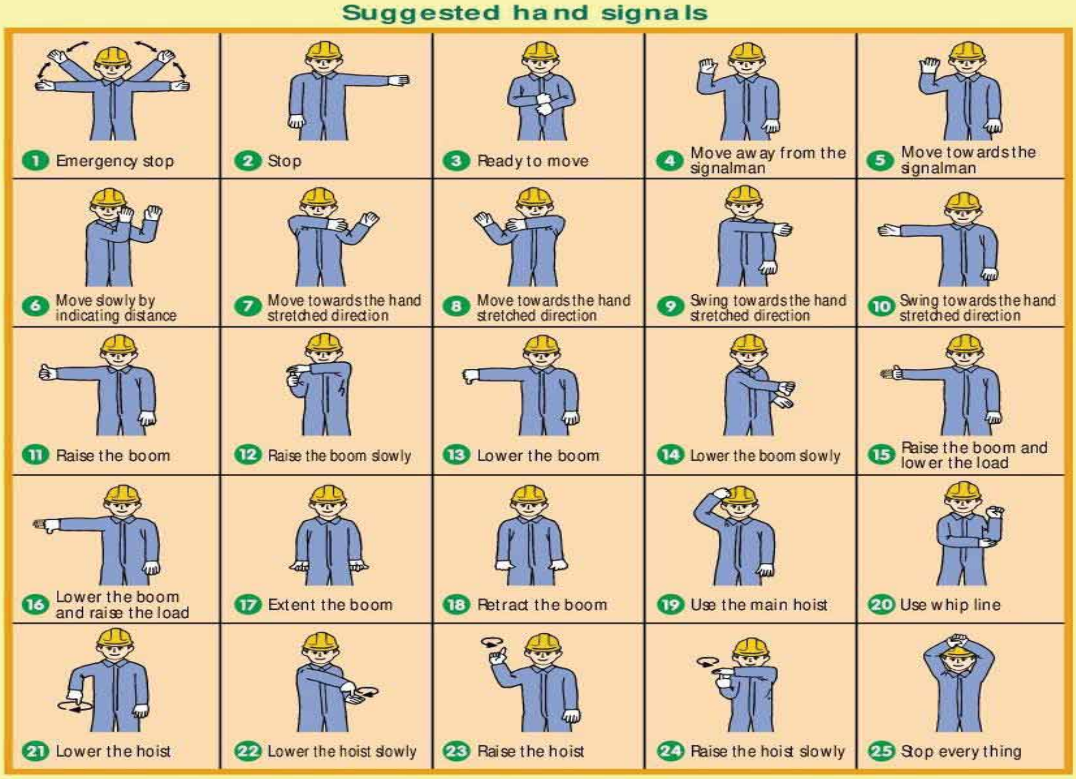
r. Requirements of Plate Clamps:

i. The rated load of the plate clamp must be marked on the main structure.

ii. Care must be taken to make certain the load is correctly distributed for the plate clamp being used.
iii. Do not allow load or plate clamp to come into contact with any obstruction.
iv. The plate clamp must not be used for side pulls or sliding the load.
v. When lifting stainless steel or special alloys, ensure plate clamp is designed for use on the specific metal.

s. Signaling Practices:

- The "slinger" is responsible for attaching and detaching the load to and from the crane. He shall:
  – have received appropriate training on general safe lifting operations;
  – be capable of selectings lifting gears suitable for the loads;
  – liaise with the operator and direct the movement of the crane safely.
- The "signaller" is responsible for relaying the signal from the slinger to the crane operator. He shall:
  – have received appropriate training on general safe lifting operations;
  – be able to direct the movement of the crane and loads.



Note: During the lifting operation, either the slinger or signaller shall communicate with the operator. Other communication methods (e.g., wireless walkie-talkies, telephones, etc.) may also be used.

Fig. 5.4 Recommended Signaling Practices

5. DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured, besides using the Work Permit:

a. All roads and open areas adjacent to the work site shall either be closed, suitably protected or restricted for movement
b. No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.

c. All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

6. T&PS GENERAL

a. All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test /calibration certificates bearing endorsement from competent authority of BHEL.
b. Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.
c. Tagging and punching in all lifting tool is compulsory with SWL, sr. no. and due date.
d. All T&Ps shall be inspected by authorized Third Party agency as per applicable frequency. BHEL shall be kept informed of any such scheduled inspection
e. All T&Ps shall be internally inspected in each quarter and colour coded.

7. CHEMICAL HANDLING

a. Displaying safe handling procedures & MSDS for all chemicals such as lube oil, acid, alkali, sealing compounds etc. at work place.
b. Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.
c. The used containers of chemicals shall be segregated and disposed of suitably
d. In case the used containers need to be re-used, all traces of the chemical to be removed by thorough cleaning with detergents etc. under trained supervision

8. ELECTRICAL SAFETY

a. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
b. No PDB or any other distribution board shall be more than 03 (three) years of purchase. Only modern PDB with industrial sockets as shown in layout below to be allowed to use at site.
c. Power supply to all equipment at site to be routed through MCBs of appropriate rating. A 'Power Supply Distribution Plan' shall be prepared and submitted to BHEL Engineer for approval
d. All power supplies through cables shall be underground or overhead with height > 3mtrs.
e. All power distribution boxes shall be locked and the key controlled by site management of concerned subcontractor.
f. All individual equipment & tools at site shall be powered through Earth Leakage Circuit Breakers of 30 mA sensitivity.
g. These MCBs and ELCBs shall be regularly tested as per Clause 14
h. All fuses and fuse wires shall be of standard size and rating.
i. All electrical appliances used in the work shall be in good working condition and shall be properly double earthed other that armour earthling.

j. All extension boards shall have separate switches for all sockets / connections.

k. All portable electric tools used by the subcontractor shall have safe plugging system (industrial top & socket) to source of power and be appropriately earthed.

l. Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts especially in confined spaces like inside water boxes, turbine casings, condensers etc.

m. Electrical appliance shall have proper earthing and for appliances equal to & more than 415V shall have two separate earthing (as per IS-3043-1987)

n. Portable Electric Lights

i. Portable electric lights used in wet or potentially wet locations must be either low voltage type (24 volts or less) or protected by a GFI (ground fault interrupter).

ii. They must be visually checked before each use and periodically while in use to assure their original integrity is maintained.

iii. Cords with cuts, breaks, deep abrasions, etc. shall be taken out of service immediately.

iv. Repairs to extension cords shall only be performed by qualified/ licensed electricians.

v. Must not be allowed to lie in wet or potentially wet areas.

o. Underground Cables:

i. Every electric line or cable of unknown origin that is discovered or exposed during a digging, drilling, probing, or similar operation is to be considered as energized and life threatening.

ii. The senior company employee on the site will ensure that all necessary safety precautions are taken in order to isolate the line from all workers and the public.

iii. Such precautions may include halting the operation if appropriate.

iv. The senior company employee on the site is to then contact the proper authorities to have the line identified and either confirmed to be abandoned and/or made safe for continuing the work.

v. Any and all underground lines that are discovered or become severed must be considered energized on both sides, and be treated accordingly.

p. Details of earth resource and their test date to be given to BHEL safety officer as per the prescribed formats of BHEL

q. The subcontractor shall use only properly insulated and armoured cables and conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.

r. BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the risk & cost of the subcontractor.

s. No maintenance work shall be carried out on live equipment

t. Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public

u. The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

v. Wiring and Branch Circuits Must be protected by a proper amperage over-current device such as a HRC fuse or circuit breaker. Such installations must be located so as to prevent physical damage to the wire conductors & panels.

w. The sub-contractor shall supply modern power distribution board of different combination (1-phase & 3-phase). All the distribution of power should be through modern PDB. Equipment drawing is mentioned below.

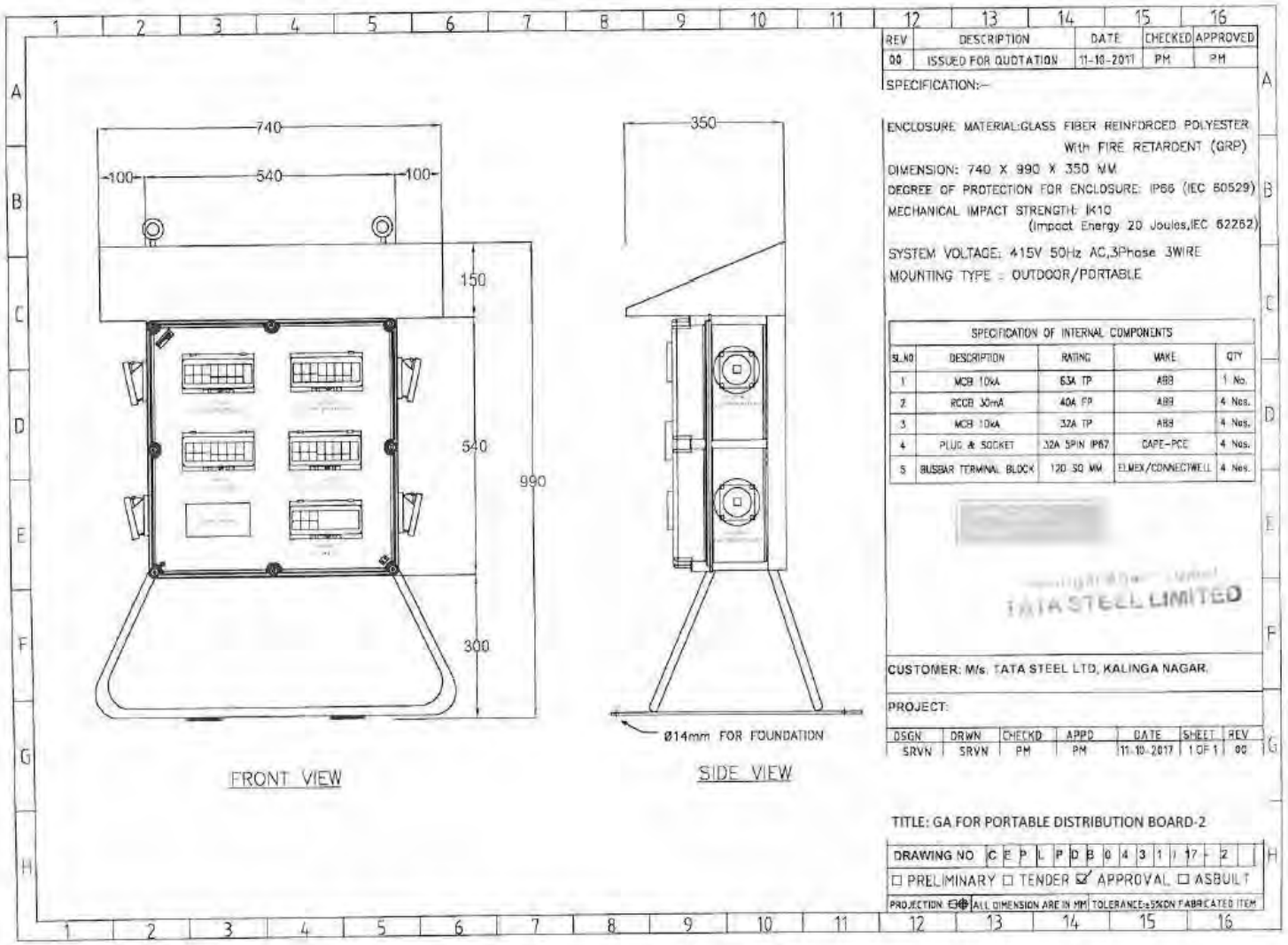


Fig. 9.1 Layout of a modern Power Distribution Board

x. General Electrical Safety

i. In general, equipment or machinery being moved or transported must maintain minimum clearances of 25 ft. to all power lines.

ii. TAG IN/ TAG OUT must be in force in Switch Room and all Distribution Boxes for live power line. The authorized person's name and contact no shall be displayed

iii. Ensure "double insulated" three - core cables and three pin connectors are used and are properly ground "all insulated" types, all electrical tools and appliances must be manufactured for industrial use.

iv. All connections shall be electrically and mechanically sound and properly insulated. Taped joints are not permitted. Connections to socket outlets must be made with proper plugs (industrial top and socket).

v. Splices in electrical cords are not permitted. Repairs must be made at the socket connection and retain the same mechanical and dielectric condition of the original connection.

vi. Damaged or defective electric tools, equipment and extension cords, etc. must not be used and shall be tagged out of service, removed from the work area and taken back to stores.

vii. Only licensed electricians are authorized to repair and work on electrical equipment. Tampering with electric tools or equipment by others could result in termination.

viii. Temporary electric cabling should be elevated 2.2 meters above the floor/ground or covered for protection. It must be kept clear of walkways and other locations where it may be exposed to damage or create a tripping hazard.

ix. Energized wiring in junction boxes, circuit breaker panels and similar places must be covered and locked at all times.

x. Areas with live high voltage wires or terminals must be barricaded against entry and warning signs posted Danger – High Voltage and Authorized Personnel Only.

xi. Personnel should never work on energized equipment, de-energizing (lockout/tag out) the equipment is always the first requirement.

xii. The lockout and tag out procedure will be used when testing or working on, or around, energized installation.

xiii. Working around energized equipment should never be done alone. A second electrician must always be available for assistance.

xiv. If lockout/tag out of the work is infeasible (must be demonstrated), work on energized electrical circuits must be approved by the Site In-charge. All safety precautions necessary must be taken, PPE use must be evaluated per the exposure and used, i.e high/low voltage gloves, insulated shoes, overcoats/aprons, face shields, and other protective equipment like insulated tools, blankets, mats, etc. must be used.

xv. The welding machines earth leads shall be properly fixed without loose contacts. The earth cable only has to be used. No steel members shall be used as earth leads.

xvi. Electrical crews must be qualified for the equipment and tools they work on, including being trained in Cardio-Pulmonary Resuscitation (CPR) methods and First Aid for rendering help in the event of electric shock.

y. Qualified Persons for Electrical Works

(One who is trained and wiremen licensed to Govt. of Respective State and familiar with the construction, operation and safety hazards of the equipment upon which they are permitted to work.)

i. Qualified persons are intended to be only those who are well acquainted/experienced with and thoroughly conversant in the electric equipment and electrical hazards involved with work being performed.

ii. Only qualified persons may be permitted to work on or near exposed energized parts. Such persons are required to have been trained in three specific areas:

iii. Qualified persons must be capable of working safely on energized circuits;

iv. Must be familiar with the proper use of special precautionary techniques and procedures bases on equipment and exposure; and

v. Must be familiar with required personal protective equipment, insulating and shielding materials, and insulated tools.

vi. Qualified persons are expected to be able to evaluate unknown situations and adjust their activities in such a way that only safe work practices are used. Such behavior is the responsibility of the qualified person.

vii. It is possible and likely for an individual to be 'qualified' with regard to certain equipment in the work place, and unqualified on other equipment they must know their limitation and stop work if not qualified on what equipment they were to work on.

viii. An employee who is undergoing on-the-job training, who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training, and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties. The process must be documented as proof.

z. Mandatory PPEs of electrical work on LV & HV

i. HV arc flash suit with protective hood (for protection of face and head) as specified for hazard risk category-4 in NFPA-70E or similar IS specification for working on HT switch gear (for all voltage >690 V) to the concerned licensed electrician or competent person.

ii. LV arc flash jacket/FR as specified for hazard risk category-4 in NFPA-70E or similar IS specification having ATPV rating of 8.5 to 9 cal/cm2 for working on LV (>260V and <=690V) to the concerned licensed electrician or competent person.



iii. The LV arc flash jacket as shown above shall be worn continuously while working on LV (>260V and <=690V). The color specification of LV arc flash jacket should be blue.

iv. Electrical hand gloves should have following specification: Flame resistance, arc flash and cut protection of voltage rating (>260V and <=690V).

v. Electrical safety over shoe of relevant IS make for foot protection of licensed electrician or competent person while working in HV & LV line or equipment.

9. USE OF HAND TOOLS AND POWER-OPERATED TOOLS

a. General Provisions

i. All hands and power tools and similar equipment, shall be maintained in safe condition.

ii. When power operated tools are designed to accommodate guards, they shall be equipped

iii. with such guards, when in use;

iv. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;

v. Personnel using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards;

vi. All hand-held powered platen sanders, grinders, grinders with wheels of 5 cm or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws and jigsaws with blade shanks of 0.5 cm wide or less shall be equipped with only a positive on-off control.

vii. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical or angle grinders with wheels greater than 5 cm in diameter, disc sanders, belt sanders, reciprocating saws, saber saws and other operating powered tools shall be equipped with a momentary contact on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

b. Hand Tools

i. The subcontractor shall not issue or permit the use of unsafe hand tools;

ii. Wrenches including adjustable pipe end and socket wrenches shall not be used when saws are sprung to the point that slippage occurs;

iii. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads;

iv. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.

c. Power Operated Tools

i. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;

ii. The use of electric cords for hoisting or lowering loads shall not be permitted;

iii. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming incidentally disconnected;

iv. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being incidentally expelled;

v. All pneumatically riveting machine staplers and other similar equipment provided with automatic fastener feed, which operate at more than 7 kg/cm2 pressure at the tool a safety device on the muzzle to prevent the tool from ejecting the fasteners unless the muzzle is in contact with the work surface;

vi. Compressed air shall not be used for cleaning purposes except when the pressure is reduced to less than 2 kg/cm2 and that too with effective chip guarding. The 2 kg/cm2 pressure requirement does not apply to concrete form, mill scale and similar cleaning purposes;

vii. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;

viii. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;

ix. The tool shall be tested each day before loading to see that the safety devices are in proper working condition. The method of testing shall be accordance with the manufacturer's recommended procedure;

x. Any tool found not in proper working order, or that which develops a defect during use, shall be immediately removed from service and not used until properly repaired;

xi. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any other person. Hands shall be kept clear of the open barrel end;

xii. Loaded tools shall not be left unattended;

xiii. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tiles, surface hardened steel, glass block, live rock, face brick or hollow tiles;

xiv. Driving into materials that can be easily penetrated shall be avoided unless backed by a
xv. substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;
xvi. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;
xvii. Only non-sparking tools shall be used in an explosive or flammable atmosphere;
xviii. All tools shall be used with the correct shield, guard or attachment as recommended by the manufacturer.

d. Abrasive Wheels and Tools

i. All grinding wheel must be ISO certified only.
ii. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;
iii. Grinding machines shall be equipped with suitable safety guards;
iv. The maximum angular exposure of the grinding wheel periphery and sides shall not be more than 900, except that when the work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 1200. In either case, the exposure shall begin not more than 8.650 above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the bursting of the wheel;
v. Floor and bench-mounted grinders shall be work-rests, which shall be rigidly supported and readily adjustable. Such work-rests shall be kept at a distance not to exceed 5 mm from the surface of the wheel;
vi. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;
vii. When safety guards are required, they shall be mounted as to maintain proper alignment with the wheel and the guard and the guard and its fastening shall be adequate strength to retain the fragments of the wheel in case of incidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 1800;
viii. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;
ix. When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of incidental breakage, shall be used;
x. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects;
xi. Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place;
xii. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

e. Wood Working Tools

i. All fixed power-driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the off-position;
ii. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is re-tensioned for a different speed,

the marking shall be corrected to show the new speed;

iii. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points;

iv. All portable power-driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

10. START UP, COMMISSIONING AND TESTING:

There are various activities involved prior to commissioning- the major ones are -Hydraulic Test, Steam Blowing, Transformers Charging, Boiler Light Up, Rolling and Synchronisation and Full loading of unit.

a. These activities shall be personally supervised by the site executive along with the commissioning engineer.
b. Appropriate Work Permits shall be taken as applicable
c. The readiness of upstream and downstream system shall be ensured before taking up.
d. These shall be handled strictly by the authorized persons only and the team shall be suitably briefed about the activity including hazards & risks involved and control plan by the concerned executive-in-charge before start.
e. Entry of persons to the area of activity shall be suitably restricted and the emergency functions like Ambulance, first aid center and Fire station shall be intimated about the plan well in advance.
f. Tag-in/ Tag-out shall be in place while charging transformer and whenever necessary.
g. Electricians with valid wiremen license only shall be permitted to work on power lines.
h. The area and the passage shall be adequately illuminated.

11. FIRE SAFETY

a. The Fire Prevention, Protection and Preparedness Program is an integral part of the overall HSE Program. Effort and consideration must be given to safety, life and potential for delays in construction schedules and plant startup, as well as protection of property on a given project. The purpose of which is to prevent
    i. Inception of fire
    ii. Loss of life or personal injury
    iii. Loss of Property
    iv. Interruption of operations
b. Site-in-charge / Safety Officer will make periodical review of the site Fire Protection, Prevention Preparedness Programme, Site conditions and available fire protection equipment. It is very imperative that the Sub-contractors along with BHEL to establish good contact with Local fire station for availability of Fire tender in case of emergencies, in additional to their own fire equipment.
c. Fire Protection, Prevention and Preparedness Inspections - The Contractor /Sub-Contractor will be required to make frequent fire prevention inspections of his work site and operating facilities.
   Deficiencies will be corrected at once.
d. Area where Hot work activities are carried out (Gas cutting / Welding/ any other spark producing work)

above a working spot, a GI / fire-resistant non-asbestos sheet or suitable material shall be placed to prevent the fall of hot sparks. A bucket of water shall be kept nearby while doing hot work

e. Hot work shall be preferably carried out in a designated area with a standing Hot Work Permit, to be renewed monthly. The designated area shall have fire extinguishers.

f. Any hot work outside designated area shall require a Hot Work permit and fire watch. No flammable material shall be stored within 35 feet from any fire load.

12. PAINTING:

a. Requirements provide a detailed procedure to be implemented by all concerned employees and sub-contractors involved in painting activities.

b. Significant Environmental Hazards:
   i. Chemical hazard due to inhalation of lead fumes (lead containing paint)
   ii. Chemical hazard due to inhalation of VOC's from paining operations
   iii. VOC's from painting and coating operation
   iv. Disposal of paints and coats drums

c. Control Procedure for Paining:
   i. Chemical products used in painting and coating operation shall have proper MSDS sheet in place. Whenever any doubt arises with respect to handling and safety point of view it should be accessed to all concerned.
   ii. Toxic substances and hazards relate the toxic chemicals shall be identified.
   iii. Proper PPE shall be used including plastic gloves appropriate overall etc.,
   iv. Arrangement for cleaning of spillage shall be ensured

d. Only trained workers shall be allowed and proper training should be imparted to the works.

e. Exposure limits of the toxic substances shall be checked before starting the work and nobody shall be allowed to carry the work beyond the permissible limit.

f. Ventilation or exhaust facility shall be provided at place where painting and coating operations are carried out.

g. Overalls shall be supplied by the contractors/subcontractors to the workmen and adequate facilities shall be provided to enable the painters to wash at the cessation of work.

h. Smoking, open flames or sources of ignition shall not be allowed in places where paints and other flammable substances are stored.

i. A caution board in national /regional language "**smoking strictly prohibited**" shall be displayed in the vicinity.

j. Suitable fire extinguishers/sand buckets shall be kept available at places where flammable paints are stored, handled or used.

k. In case of indoor painting or painting in confined spaces, exhaust ventilating shall be provided. If adequate ventilation is not provided a proper respirator shall be provided and used by persons who are trained and fit tested.

l. The VOC's from painting and coating operations shall not exceed the permissible level of CPCB/ SPCB norms. The paints and coats must be selected as per the guidelines.

m. Workers shall thoroughly wash their hands and feet before leaving the work.

13. "HAZARDOUS ENERGY" CONTROL PROCEDURE/ LOCKOUT/TAGOUT (LOTO)

Hazardous Energy Control Procedures, known as "Lockout/Tagout (LOTO)" refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

Contractors must develop and submit a written LOTO program This requires that a designated qualified individual turns off and disconnects the machinery or equipment from its energy source(s) before performing service or maintenance and that the authorized employee(s) either lock and tag the energy- isolating device(s) to prevent the release of hazardous energy and test the machine or equipment to verify that the energy has been isolated effectively.

a. Minimum Requirements:

The following are minimum requirements that must be included in the Contractor's LOTO program:

i. Inspection of equipment by a trained individual who is thoroughly familiar with the equipment operation and associated hazards.
ii. Identification and labeling of lockout devices. Purchase of locks, tags, and blocks Development of a standard written operating procedure, permitted through a controlling authority that is followed by all workers.

b. General Requirements

The following steps must be taken to protect workers that install or service equipment and systems:

Follow the hazardous energy procedures and statutory regulations. Follow the manufacturer's service/repair instructions. Identify and label all sources of hazardous energy. Before beginning work, accomplish the following:

i. De-energize all sources of hazardous energy:
ii. Disconnect or shut down engines or motors.
iii. De-energize electrical circuits.
iv. Block fluid (gas or liquid) flow in hydraulic or pneumatic systems.
v. Block or secure machine parts against motion.
vi. Block or dissipate stored energy.
vii. Discharge capacitors.
viii. Release or block springs that are under compression or tension.
ix. Vent fluids from pressure vessels, tanks, or accumulators—but never vent toxic, flammable, or explosive substances directly into the atmosphere

c. Lockout and tag out all forms of hazardous energy including electrical breaker panels, control valves, etc. Make sure that only one key exists for each of your assigned locks and that access to the key is controlled. Verify by test and/or observation that all energy sources are de- energized.

d. After completion of the work, accomplish the following:

i. Inspect repair work before removing the lock and activating the equipment.
ii. Make sure that only the worker that installed the lock removes his/her assigned lock.
iii. Make sure that all workers are clear of danger points before re-energizing the system.

e. LOTO Procedure

PURPOSE AND SUMMARY

This procedure provides the requirements and responsibilities of Hazardous Energy Control and the process for Lockout / Tag out (LOTO) of energy isolating devices (valves, circuit breakers, disconnect, etc.). Its use

shall ensure that machinery, equipment, or systems are isolated from all potentially hazardous energy to prevent unexpected energization, startup, or release of stored energy which may cause personnel injury or property damage.

This procedure applies to all BHEL personnel and subcontractors working on the WBPDCL (1X660MW) STAGE-III projects where equipment must be taken out of service for the performance of work activities such as installation, maintenance, repair, construction, or equipment removal. The procedure may also be used to isolate equipment of which the energization or operation may present danger to personnel or property.

Lockout / tag out are not required for electrical equipment that can be unplugged from the source and the person performing the work has control of the plug.

This procedure shall be applied to prevent injury or damage caused by the unexpected release of active or stored energy. Hazardous energy sources could be in the form of the following:

- Electrical
- Hydraulic
- Chemical
- Thermal
- Mechanical
- Pneumatic

Preplanning of work activities includes the identification of all potential hazardous energy sources so that they may be properly controlled and isolated, locked, and tagged out.

Prior to initiating work activities on or around locked out / tagged out equipment, the equipment must be tested and tried by or in the presence of the person(s) performing the work activities.

RESPONSIBILITIES

- The Engineers in Charge is responsible for implementing and enforcing this procedure and approving lockouts /tag outs that impact the operation of the project.
- The Engineer in Charges responsible for authorizing Lockout /Tag out Requests.
- The Lockout / Tag out Coordinator is responsible for maintaining the Lockout / Tag out Log. Each shift should have a designated Lockout / Tag out Coordinator.
- The Isolator is responsible for determining the proper isolation devices and device positions required to isolate all potential energy sources so that the work stated on the Lockout /Tag out Request Permit may be safely performed. The Isolator must be familiar with the equipment and energy type(s) that require isolation. For this reason, in some cases the Isolator may be more than one person (i.e. Engineer, System Operator and/or Electrician). The Isolator shall position the specified device points, and apply locks and tags, and sign the tags and the LOTO Permit isolation point blocks.
- The Safety Manager is responsible for conducting an annual audit that is documented to ensure all procedures and requirements are current and being followed as written.

DEFINITIONS

Affected Employee: -

An employee whose job requires him/her to operate or use machinery or equipment on which servicing or maintenance is being performed under a lock out/tag out procedure or whose job requires him/her to work in an area in which servicing or maintenance is being performed under a lockout/tag out procedure

Authorized Employee: -

An employee who implements a lockout/tag out procedure on machinery, equipment, or systems in order that servicing or maintenance may be performed. Often an authorized employee and an affected employee may be the same person.

Danger "Do Not Operate" Tag

A tag used to identify energy isolation devices and specify the required position of the device. The tag should be affixed to the isolation device such that it is in plain view of anyone attempting to operate the device. The tags shall be sequentially numbered and shall specify the lockout/ tag out request number. The tag shall also state the purpose, and the expected duration of the lockout /tag out

Isolation Device

A device that is designed and intended to prevent the passage of energy. These devices, usually located at the energy source, are typically valves, circuit breakers, etc. Isolation devices should have a means of being locked in position

Lockout Device

A device that uses a positive physical means such as a lock, either key or combination type to maintain an energy isolation device in the safe position and prevent the in advertent energization of machinery, equipment, or systems. Device locks should serve no other purpose other than hazardous energy control isolation

Lockout Tag out Request Permit

A pre-numbered form used to request that machinery, equipment or systems be taken out of service. A Lockout/Tagout Request Permit may be initiated by any one requiring energy isolation for work activities or for taking faulty equipment out of service

Lockout / Tag out Request Log

A record of all Lockout /Tag out Request Permits shall be maintained by the Lockout /Tag out Coordinator.

PROCEDURE

1. REQUESTING A LOCKOUT / TAGOUT PERMIT

When machinery, equipment, or systems are partially or completely taken out of service for work activities or equipment protection, a lockout / tag out shall be requested. The requestor shall be familiar with scope of work required and shall provide a brief description of the work on the Lockout / Tag out Request Permit. The requestor shall also provide the proposed start time and estimated duration of lockout / tag out. If familiar with the machinery, equipment, or system to be taken out of service, the requestor may identify the devices that are required to be isolated. The LOTO Request Permit shall be forwarded to the Authorized Lockout / Tag out Coordinator for reviewed and signature, along with Permit to Work number to be entered on the LOTO Request Permit.

a. The Lockout / Tag out Coordinator shall record the necessary information on the Lockout / Tag out Request Log and forward the request to the Engineer in Charge for approval.
b. The Safety Manager or Engineer in Charge shall review the Lockout / Tagout Request Permit for impact on project operations. Project operations could be impacted by the equipment being taken out of service or by the required isolation to take the equipment out of service. If project operations are impacted by the Lockout / Tagout, the request shall be forwarded to the Engineer in Charge for approval.
c. The Engineer in Charge shall provide the lockout / tag out isolation points necessary to perform the task stated on the request. The device identification, device location, device position, and locking mechanism

shall be entered into the appropriate blocks on the Lockout / Tag out Request Permit.

d. The Engineer in Charge indicates approval of the Lockout / Tagout Request Permit by signing in the appropriate space on the request. If the Lockout /Tag out Request Permit is rejected, the Engineer in Charge shall return it to the requestor, via the Lockout / Tagout Coordinator with a written explanation of the rejection.
e. Once approved, the Lockout / Tag out Request Permit shall be forwarded to the Lockout / Tag out Coordinator to assign tags and locks.
f. The log shall show current status of all Lockout / Tag out Request Permits from submittal to approval, through lifting of locks and tags to final closeout. The log shall be maintained by the Lockout / Tag out Coordinator in their office.

2. PLACEMENT OF LOCKS AND TAGS

a. The tags shall be filled out to match the information on the LOTO Request Permit. Appropriate locks for the types of isolation devices specified shall be collected and placed with the tags and the Lockout / Tag out Request Permit.
b. The isolator(s) shall take the device locks, tags, and the Lockout / Tagout Request Permit to position the specified isolation devices, sign and hang the tags, and place the locks. If the isolator does not agree with or understand the Lockout / Tagout Request Permit, or has a problem performing the isolation, the problem should be brought to the attention of the Safety Representative or Area Supervisor immediately and the lockout / tag out should be postponed until the situation is resolved.
c. Once the Isolator has placed all “locks” on isolation points, they will “test ”and “try” the machinery, equipment, or system to ensure all hazardous energy has been completely removed and the isolation is one totally accomplished, and has initialed and signed the Lockout /Tag out Request Permit indicating all isolation points have been confirmed. Examples of “lock”, “test” and “try”:
    - by checking that all locks on the LOTO Request Permit have been applied and are in the specified position open/closed, on/off, etc.; metering test of electrical circuits, opening of drain valves, checking pressure gauges or indicators; and try by pushing start buttons and on/off switches, etc.
    - Testing shall be performed by person(s) knowledgeable of the energy source(s) being isolated (e.g., an electrician should meter electrical circuits).
d. A copy of the completed Lockout /Tag out Request Permit shall remain with the Work Package and used as part of the daily Pre-Job Briefings

3. WORKING UNDER A LOCKOUT / TAGOUT REQUEST

a. Prior to starting the work activity, the person(s) performing the work shall review the Lockout / Tag out Request Permit and place the necessary tags and personal locks on the identified isolation devices. Personal locks may be placed only on devices that have already been locked and tagged in accordance with the Lockout / Tag out Request Permit.
- All personal locks shall be accompanied by a tag that is signed and dated by the worker(s) and specifies the work activity being performed.
- Personal locks should be of a different color than device locks for ready identification.

b. Verification of the effectiveness of the isolation by the Isolator shall be performed for Worker’s working under the lockout / tag out, by demonstrating the checks on “lock”, “test” and “try”,
c. When the work activity is finished, personal locks and tags shall be removed and the Safety Representative

shall be notified that the Lockout / Tagout is no longer required. If work under a lockout / tag out is to be delayed or interrupted for a period in excess of 24 hours, personal locks shall be removed until the work restarts. Personal locks shall be removed prior to the worker(s) leaving the project at the end of shift unless the key(s) are maintained at the project.

4. REMOVAL OF LOCKS AND TAGS

a. When the lockout / tag out is no longer required, the Safety Representative or Area Supervisor shall obtain the Lockout / Tagout Request Permit from the work package for LOTO removal. Prior to removing locks or tags that may allow equipment to be energized, a check shall be made to verify that the equipment is free to safely operate (i.e., will not cause damage or injury). The locks and tags shall be removed and returned to the Lockout / Tagout Coordinator. Isolation devices may be repositioned at the discretion of the Engineer in Charge according to operational requirements. The Isolator shall complete the Lockout / Tagout Request Permit indicating each lock and tag has been removed and the Safety Representative or Area Supervisor forward to the Lockout / Tagout Coordinator.

b. The Lockout / Tagout Coordinator shall discard the tags and maintain the completed Lockout / Tagout Request Permit for future reference.

c. In the event that an employee leaves the job site without removing the personal lock I tag, the following measures shall be taken and documented. The measures listed below are a minimum set of guidelines and under all circumstances, refer to the site-specific safe work plan for detailed procedures:

- Attempt calling / contacting the employee to return to the site for removal.
- In the event an employee cannot be contacted, the Site Manager and Safety Manager shall sign an Emergency Lockout/Tagout Removal Form, which has been completed by the Area Supervisor.
- Employee shall be notified upon returning to the site, prior to beginning any work.

5. INTERRUPTION OF A LOCKOUT / TAGOUT

Operational Emergency

The Engineer in Charge / Safety Manager /Area Supervisor may deem it necessary to temporarily remove the locks and tags from isolation devices, prior to the end of the work activity. The standard procedure for removal of locks and tags shall be followed. Extreme caution shall be taken by the Isolator removing the locks and tags to prevent personnel injury.

Testing

When the performance of a work activity requires the functional testing of a machine, component, or system, the locks and tags may be temporarily removed in accordance with the tag removal, to perform the test. As a result of the testing, if it is determined that the equipment needs further work, the locks and tags shall be positioned back on to the device. If it is not necessary to replace all the locks and tags, then the unnecessary locks and tags may be returned to the Lockout / Tagout Coordinator. The Engineer in Charge shall initial the Lockout / Tag out Request Permit in the removal block to indicate that these locks and tags have been removed. When testing has been satisfactorily completed, the locks and tags shall be removed.

ISOLATION DEVICES

- In most industrial applications, there are isolation devices that were not designed to accommodate a locking device. In these instances, an acceptable alternative that physically obstructs or prevents the use of the isolation device shall be found. Chains shall be placed on valves or electrical panels. Wires shall be determinate, pulled back, taped, and secured.

- If an isolation device does not accept a lock, a tag only is acceptable; however, all possible precautions shall be undertaken to provide a level of safety for the workers. The tag shall be readily visible to anyone attempting to operate the device.
- If more than one Lockout / Tagout Request Permit requires that a single isolation device be locked and tagged, a lock and tag for each request shall be placed. Each lock in itself prevents the inadvertent operation of the device.

GROUP / COMPLEX LOCKOUT

In a multiple lockout / tag out procedure, each person working on the machinery or equipment must place a lock or tag on the energy isolating device. If the energy isolating device will not accept multiple locks or tags, a hasp (a multiple lockout device, may be used. The locks or tags must be placed in such a way that energy cannot be restored to the machinery or equipment until every lock or tag is removed. As each employee involved no longer needs to maintain lockout / tag out protection that employee removes his - her lock and/or tag. The employee attaching the lock or tag is the only person authorized to remove the lock or tag.

6. TRAINING

The training must include recognition of hazardous energy source, type and magnitude of energy available, methods and means necessary for energy isolation and control. Each authorized employee shall receive adequate training. The training should address that all affected employees are instructed in the purpose and use of the energy control procedure. There should be training provisions included for any other employee whose work operations are or may be in an area where energy control procedures may be utilized. The employee training should also address when tag out systems are used including the limitations of a tag (tags are warning devices and do not provide physical restraint). The training should also include that a tag is not to be removed without authorization. The tag is never to be ignored or defeated in any way. Retraining is required when there is a change in job assignments, in machines, a change in the energy control procedures, or a new hazard is introduced. All training and I or retraining must be documented with employee's name and dates of training.

7. PROGRAM REVIEW

The lockout / tag out program must be reviewed at least annually. The review must ensure that procedures are being followed and that they are effective. A documented review of the inspection must include the date, the equipment, employees involved & the inspector. The inspector must be someone other than those actually using the lockout / tag out in progress.

ATTACHMENTS

#1. Danger (DO NOT OPERATE) Tags

#2. Device & Personal Locks and Multi Lock Hasp:

#3. Lockout / Tagout Request Permit

BHEL	**LOCKOUT / TAGOUT REQUEST PERMIT**		LOTO Request Permit No.:
			Work Permit No.:
Equip. Out of Service:	LOTO Date Required by: _____/_____/_____	Estimated Duration:	**LOTO Requested** Date:
Scope of Work:			**LOTO Authorization** Signed by:
			Date:
			LOTO Removal Authorization Signed by:
			Date: Time:

Tag No.	Device to be Tagged / Locked I.D. No.	Device Location	Device Position *OPEN / CLOSED*	Lock No.	Tag/Lock Placed by Print/Sign - Date/Time		Tag /Lock Removed by Print/Sign - Date/Time	

Comments Instructions: **Attachment 3.Lockout / Tag out Request Permit:**

#4. Lockout / Tag out Request Log

LOTO Permit No.	Requestor Name	Equipment & Location	Est. Work Completed Date	Approval Date	LOTO Placed Date	LOTO Removed Date	Comments

14. RISK ASSESSMENT

Risk and Hazard Analysis

In order to produce an overall Project EHS Plan, a project must be assessed for its risks. There are two components to the risk and hazard analysis. The procedure used to examine and plan for the identified risks and hazards is called a General Hazard and Risk Assessment.

JSA/HIRA review

Prior to commence the following activities Method statement and JSA/HIRA to be prepared by the concern engineer in coordination with EHS officer and submit to the client for review and approval. After getting approval the work will be started under PTW after clearance. For HIRA and criteria for the defining the high, medium & low risk the relevant annexure be referred. In case any deviations required in the approved method statement the concerned engineer/supervisor has to prepare additional HIRA/JSA to cover the new activities and associated risk. Following activities to be covered,

- Deep excavation (more than 5 feet)
- Significant concrete pouring (like heavy foundation, TG deck, Slab casting etc.)
- Confined entry
- Blasting
- Working on electrical/ energized equipment's
- Steel erection more than 5-Ton weight
- Working at height prior to completion of stairs/ladders/hand railing etc.

Definition:

HAZARD - Any potential or present danger to persons or property within the project site, e.g., oil on the floor is a hazard.

INCIDENT - An unintended happening that may result in injury, loss or damage, e.g., Slipping on the oil is an Incident.

INJURY – Physical harm, the result of an Incident, e.g., a sprained wrist from the fall would be an injury.

Hazard Analysis Document

- For high risk and dangerous work identified, the Applicant shall complete and submit a Hazard Analysis Document together with the PTW request. It will be a JSA (Job Safety Analysis) or Preliminary Hazard Analysis Checklist. And it shall be reviewed and approved by respective Construction and HSE Representatives.
- Issues such as work interface, coordination, drawings, toolbox meetings and work type/duration shall be detailed and included with supporting documentation for the Applicant's request for PTW.
- If applicable, Hazard Analysis Document shall be used as the foundation for development of Safe Work Method Statement. Each hazard identified shall be addressed in the Safe Work Method Statement and be submitted as part of the Applicant's submittal package.

Evaluation of Sub-contractor Risk Assessments includes

- Experience and expertise in performing similar type work.
- Duration of work performed
- Location of the work to be performed.

- Nature of the work to be performed.
- Potential for a subcontractor performing the work to expose themselves, other persons or employees, to hazards.
- Potential for exposure to work site hazards.

Review of Subcontractor specific issues

Preventive and protective measures must be introduced according to the following order of priority

- Eliminating the hazard by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc.
- Controlling the hazard at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc.
- Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.
- Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.

15. HSE PREPAREDNESS FOR ADVERSE CLIMATES AND WEATHER

All Preventive and Precautionary measures to ensure Health & Safety of workers in all possible adverse weather conditions based on the analysis of the local area conditions to be taken by the subcontractor

15.1 SUMMER

1. The Working Time and Lunch Hour will be as per instruction of Statutory Authorities (no work between 11am to 3:30pm). However, in case temp comes down due to rain/cloudy weather work will continue as per normal routine.
2. During long lunch break, worker will be allowed to go back home for rest. Those who will like to stay back will avail at the facility of rest shed or other designed area.
3. They will be allowed to take small break during work as per their need.
4. Water sprinkling will be done on roads to reduce dust concentration.
5. Workers will be provided with adequate cool drinking water and Butter milk/Lemon water etc.
6. Adequate ORS stock will be made available at the work location in the First-Aid Box for use as needed and at First-aid Centre for emergency need.
7. Fire prevention shall be on high alert, with removal of dry grass and bushes, etc, inside and outside the surrounding work areas. No smoking, and control of open flame/sparks shall be maintained and monitored.
8. Worker will be informed about the Do's and Don'ts to be followed during summer in the Pre Job Brief.

Dos & Don'ts

1. Drink plenty of cool water and other non-alcoholic fluid and keep body well hydrated.
2. Eat salt in food to replenish loss of salt through sweating.
3. Avoid over physical exercise.
4. Have adequate sleep at night.
5. Eat light and less spicy food
6. Avoid eating food which was cooked long time ago.

7. Nobody should use small water bodies such as pits, running rain water through crevices etc. for drinking and cleaning purpose as it may be unhygienic.

Emergency Handling

In case of emergency due to heat disorder:

1. Rescue the victim from workplace and place under shed.
2. If to be rescued from height, use stoke basket or rescue kit.
3. Inform Ambulance immediately.
4. If nearby any air conditioned room/shed is available, place him inside the room/shed.
5. Administer First aid by trained First aider for Heat Disorder
6. If conscious, give him ORS solution to drink.
7. If required send the victim hospital immediately.

15.2 MONSOON

A. Height Work & Structural Safety:

1. Ensure that all height work platforms are barricaded and avoid any highly hazardous
2. Height work.
3. Ensure that all personnel have good quality and intact safety shoes
4. Stop all dangerous height work during rain
5. Explain Do's and Don'ts to workers during Tool Box Meetings
6. Ensure that there are no weak structures, boards etc. that can fall during high winds
7. Do not allow any loose material (e.g. GI sheet, Ply board, empty cement bag, aluminium foil, foam sheets etc.) on roof sheds or top of structures.
8. Do not permit any one to ride up or come down scaffolds frame work during heavy wind or rain.
9. Provide "anchor" of adequate strength to scaffolds and other high-rise structures.
10. All rest sheds and GI sheds will be anchored into the round and wall and roof panels will be secured with J hook to prevent shed from blowing over or parts/pieces becoming airborne. Proper earthing per IS standard is also to be installed.
11. Do not go alone nor permit anyone to stay at tower-tops, roof-tops, high structures or on electrical poles during the course of stormy weather or heavy rain.

B. Electrical:

1. All electrical connections / loads have to be routed through ELCB / RCCB (residual current circuit breaker) whose rating should be 30mA.
2. RCCB operational checks need to be done DAILY / WEEKLY during monsoon season.
3. Avoid joints on power cables which need to be laid over-head or under-ground, better not to have any joint at all. In case joints become essential, such cables must be housed rigidly and insulation must be provided as per approved standard. The joint shall be suitable for outdoor use.
4. All electrical distribution board shall be properly covered at top and sides to protect from rain water. Extension boards shall be protected from rain water.
5. Ensure proper "earthing" for each and every electrical appliance.
6. Double earthing need to be provided for 3-phase power supply and for voltage more than 220V.

7. Provide lightening arrestors at the top of Boiler 3 and boiler 4 and rest sheds which are not covered by existing lightening arrestor of other installation.

C. Others:

1. Maintain smooth flow on open drains. i.e. no obstruction or blockade shall be made on storm water drains. If required, make temporary drains.
2. Arrange back-filling of excavated pits on war-footing basis.
3. Arrange bringing down booms of all cranes, hydra machines during stormy weather (wind speed 40-50 km/hr)
4. Confirm that all gantry cranes are effectively choked to prevent rolling and toppling.
5. Do not forget to deep ready a dew battery operated lights at site-offices during rainy season.
6. Avoid using wet damp clothes.
7. Hard Barricade excavated zone filled with water with scaffolding pipe & clamp with reflective net
8. Engage diesel operated water pump to dewater work area. For electrically operated water pump, the starter shall be protected from rain water. All rotating parts shall be guarded. Ensure availability of sufficient water pumps.

D. Health and hygiene:

1. Monsoon reduces the immunity of our body and makes us vulnerable to many diseases which are commonly associated with this season. It is time for us to keep our body challenging against disease by boosting our immunity and taking safety measures against these diseases.
2. The diseases associated with monsoon are Malaria, Jaundice, Gastro-intestinal infections, like typhoid, cholera etc. apart from these viral infections like cold and cough also make their presence felt. Majority of above said diseases are on account of:
3. Puddle of water formed due to rain become breeding grounds for mosquitoes which spread disease like, malaria and dengue fever. As a precautionary measure against mosquito-bite disease one can use mosquito net around the end which is better choice to mosquito repellents like mats and coils.
4. Pollution of drinking water during monsoon is very common. It is very necessary to drink clean and pure water when water-borne monsoon diseases like diarrhoea and gastro-intestinal infections threaten us.
5. Walking in dirty water during rainy season leads of numerous fungal infection which affect toes and nails. Diabetic patients have to take a special care about their feet. Keeping feet always dry and clean is very necessary. Avoid walking in dirty water. Keep shoes socks and raincoats dry and clean.

E. Workmen will be made aware of following Do's and Don'ts:

1. Do not sleep in daytime.
2. Avoid over physical exertion.
3. During lightning and thunder storm, do not take shelter under tree. Take shelter inside rest shed or store room.
4. Wash vegetables with clean water and steam them well to kill germs.
5. Avoid eating un-cooked foods and salads should be washed properly before consumption.
6. Drink plenty of water and keep body well-hydrated.
7. Always keep the surrounding area dry and clean. Don't allow to get water accumulated around.
8. Keep body warm as viruses attack immediately when body temperature goes down.

9. Do not enter air conditioned room with wet hair and damp cloths.
10. Dry your feet and webs with soft dry cloth whenever they are wet.
11. Eat light and less spicy food.
12. Avoid eating food which was cooked long time ago.
13. Eat salt in food to replenish loss of salt through sweating.

15.3 EMERGENCY WEATHER CONDITIONS

Cyclone/Severe thunder storm

In the event of Cyclone/Severe thunder storm, alert will be issued by subcontractor on notification received by Govt. authorities/Metrological departments Customer or BHEL.

The actions required during cyclone/rough weather:

1. Check and advice subcontractors to clean-up work area. Pick up all loose and unused material of respective supervisor's area.
2. Tie to secure all gas cylinders to avoid displacement and unsafe conditions which could be due to wind pressure.
3. Secure portable electricity generating sets and other equipment, pumps, hoses etc.
4. Make preparation for removal of water logging.
5. Take review of work activity and make preparation for removal of equipment and material from vulnerable areas.
6. Isolate/turn off all electrical power form the main panel/switches. Secure and anchor panels properly.
7. Recheck anchorage/tie of all temporary structures/sheds, tall objects, cranes, rigs, scaffolds etc. to avoid toppling due to wind force.
8. Cranes boom shall be secured, either locked or lowered the booms as reasonably and practicably possible and rigs to safe position for the safety point of view.
9. Group up all trash barrels, wooden pallets, forms; wooden decks etc. and anchor properly.
10. Welding machines, air compressors and such equipment are to be grouped together and secured to the stable objects. Welding leads, electrical cables, hoses are to be rolled up and secured properly.
11. Set on site vehicles on high ground in the site area with brakes set firmly.
12. Anchor all tanks, vessels, gas cylinders that may be moved by high wind and water.
13. Evacuate job site.

Personnel Evacuation:

1. Personnel Evacuation will be required if predicted wind speed and storm surge heights are beyond acceptable limits as per the instructions from Govt. Authorities/ Metrological departments or Customer.
2. Once the warning is received for personnel evacuation, an emergency response team shall be formed. The team will work with local authorities and other agencies formed/deployed to evacuate and transport all personnel involved in the project to the cyclone shelter.
3. Cyclone may be followed by the calm "EYE", be aware of it. If the wind suddenly drops, don't assume the cyclone is over. Violent wind may resume from the opposite side direction. Wait for the official "All clear Signal".

4. After the cyclone, do not go outside until officially communicated about safe situation outside. Use recommended routes for returning. Do not panic or rush while returning.
5. Checking of gas leaks and well-being of electrical appliances is essential before leaving the site.
6. Follow local communications for official warning and advice. The construction Manager shall also obtain updates from customer/metrological departments and communicate to the personnel on project site.

15.4 PREVENTION OF COVID-19 (COVID-19 HERE TO BE READ AS COVID-19 AND OTHER PANDEMICS/ COMMUNICABLE DISEASES) AT PROJECT SITE & LABOUR COLONY:

Resumption of Construction Activities after Lock Down and Prevention of Coronavirus Infection during Site Operations and OCP 61A: Prevention of COVID-19 Infection in Labor Colony will be strictly followed.

A. Preventive measures at project site:

- BHEL and Agencies shall nominate COVID Marshalls, who will be responsible for monitoring the COVID prevention measures and apprising management on the same.
- Mandatory health check-up for every worker/ official joining the site
- All activities to be carried out using least amount of paperwork and physical proximity as far as possible.
- ***HSE Observer App*** to be used to monitor HSE Activities and follow up with agencies for closure of non-conformities.

a. Strict Control at the Gate/ Banning Entry to Anyone Not Wearing Masks

i. Security personnel at the gate may erect a barricade preferably approx. 10 meters from the gate and only allow personnel who are wearing proper masks inside.

ii. Public address system may be used to warn any non-compliant visitors

iii. Near entry gate, round markers at minimum 1-meter distance to be ensured so that distancing is ensured

iv. A hand-wash or hand sanitiser facility is preferable at the gate to allow entry after hand wash or hand sanitisation. These are also to be provided at key locations to enable hand wash / hand sanitisation before starting work, before eating, etc.

v. Gutkha, Paan, tobacco etc. to be banned from the site. Spitting to be strictly prohibited.

b. Screening at Gate with Contactless Thermometer & Action on Suspected Cases

i. Security Personnel at the Gate to screen each person entering the premises using a non-contact infrared thermometer, which is duly serial numbered and calibrated.

ii. In case any site worker/ official is found to have fever more than 99 Degrees Fahrenheit or found coughing/ sneezing, he/she may be advised rest till recovery and entry to be permitted after obtaining clearance from medical officer/assistance/attendants.

- Parcel to be collected from gate by concerned person preferably with provision of Special Box
- Any construction material received at site, unless properly sanitized, to be kept undisturbed for at least 3 days and to be used only after that period.
- During Toolbox Talks, minimum 1-meter distance between any two workers to be ensured

c. During site execution activities:

For all site execution activities, social distancing is to be maintained. In case this is not possible due to nature of work, speciality of work, etc, ensure sensitisation of the labour/staff involved and use of appropriate PPEs, especially mandatory face mask. In any case, close working to be allowed only in special

circumstances and ensuring these activities are preferably time staggered to the extent possible

d. In office premises:

i. Sharing of items like pens, water bottles etc. in office premises to be avoided

ii. Doors preferably to be in open condition to avoid contact

iii. All common touch points to be frequently disinfected in a day.

e. Regular disinfection of all Areas, Equipment and facilities

i. A dedicated disinfectant gang to be identified for the task by each agency. The disinfectant gang to be provided full body suits for the task.

ii. All areas (including office premises, site areas, chairs, tables, furniture etc.), tools & equipment to preferably be disinfected by dedicated gang every day before resumption of work.

iv. Common touch points like handrails, lift buttons, door/window knobs or handles, vehicle door handles, taps, conference room & dining hall tables/chairs, common sofas/chairs, visitor sofa/chairs, files & folders, etc to preferably be disinfected regularly at frequent intervals every day.

v. Pool vehicles, to be disinfected after every use. Social distancing to be maintained inside the common pool vehicles as per Govt./ statutory body guidelines.

f. Disinfecting the operator/driver touch points of Vehicles/cranes, T&Ps etc.

Disinfection to also be carried out for all Cranes, Vehicles, Equipment, consoles, T&Ps etc. which come into contact with operating personnel.

g. Posters on COVID-19

Sufficient Posters on COVID-19 to be ensured across the site in languages understood by most workers.

h. Brief guidelines for hand washing are as below:

i. Soap to be provided at each wash basin and replenished regularly.

ii. Washing with soap for at least 20 seconds is recommended.

iii. As a general guideline, for every 100 workers, 1 wash-basin may be provided at site areas.

iv. Close queue to be avoided near wash-basins and 1-meter distance to be maintained. Round markers at 1-meter distance can be ensured as guidance

Composition of Disinfectant:

i. Readily available 1% hypochlorite solution or 4%

ii. Liquid chlorine-1% solution

Iii. Surgical spirit-95% alcohol content

iv. Hand sanitizer should have: Isopropyl alcohol-75%, Gycerol-1.45%, Hydrogen Peroxide-0.125%

B. Prevention of COVID-19 Infection in Labor Colony:

- Spacing of minimum 2 meters between living areas of workers inside a room may be maintained. Preferably, the living area of each worker may be partitioned using sheet of cloth, plastic etc.
- Rooms to be properly ventilated as far as possible
- Sanitation to be given prime importance and personal hygiene to be promoted
- Face masks shall be worn by everyone inside the colony premises
- Spitting of Pan. Gutkha etc. inside the colony and urinating etc. outside the toilets to be strictly avoided
- Regular visits by Doctors to the labor colony can be arranged on non-working day for check-up of all workers
- **Identification of "COVID Wardens" (CWs) by each agency for maintaining the following:**

i. Keeping an eye on the health of workers and report any suspected cases of fever, coughing etc. to the

management

ii. Keeping an eye on the social distancing measures in the labor colony and report any non-conformances to the management.

iii. Educate the workers about social distancing and COVID prevention measures.

- Training/ Awareness regarding COVID-19 to be provided to workers regularly.
- Workers to be instructed to maintain social distancing of minimum 1 m at all time
- **Posters on COVID-19:** Sufficient Posters on COVID-19 to be ensured across the labor colony in languages understood by most workers.
- All workers to be instructed to inform any suspected cases of illness (individual or others) to an emergency contact number of CW, the emergency contact numbers and CW contact numbers to be displayed at prominent locations
- **Inspection & Review**

  i. Daily Inspection by concerned COVID Wardens and reporting to Agency

  ii. Regular inspection by Agency & BHEL

15.5 Noise Mitigation

High noise is harmful to the human health and it can cause impairment if exposed for long duration at regular intervals, and also cause disruption in nearby communities.

- Noise monitoring shall be carried out in all construction locations periodically.
- Use of silent DG is allowed at site during construction.
- Low noise generation equipment's to be preferred.
- Work areas where noise levels exceed the 85db shall be posted as hearing protection required.
- Use of PPEs / ear plug/ear muff for personnel entering into high noise area.
- Activities generation High noise will be planned in day shift.

Noise Level Chart

Parameter	Night Noise level dBA	Daytime Noise Level dBA
At 1-meter from each piece of equipment	85	85
At Property boundary	70	70

ANNEXURE J

First-Aid Box

Details & Contents of First Aid Box as per Contract Labor (Regulation & Abolition Act), Central Rules, 1971

(1) The first-aid box shall be distinctively marked with a Red Cross on a white background and shall contain the following items, namely:

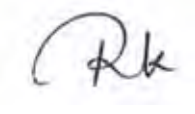
(a) For establishments in which the number of contract labor employed does not exceed fifty, each first aid box shall contain the following equipment:

(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(ix)	Three packets of safety pins.
(x)	Kidney tray.
(xi)	3 large sterilized burn dressings.
(xii)	1 (30ml) bottle containing a two percent alcoholic solution of iodine
(xiii)	1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label
(xiv)	1 snake bite lancet
(xv)	1 (30gms) bottle of potassium permanganate crystals.
(xvi)	1 pair scissors
(xvii)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labor Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labor exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.
(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labor Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.



ANNEXURE K

Vertigo Test

Vertigo Test Procedure/ Guidelines

This document specifies minimum requirements for vertigo test. These may be supplemented by any additional requirements deemed fit by the medical examiner/ HSE department)

Fear of height may be physiological or psychological. Therefore, to rule out any possibility of physiological factor, detailed medical check-up of workers is carried out before vertigo test. Medical check-up of workers includes the following:

history of past illnesses (like epilepsy, drug allergy, diabetics/ hypertension, unconsciousness etc.), general physical examination (like height, weight, BMI, build and nourishment etc.), measurement of pulse rate, Blood Pressure, respiratory rate.

After this check-up, those who are found suitable for height work by examining doctor, are allowed to undergo vertigo test.

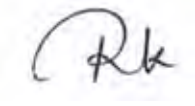
During this health check-up, psychology of workers is also studied. If any worker finds it extremely difficult/ frightening to climb the monkey ladder & walk on the beam, during/after performing vertigo test or even before performing, then he is treated as disqualified.

As per standard, during vertigo test, worker is allowed to climb on a foundation through monkey ladder, walk on a beam, then steps down at the other end of beam, through monkey ladder. Height of the beam should be at least six feet from ground level. All necessary safety precautions are taken during this test. Worker has to wear full body harness with double lanyard. A horizontal lifeline is run parallel to the beam and worker has to put his lanyards into the lifeline. Additionally, a safety net is also put below the beam for rescue of the victim in case of a fall from beam.

Following activities are suggested to be carried out during testing:

1. Walking Bench Training:
   a. Person should walk over the channel. He should maintain balance & walk without much problem.
   b. If the person has problem to balances himself on repeated chances, he may be having flat foot or some other problem. So, he may not be fit for height work.
2. Rope Climb Training:
   Person should be able to climb the rope up to the top channel for ensuring that in case of fall, a person hanging on the safety harness, will be able to safely climb back to the platform within minimum time period before the safety harness start breaking down under the load.
3. Height Work Training:
   Person should walk freely on the middle channel while holding the top channel with the help of safety harness.
4. Ladder for Vertical fall arrestor Training:
   Vertical fall arrestor rope is fixed from top to bottom of the ladder. It will ensure:
   - Usage of vertical fall arrestor.
   - Usage of two lanyards of a safety harness.
   - Ensure 3-point contact on the ladder while climb.
5. Chair for work at height Training:
   - Climb though vertical ladder with two lanyard ropes.
   - Hooking of two lanyard ropes to life line. With this safe arrangement, he can walk to chair.
   - Sits in the chair safely, comes out & walks back to the vertical ladder & come down from vertical ladder. After completion of vertigo test, blood pressure of worker is again measured. If it is not within acceptable limits for any worker, concerned worker is denied height pass.

Only those who pass the above training are to be considered as fit for height work.



SECURITY DEPOSIT OR PEFORMANCE SECURITY: (APPLICABLE)

The successful bidder shall submit Security deposit or performance security of 10 % of the total order value within 14 days of placement of PO. The Security deposit / Bank Guarantee shall be kept valid for a period of 60 (Sixty) days beyond the date of completion of all contractual obligations of the supplier, including Guarantee /warranty obligations as mentioned in Tender.

(A) MODE OF DEPOSIT OF SECURITY DEPOSIT OR PERFORMANCE SECURITY:

Security Deposit may be furnished in the following forms:

(i) Local cheques of Scheduled Banks (subject to realization)/ Pay Order/ Demand Draft/ Electronic Fund Transfer in favour of BHEL.

(ii) Bank Guarantee from Scheduled Banks / Public Financial Institutions as defined in the Companies Act.

(iii) Fixed Deposit Receipt issued by Scheduled Banks / Public Financial Institutions as defined in the Companies Act (FDR should be in the name of the Contractor, a/c BHEL).

(iv) Securities available from Indian Post offices such as National Savings Certificates, Kisan Vikas Patras etc. (held in the name of Contractor furnishing the security and duly endorsed/hypothecated/ pledged, as applicable, in favour of BHEL).

(v) Insurance Surety Bond.

Note:

(i) The Bank Guarantee shall be submitted as per BHEL format only.

(ii) BHEL will not be liable or responsible in any manner for the collection of interest or renewal of the documents or in any other matter connected therewith)

FORFEITURE OF PRFORMANCE SECURITY/SECURITY DEPOSIT:

The security deposit will be forfeited and credited to BHEL's account in the event of a breach of contract by the supplier.

RELEASE OF SECURITY DEPOSIT:

Performance Security should be refunded to the contractor without interest, after he duly performs and completes the contract in all respects but not later than 60(sixty) days of completion of all such obligations including the warranty under the contract.

Treatment of cases regarding conflict of interest:

The bidder notes that a conflict of interest would said to have occurred in the tender process and execution of the resultant contract, in case of any of the following situations:

i) If its personnel have a close personal, financial, or business relationship with any personnel of BHEL who are directly or indirectly related to the procurement or execution process of the contract, which can affect the decision of BHEL directly or indirectly;

ii) The bidder (or his allied firm) provided services for the need assessment/ procurement planning of the Tender process in which it is participating;

iii) Procurement of goods directly from the manufacturers/ suppliers shall be preferred. However, if the OEM/ Principal insists on engaging the services of an agent, such agent shall not be allowed to represent more than one manufacturer/ supplier in the same tender. Moreover, either the agent could bid on behalf of the manufacturer/ supplier or the manufacturer/ supplier could bid directly but not both. In case bids are received from both the manufacturer/ supplier and the agent, bid received from the agent shall be ignored. However, this shall not debar more than one Authorised distributor (with/ or without the OEM) from quoting equipment manufactured by an

Original Equipment Manufacturer (OEM) in procurements under a Proprietary Article Certificate.

iv) A bidder participates in more than one bid in this tender process. Participation in any capacity by a Bidder (including the participation of a Bidder as a partner/ JV member or sub-contractor in another bid or vice-versa) in more than one bid shall result in the disqualification of all bids in which he is a party. However, this does not limit the participation of an entity as a sub-contractor in more than one bid if he is not bidding independently in his own name or as a member of a JV.

The Bidder declares that they have read and understood the above aspects, and the bidder confirms that such conflict of interest does not exist and undertakes that they will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s), in this regard. 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. **In case, the Bidder is found having indulged in above activities, the same will be considered as a violation of the tender conditions, and suitable action shall be taken by BHEL as per extant policies/ guidelines.**

BREACH OF CONTRACT, REMEDIES AND TERMINATION:

In case of Breach of Contract, BHEL shall recover 10% of the contract value from the vendor using following instruments:
a) Encashment of security instruments like EMD, performance security available with BHEL against the said contract.
b) Balance amount (if value of security instruments is less than 10% of the contract value) from other financial remedies i.e. available bills of the vendor, retention amount etc. with BHEL.
c) Balance amount from security instrument like EMD, Performance Security and other financial remedies i.e. available bills of the vendor, retention amount etc. with other units of BHEL.
d) If Recovery is not possible then Legal Remedies shall be pursued.

EVALUATION IN CASE OF MORE THAN ONE BIDDER OCCUPY L1 STATUS:

In the course of evaluation, if more than one bidder happens to occupy L-1 status, effective L-1 will be
decided by soliciting discounts from the respective L-1 bidders.
In case more than one bidder happens to occupy the L-1 status even after soliciting discounts, the L-1 bidder shall be decided by a toss / draw of lots, in the presence of the respective L-1 bidder(s) or their representative(s).
Ranking will be done accordingly. BHEL's decision in such situations shall be final and binding.

CONTCAT DETAILS FOR TENVDER AGENCY: -

Agency	Contact details	
BHEL, PSER, Kolkata	Address	BHARAT HEAVY ELECTRICALS LIMITED, POWER SECTOR – EASTERN REGION 2ND FLOOR, BLOCK-DJ, PLOT- 9/1, SECTOR, SALT LAKE CITY, KOLKATA – 700 091
	Phone no.	033-2339 8221
	FAX no.	033-23211960
	E-mail ID	Rajendra.prasad.yadav@bhel.in, a_sarkar@bhel.in

Mandatory Declaration regarding MSME category:-

Any Bidder falling under MSME category, shall furnish the following details & submit documentary evidence/Govt. Certificate etc. in support of the same along with their techno-commercial offer: -

Type under MSME	SC/ST owned	Women owned	Others (excluding SC/ ST & Women Owned)
Micro			
Small			
Medium			

Note: - If the bidder does not furnish the above, offer shall be processed construing that the bidder is not falling under MSME category.

ANNEXURE & FORMATS

NOTE: - Tenderers are required to fill in the following details and no column should be left blank

1	Name and Address of the Tenderer	
2	Details about type of the Firm/Company	
3.a	Details of Contact person for this Tender	**Name:** Mr/Ms **Designation:** **Telephone No:** **Mobile No:** **Email ID:** **Fax No:**
3.b	Details of alternate Contact person for this Tender	**Name:** Mr/Ms **Designation:** **Telephone No:** **Mobile No:** **Email ID:** **Fax No:**

Format – I

DECLARATION REGARDING MINIMUM LOCAL CONTENT IN LINE WITH

REVISED PUBLIC PROCUREMENT (PREFERENCE TO MAKE IN INDIA), ORDER 2017 DATED 04TH JUNE, 2020 AND SUBSEQUENT ORDER(S)

(To be typed and submitted in the Letter Head of the Entity/Firm providing certificate as applicable)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub: Declaration reg. minimum local content in line with Public Procurement (Preference to Make in India), Order 2017-Revision, dated 04th June, 2020 and subsequent order(s).

Ref: 1) **Tender Specification No:**

2) All other pertinent issues till date

We hereby certify that the items/works/services offered by…… *(specify the name of the organization here)* has a local content of _____ % and this meets the local content requirement for **'Class-I local supplier' / 'Class II local supplier' **** as defined in Public Procurement (Preference to Make in India), Order 2017-Revision dated 04.06.2020 issued by DPIIT and subsequent order(s).

The details of the location(s) at which the local value addition is made are as follows:

1. _____ 2. _____

3. _____ 4. _____

Thanking you,

Yours faithfully,

(Signature, Date & Seal of

Authorized Signatory of the Bidder)

****** - *Strike out whichever is not applicable.*

Note:

1. Bidders to note that above format Duly filled & signed by authorized signatory, shall be submitted along with the techno-commercial offer.
2. **In case the bidder's quoted value is in excess of Rs. 10 crores, the authorized signatory for this declaration shall necessarily be the statutory auditor or cost auditor of the company (in the case of companies) or a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies).**
3. In the event of false declaration, actions as per the above order and as per BHEL Guidelines shall be initiated against the bidder

Format - II

Declaration

GEM Bid Ref. No.

Scope: -

I/ We, M/s ---------- hereby confirm that we are not under any liquidation, court receivership or similar proceedings and not bankrupt

Signature of Tenderer

Format - III

(To be submitted in the bidder's letter head)

In-line with Department of Expenditure's (DoE) Public Procurement Division Order vide ref. F.No.6/18/2019-PPD dated 23.07.2020 & 24.7.2020

Tender No: ……

Job: ……

"I/ we have read the clauses pertaining to Department of Expenditure's (DoE) Public Procurement Division Order (Public procurement no 1, 2 & 3 vide ref. F.No.6/18/2019-PPD dated 23.07.2020 & 24.7.2020) regarding restrictions on procurement from a bidder of a country which shares a land border with India. I/We hereby certify that I/ we the bidder **< name of the bidder……>** is / are

a) Not from such a country and eligible to be considered for this tender.

OR

b) From such country, has been registered with the competent authority and eligible to be considered for this tender. (Evidence of valid registration by the competent authority shall be attached)

(Please select applicable option a or b)

For and behalf of _____ (Name of the bidder)

(Signature, date & seal of authorized representative of the bidder)

Format – IV

CERTIFICATE OF NO DEVIATION

GEM Bid Ref. No.

Scope: -

I/WE, M/s

We hereby confirm that we have not changed/ modified/materially altered any of the tender documents as downloaded from the website/ issued by BHEL and in case of such observance at any stage, it shall be treated as null and void.

We also hereby confirm that we have neither set any Terms and Conditions and nor have we taken any deviation from the Tender conditions together with other references applicable for the above referred NIT/Tender Specification.

We further confirm our unqualified acceptance to all Terms and Conditions, unqualified compliance to Tender Conditions, Integrity Pact (if applicable) and acceptance to Reverse Auctioning process.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Signature of Tenderer

Format-V

Form No: F-06 (Rev 00)

NON-DISCLOSURE CERTIFICATE

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

NON-DISCLOSURE CERTIFICATE

I/We understand that BHEL PS is committed to Information Security Management System as per their Information Security Policy.

Hence, I/We M/s …… who are submitting offer for providing services to BHEL PS against Tender Specification No: ……..…….. Date: …… hereby undertake to comply with the following in line with Information Security Policy of BHEL PSER.

a) To maintain confidentiality of documents & information which shall be used during the execution of the Contract.

b) The documents & information shall not be revealed to or shared with third party which shall not be in the business interest of BHELPSER.

Date:

(Signature, date & seal of Authorized Signatory of the bidder)

Format-VI

Declaration for Prevention/ Elimination of Suspected Cartel formation between Suppliers

To

Sr Dy General Manager (Purchase)

Bharat Heavy Electricals Limited

Power Sector Western Region

KOLKATA

Dear Sir/ Madam,

Subject: Declaration for Prevention/ Elimination of Suspected Cartel Formation Between Suppliers

Reference: GeM Tender No:

I/ We hereby declare that I/We shall not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other bidder(s).

This applies in particular to prices, specifications, certifications, subsidiary contract, submission or non-submission of bids of any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

Signature & Seal of Authorized Signatory

Place:

Date:

Form for getting payment through RTGS (Real Time Gross Settlement)

01.	Name of Vendor	BHARAT HEAVY ELECTRICALS LTD.
02.	Address	~~BHEL~~ BHEL HOUSE, SIRI FORT, N.DELHI
03.	Vendors Bank A/c Name	BHARAT HEAVY ELECTRICALS LTD.
04.	Vendors Bank A/c No.	11107800029
05.	Name of Bank	STATE BANK OF INDIA
06.	Name of Branch	COMMERCIAL BR., SALT LAKE, SECTOR-V KOLKATA
07.	Branch Phone No.	033-23575665
08.	City	KOLKATA
09.	IFSC Code of the Branch	SBIN 0004289

The charges if any for payment through RTGS may be recovered from the Bill submitted by us

Signature of Authorised Representative with office seal

के. के. कोआरी/K. K. Coari
उप महाप्रबंधक (वित्त)/Dy. General Manager (Fin)
भा. हे. इ. लि. : पी.एस.ई.आर : कोलकाता-700 091
BHEL: PSER / Kolkata-700 091

Confirmation by Banker with office seal

State Bank of India ★ Commercial Branch ★ SALT LAKE 4289

Note : Incorrect information will create Accounting complications and payment will be delayed

List of Consortium Banks *			
	Nationalised Banks		**Nationalised Banks**
1	Allahabad bank	19	Vijaya Bank
2	Andhra bank		**Public Sector Banks**
3	Bank of Baroda	20	IDBI
4	Canara Bank		**Foreign banks**
5	Corporation bank	21	CITI Bank N.A
6	Central bank	22	Deutsche Bank AG
7	Indian Bank	23	The Hongkong and Shanghai Banking Corporation Limited
8	Indian Oversea Bank	24	Standard Chartered Bank
9	Oriental bank of Commerce	25	J P Morgan
10	Punjab National Bank		
11	Punjab & Sindh Bank		**Private banks**
12	State Bank of India	26	Axis Bank
13	State Bank of Hyderabad	27	The Federal Bank Limited
14	Syndicate Bank	28	HDFC
15	State Bank of Travancore	29	Kotak Mahindra Bank
16	UCO Bank	30	ICICI
17	Union Bank of India	31	Indusind Bank
18	United Bank of India	32	Yes Bank

* wef 22.03.2016

ANNEXURE B

PROFORMA OF BANK GUARANTEE (in lieu of SECURITY DEPOSIT)

In consideration of Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at _____[1] through its Unit at……...(name of the Unit) having agreed to exempt (Name of the Vendor / Contractor / Vendors) with its registered office at_____ [2] (hereinafter called the said "Contractor" which term includes vendors), from demand under the terms and conditions of the Contract reference No._____ dated _____ [3] valued at Rs.……[4] (Rupees ----------)[4] (hereinafter called the said Contract), of Security Deposit for the due fulfilment by the said Contractor of the terms and conditions contained in the said Contract, on production of a Bank Guarantee for Rs._____ [5] (Rupees _____ only),

we ____(indicate the name and address of the Bank) having its Head Office at _____(address of the head Office) (hereinafter referred to as the Bank), , at the request of _____ [Contractor(s)], being the Guarantor under this Guarantee, do hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer, , an amount not exceeding Rs._____ without any demur, immediately on demand from the Employer and without any reservation, protest, and recourse and without the Employer needing to prove or demonstrate reasons for its such demand

Any such demand made on the bank, shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs._____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor(s) in any suit or proceeding pending before any Court or Tribunal or Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this guarantee shall be a valid discharge of our liability for payment hereunder and the Contractor(s) shall have no claim against us for making such payment.

We, further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied & the Employer certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said contractor(s) or acceptance of the final bill or discharge of this guarantee by the Employer, whichever is earlier. This guarantee shall initially remain in force upto and including _____6 and shall be extended from time to time for such period as may be desired by the Employer. Unless a demand or claim under this guarantee

is made on us in writing on or before the _____[7], we shall be discharged from all the liability under this guarantee thereafter.

We, ____(indicate the name of the Bank)_____further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said contractor(s) and to forbear or enforce any of the terms and conditions relating to the said Contract and we shall not be relieved from our liability by any reason of any such variation or extension being granted to the said contractor(s) or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

We,……. BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.
Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed…… [5]

b) This Guarantee shall be valid up to ……[6]

c) Unless the Bank is served a written claim or demand on or before _____[7] all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.
Any claim or dispute arising under the terms of this Guarantee shall be subject to the exclusive jurisdiction of the court at Kolkata only.

Date _____ Day of _____

for____(indicate the name of the Bank)__

(Signature of Authorised signatory)

[1] *ADDRESS OF THE EMPLOYER. I.e Bharat Heavy Electricals Limited*

[2] *ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER .*

[3] *DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE*

[4] *CONTRACT VALUE*

[5] *BG AMOUNT IN FIGURES AND WORDS*

[6] *VALIDITY DATE*

[7] *DATE OF EXPIRY OF CLAIM PERIOD*

Note:

1. Units are advised that expiry of claim period may be kept 3-6 months after validity date. It may be ensured that the same is in line with the agreement/ contract entered with the Vendor.

2. The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.

3. In line with the GCC, SCC or contractual terms, Unit may carry out minor modifications in the Standard BG Formats. If required, such modifications may be carried out after taking up appropriately with the Unit/Region's Law Deptt.

4. **In Case of Bank Guarantees submitted by Foreign Vendors-**

   a. **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.

   b. **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**

   b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank's (BHEL's Consortium Bank) branch in India. It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

   b.2 **In case, Foreign Vendors intend to provide BG from** Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.

   b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). The BG Format provided to them should clearly specify the same.