



**Indian Institute of Science Bangalore
560012**

Website : <https://IISc.ac.in/business-with-IISc/tenders/>

Contact: 080-2293 2765/2202/2203

**TENDER DOCUMENT
(e-Procurement)**

For

**“Supply, Installation and Commissioning of 2 Nos. of 2000 KVA, 11 KV of D.G. Sets at
IISc, Bangalore”**

Tender No: IISc/Tender 1/2019-20, dated:17th June 2019

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1: Short Term Tender Notification

Scope of Work	“Supply, Installation and Commissioning of 2 Nos. of 2000 KVA, 11 KV of D.G. Sets at IISc, Bangalore”
Estimated Value of work	Rs 540,00,000/-
Period of Work Completion	10 (Ten) Months from the date of Work Order
Name of the Client	Indian Institute of Science, Bangalore
Address of the Client	The Project Engineer cum Estate Officer Indian Institute of Science Bangalore – 560 012 Tel No. 080-2293 2765/2202/2203 e-Mail: office.ccmd@IISc.ac.in
Tender Processing Fee	As per e-procurement portal
Submission of Tender Document	e-procurement portal- https://eproc.karnataka.gov.in Helpline no: 080-25501216/25501227
Amount of Earnest Money to be deposited with the Tender	Rs. 8,10,000/-
Last date and Time for online submission (uploading) of tender	08.07.2019 at 15.00 hrs.
Date and Time of opening of Tender (Technical Bid)	09.07.2019 at 16:00 hrs.
Date and Time of opening of Tender (Financial Bid)	Shall be intimated to technically qualified bidders.
Date, Time & Venue of Pre-bid meeting	28.06.2019 at 16.00 hrs. Centre for Campus Management and Development Indian Institute of Science Bangalore – 560 012

2. Scope of Tender

The REGISTRAR, Indian Institute of Science invites tenders from eligible Bidders, for **“Supply, Installation and Commissioning of 2 Nos. of 2000 KVA, 11 KV of D.G. Sets at IISc, Bangalore”** (as defined in these documents). The eligible Bidders may submit tenders”

2. Eligibility Criteria

- 2.1 Bidders shall not be under a declaration of ineligibility for corrupt and fraudulent practices issued by the Government of India or any State Government of Union of India. (authorized signatory should provide an undertaking).
- 2.2 Tenders from Joint ventures are not acceptable.
- 2.3 All Bidders shall provide the required information accurately and sufficient detail in Section 3: Qualification Information.
- 2.4 The bidder shall be OEM (Original equipment manufacturer) of the Engine makes mentioned in this tender document.
- 2.5 The Tenderer shall have executed and completed successfully in the last five years i.e., between 2014-15 to 2018-19 a single work of similar nature of value **not less than Rs. 4,32,000,00/-**.
- 2.6 The Tenderer shall have achieved in at least two consecutive financial years a minimum sum of turnover not less than **Rs. 10,80,00,000/-in the last five years i.e. 2014-15 to 2018-19**.
- 2.7 Work completion certificate for having completed at least one work of similar nature of value not less than the estimated value of contract certified from the competent authority not below the Rank of Executive Engineer or equivalent shall be uploaded. The work completion certificate shall mention the nature of work, items of work executed and the date of commencement scheduled date of completion and actual date of completion of the work.
- 2.8 The tenderer shall upload the valid and present certificate copies of PAN, GST, Contractor's Registration passbook in technical bid, **failing which the tender will be rejected**. If necessary, bidder shall produce all the original documents for verification.
- 2.9 If the rate quoted by the Contractor for each category of works is below the estimated value of the work, the contractor should pay the difference of amount in favour of The Registrar, IISc in the form of DD or Pay order or FDR (Fixed deposit receipt) or Bank Guarantee as an additional security deposit before entering into Agreement. The same will be refunded only after satisfactory completion of the work.
- 2.10 The work shall be carried out as per the directions of the Project Engineer cum Estate Officer and Project Engineer.
- 2.11 Blacklisted contractors/in govt/Quasi govt/boards/BBMP etc., are not eligible to quote, if found such tenders will be rejected. One who (Contractor/Agency is penalized due to delay in completion of the previous work, those bidders will be rejected.
- 2.12 The successful Bidder shall execute an Agreement within 10 days from the date of Receipt of intimation from this office, The Tender Document will form the part and parcel of the agreement, failing which the tender will deem to be get cancelled.
- 2.13 The material shall be got approved by the Project Engineer cum Estate Officer, IISc before execution of the work.
- 2.14 Further details of the work can be obtained from this office.
- 2.15 The rates quoted in the schedule shall be inclusive of all applicable taxes (inclusive of GST/CESS/Royalty etc.).
- 2.16 The IISc. reserves the right to accept / reject any or all the tenders without assigning any reasons.
- 2.17 The work shall be commenced with all men and machinery within 10 days from the date of work order, failing which it would be presumed that the successful tenderer is not interested in the work and action will be taken to get the work executed through alternate agency at the risk and cost of the former Tenderer.
- 2.18 Conditional tenders will not be accepted.

- 2.19 Bidders who meet the above specified minimum qualifying criteria, shall be eligible.
- 2.20 Even though the Bidders meet the above criteria, they are subject to be disqualified if they have:
- Made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements; and/or
 - Record of poor performance such as abandoning the works, not properly completed the contract, inordinate delays in completion, litigation history, or financial failures etc.
3. Site visit:
- The Bidder at his own responsibility is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Tender and entering into a contract for the Works. The cost of visiting the Site shall be at the Bidder's own expense.

B. Tender documents (Two bid system – Technical & Financial)

The Tender document can be downloaded from e-procurement website: <https://www.eproc.karnataka.gov.in>

It may be noted that all subsequent notifications, changes and amendments on the project/document would be posted only on the same website: <https://www.eproc.karnataka.gov.in>.

The bidders will be required to register themselves with the centre for e-governance to participate in the bidding. Necessary details could also be obtained over telephone at 080-25501216/25501227.

4. Content of Tender documents

The bidders should go through the Tender Document and submit online response through e-procurement portal only.

5. Amendment of Tender documents

- 5.1 Before the deadline for submission of tenders, the IISc. may modify the tender documents by issuing corrigendum / addendum.
- 5.2 Such corrigendum/ addendum thus issued shall be part of the tender documents and shall be published online in e-Procurement portal.
- 5.3 To give prospective Bidders reasonable time in which to take corrigendum/ addendum into account in preparing their tenders, the IISc. shall extend as necessary the deadline for submission of tenders.

C. Preparation of Tenders

6. Documents comprising the Tender

- 6.1 **The Technical Bid** submitted by the Bidder shall contain the documents as follows:
- (a) Earnest Money Deposit & Tender processing fee paid in any of the payment modes specified in e-Procurement platform.
 - (b) Qualification Information as per formats to comply the task created in the e-Procurement Portal under General Terms and Conditions and Technical parameters and Documents required from Bidder.
 - (c) Any other documents / materials required to be completed and submitted by Bidders in accordance with these instructions. The required documents shall be filled in without exception.

6.2 The financial bid submitted by the Bidder shall contain the documents as follows:

Priced Bill of Quantities; online through e-procurement portal, no hardcopy of commercials should be attached or disclosed.

7. Tender prices

7.1 The contract shall be for category of works / whole works based on the priced Bill of Quantities submitted by the Bidder.

7.2 deleted

7.3 All prevailing duties, taxes, and other levies like GST/CESS/Royalty payable by the contractor under the contract, or for any other cause, shall be included in the rates, prices and total Tender Price submitted by the Bidder.

8. Tender validity

8.1 Tenders shall remain valid for a period not less than **180 days** after the deadline date for tender submission. A tender valid for a shorter period shall be rejected by the IISc. as non-responsive.

8.2 In exceptional circumstances, prior to expiry of the original time limit, the IISc. may request that the Bidders may extend the period of validity for a specified additional period. The request and the Bidders' responses shall be made in writing or by email. A Bidder may refuse the request without forfeiting his earnest money deposit. A Bidder agreeing to the request will not be required or permitted to modify his tender, but will be required to extend the validity of his earnest money deposit for a period of the extension, and in compliance with Clause 9 in all respects.

9. Earnest money deposit

9.1 Earnest Money Deposit/ Bid security

The Bidder shall furnish, as part of his tender, earnest money deposit (EMD) of **Rs.8,10,000/-**.

The Bidder can pay the Earnest Money Deposit (EMD) in the e-Procurement portal using any of the following payment modes:

- Credit Card
- Direct Debit
- National Electronic Fund Transfer (NEFT)
- Real Time Gross Settlement (RTGS)
- Over the Counter (OTC)

EMD amount will have to be submitted by the bidder taking into account the following conditions:

- a. EMD will be accepted only in the form of electronic form and not through Demand Draft or Bank Guarantee and will be maintained in E-procurement Bank account until the finalization of the Tender.
- b. The entire EMD amount for a particular tender has to be paid in a single transaction

9.2 The earnest money deposit of unsuccessful Bidders will be returned after awarding the contract to the successful bidder.

9.4 The earnest money deposit may be forfeited:

- (a) If the Bidder withdraws the Tender after tender opening during the period of tender validity;
- (b) If the Bidder fails within the specified time limit to
 - (i) Sign the Agreement; or
 - (ii) Furnish the required Security deposit

10. Format and signing of Tender

Successful Bidder shall sign all the pages of the tender document as a token of acceptance of all the terms and conditions of the contract.

D. Submission of Tenders

11. Tenders must be submitted on-line in the e-Procurement portal by the Bidder before the notified date and time.

12. Deadline for submission of the Tenders

The Bidder shall submit a set of hard copies of all the documents in a sealed cover to IISC., required as a pre-qualification bid (Technical bid) which were uploaded through e-procurement portal. In the event of any discrepancy between them, the original uploaded document in e-procurement shall govern.

The IISC. may extend the deadline for submission of tenders by issuing an amendment in accordance with Clause 5, in which case all rights and obligations of the IISC and the Bidders previously subject to the original deadline will then be subject to the new deadline.

13. Late Tenders

In e-procurement system, Bidder shall not be able to submit the bid after the bid submission time and date as the icon or the task in the e-procurement portal will not be available. IISC will not be liable (or) responsible for any delay due to unavailability of the portal and the Internet link.

14. Modification and Withdrawal of Tenders

- 14.1 Bidder has all the time to modify and correct or upload any relevant document in the portal till last date and time for Bid submission, as published in the e-procurement portal.
- 14.2 The Bidder may withdraw his tender before the notified last date and time of tender submission.
- 14.3 No Tender may be modified after the deadline for submission of Tenders.
- 14.4 Withdrawal or modification of a Tender between the deadline for submission of Tenders and the expiration of the original period of Tender validity specified in Clause 8.1 above or as extended pursuant to Clause 8.2 may result in the forfeiture of the earnest money deposit pursuant to Clause 9.
- 14.5 Discount or price modification may be offered by bidders as per portal format

E- Tender opening and evaluation**15. Tender Opening:**

- 15.1 The IISC will open all the Tenders received in the presence of the Bidders or their representatives who choose to attend on the specified date, time and place specified. In the event of the specified date of Tender opening being declared a holiday for the IISC. the Tenders will be opened at the appointed time and location on the next working day.
- 15.2 The IISC. will evaluate and determine whether each tender meets the minimum qualification /eligibility criteria.

- 15.3 Bidder to submit all the Original Documents, which are submitted in e-procurement portal, to the IISC. for verification at the time of opening of Tender.
- 15.4 The IISC record the Tender opening

16. Process to be confidential

- 16.1 Information relating to the examination, clarification, evaluation, and comparison of Tenders and recommendations for the award of a contract shall not be disclosed to Bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced.

17 Clarification of Tenders

- 17.1 To assist in the examination, evaluation, the IISC. may, at his discretion, ask any Bidder for clarification of his Tender. The request for clarification and the response shall be in writing or by e-mail along with the section number, page number and subject of clarification, but no change in the price or substance of the Tender shall be sought, offered, or permitted.
- 17.2 Subject to sub-clause 17.1, no Bidder shall contact the IISC. on any matter relating to its Tender from the time of the Tender opening to the time the contract is awarded. If the Bidder wishes to bring additional information to the notice of the IISC., he should do so in writing.
- 17.3 Any effort by the Bidder to influence the IISC. in the IISC.'s Tender evaluation, or contract award decisions may result in the rejection of the Bidders' Tender.

18. Examination of Tenders and determination of responsiveness

- 18.1 Prior to the detailed evaluation of Tenders, the IISC. will determine whether each Tender (a) meets the eligibility criteria defined in Clause 2; (b) has been properly signed; (c) is accompanied by the required earnest money deposit and; (d) is substantially responsive to the requirements of the Tender documents.
- 18.2 A substantially responsive Tender is one which conforms to all the terms, conditions, and specifications of the Tender documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality, or performance of the Works; (b) which limits in any substantial way, inconsistent with the Tender documents, the IISC.'s rights or the Bidder's obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other Bidders presenting substantially responsive Tenders.
- 18.3 If a Tender is not substantially responsive, it will be rejected by the IISC., and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

19. Correction of errors

- 19.1 After final uploading of bid on portal, no correction of errors is permitted. Correction of error in tender will be uploaded as corrigendum/addendum

20. Evaluation and comparison of Tenders

- 20.1 Opening of the Financial bid will be preceded by the evaluation of the Pre-qualification Offer (Technical bid), vis-a-vis the capability, capacity and credibility of the Bidder. Evaluation of the Pre-qualification Offer will be done by the Evaluation Committee constituted for the purpose. After

evaluation is completed, all the Bidders who are qualified will be notified and will be intimated at the time of opening of the Financial bid. Financial bid will be opened in the presence of those who choose to be present or even in the absence of any Bidder.

The IISc. will evaluate and compare only the Tenders determined to be substantially responsive in accordance with Clause 18.

- 20.2 In evaluating the Tenders, the IISc. will determine for each Tender the evaluated Tender Price by adjusting the Tender Price as follows:

- (a) Making any correction for errors pursuant to Clause 19 and
- (b) Making appropriate adjustments to reflect discounts or other price modifications offered in accordance with Sub Clause 14.5.

- 20.3 The IISc. reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, and alternative offers and other factors which are in excess of the requirements of the Tender documents or otherwise result in unsolicited benefits for the IISc. shall not be taken into account in Tender evaluation.

20.4 NEGOTIATIONS

The Bidder though technically qualified and who's financial offer is the lowest, fails to convince the Tender Evaluation Committee of his capability, capacity, credibility, his offer may be reviewed and the Bidder intimated accordingly. In such case, the Bidder, who has quoted the lowest price, may be considered and his price may be negotiated.

F. Award of Contract

21. Award criteria

- 21.1 Subject to Clause 22, the IISc. will award the Contract to the Bidder whose Tender has been determined to be substantially responsive to the Tender documents and who has offered the lowest evaluated Tender Price, provided that such Bidder has been determined to be (a) eligible in accordance with the provisions of Clause 2, and (b) qualified in accordance with the provisions of Clause 3.

22. IISc.'s right to accept any Tender and to reject any or all Tenders

- 22.1 Notwithstanding Clause 21, the IISc. reserves the right to accept or reject any Tender, and to cancel the Tender process and reject all Tenders, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the grounds for the IISc.'s action.

23. Notification of award and signing of Agreement

- 23.1 The Bidder whose Tender has been accepted will be notified of the award by the IISc. prior to expiration of the Tender validity period by e-mail or confirmed by letter. This letter (hereinafter and in the Conditions of Contract called the "Letter of Intent") will state the sum that the IISc. will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").
- 23.2 The notification of award will constitute the formation of the Contract, subject only to the furnishing of a performance security in accordance with the provisions of Clause 24.
- 23.3 The Agreement will incorporate all agreements between the IISc. and the successful Bidder /

Bidders. It will be kept ready for signature of the successful Bidder in the office of IISc. following the notification of award along with the Letter of intent. The successful Bidder will sign the Agreement and deliver it to the IISc.

- 23.4 Upon the furnishing by the successful Bidder of the Security deposit, the IISc. will issued formal work order

24. Further Security deposit (FSD)

- 24.1 6.0% on the running bills and final bill in addition to Earnest Money Deposit. When the FSD deducted from R.A Bills of the contractor @ 6.0% of the bill amount exceeds Rs.1.00 Lakh, the amount in excess of Rs. 1.00 Lakh may, at the request of the bidder, be released to him against the production of the bank guarantee issued from a Nationalised / Scheduled Bank only for an equal amount in the prescribed form. The bank guarantee should be valid till the completion of the defect liability period.
- 24.2 If the security deposit is provided by the successful bidder in the form of a Bank Guarantee, it shall be issued either by a Nationalized/Scheduled bank
- 24.3 Failure of the successful Bidder to comply with the requirements of Sub-Clause 24.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the earnest money deposit.

25. Corrupt or Fraudulent practices

- 25.1 The IISc. requires that the Bidders observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, IISc.:
- (a) will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;
 - (b) will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a IISc contract if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing, a IISc contract.

3. DECLARATION OF TENDERER

Name of Work: Supply, Installation and Commissioning of 2 Nos. of 2000 KVA, 11 KV of D.G. Sets at IISc, Bangalore

- 3.1 I/We, declare that specifications, plans, designs and conditions of contract on which the rates have been quoted are completely studied by me/us before submitting this tender.
- 3.2 I/We declare that I/We have inspected the work spot and have made myself/ourselves thoroughly conversant and satisfied as regards the field conditions prevalent there, regarding the materials, labour and the particulars of various leads with which the materials required to be brought for the work.
- 3.3 I/We, declare that the rates quoted for items of works for which now tenders are called for are inclusive of leads with which I/We propose to bring the materials whether it is from nearest approved quarry or from any other approved quarries. I/We will not have any claims for higher leads, and my/our quoted rates are with all leads and lifts etc.,
- 3.4 I/We, declare that the rates tendered by me/us for this work have not been witnessed by any other contractor/s who has/have tendered for this work.
- 3.5 I/We, declare that I/We, have understood all the conditions mentioned above and also the specifications stipulated in tender condition either by going through myself/ourselves or by getting translated into my/our own mother tongue.

4. INSTRUCTIONS TO TENDERER

- 4.1 **Cement & Steel** - The contractor has to make his own arrangements for the procurement of Cement & Steel of approved brands and make required for the Project. For all the cement works (including RMC) The cement to be used should be Ordinary Portland Cement (OPC) - 43 Grade of Coromandal / Ultratech / ACC / PPC for GRIHA Project. The steel to be used shall be TMT Fe 550 of TATA/ SAIL/RINL (Primary plants only)
Note: No blended cement will be permitted and M sand may be used for the construction works at site.
- 4.2 **Water Supply** - Contractor is permitted to dig bore wells required at work site at their own risk and cost. After the completion of work the agency has to hand over the bore well along with the pump and panel board in working condition to the Institute completely at free of cost and no extra charges can be claimed towards this. If sufficient quantity of water is not available then the water required for the construction shall be arranged by the contractor them self at their own risk and cost.
- 4.3 **Supply of Electricity** - Electricity required for construction shall be arranged by the contractor himself. Electricity if supplied to the contractor by the Institute will be metered and amount will be recovered in the Bills as per actual at rates fixed by the Institute. Supply of electricity from the Institute is not mandatory. Non-supply of electricity by the Institute cannot be held as reason for shortfall in progress.
- 4.4 **Royalty on Materials** - Rates quoted for items shall be inclusive of Royalty and all other taxes, which are in force or levied from time to time or become leviable / payable by him to any authority. There will be no deduction of royalty if bidder/contractor use royalty paid material for building.
- 4.5 **Mobilization Advance-** *For the speedy execution of work, Mobilization advance will be paid to the contractor @ 7.50% of the Contract Value which will be paid after entering into the agreement against production of Bank Guarantee issued by a Public Sector Undertaking Bank/Scheduled commercial Bank/Nationalized Bank for 110% of advance amount value. BG for the Advance amount value shall be valid till the advance together with interest is recovered. A simple interest of 10% Per Annum will be charged on the advance amount.*
- 4.5.1 **Recovery of Mobilization Advance:** *The recovery of Mobilization Advance along with the simple interest of 10% per Annum, will be effected from the 2nd Running Bill onwards and shall be recovered in full in 5 monthly installments in their Running account bills.*
- 4.6 Income tax will be deducted as per the orders of the Govt. in vogue.
- 4.7 deleted
- 4.8 The items like plastering, flooring etc., are for specified thickness only and any additional thickness that may need to be executed as a result of existing structure is considered incidental and covered under quoted rates and no additional payments will be entertained in this regard. Also Ant termite treatment has already been executed up to ground level and only needs to be executed before plinth protection. Rates may be quoted keeping such things in hindsight.
- 4.9 The rates to be quoted including all taxes with GST and shall not be quoted above 125% and below 75% of the prevailing rates. otherwise above 125% and below 75% of the Amount will be treated as unbalanced amount which will be accounted for security deposit

5: QUALIFICATION CRITERIA

The information to be filled in by the Bidder hereunder will be used for purposes of computing Tender capacity as provided in Clause 2 of the Instructions to Bidders. This information will not be incorporated in the Contract.

1.1 Name of Agency as registered :

Postal Address for communication :

Principal Place of business :

Name of the Owner :

Nature of Company/individual/partnership/firm etc :

Name of the authorized person with contact details :

Constitution or legal status of Bidder:

Place of Registration :

[Attach self-attested photo copy]

1.2 Total value of Building / ~~Painting~~ works executed and payments received in the last five years (In Rs. Lakhs)

2014-15 _____
 2015-16 _____
 2016-17 _____
 2017-18 _____
 2018-19 _____

1.3 (a) Details of Works performed as a Prime Contractor (in the same name) on works of similar nature over during the five years specified in 1.2 above.

Project Name	Name of Employer	Description of work	Contract number	Value of Contract	Stipulated Period of completion	Actual date of completion	Remarks (Reason for delay)

[Attach satisfactory certificate and date of completion from the concerned Project Engineer not below the rank of Executive Engineer or Competent Authority]

(b) Details of works performed in Govt / Semi Government / Reputed firm single work of similar nature of value **Rs.432,00,000** of the amount put to tender & above carried out during the five financial years specified in 1.2 above.

Project Name	Name of Employer	Description of work	Contract number	Value of Contract	Date of work order	Stipulated Period of completion	Actual date of completion	Remarks (Reason for delay)

[Attach satisfactory certificate and date of completion from the concerned Project Engineer not below the rank of Executive Engineer or Competent Authority]

1.4 Information on works for which Tenders have been submitted and works which are yet to be completed as on the date of this Tender.

(A) Existing commitments and on-going works:

Description of work	Place & state	Contract Number And Date	Name & Address of the Customer	Value of contract Rs. Lakhs	Specified period of completion	Value of work remaining to be completed (Rs. Lakhs)	Anticipated date of completion
1	2	3	4	5	6	7	8

[Details to be furnished with necessary work order signed from concerned Project Engineer not below the rank of Executive Engineer or Competent Authority. Work order/Testimonials will be verified, if required]

(B) Works for which Tenders already submitted:

Description of work	Place & state	Name & Address of the Customer	Estimated value of work Rs in lakhs	Stipulated period of completion	Date when decision is expected	Remark If any
1	2	3	4	5	6	7

1.5. Reports on the financial standing of the tendered, such as profit and loss statements and auditor's reports (audited balance sheet) and Annual Turn Over for the last five years to be uploaded as per the format below:-

Sl.No	Year	Turn Over Amount	Remark
1	2	3	7
2	2014-15		
3	2015-16		
4	2016-17		
5	2017-18		
6	2018-19		

[Report on the financial standing of the tendered, such as profit and loss statements and auditor's report (Audited balance sheet) for the last five years to be uploaded

***Note: A separate certificate from Chartered Account stating turn over for the last five years to be submitted]**

- 1.6 Evidence of access to financial resources to meet the qualification requirement specified in ITT Clause 3.3 (b): Cash in hand, Letter of Credit etc. List them below and attach certificate from the Banker in the suggested format as under:

BANKER'S CERTIFICATE

This is to certify that M/s. is a reputed company with a good financial standing. If the contract for this work, namely (name of the work) is K/W – 3 Works /Open awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of Rs. (30% of the Estimated value of work as in page 3, Item 2) to meet the working capital requirements for executing the above contract

Sd/-

Name of the Bank, Senior Bank Manager

Address:.....

Name, address, and telephone, telex, and fax numbers of the Bidders' bankers who may provide references if contacted by the IISc..

Income tax returns to be uploaded duly signed by competent Authority

6 SPECIAL CONDITIONS

- Establishment of Labour Camp is strictly prohibited in the premises of Indian Institute of Science Campus. Essential labor for round the clock work at site will be allowed with prior permission of Project Engineer cum Estate Officer.
- Bill Of Quantities or commercial bid has been disabled in the e-procurement portal of Government of Karnataka, which is as per the Government Orders vide FD/165/EXP-12/2017 dated 21/03/2017 and FD/539/EXP-12/2017 dated 02/06/2017. Uploading the BOQ scanned document shall lead to disqualification of the bid. Whereas the prices of all the line items are to be entered on the e-procurement portal with all taxes and statutory levies inclusive of GST .
- **BOQ:** Since the e-Portal doesn't support Negative Values for the Item No. 14 a,b,c,d,e and f (Serial No. 68 to 73) (Buying Back Items) the amount quoted will be deducted twice out of the quoted total amount and the item described above will be handed over to the bidder at his disposal after getting prior approval from the competent authority
- Any damage to the existing service lines during execution of work shall be got rectified by the tenderer at his own cost and risk.
- Tenderer shall use new shuttering material exclusively for this work
- Only 43 Grade OPC cement of brand Birla Super / ACC / Ultra tech shall be used.
- The reinforcement steel used shall be of Grade Fe 550 tar steel of brand TISCO / SAIL / JSW / TATA.
- Concrete Design Mix shall be got approved by the competent authority
- Debris shall be disposed off to an undisputed place of Bangalore outskirts as per the direction of the Engineer-in-Charge, when ever required.
- One who is (Contractor/Agency) penalized by the employer due to delay in completion of work, those tenderer will be rejected. Any bidders who is served with a slow progress of the work notice for inadequate deployment of

Labors and or any mobilization of material resources in on going project is liable for rejection or for suppression of information at any stage of evaluation

- **Labour employed at site will not be allowed to use cell phone while working at site.**

TECHINICAL SPECIFICATION

	TITLE	Rev
6.1	Scope of Enquiry	R0
6.2	Project Information	R0
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6.1 Scope of Enquiry

- 1.0 This specification covers the design, engineering, procurement, manufacture, inspection and testing at the works of manufacturer and/or sub-vendor, packing for shipment, forwarding, including transit insurance, receipt at site, storage and handling at site, erection, testing, cleaning, start-up & commissioning and performance testing - all to the satisfaction of Owner or Owner's authorized representatives and in accordance with these specifications and as per good engineering practices of Two Diesel Generator sets each capable of delivering a power output of **2000 kVA @ 0.8PF, 1600kWe** at generator terminals under specified, site conditions, complete with auxiliaries, integral systems and foundation relevant civil works as part of Project **"SUPPLY, INSTALLATION AND COMMISSIONING OF 2 Nos 2000 kVA DGSETS AT IISc, BANGALORE"**
- 2.0 **DG sets shall be PRIME POWER rated (PRP rating as per clause No 13.3.2 of ISO 8528 part1)**
- 3.0 It is not the intent to specify completely herein, all the details of design and construction of the equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation in a manner acceptable to the purchaser, who will interpret the meaning of the drawings and specifications and shall have the right to reject any work or material which in his judgement are not in full accordance therewith.
- 4.0 Bidder shall quote for all the systems covered in this specification. If any item other than those specified is required for the proper operation of the system, the same shall be included in the offer.

6.2 Project Information

1.0	PROJECT TITLE	SUPPLY, INSTALLATION AND COMMISSIONING OF 2 Nos 2000 kVA DG SETS AT IISc, BANGALORE
2.0	LOCATION	Bangalore, Karnataka
3.0	ELEVATION ABOVE MEAN SEA LEVEL	908 meter
4.0	NEAREST RAILWAY STATION	Bangalore City Railway Station
5.0	NEAREST NATIONAL HIGHWAY	NH No.7
6.0	NEAREST AIRPORT	Bangalore International Airport
7.0	ANNUAL AVE. AMBIENT TEMP.	
	a. Maximum	40 °C
	b. Minimum	12° C
	c. Amb. Temp (For DG set/ Equipment Design)	40° C
8.0	ANNUAL RAIN FALL	650-850 mm.
9.0	HUMIDITY (For Equipment Design)	Not more than 85% at maximum temperature
10.0	SEISMIC ZONE	Zone -II as per IS 1893
11.0	TROPICALIZATION	All equipment supplied against this specification shall be given tropical and fungicidal treatment in view of the climatic conditions prevailing at site. Tropical protection shall conform to BS CP -1014-1963, Protection of Electrical Power Equipment against climatic conditions.
12.0	PLANT MAIN EARTH GRID	50x10 GS Flat
13.0	AUXILIARY POWER SUPPLY	
13.1	MV AC Power Supply	415V, 3-phase, 4-wire, 50 Hz effectively earthed system
13.2	Lighting Fixtures, spring charging motors and Space Heaters	240V, 1-phase, 2-wire, 50Hz,
13.3	Control Supply	110V DC
14.0	AUXILIARY SUPPLY VOLTAGE VARIATION	
14.1	ACSupply	Voltage Variation: +/- 10% Frequency Variation +/- 5% Combined Voltage and Frequency Variation: +/- 10%
14.2	DCSupply	Voltage Variation : + 10% to – 15% All devices and equipment shall be suitable for continuous operation over the entire range of voltage and frequency indicated above, without any change in their performance.

6.3 Specific Technical Requirement (Electrical)

1.0 INTRODUCTION

- 1.1 Indian Institute of Science (IISc) is a public institute for research and higher education in science, engineering, design, and management. It is a premier scientific research institute in India, located in Bangalore. IISc was established in 1909 with active support from Jamsetji Tata and Krishna Raja Wadiyar IV and thus is also locally known as the "Tata Institute"
- 1.2 IISc, Bangalore has got a very old electrical system and has planned for revamping and strengthening the electrical system to increase capacity and reliability. The work is planned to be executed in phased manner.
- 1.3 IISc receives grid power at 66kV which is stepped down to 11kV.
- 1.4 Backup power supply to the facility was catered by Four Nos. of 11kV DG sets. DG-1, 23 and 4 were rated as 1000kVA. These DG sets are connected to supply emergency power in case of KPTCL supply outage. Since they have out lived their life and the requirement of power has gone up, it was decided to replace them.
- 1.5 Out of these Two (2) Nos of 1000kVA DG sets (1 & 2) were replaced by 2000kVA and are operational since few months.
- 1.6 IISc has plans to replace remaining Two (2) Nos of old DG (3&4) sets with Two (2) Nos 2000kVA, 0.8 power factor, 11kV Sets.
- 1.7 As part of this project Two (2) Nos. of 2000kVA, 0.8 power factor, 11kV, Diesel Generator Sets will have to be procured, erected and commissioned.

2.0 GENERAL

- 2.1 This Section describes the scope of work and must be read in conjunction with complementary Sections, 'Exclusions, 'Terminal Points' and attached drawings to obtain a proper interpretation of the scope. It shall be clearly understood by Bidders that all supplies and services required for trouble free operation of the system form part of the scope.
- 2.2 In keeping with the concept of turnkey contract, Bidder shall be responsible for the design, engineering, procurement, manufacture, inspection and testing at the works of manufacturer and/or sub-vendor, packing for shipment, forwarding including transit insurance, receipt at site, storage and handling at site, erection, testing, start-up & commissioning and performance testing, consumable for erection, testing and commissioning, power supply, safety - all to the satisfaction of the Institute/Project Engineer cum Estate Officer/Project Engineer's authorized representatives and in accordance with these specifications and as per good engineering practices.

2.3 The above responsibilities of the Bidder would include but not limited to Two (2) numbers 2000kVA, 11kV **Prime power rated** Diesel Generator Sets and all associated auxiliaries. Bidders shall indicate in their offer items if any that are not included in this specification but are required for proper operation of the system.

2.4 In the event of conflict in details for any equipment / item / sub-system, etc., between data sheets, drawings, Section-7.4, the explanation furnished in this section i.e., **Section-7.3** shall be considered for bidding purposes.

2.5 Battery Limit for DG Specification:

- a) Air inlet fans on inlet side wall of the DG room.
- b) Louvers on the exhaust side of acoustic enclosure.
- c) End of exhaust pipe with thermal insulation upto the end.
- d) Aviation warning light on exhaust stack
- e) 2 Nos earth pits each for neutral and body earthing, and earth pits for other equipment
- f) 11kV Switchgear-Bus Bar at 66/11kV near by substation.
- g) Input terminals supplying power to DG auxiliary MCC.
- h) Input terminals supplying power to Battery charger.
- i) Outlet flange of bulk oil tank.

3.0 OPERATINGPRINCIPLE

3.1 System Configuration:

3.1.1 There will be Four (4) Nos. of 2000 kVA 11 kV DG sets, two (2) numbers already installed and two (2) Nos. of 2000kVA new DG Sets to be installed against this enquiry.

3.1.2 The Two (2) new DG Sets shall be connected to existing 11kV DG Switchboard, where already Two (2) existing DG Sets of 2000kVA are connected.

3.1.3 All the Four (4) DG sets are connected to the common bus as there is no bus section/bus coupler in the existing 11kV DG Switchboard.

3.2 Operating Conditions, Sequence and Interlocks:

3.2.1 The DG sets are proposed to be operated as follows

The system will be such that depending on the load required number of DG sets will be started and synchronized. Provision shall be available all four (4) DG sets to operate in parallel depending on the total load.

3.2.2 In case of grid supply failure DGs will start automatically through AMF feature or as per Manual command and Master DG will be closed on 11kV Switchboard dead bus. Remaining DGs will be closed through synchronization check function.

3.2.3 A Woodward based control similar to that of existing system shall be provided to achieve the Auto control and Interlock functions.

3.2.3.1 One of the DG Sets will be selected as Master.

3.2.3.2 The others will be selected as Followers.

3.2.3.3 One lockable Auto-manual selection switch shall be provided in the AMF panel of each DG set. In Auto mode, the DG will be on PLC control.

3.2.3.4 In manual mode DGs will be start/stop , synchronizing with 11kV Switchboard manually

3.2.4 Parallel operation between the DG sets and utility grid supply is not envisaged

3.2.5 Operation of Neutral, Neutral Switch and Neutral Grounding Resistor

3.2.5.1 The Neutral of the generators shall be earthed through an individual neutral grounding resistor (NGR) rated as 100A for 10 seconds via a neutral switch(Contactors).

3.2.5.2 The NGR cum NIS panel shall conform to enclosed specification PCPL-4-S4-152 along with Data Sheets listed in PCPL-1850-4-S4-152-01.

3.2.5.3 To avoid multiple earthing of generators when the DG sets are operating in backup power mode as mentioned in Clause 3.2 above, the neutral of only one Generator will be earthed by closing the neutral switch. The neutrals of other generators will be kept isolated by keeping open the respective neutral switch to avoid multiple earthing of generators.

3.2.5.4 Annunciation:

The following annunciation shall be provided for each mode of operation:

- None of the neutral switches are closed.
- More than one neutral switch in the group is closed.

3.2.6 All required auxiliary relays and other hardware as required to provide the above scheme of operation shall be supplied and mounted in AMF/ CRM (Control Relay Metering) Panel.

3.2.7 The Mains failure input for auto start of DG sets shall be obtained from Bus PT of 11kV Switchboard in substation control room.

4.0 EQUIPMENT / SYSTEMS AND SERVICES TO BE PROVIDED BY THE BIDDER

- 4.1 Two (2) Nos. of 2000kVA, 0.8 lagging power factor, 11kV, 3 phase, 50Hz, 1500-RPM Diesel Engine driven, Prime power rated generating sets complete with AMF Cum Auto synchronizing, Auto load sharing control panel with manual starting and manual synchronizing facility. The DG Sets shall be suitable for continuous operation in parallel with each other and existing 2(two) Nos 2000 kVA DG sets.
- 4.2 All the sketches enclosed as part of the specification are for bidding purposes only and are suggestive. Successful Bidder shall furnish detailed design drawings for approval before manufacture.
- 4.3 Diesel engine, 4-stroke cycle, water cooled, turbo charged after cooled developing at 1500 rpm and specified site conditions, kW required to deliver alternator output of 2000kVA at 0.8.power factor. Bidders shall submit calculation to prove adequacy of engine selected, taking into account de rating due to site conditions, power consumed by engine driven auxiliaries and efficiency of the alternator offered. Following accessories shall be supplied for each set:
 - 4.3.1 Fly wheel and suitable flexible couplings with coupling guards if required.
 - 4.3.2 Intake air system with air cleaner (dry type).
 - 4.3.3 Water pump-centrifugal type-engine mounted.
 - 4.3.4 Complete fuel oil system covering HSD Booster pumps, day tanks, piping, valves and fittings, etc. as per Drg no. PCPL-1850-3-PI-001. The Bidder shall size the piping and booster pumps suitably.
 - 4.3.5 Bidder shall study the existing fuel oil system and modify same as required to achieve an automatic fuel filling system.
 - 4.3.6 Fuel filters
 - 4.3.7 Lube oil filters.
 - 4.3.8 Lube oil coolers
 - 4.3.9 Turbo chargers
 - 4.3.10 Radiators:
 - i) The DG sets shall be designed for water cooling with set mounted radiators.
 - ii) All accessories required for the cooling system scheme shall be supplied.
 - 4.3.11 Fan (Blower type) with safety guard if required.
 - 4.3.12 Electronic Governor having facility for remote control of speed shall be provided. The Governor shall have site adjustable droop characteristic (typically 1-5%).

4.3.13 Battery and Battery charger systems. : Required number of 12V batteries and battery charger systems complete with DC starter, Dynamo, built in voltage regulator, battery stand, etc, for each DG Set. The Battery offered shall, when fully charged, be suitable for minimum of 6 consecutive starts of DG Set in cold conditions.

4.3.14 Remote stopping (shut-off) facility.

4.3.15 Instrumentation system including engine and generator protection system.

4.3.16 Safety control against low lube oil pressure, high cooling water temperature and overspeed.

4.3.17 Lube oil Temperature gauge.

4.3.18 Lube oil Pressure gauge.

4.3.19 Coolant temperature gauge for both inlet and outlet.

4.3.20 Battery charging ammeter and voltmeter.

4.3.21 Hour run meter cum RPM meter.

4.3.22 Exhaust System:

The Exhaust System shall meet the requirements of Pollution Control Board, Karnataka.

Independent galvanised steel exhaust pipes for each DG set as per CPCB and PCB- Karnataka guidelines. The Vendor shall provide necessary structural supports for the exhaust piping system. A common Hot Dip Galvanised steel lattice support structure shall be provided for the exhaust stacks as shown in the Drg.No.PCPL-1850-3-GA-001.

4.3.23 Exhaust system covering ducts, expansion joints, silencer and exhaust pipe insulation and necessary supports etc. The insulation shall be of rock/mineral wool to a min. thickness of 75mm (wool density of 150kg/m³) with wire mesh binding and Aluminium sheet cladding.

4.3.24 Civil foundation for the lattice structure support shall be carried out by contractor. For detailed requirement of civil works refer document: PCPL-1850-3-401-03-02 (Specific Technical Requirements-Civil Works).

4.3.25 Exhaust system earthing and lightning protection shall be a part of this contract.

4.3.26 Support structure shall be hot dip galvanised finish complete with ladder for maintenance, landing space, etc.

4.3.27 Complete piping, valves, fittings and other accessories for fuel oil, lube oil, cooling water, and intake air and exhaust system.

4.3.28 All foundation channels, bolts, anchors, shims, resilient mounting pads, anti-vibration pads and other accessories as per manufacturer's recommendations.

- 4.4 Automatic fuel filling system comprising of a Buffer tank, 990 litre day tanks piping from buffer tank to day tanks, day tanks to DG set, flow meter for each DG set and associated valves and other fittings. Level controller shall be provided in the buffer tank and day tanks. Booster pump shall be controlled by level controller in the buffer tank. Two pumps one for normal operation and one standby shall be provided. Local isolation shall be provided for HSD Booster pumps. Flow of fuel from buffer tank to day tank shall be by gravity.
- 4.3.1 Fuel oil system comprising of 990 litre capacity day tanks and piping from day tank to DG set. Typical scheme is detailed at the enclosed drawing PCPL-1850-3-PI-001. The Bidder shall size the piping to suit the requirements.
- 4.3.2 Complete lube oil system including initial charge of lubricating oil.
- 4.3.3 Necessary safety equipment (fire extinguisher, rubber mat, first aid chart etc.) as stipulated by statutory authorities.
- 4.3.4 Four sets of operating and instruction manuals and Spare parts book.
- 4.5 Common base frame fabricated out of MS for coupling the engine to alternator through flexible coupling, anti vibration mounting etc.
- 4.6 Acoustic enclosure shall also be assembled on this common base frame.
- 4.4.1 Integral acoustic enclosure. The enclosure shall be designed for minimum 25dB (A) insertion loss or for meeting the ambient noise standards whichever is on the higher side (Ref. MOEF notification GSR 371(E)).
- 4.7 Bidders shall make suitable arrangements for supply of combustion and cooling air required by the DG sets.
- 4.8 Bidders shall make suitable arrangements to discharge hot air from the DG sets outside the DG room. This may involve ducting, louvers and modifications on the DG room wall on the acoustic enclosure outlet side
- 4.9 Control Relay and Metering Panel.
- Automatic Mains Failure (AMF) cum Auto synchronizing Auto load sharing panels described in Section – 7.4 of this specification. Panel shall comprise the following:
- i. Engine Generator control unit. Generator AVR, field breaker of the exciter, discharge resistors etc.
 - ii. Generator Protection relay numerical type suitable for IEC 61850 communication protocol
 - iii. AMF/Auto /Manual Synchronization and Load sharing system : The present DG-1 & 2 are provided with Woodward Easygen-3200 XT controller. Considering the seamless

interfacing & integration of all DG -1,2,3 & 4 for parallel operation same make and model of the controller shall be provided for DG-3 &4.

iv. Annunciation for tripping of Engine and Generator on faults and abnormal operating conditions.

v. Temperature Scanner for each DG, Trivector Meters for each DG, Electro-Mechanical relays for Master Trip/Lock out, Contact Multiplication only.

vi. Engine Battery Chargers.

4.10 One (1) lot 11kV (UE) grade, Aluminium multi strand, XLPE insulated, armoured, Power cable required for connection from generator neutral terminal to NGR Cubicle.

4.11 One (1) lot 11kV (UE) grade, Aluminium multi strand, XLPE insulated, armoured, Power cable required for connection from generator line terminals to 11 kV Circuit breakers

4.12 One (1) lot 11kV (UE) grade, Aluminium multi strand, XLPE insulated, armoured, Power cable required for connection from 11kV DG Switchgear to 11kV Switchgear DG Incomer at 66kV MUSS room.

4.13 One (1) lot 1.1kV grade, Copper multi strand, XLPE insulated, armoured, control cables and Copper multi strand, PVC insulated, armoured screened Instrumentation cables required for DG sets, Day tank, AMF panels and synchronizing panel.

4.14 One (1) lot cable terminations, comprising gland plates, cable glands, cable lugs etc for power and control cables.

4.15 One (1) lot earthing materials required for each DG set neutral and body earthing.

4.16 Control circuits shall be wired using copper conductor of at least 4 Sq.mm for CT circuits. All control wiring shall be carried out using multi-stranded copper conductor; FRLS PVC insulated wires of sizes as indicated at various sections.

4.17 One(1) No DG auxiliary MCC,existing MCC, being old equipment and due space constraint to accommodate new control panels, the same shall be discarded and New Compact MCC Panel catering to DG-1,2,3 & 4 is to be provided., The present cables shall be relocated to New MCC. Refer SLDPCL-1850-4-SLD-002

4.18 One(1)set of 11kV Switchgear comprising 2Nos 25kA Short circuit capacity VCB Incomer Panel, Adapter Panel for coupling to existing 11kV Switch Board along with required modification in the existing switchgear panel as listed in BOQ and as marked in the Single Line Diagram.PCPL-1850-4-SLD-001.

1.8 Two (2) Nos Neutral Grounding Resistor (NGR) panel as indicated in Dwg. No: PCPL-1850-4-SLD-001.NIS of DG-1,2,3 & 4 are to be electrically interlocked to avoid circulating current.

- 4.19 One(1)set of 110VDC Dual Float Cum Boost Charger along with Battery Bank, Battery Stand, Local Junction Box, Interconnection cabling to feed DG-3&4, 11kV Switchgear Panel, CRM Panel, NGR Panel etc.,
- 4.20 Replacing of existing Building Ventilation Inlet Air Fans with Fans capable of catering all the fourDGSetairconsumptionandtolimitroomtemperaturerisewithinpermissiblelimits.
- 4.21 Dismantling Works of existing old Diesel Engine Generator Sets- 3 & 4 and its Balance of Plant/Auxiliaries system/Cooling tower.
- 4.22 Buy Back of above said equipment and its relevant Switch gear (LAVT, NIS/NGR), Control gears & PLC Automation (located in first floor), Unused Power and control Cables, entire cooling tower materials, chimney materials are to proposed to be bought back by the successful bidder supplying new system.
- 4.23 DG-3 & 4 existing foundation shall be removed/dismantled and floor shall be leveled off. New foundation shall be constructed as per successful bidder's OEM standards/guidelines. Other associated minor civil works are also included as part of the contract.
- 4.24 Engine performance testing at OEM factory premises during Factory Acceptance Testing (FAT) to be witnessed by Purchaser or their representative.

5.0 TECHNICAL REQUIREMENT

- 5.1 The DG sets shall be capable of starting on their own when external power supply is not available.
- 5.2 Alternators shall be of salient pole, brush less, synchronous, revolving field, Insulation Class "F", air-cooled and drip-proof with a separately excited system using a permanent magnet generator and RTD for Winding and Bearing. Generators shall have the capability to provide minimum of 300 percent of rated three-phase current for 10 seconds. Phase segregated terminal box shall be provided which shall be suitable for terminating 11kV 3C 240 sq.mm. XLPE Cable. The neutral terminal shall be brought out in a separate terminal box on the opposite end.
- 5.3 The DG set shall be capable of starting from cold condition and reaching synchronous speed and ready to take load in a period of ten (10) seconds from the initiation of start impulses with out suffering undue stress, wear and tear. The DG sets shall be capable of accepting the maximum rated load of the generator within a period of thirty (30) seconds from the initiation of start impulse.
- 5.4 1600 kW Prime duty for 2000 KVA sets at 0.8 P.F at 11KV when the ambient surrounding the alternator is 40 deg C, intake air for combustion 40 deg C. The DG sets shall be capable of

peak-output of 10% in excess of the rated output for a period of one (1) hour in every 12 hours of continuous running at rated load, without exceeding permissible temperature limits and with a faintly visible exhaust.

- 5.5 The DG sets shall be capable of meeting the specified performance when using commercially available HSD oil to as per IS:1460-1974.
- 5.6 Diesel generator shall maintain output accuracy of +/-1% of voltage and +/- 0.25% of frequency at the terminals of the alternator under steady state condition.
- 5.7 The DG set shall be capable of taking a step load of 25% of its rated kW while running at rated speed at any load from 0 to 75% with speed drop of not more than 5% of rated speed and regaining final speed within 10 sec. Further the DG set shall be capable throwing 100% rated load when running at rated speed without causing over speed trip device to operate.
- 5.8 The digital governing system shall conform to accuracy class A1 as per ISO 8528. The speed governor shall have steady state transient response and recovery times fully conforming to class A1 governors as per as per ISO 8528. In addition when a 93KW motor for 2000KVA having a starting current of 3 Full load current(FLC) is started, the frequency dip and recovery time shall not be more than 5% and 3 Secs respectively. Governor shall have the following features.
 - a. It shall be capable of operating both as an 'isochronous' or a 'speed droop' governor. The droop for parallel operation shall be adjustable from 0-5% of the engine.
 - b. The governor system shall be provided with electronic devices, which would sense change in generator kW load and initiate corresponding change in governor setting prior to a signal being received from normal speed governing.
 - c. Governor shall be suitable for operation without external source of power supply. A kW load sensing facility shall be available in the engine governor /controller.
 - d. A over speed trip shall be provided to automatically shut off fuel in case the set reaches 110% rated speed. An engine mounted emergency stop push button shall be provided.
- 5.9 During recovery from transients caused by step load increase or resulting from the disconnection of the largest single load the speed of the D.G.set shall not exceed 115% of the nominal. Further, the transient following the complete loss of load shall not cause the speed of the unit to attain the over speed set point. The sub transient and transient reactance of the generator shall be chosen to meet the above requirements.
- 5.10 The voltage and frequency of the generator shall be adjustable between + / - 5% and + / -2.5% of the nominal values respectively from local D.G. control panel and remote control panel.

- 5.11 Successful bidder shall be responsible for getting all statutory clearances/ approvals (like PCB, CEIG/CEA) as applicable. The applicable statutory fees shall be reimbursed by the Institute at actual on submission of receipts.
- 5.12 Typical layout of the DG Sets is indicated on Dwg. No.PCPL-1850-4-GA-001.
- 5.13 The entire electrical control system shall be designed as a fuse less system. For Short Circuit protection, MCBs of suitable rating and characteristics shall be used.
- 5.14 Potential transformers shall be provided with MPCB on primary and RCBO (30mA) protections on secondary.
- 5.15 Space heaters provided in generator and panels shall be controlled by 50-90% setting range Humidistat protected by MCBs of suitable rating.
- 5.16 All instrumentation, meters, relays, switches, etc., used shall be totally shrouded design with finger touch proof terminations for human safety.
- 5.17 The response time of the AVR shall be such that on 20% voltage dip on sudden application of the load, Generator terminal voltage shall recover to within 0.5% set voltage in less than 500 ms.
- 5.18 All the protection functions are required to be provided for each DG set are shown in SLD No. PCPL-1850-4-SLD-001. If any of the protection function is not covered in the standard DG controller, same shall be covered by providing discrete numerical relays. These relays shall be located in the AMF/CRM panel.
- 5.19 AMF/CRM panels shall generally comply with in requirements of the enclosed specification PCPL-4-S4-175 and, also include all the items in Data sheet A3 & A4 therein.
- 5.20 Bidder shall be responsible for obtaining necessary DC voltages for all the equipment offered. If different voltages are required, same shall be obtained by providing adequate DC - DC converter power pack with protective devices both on the input and output side of the power pack. Each DG shall have a separate power pack. If common power pack is considered, redundant power pack with decoupling diodes shall be provided. Failure of power pack shall be annunciated.
- 5.21 Test specified in clause **13.3** of document no. PCPL-3-S4-101 shall be conducted at vendors works prior to dispatch.
- 5.22 Piping for cooling water, oil etc, shall be designed fabricated and tested in accordance with IS / ISO pressure piping code. All terminal connections and all pipe joints shall as far as possible be of welded constructions, screwed terminal connection shall be avoided. Piping design and installation shall be suitable for periodic testing.

5.23 PROTECTION DURING SHIPMENT : Materials shall be handled and stored so that they are protected against corrosion, damage or ingress of foreign matter. Flanges, openings, nozzles and terminals shall be thoroughly cleaned and adequately protected to prevent entry of extraneous material during transit and storage. Parts shall be suitably marked to facilitate matching during erection

5.24 PAINTING : Machined and finished surfaces shall be protected against formation of rust and corrosion by application of a rust inhibitor. All steel surfaces which are to be painted shall be thoroughly cleaned, de-greased and given one shop coat of primer, prior to assembly. All castings shall be sand blasted, de-greased and cleaned before painting. Primary and final painting for work done at factory and site should be done by contractor

5.25 Field Check for Proper Ventilation ; Bidder to demonstrate the adequacy of Ventilation System provided during Load Tests as detailed below:

Run the engine on full load / typical load for about 1 hour so that temperature in the genset room gets stabilised. Measure the ambient air temperature (ambient temperature should be measured outside the genset room in shade). Measure the temperature inside the genset room. Genset room temperature should be measured near air cleaner inlet of engine. Calculate temperature difference between genset room temperature and ambient i.e. ΔT .

5.26 Carrying out Soil Electrical Resistance measurement before starting the work and Earth Resistance after installation.

5.27 General maintenance Basic tools shall be included in the scope of supply.

5.28 Training of IISc Operating and Maintenance Personnel and Handing over. The Employer's technical team shall be trained in all aspects of operation, maintenance and administration of the system.

5.29 Any other Items Bidder feels to be included for Safe Installation, Testing and Commissioning and efficient and satisfactory operation of the system. Bidder to include the price and attach separate list of such items.

6.0 INSTRUCTIONS TO BIDDERS

- 6.1** Bidder shall quote for all the systems covered in this specification.
- 6.2** Bidder shall furnish complete information as called for in Data Sheet-B failing which the bid will be considered as incomplete and the Institute reserves the right to reject the bid.
- 6.3** The Institute's general terms and conditions shall form an integral part of this specification. In the event of conflict between the general conditions of the Institute and the conditions outlined in this specification, the former shall govern.
- 6.4** In the event of conflict between the contents of section-7.3 and other sections of the specification (except Data Sheet-A of section-7.4) the former shall govern. In the event of conflict between Data sheet-A of section-7.4 and the contents of section 7.3, the former shall govern.
- 6.5** BIDDERS shall carefully study all sections of this specification and shall clearly indicate in the "Schedule of Deviations" all deviations from the technical specification. If no deviations are indicated or except for the deviations indicated, it will be understood that in all other respects, the offer conforms to the specification and the Institute reserves the right to evaluate the bids without any further reference to the bidder. If the bidder indicates any comments on the specification elsewhere in the bid, the same will not be accepted. It is binding on the Bidder to supply the equipment and system in accordance with the specification except for the deviations accepted by the Institute. No extra claims on this account after the award of contract will be entertained by the purchaser.
- 6.6** Prices quoted shall be firm till execution of the order. No increase in price shall be accepted by the purchaser.
- 6.7** Vendor shall submit quality assurance plan, which would form part of purchase order. This should enable the Institute to assure the quality of equipment at various stages of manufacture.
- 6.8** Negotiation of technical parameters by Bidder after the bids are opened will not be entertained.
- 6.9** The vendor shall keep their testing instruments duly calibrated with standard meters not earlier than 6 months from the date of inspection. Calibration certificates shall be made available to the Project Engineer cum Estate Officer or Project Engineer cum Estate Officer's authorized representative(s) at the time of inspection. In case instruments built into DG controllers are used for measurements, calibration certificates of controllers shall be made available.
- 6.10** Bidder shall submit along with the bid, copies of registration documents, with appropriate authorities of the concerned state government or any other statutory authorities.
- 6.11** Bidder is advised to visit the site of work with the prior permission of Project engineer cum Estate officer in order to acquaint with all the connected information before submitting the bid. Bidder or his/ her representative shall be deemed to have inspected and examined the site and

surroundings and to have collected all information for making his/ her bid complete and to have ascertained as to risks, contingencies and other circumstances which may influence or affect the terms of the bid. Written confirmation regarding visit to site and collection of all the necessary information shall be sent with the offer.

- 6.12 Bid shall be submitted along with all the commercial schedules and with full technical particulars as required in schedule included in this specification. Design features, descriptive literature of the equipment offered and installation details shall also be included.
- 6.13 Bid shall be submitted strictly as per the format outlined in the schedules to enable Institute/Project engineer cum Estate officer to evaluate the bids expeditiously and finalize award of contract.
- 6.14 The Institute reserves the right to evaluate the bids as such without any further reference to the BIDDER. It is binding on the BIDDER to supply the equipment/ systems except for deviations accepted by the Institute.
- 6.15 BIDDER shall submit particulars of SUB-CONTRACTORS if any on whom the BIDDER intends to sub-contract part of the work and also the nature and extent of such sub-contracted work. This shall be subject to the Institute/Project Engineer cum Estate Officer's approval.
- 6.16 The Institute does not bind itself to accept the lowest or any tender, nor to assign any reason for the rejection of any tender.
- 6.17 Offers for individual or part scope of work will be treated as incomplete and hence will be rejected outright.
- 6.18 Notwithstanding anything stated above the Institute reserves the right to assess the Bidder's capacity and capability to execute the contract, should the circumstances warrant such assessment in the overall interest of the Institute.

7.0 BASIS FOR BIDDING

- 7.1 Bidder shall use the formats furnished in this specification.
- 7.2 Bidder shall fill up the data requested in Data Sheet-B in electronic form and the same may be protected. One hard copy duly signed with company's seal shall be enclosed with the bid. In case of any discrepancy between hard copy and the electronic copy, the details / values furnished in electronic copy will be treated as final and evaluation will be carried out.
- 7.3 Bidder shall fill up Section-8 electronically and the same may be protected. One hard copy duly signed with company's seal shall be enclosed with the bid. Bidder can increase the number of rows, if the rows provided are not sufficient, and can use multiple sheets.
- 7.4 CD's containing partly protected Data Sheet-B, schedule for deviations and Section-8 will be provided to the Bidder and the same CD after filling all the details shall be returned to the Institute with the Bid.
- 7.5 If Bidder furnishes the details in different format, the bid is liable for total rejection.

8.0 APPROVED MAKES.

8.1 The following makes of components are acceptable. Any other make if offered shall be subject to Institute/ Project engineer cum Estate officer's approval:

1.0	Diesel Engines	MTU / Caterpillar / Cummins / Perkins/
2.0	Generator	Cummins Generator technologies / Leroy Somers / TDPS / ABB
3.0	AV Mounts	GERB (Germany) / Resistoflex
4.0	Electronic Governor	Engine manufactures standard
5.0	Generator Synch and Load Share Controller	Woodward Easygen Only.
6.0	11kV Switchgear Panel	Schneider Electric (OEM/Channel Partner)
7.0	NIS+NGR Panel	Amp Controls (Pune)/ Ohmark Controls/ Vee Vee Controls / Amba Industries.
8.0	HT Isolator for NIS+NGR Panel	Pentagon/Essen/Crompton
9.0	Neutral Grounding Resistor	Amp Controls (Pune)/ Ohmark Controls
10.0	MCCB	Siemens / ABB / Schneider
11.0	HV Circuit Breakers	Schneider Electric make and model is preferred as per the existing so as to have interchangeability.
12.0	Air Circuit Breakers	Siemens / ABB / Schneider
13.0	MCCB/MCB/ ELCB	Siemens / ABB / Schneider
14.0	Power & Aux Contactors	Siemens / ABB / Schneider
15.0	Battery Bank	Amara Raja / Exide / HBL Power Sys / Rocket
16.0	Battery Charger	Amara Raja / HBL Power Sys / Caldyne
17.0	Instrument Transformers	Kappa / Pragathi / Kalpa
18.0	11kV Grade Cables	CCI / NICCO / Universal/ KEI / KEC-RPG
19.0	415V Power / Control / Instrumentation Control Cables	CCI / NICCO / Universal / RR kabel / LAPP / KEI / KEC-RPG
20.0	Wall mounted DBs	MDS Legrand/ Siemens/ Schneider/ ABB
21.0	Switches/ Sockets/ Boxes	ABB/ Siemens/ Legrand/ Schneider
22.0	Steel	SAIL/ TISCO/ ESSAR
23.0	Terminal connectors/ Glands	Wago/ Phoenix / Connectwell
24.0	Bushings/ Insulators	Modern/ BHEL/ WSI/ Jayashree/ IEC

25.0	Protective relays	ABB/ Siemens/ GE/Schneider/ Woodward
26.0	Trivector Meter	L&T/Secure Meters
27.0	Analog & Digital meters	Siemens/ Schneider(Digital)/ AE (Analog)
28.0	MS Conduits & Accessoires, Cable lugs	AMP/ Dowells
29.0	Temp. Scanner	Masibus
30.0	Insulation	Dupont/ 3M
31.0	Fasteners	TVS/ Internationally reputed
32.0	Glass wool:	Twaiga / Lloyd / eqt.
33.0	Fresh air / Exhaust fan	GEC / Almonard / Nadi
34.0	Indicating Lamps / Push Buttons	Siemens / ABB / Schneider / Teknic

9.0 DOCUMENTATION

- 9.1** Vendor shall submit DG Set overall general arrangement drawings giving plan, elevation and side view with complete bill of material and makes; drawings for external terminations like cable box chambers, major component drawings, schematic & wiring diagrams with ferrule and terminal numbers etc., in **THREE** sets each to the Project Engineer cum Estate Officer/Institute for approval before start of manufacture.
- 9.2** Whether explicitly mentioned or not in the various sections of this specification, Vendor documentation shall include hard copies of all drawings related to this package, operating and instruction manuals, training manuals, etc., in **SIX sets** after delivery of DG Sets to site.
- 9.3** The following minimum documentation shall be furnished along with the completed bid:
- a. Description of the DG set with basic technical details
 - b. Derating calculations for engine and alternator.
 - c. Type test certificates for engine and alternator models offered. The certificates shall be based on tests conducted not earlier than 2 years from date of offer.
 - d. Back pressure allowed and exhaust pipe size calculation.
 - e. Noise level measurement on DG sets with engine and alternator models offered.
 - f. Data sheets for DG set including generator and accessories as called for in Data Sheet-B.
 - g. Guaranteed performance data as per clause 13.0
 - h. G.A. drawings & Catalogue.
 - i. Schedule for project execution with major milestones
 - j. Details of manufacturing and testing facilities
 - k. Reference list of similar equipment supplied with contact details of clients.
 - l. Performance certificates for DG sets with same engine and alternator models from customers **in India**. The DG sets must be currently in operation and shall have worked for more than 6000 hours.
 - m. Confirmation regarding visit to site and collection of information required for preparing proper offer.
 - n. Details of the painting, and special treatment for tropical conditions,
 - o. Details of servicing facility available in Bangalore/ nearest city with contact details.

p. Qualifications and experience of the personnel proposed for supervision of operation and maintenance during the defect liability period.

q. List of spare parts required for operation of the DG sets for 3 years along with part numbers and unit rates

9.4 On award of contract, the Vendor shall furnish the following documentation/ drawings for approval:

- a. Data sheets for DG set including generator and accessories as called for in Data Sheet-B.
- b. DG Set & Control panel GA drawings
- c. Single Line Diagrams,
- d. Fuel System P&I Diagrams.
- e. Control panel Drawings
- f. DG Room Ventilation System adequacy check and Fan sizing calculation.
- g. 110VDC Battery sizing, & Charger System Drawings.
- h. 11kV Switchgear Panel, NGR Panel, DG Aux MCC GA drawings.
- i. Block interlock diagrams
- j. Schematic and control wiring diagrams.
- k. Quality plan
- l. Cable schedule and ICS
- m. Earth Resistance measurement Report
- n. Earthing layout
- o. Foundation layout
- p. Exhaust Stack/Chimney drawings
- q. Exhaust Stack and structural support Calculations/ design details
- r. Copies of valid type test reports.
- s. Schedule of maintenance with O&M manuals

9.5 After Commissioning, the Vendor shall furnish the As built drawings/ documentation, Operation and Maintenance Manual in bound volume for records in six set of Hard copy and 2 Nos of CDs.

- a. General Arrangement drawings
- b. Sectional Elevation of all mechanical equipment.
- c. Exhaust routing etc.,
- d. Chimney details
- e. Maintenance instructions.
- f. Manuals
- g. Spare parts with part numbers.
- h. All routine and site test reports.

10.0 EXCLUSIONS:

10.1 Supply and installation of DG room lighting.

10.2 Building Roof relevant works.

10.3 DG Room Wall Painting.

10.4 Bulk Diesel storage tank.

11.0 INSPECTION, TESTING AND DISPATCH

11.1 Inspection and testing shall be carried out based on this specification and with approved drawings certified by the consultant / Client. The Client and their consultants shall have the right to carry out stage inspection and shop visit to review the manufacturing progress. All routine and type tests specified shall be carried out during final inspection. 15 days advance notice shall be given for carrying out the final inspection. Any fuel charges for load testing shall be included in the offer, which shall be indicated separately in the Offer. Bidder shall ensure that a competent testing authority calibrates all meters and equipment used testing and the calibration certificates are valid at the time of carrying out test. After completion of inspection and testing Bidder shall furnish all as built documents in two sets. Only on receipt of final documents the release order for dispatch of equipment shall be issued.

12.0 DELIVERY:

12.1 The DG sets to be procured under this specification shall be supplied to site within the period stipulated in the forwarding letter. Bidder shall submit a bar chart for various activities of manufacturing, testing, inspection and delivery.

13.0 HANDLING

13.1 The engine/generator set shall be delivered to site properly packaged and mounted on pallets or skids to facilitate handling of heavy items. Factory-fabricated type containers or wrappings shall be utilized for engine/generator and components, which shall protect equipment from damage. Engine-driven generator equipment shall be handled carefully to prevent physical damage to equipment and components. Any damaged equipment shall be removed from site and replaced with new equipment.

14.0 INSTALLATION AND COMMISSIONING

14.1 Installation & Commissioning shall be carried out based on the latest requirement of the various statutory authorities such as electrical inspector, factory inspector, pollution control board, regulatory authority, and any other statutory agency appointed by the purpose by the state / central / municipal bodies. The document / drawings required for obtaining the approval shall be prepared by the bidder. The Bidder shall obtain the approval for the installation from all the above agencies. All official payment made for such approvals shall be reimbursed at actual on submission of original receipts. After installation as per the final approved drawing, the Bidder shall carry out the site testing as specified in presence of consultant. DG shall be taken over by Client only on acceptance by the consultant and satisfactory test results. The Employer shall witness the commissioning. A minimum of seven working days notice shall be given to the Consultant / Employer prior to the start of commissioning. A Specialist Agency approved by the Consultant / Employer shall be responsible for the testing and satisfactory performance of the complete synchronizing system.

15.0 SERVICE

15.1 Manufacturers shall have established network of service centers in the place of installation and capable of servicing the specified equipment. The Personnel shall be factory trained and shall be available for servicing within 24 Hrs.

16.0 FUEL SPECIFICATION

16.1 The specification of commercial fuel applicable for -diesel gensets shall be the same as applicable for commercial HSD (High Speed Diesel) applicable for diesel vehicles in the area, from time to time.

17.0 PERFORMANCE GUARANTEE AND DEFECT LIABILITY PERIOD

17.1 The Engine, Generator, Electrical Switchgear, Control Gear Mechanical accessories and the associated civil works as covered in Section-5 Price schedule shall have a warranty of **Twenty Four (24) months** from the date of Site acceptance Testing of both the sets as witnessed and certified by IISc Project Engineer.

17.2 Performance tests shall be as per ISO 8258, ISO 3046 and IEC60034

18.0 GUARANTEED PARAMETERS

18.1 The performance figures indicated in data sheets / GTP shall be guaranteed within the tolerance specified or as permitted by relevant standards. In case of failure of equipment to meet the guaranteed performance, client reserves the right to reject the equipment. However, client also Reserves the right to use the rejected equipment until the Bidder supplies new equipment meeting the guaranteed performance requirements. If any equipment supplied by the Bidder fails at site during erection, commissioning or service [within guarantee period], the Bidder shall repair and put back into successful operation the failed equipment within the time frame and procedure of repair agreed with the client depending on nature of failure at no extra cost to the client.

18.2 Following items of performance shall be guaranteed by the supplier in respect of the DG sets and auxiliaries, when operating under specified site conditions given in Annexure.- Guaranteed values for following parameters shall be indicated in the offer.

- a. Specific fuel oil consumption – **without tolerance**
- b. Specific lube oil consumption
- c. Temperature rise of engine & alternator.
- d. Emission level - exhaust gas & noise
- e. Efficiency of alternator at 75% load & 0.8p.f
- f. Generator output (kW /KVA)
- g. Time to start and develop rated voltage.
- h. DG set auxiliary power consumption
- i. Net electrical power output at specified power factor and terminal voltage under specified conditions considering de-rating factors as given in ISO standards.
- j. Jacket water temperature to and from engine. (As applicable)
- k. • Lubricating oil temperature to and from engine.

l. Governor response and over speed capability.

m. Voltage regulator response.

Contractor shall indicate the tolerance applicable to each of the guaranteed parameters above and the reference standard.

19.0 Advice to site personnel when working near underground Electrical cables

Important Note: Always assume that Electrical cables are present. Treat any cables found anywhere as LIVE. During the course of the excavation, all site workers should exercise the following precautions: Whenever possible, hand dig near underground services. Spades and shovels are safer than picks or forks. Watch out for signs and the position of cables as work continues. Do not use hand-held power tools directly over the marked alignment of an underground electricity cable identified by the competent person. Only use such tools if the work cannot feasibly be carried out by hand tools. For hand-held power tools used for the purpose of breaking paved concrete surfaces, a horizontal clearance of 250 mm from any underground electricity cable must be maintained. Otherwise, a clearance of 500 mm around any underground electricity cable nearby must be maintained. Keep a clear distance of 1 m between the side of any distribution cable and the bucket of a mechanical excavator, and for transmission cables, the distance is extended to 3 m. Keep a clear distance between underground electricity cables and other utility plant (e.g. gas and water pipes, telecommunication cables, etc). The distance should be at least 300 mm for cables of below 66 kV and at least 1 m for cables of 66 kV and above. Do not build existing underground electricity cables into a manhole or other structure or encase them in concrete. Always provide adequate support and anchoring of exposed underground electricity cables according to the electricity supplier's recommendations. Report any electrical accident or damage to an underground electricity cable or its

sheath, to Engineer-in-charge, CCMD. Even if there is no immediate danger, damage could lead to danger at a later date. Evacuate everyone from the immediate area of the damage but do not attempt to remove any objects or to touch injured persons, who are in contact with the damaged cable because the cable may still be LIVE. Even if the underground electricity cable seems to be disconnected and abandoned, do not attempt to drill or cut into it, or to dismantle it until approval has been given by the Engineer-in-charge, CCMD. All back filling of excavations must be done carefully and warning tapes, tiles, protection plates or other protection must be replaced in their original position. The electricity supplier should be approached for make-up cable protection materials if they are missing or damaged before the back filling. The same back filling materials should be used unless otherwise agreed with the electricity supplier. If in doubt, the contractor must seek advice from CCMD on the specific requirements, etc. Damaging underground electricity cables is dangerous and can often cause flash over, explosion or fire. Damage can result from excavation or penetration of the ground. Underground electricity cables may be found in roads, footpaths and on sites.

6.3.2 Specific Technical Requirement (Civil)

1.0 SCOPE OF ENQUIRY:

1.1 The scope of this enquiry is to briefly describe the various civil and structural works required as a part of Electrical System up-gradation works at the IISc. Campus at Bangalore. As part of the up-gradation works it is proposed to install two no.s 2000 KVA DG sets. These DG sets are proposed to be installed in the existing DG room in place of two old DG sets which will be disposed off. The proposed layout is shown in Drawing No. PCPL-1850-4-GA-001. Foundations of the existing 2 DG sets will be dismantled and new foundations will be provided. Wall in front of new DG sets will be dismantled to allow for the hot air outflow. new brickwork will be constructed around the louver opening of the DG sets. Some minor modification may be required in the existing pipe trench. New foundation will be provided for the exhaust structure outside the building.

1.2 In brief following works are part of the scope of contractor:

- 1.2.1 Dismantling of 2 existing DG set Foundations
- 1.2.2 Construction of RCC foundations for DG Sets and the exhaust structure.
- 1.2.3 Dismantling of existing wall.
- 1.2.4 Dismantling of portion of pipe trench..
- 1.2.5 Cutting the portions of loft inside the building and chajja outside the building from the existing RCC beam.
- 1.2.6 Construction of new pipe trench as per requirement
- 1.2.7 Construction of new brick masonry around the hot air louver opening from the DG sets..
- 1.2.8 Providing GI framework made of angles, plates or other GI members around the hot air louver opening to fill up the gaps.
- 1.2.9 Any other minor civil works required for the completion of the entire work.

2.0 EARTHWORK SPECIFICATION:

2.1 In general, earthwork excavation in different materials, site grading, filling back around foundations and in plinths, disposal of surplus spoils or stacking them properly, compaction and all related work shall be carried out as per the following specifications.

2.2 The following Indian Standard codes, latest versions, shall be applicable.

- 2.2.1 IS-1200 - Method of measurement of Building Works.
- 2.2.2 IS-3764 - Safety code for excavation works.
- 2.2.3 IS-3385 - Code of practice for measurement of Civil Engineering works.
- 2.2.4 IS-2720 - Part – II - Determination of moisture Content
- 2.2.5 Part –VII- Determination of Moisture Content-Dry Density Relation Using Light Compaction.

2.2.6 Part-VIII – Determination of Moisture Content-Dry Density Relation Using Heavy Compaction.

2.2.7 Part-XXVIII- Determination of Dry Density of Soils, in-place, by the Sand Replacement Method

2.2.8 Part-XXIX- Determination of Dry Density of Soils, in-place, by the Core Cutter Method.

2.3 Owner will furnish drawings wherever such drawings are required to show areas to be excavated/filled, sequence of excavation etc. Contractor shall strictly follow such drawings.

2.4 Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour materials, any temporary works, consumables, any and everything necessary for completion of the job in accordance with requirements.

2.5 Contractor shall carry out the survey of the site before excavation and set properly all lines and establish levels for various works such as earthwork in excavation for grading, basement foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out taking accurate cross sections of the area perpendicular to established reference/grid lines determined by Owner based on ground profile. These shall be properly recorded.

2.6 The excavation shall be done to correct lines and levels. This shall include proper shoring to maintain excavations and also the furnishing, erection and maintenance of substantial barricades around excavated areas and warning lamps at night for ensuring safety.

2.7 Earthwork is classified under any of the following categories:

2.7.1 Ordinary & Hard Soils: - These include all kinds of soils containing Kankar, sand silt, murrum and/or shingle, gravel, clay, loam, peat, ash, shale, etc. which can generally be excavated by spade, pick axes and shovel, and which is not classified under soft and decomposed rock” and “hard rock” defined below. This shall also include embedded rock boulders not longer than 3 feet in any direction and not more than 8 inches in any one of the other two directions.

2.8 Excavation for permanent work shall be taken out to such widths, lengths, depth and profiles as are shown on the drawings. Rough excavation shall be carried out to a depth of 6 inches above the final level. The balance shall be excavated with special care. Soft pockets shall be removed at the final level. The final excavation shall be carried out just prior to laying the mud-mat.

2.9 Contractor may, for facility of work or similar other reasons excavate, and also backfill later, outside the lines shown on the drawings. Payment, however, shall be made only as per the drawings. Should any excavation be taken below the specified levels, Contractor shall fill it up, with concrete of the same class as in the foundation resting thereon, upto the required level. No extra payment shall be made to Contractor on this account.

3.0 SPECIFICATIONS FOR STRUCTURAL CONCRETEWORKS

- 3.1** This specification covers the general requirements for concrete to be used using on-site production facilities including requirements relating to the quality, handling, storage of ingredients, proportioning, batching, mixing and testing of concrete and also requirements relating to the quality, storage, bending and fixing of reinforcement. This also covers the transportation of concrete from the mixer to the place of final deposit and the placing, curing, protecting, repairing and finishing of concrete.
- 3.2** The following specifications, standards and codes are made a part of this specification. All standards, specifications and code of practices referred to herein shall be the latest edition including all applicable amendments and revisions. In case of discrepancy between this specification and those referred to herein, this specification shall govern by relevant IS codes.
- 3.3** In the event that the local statutory or pollution control board requirements are more stringent than those set forth in this specification, such requirements shall be considered part of this specification and shall supersede this specification where applicable.
- 3.4** Owner shall inspect the source/s of material, the operation of procurement and the layout for storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Owner's approval obtained, prior to starting of concrete work.
- 3.5** The materials to be used in manufacture of standard concrete shall consist solely of a standard type portland cement, clean sand, natural coarse aggregate, clean water, admixtures, if specially called for on drawings or specifications.
- 3.6** Unless otherwise specified in the drawings or called for by Owner, cement shall be ordinary Portland cement in 50 kg. Bags. Changing of brands or type of cement within the same structure will not be permitted.
- 3.7** A certified report attesting to the conformance of the cement to I.S specifications by cement manufacturer's chemist shall be furnished, for each consignment received at site to Owner.
- 3.8** All fine and coarse aggregate proposed for use in the work shall be subject to Owner's approval and after specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of Owner.
- 3.9** Samples of aggregate for mix design and determination of suitability shall be taken under the supervision of Owner and delivered to the laboratory, and records of test results on aggregates and concrete submitted to Owner in advance of the scheduled placing of concrete.
- 3.10** Aggregates having a specific gravity below 2.6 (saturated surface dry basis) shall not be used.

- 3.11 Fine aggregate shall consist of natural or crushed sand to I.S. 383. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, and adherent coating. Clay, loam, alkali, organic matter, mica, salt, or other deleterious substances, which can be injurious to the setting qualities / strength/durability of concrete.
- 3.12 Sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter.
- 3.13 The percentage of deleterious substances in sand delivered to the mixer shall not exceed the following:
- 3.14 Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron I.S. sieve, by total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron I.S. sieve or to percentage passing any other sieve size on the coarser limit of Grading Zone I or the finer limit of Grading Zone IV. Fine aggregates conforming to Grading Zone IV shall not be used.
- 3.15 The sand shall have a fineness modulus of not less than 2.6 or more than 3.2. The fineness modulus is determined by adding the cumulative percentage retained on the I.S. sieve sizes 4.75 mm 0.36 mm, 1.18 mm, 600 micron, 300 micron, 150 micron and dividing the sum by 100.
- 3.16 Coarse aggregate for concrete shall conform to I.S. 383. This shall consist of natural or crushed stone and gravel, and shall be clean, free from elongated, flaky or laminated pieces adhering coatings, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter.
- 3.17 Natural gravel and crushed rock shall be screened and/or washed for the removal of dirt, or dust coating.
- 3.18 Coarse aggregate shall be graded in and the grading shall be within limits.
- 3.19 Water used for both mixing and curing shall be free from injurious amounts of deleterious materials. Potable water is generally satisfactory for mixing and curing concrete.
- 3.20 In case of doubt, the suitability of water for mixing concrete shall be ascertained by the compressive strength and initial setting time test specified in I.S. 456. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account taken of seasonal variations. The sample shall be stored in clean container previously rinsed out with similar water.
- 3.21 Average 28 days' compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90 % of the average strength of three similar concrete cubes with distilled water.

- 3.22 In initial setting time of test block made with appropriate test cement and the water proposed to be used shall not be less than 30 minutes and shall not differ more than 30 minutes from the initial setting time of control test block prepared with the appropriate test cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of I.S.4031.
- 3.23 Where water can be shown to contain an excess of acid, alkali sugar or salt, Owner may refuse to permit its use. Percentage of solids in water when tested in accordance with the method indicated below, shall not exceed the following:
- 3.24 Reinforcement bars, if supplied by Contractor, shall be either plain round mild steel bars grade I as per I.S. 432. (Part I) or medium tensile steel bars as per I.S. 432 (Part I) or hot rolled mild steel and medium tensile steel deformed bars as per I.S. 1139 or cold twisted steel bars as per I.S.1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with I.S. 1566. Substitution of reinforcement will not be permitted except upon written approval from Owner.
- 3.25 The reinforcement shall not be kept in direct contact with the ground but stacked on top of an arrangement of timber sleepers or the like. Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.
- 3.26 All steel shall be of Grade I quality. No re-rolled material will be accepted. If demanded by Owner, Contractor shall submit the manufacturer's certificate for steel. Random tests on steel supplied by Contractor may be performed by Owner as per relevant I.S. All costs incidental to such tests shall be at Contractor's expense. Steel not conforming to specifications shall be rejected.
- 3.27 Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be staggered and the locations of all splices, except those specified on the drawings, shall be approved by Owner. The bars shall not be lapped unless the length required exceeds maximum available lengths of bars at site.
- 3.28 Reinforcement shall be accurately fixed by any approved means and maintained in the correct positions shown in the drawings by the use of blocks, spacers and chairs as per I.S. 2502, to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be securely bound together at all such points with no. 16 gauge annealed soft iron wire. The vertical distance required between successive layers of bars in beams or similar members shall be maintained by the provision of mild steel spacer bars at such intervals that the main bars do not sag between adjacent spacer bars.
- 3.29 Erected and secured reinforcement shall be inspected and approved by Owner prior to placement of concrete.

- 3.30 For payment of work done under this item, the actual quantity of steel as required by and as calculated from the drawings and approved by Owner, irrespective of the level or the height at which the work is done, shall be taken. The unit rate for reinforcement shall include all wastage, binding wire, etc., for which no separate payment shall be made. Laps as shown in drawings and as per required at site and approved by Owner, shall be measured and paid for.
- 3.31 All concrete in the work shall be "Controlled Concrete" as defined in I.S. 45, unless it is a nominal mix concrete such as 1:3:6, 1:4:8 or 1:5:10. Whether reinforced or otherwise, all controlled concrete works to be carried out under this specification shall be divided into the following.
- 3.32 Contractor shall carry out concrete mix design to investigate the grading of aggregates, water to cement ratio work ability and the quality of cement required to obtain the maximum strength specified of preliminary and work cubes. The proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made.
- 3.33 Whenever there is a change either in required strength of concrete or water/cement ratio or work ability or the source of the aggregates and/or cement, preliminary tests shall be repeated to determine the revised proportion of mix to suit the altered conditions.
- 3.34 Materials shall be brought to room temperature and all materials shall be in dry condition. The quantities of water, cement and aggregate for each batch shall be determined by weight to an accuracy of 1 part in 1000 parts.
- 3.35 It shall be done in a small batch mixer as per I.S.516 in such a manner as to avoid loss of water. The whole batch is mixed thoroughly for a period of not less than 2 minutes until the resulting concrete is uniform in appearance.
- 3.36 The consistency of each batch of concrete shall be measured immediately after mixing, by the slump test in accordance with I.S.1199.
- 3.37 Concrete test cubes shall be moulded by placing fresh concrete in the mould and compacted as specified in I.S.516.
- 3.38 Only such quality of water shall be added to cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, and satisfactory work ability, consistent with the strength stipulated for each class of concrete. The water added to the mix shall be such as not to cause segregation of materials or the collection of excess water on the surface of the concrete.
- 3.39 The water cement (W/C) ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix.
- 3.40 The actual water cement ratio to be adopted shall be determined in each instance by Contractor and approved by Owner.

3.41 The W/C ratio specified for use shall be maintained. Contractor shall determine the water content of the aggregates frequently as the work progresses and as specified in I.S.2386 (Part III) and the amount of mixing water added at the mixer shall be adjusted as directed by Owner so as to maintain the specified W/C ratio. To allow for the variation in weight of aggregates due to variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

3.42 After the amount of water required is determined, the consistency of the mix shall be maintained throughout the progress of the work and approved tests e.g. slump tests, compacting factor tests, in accordance with I.S.1199, shall be conducted from time to time to ensure the maintenance of such consistency.

3.42.1 The following slumps shall be achieved for various types of construction.

Slumps for various types of constructions	Slump in millimetres	
	Maximum	Minimum
Reinforced foundation walls and footings, pile caps	80	50
Plain footings, Caissons and sub structure walls	75	35
Slabs, Beams and reinforced walls	100	50
Columns	100	60

3.43 The materials and proportions of concrete materials as established by the preliminary tests for the concrete mix design shall be rightly followed for all concrete on the project and shall not be changed except when specifically permitted by Owner.

3.44 Each time the work stops, the mixer shall be cleaned out and when next commencing the mixing, the first batch shall have 10% additional cement to allow for sticking in the drum

3.45 Facilities required for sampling materials & cement in the field shall be provided by the Contractor and this cost shall be included in his quoted rates.

3.46 Slump tests shall be carried out immediately after sampling.

3.47 Where specified and approved by Owner, suitable air entraining agent may be used to produce specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6-260, Air Entraining Admixtures for Concrete. The recommended air content of the concrete is 4% + or - 1%. The method of measuring air content shall be as per I.S.1199

3.48 Where specified and approved by Owner, water reducing admixtures shall be added in quantities specified by owner. The admixtures shall be added in the form of a solution.

- 3.49 Where specified and approved by Owner, retarding agents shall be added to concrete mix in quantities specified by Owner.
- 3.50 Where specified and approved by Owner, water proofing agent conforming to IS.2645, shall be added in quantities specified by Owner.
- 3.51 Owner may at his discretion instruct the Contractor to use any other admixture in the concrete.
- 3.52 The above test shall be carried out by Contractor, even if the materials are supplied by Owner. No separate payment shall be made for these tests & Contractor shall include the cost of these in his unit rates of concrete works.
- 3.53 If the work cubes do not give stipulated strength, Contractor shall dismantle portions of the work, which are un-acceptable and re-do the work to the standard stipulated at Contractor's cost. The unit rate for concrete shall be all inclusive, including making preliminary mix design and test cubes, works cubes, testing them as per specification, slump test, optional tests etc., complete.
- 3.54 In the event of any work being suspected of faulty material or workmanship or both, Owner before requiring its removal and reconstruction, may order that it should be load tested in accordance with the following provisions
- 3.55 The test load shall be 125% of the maximum superimposed load for which the structure was designed. Such test load shall not be applied before 56 days after the effective hardening of concrete. During the test, struts strong enough to take whole load shall be placed in position leaving a gap under the members. The test load shall be maintained for 24 hours before removal.
- 3.56 If within 24 hours of the removal of the load, the structure does not show a recovery of at least 75 percent of the maximum deflection shown during the 24 hours under the load, the test loading shall be repeated after a lapse of at least 72 hours, the structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 75 percent of the maximum shown during the second test. The cost of the load test shall be borne by the Contractor.
- 3.57 Any other tests, e.g. taking out in an approved manner concrete cores, examination and tests on such cores removed from such parts of the structure as directed by Owner, sonic testing etc., shall be carried out by Contractor if so directed.
- 3.58 Should the result of any test prove unsatisfactory, or the structures show signs of weakness, undue deflection or faulty construction, Contractor shall remove and rebuild the member or members involved or carry out such other remedial methods as may be required by Owner. Contractor shall bear the cost of doing so.

- 3.59 Before the concrete is actually placed in position, the insides of the form work shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottom of columns and wall forms, to permit removal of saw dust, wood shavings, binding wires, rubbish dirt etc., Openings shall be placed or holes drilled so that these materials and water can be removed easily. Such openings/holes shall be later suitably plugged.
- 3.60 The various trades shall be permitted ample time to install drainage and plumbing lines, floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedment's to be cast in concrete as indicated on the drawings or as is necessary for the proper execution of the work. All such embedment's shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.
- 3.61 Slots, openings, holes, pockets etc., shall be provided in the concrete work in the positions indicated in the drawings or as directed by Owner.
- 3.62 Reinforcement and other items to be cast in concrete shall have clean surfaces that will not impair bond.
- 3.63 Prior to concrete placement all work shall be inspected and approved by Owner and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected at Contractor's cost.
- 3.64 Approval by Owner of any and all materials and work as required herein shall not relieve Contractor from his obligation to produce finished concrete in accordance with the drawings and specifications.
- 3.65 Immediately before concrete placement begins, prepared surfaces, except form work, which will come in contact with the concrete to be placed, shall be covered with a bonding mortar as specified later in this document.
- 3.66 All buckets, containers and conveyors used for transporting concrete shall be mortar-tight. All means of conveyors shall be suitable to deliver concrete of the required consistency and plasticity without segregation or loss of slump whatever method of transportation is employed. Chutes shall not be used for transport of concrete without the written permission of Owner and concrete shall not be re-handled before placing.
- 3.67 Concrete must be placed in its final position before it becomes too stiff to work. On no account water shall be added after the initial mixing. Concrete which has become stiff or has been contaminated with foreign materials shall be rejected and disposed off as directed by Owner.

- 3.68 All equipment used for mixing, transporting and placing of concrete shall be maintained in clean condition. All pans, buckets, hoppers, chutes, pipelines and other equipment shall be thoroughly cleaned after each batch of placement.
- 3.69 Before any concrete is placed, the entire placing programme consisting of equipment, layout, proposed procedures and methods shall be submitted to Owner for approval and no concrete shall be placed until Owner's approval has been received. Equipment for conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete during depositing without segregation of materials, considering the size of the job and placement location.
- 3.70 Concrete shall be placed in its final position before cement reaches its initial set and concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer, and once compacted it shall not be disturbed.
- 3.71 The control of placing shall begin at the mixer discharge. Concrete shall be discharged by a vertical drop into the middle of the bucket or hopper and this principle of a vertical discharge of concrete shall be adhered to throughout all stages of delivery until the concrete comes to rest in its final position.
- 3.72 Central-bottom-dump buckets of a type that provides for positive regulation of amount and rate of deposition of concrete in all dumping position shall be employed.
- 3.73 In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1.2 metres. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any other manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.
- 3.74 Concrete placed in restricted forms by barrows, buggies, cars, short chutes or hand shovelling shall be subjected to the requirement of vertical delivery of limited height to avoid segregation and shall be deposited as near as practicable to its final position.
- 3.75 The top surface of each pour and bedding planes shall be horizontal unless otherwise instructed.
- 3.76 Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to move concrete inside the forms. Particular attention shall be paid to vibration at the top of a lift, e.g. in a column or wall.
- 3.77 When placing concrete in layers, which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, mixing and joining of concrete between the succeeding layers.

- 3.78 The immersion vibrators shall penetrate the layer being placed and also penetrate the layer below while under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.
- 3.79 Care shall be taken to prevent the contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.
- 3.80 Form attached vibrators shall be used only with specific permission of Owner
- 3.81 The use of surface vibrators will not be permitted under normal conditions. However for thin slabs, surface vibration by specially designed vibrators may be permitted, on approval by Owner.
- 3.82 The formation of stone pockets or mortar pondages in corners and against faces of forms shall not be permitted. If these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for thorough bonding, as directed by Owner.
- 3.83 Except when placing with slip forms, each placement of concrete in multiple lift work shall be allowed to set for at least 24 hours after final set of concrete and before the start of a subsequent placement.
- 3.84 When placing concrete in walls with openings, in floors of integral slab and beam construction and other similar conditions, the placing shall stop, when the concrete reaches the top of the openings in the walls or bottom horizontal surface of the slab, as the case may be placing shall be resumed before the concrete in place reaches initial set, but not until it has had time to settle as determined by owner.
- 3.85 When placing concrete through reinforcing steel, care should be taken to prevent segregation of the coarse aggregate.
- 3.86 If bleeding or free water on top surface of concrete being deposited into the forms occurs, the concrete pour shall be stopped and the conditions causing this defect corrected before any further concreting resumed.
- 3.87 Concrete shall be placed without interruption until completion of the work between predetermined construction joints, as specified herein after.
- 3.88 In a column, the joint shall be formed 75 mm below lowest soffit of the beam including haunches, if any. In flat slab construction the joint shall be 75 mm below the soffit of column capital. At least two hours shall elapse after depositing concrete in columns, piers or walls, before depositing in beams, girders or slabs supported thereon.

- 3.89 Vertical construction joints in watertight construction shall not be permitted unless indicated on the drawings. Where a horizontal construction joint is required to resist water pressure, special care shall be taken in all phases of the construction to ensure maximum water-tightness.
- 3.90 Dowels for construction work not likely to be taken up in the near future, shall be wrapped in tar paper & burlap.
- 3.91 Mass foundations shall be poured in lifts not exceeding 0.5 M in height unless otherwise indicated on drawings or approved by Owner.
- 3.92 A driver mix shall be used for the top lift of horizontal pour to avoid laitance. All laitance and loose stone shall be thoroughly and carefully removed by wire brushing/hacking and surface washed.
- 3.93 Certain types of finish or preparation for overlaying concrete must be done at certain stages of curing process and special treatment required for specific concrete surface finish.
- 3.94 Curing of concrete made of high alumina cement and super sulphated cement shall be carried out as directed by Owner.
- 3.95 Ample water supply should be assured under pressure in pipes if required, with all necessary appliances of hose, spraying devices.
- 3.96 Whenever a covering such as wet gunny bags which will prevent loss of moisture from concrete is used, the covering shall be kept continuously wet during the curing period.
- 3.97 All equipment, men, materials required for curing shall be on hand and ready for use before concrete is placed.
- 3.98 If reinforcement is exposed or honey combing occurs at vulnerable positions e.g. ends of beams or columns it may be necessary to cut out the member completely or in part and reconstruct. If only the patching is necessary, the defective concrete shall be cut out till solid concrete is reached. An area extending 6 inches beyond the edge and the surface of the prepared voids shall be wetted with water for 24 hours immediately before patching material is placed.
- 3.99 The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Owner. Epoxies shall be applied strictly in accordance with the instructions of the manufacturer.
- 3.100 Mortar filling by air pressure (guniting) shall be used for repair of areas too large and/or shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and the texture of the surrounding concrete. White cement shall be substituted for ordinary cement, if so directed by Owner, to match the shade of the patch with the original concrete.

- 3.101 Two hours after the repair works, the area patched shall be covered with an approved non-staining, water saturated material such as gunny bags which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by a fine spray or sprinkling for not less than 6 days.
- 3.102 All materials, procedures and operations used in the repair of concrete and also the finished repair work shall be subject to the approval of Owner. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and dried.
- 3.103 The type of finish for the formed surface of concrete shall be as follows, unless otherwise specified by Owner. For surfaces against which backfill or concrete is to be placed, no treatment is required except repairs of defective areas.
- 3.104 For surfaces below grade which will receive water proofing treatment the concrete shall be free of surface irregularities which would interfere with proper application of the waterproofing materials.
- 3.105 Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repair of damaged or defective concrete, removal of fins and abrupt irregularities, filling of holes left by form ties and rods and cleanup of loose or adhering debris.
- 3.106 Form work may be of timber, plywood, metal, plastic or concrete. For special finishes the form work may be lined with plywood, steel sheets, oil tempered hard board. etc. Sliding forms and slip forms may be used with the approval of Owner.
- 3.107 Plywood shall be used for exposed concrete surfaces. Sawn and wrought timber may be used for unexposed surfaces. Inside faces for concrete surfaces which are to be rubbed finished shall be planned to remove irregularities or unevenness in the face.
- 3.108 All new and used form lumber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness, cleanliness of surfaces. Form lumber unsatisfactory in any respect shall not be used and if rejected by Owner shall be removed from the site.
- 3.109 Shores supporting successive storeys shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed support shall be provided for shores that cannot be secured on adequate foundations.
- 3.110 Form work, during any stage of construction, showing signs of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be re-positioned and strengthened. Poured concrete affected by faulty form work, shall be removed completely and the form work corrected prior to placing new concrete.
- 3.111 Excessive construction camber to compensate for shrinkage, settlement, etc, which may impair the structural strength of members, will not be permitted.

- 3.112 Forms shall be so designed and constructed that their removal will not damage the concrete. Face form work shall provide true vertical and horizontal joints conform to the architectural features of the structure as to locations of joints and be as directed by Owner.
- 3.113 Where exposed concrete finishes are required, the forms shall be constructed with special care so that the resulting concrete surfaces require a minimum finish.
- 3.114 Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bearers.
- 3.115 The shuttering for slabs and beams shall be so erected that the shuttering on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Re propping of beams shall not be done. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the shuttering.
- 3.116 If the shuttering for the column is erected for the full height of the column, one side shall be left open and built up in sections as placing of concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.2 M maximum.
- 3.117 Care shall be taken to see that the faces of form work coming in contact with concrete are perfectly cleaned and proper mould oil applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Use of engine oil is not permitted to be used as mould oil. Concrete shall not be placed until coating of the forms is complete. Adjoining concrete surfaces shall also be protected against contamination from the coating material.
- 3.118 All corners and angles exposed in the finished structure shall be formed with mouldings to form chamfers or filets on the finished concrete. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as then forms to which it is attached.
- 3.119 Wire ties passing through the walls are not allowed. In their place bolts passing through sleeves may be used.
- 3.120 Before reuse, all forms shall be thoroughly scrapped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Owner. Warped lumber shall be sized.

- 3.121 Contractor shall record on the drawing or a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from.
- 3.122 In normal circumstances (generally where temperatures are above 20 °C) forms may be struck after expiry of the following period. :
- 3.123 Striking shall be done slowly with utmost care to avoid damage to arises and projections and without shock or vibrations, by gently easing the wedges. If after removing the form work, it is found that timber has been embedded in the concrete, it shall be removed and the concrete made good as specified earlier.
- 3.124 Reinforced temporary openings shall be provided, as directed by Owner, to facilitate removal of form work which otherwise may be inaccessible.
- 3.125 The rods, clamps, form bolts, etc, which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours and not later than 40 hours after the concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time. Ties, withdrawn from walls and beams shall be pulled toward the inside face.
- 3.126 Soft or spongy areas shall be cleaned out and back filled with either a soil-cement mixture, lean concrete or clean sand fill compacted to a minimum density of 90% Modified Proctor.
- 3.127 Prior to construction of form work for any item where soil will act as bottom form, approval shall be obtained from Owner as to the suitability of the soil.
- 3.128 Where concrete has to rest on rock, just the rock surface shall be cleaned with high pressure water and airjet.
- 3.129 Prior to placing concrete, the rock surface shall be kept wet for a period of 2 to 4 hours unless otherwise directed by the Owner.
- 3.130 The preparation of concrete surfaces on which additional concrete is to be placed later, shall preferably be done by cleaning. All laitance shall be removed and the surface roughened. The surface should not contain any unsound concrete and glazed mortar.
- 3.131 After rock or concrete surfaces upon which new concrete is to be placed have been roughened, cleaned and wetted, a coat of cement-sand mortar shall be placed on the surface. The mortar shall have the same cement-sand proportions as the concrete which shall be placed on it. The Water-cement ratio shall be determined by prevailing conditions of placing and as approved by Owner.

- 3.132 Provision shall be made for expansion and contraction in concrete by use of special type of joints located as shown on the drawing. Contraction joint surfaces shall be treated as directed by the specifications or the drawings or as directed by the Owner.
- 3.133 Under all ordinary conditions all foundations shall be dewatered and concrete placed in the dry.
- 3.134 Side shutters shall not be struck in less than 24 hours after depositing concrete and no pre-cast unit shall be lifted until the concrete reaches strength of at least twice the stress to which the concrete may be subjected to at the time of lifting.
- 3.135 All pre-cast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each unit shall be kept constantly watered or preferably be completely immersed in water if the size of the unit so permits.
- 3.136 Slots, openings or holes, pockets etc., shall be provided in the concrete work in the positions indicated in the drawings or as directed by Owner. Any deviation from the approved drawings shall be made good by Contractor at his own expense, without damaging any other work. Sleeves, bolts, inserts, etc. shall also be provided in concrete work where so specified.
- 3.137 All materials, workmanship and finished construction shall be subject to the continuous inspection and approval of Owner.
- 3.138 All material supplied by Contractor and all work or construction performed by Contractor rejected as not in conformance with the specifications and drawings, shall be immediately replaced at no additional expense to the Owner.
- 3.139 Approvals of any preliminary materials or phase of work shall in no way relieve the Contractor from the responsibility of supplying concrete and or producing finished concrete in accordance with the specifications and drawings.
- 3.140 Upon the completion of the concrete work, all forms, equipment, construction tools, protective coverings and any debris resulting from the work shall be removed from the premises.
- 3.141 All debris, i.e. empty containers, scrap, wood, etc. shall be removed to "dump" daily.
- 3.142 The finished concrete surfaces shall be left in a clean condition satisfactory to Owner.

4.0 GENERAL BUILDING WORKS SPECIFICATIONS

4.1 This specification covers the general requirement for brick and stone masonry, plastering, flooring, doors, windows, ventilators, wood work, water proofing, false ceiling, painting and such other related works forming a part of this job, which may be require to be carried out though not specifically mentioned above. The work under this specification shall consist of furnishing of all tools, plants, labour, materials, any and everything necessary for carrying out the work.

4.2 Applicable codes and specifications

4.2.1 The following codes, standards and specifications are made a part of this specification. All standards, tentative specifications, specifications, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions.

4.2.2 In case of discrepancy between this specification and these referred to herein, this specification shall govern.

- IS:1077 Common burnt clay building bricks.
- IS:3102 Classification of burnt clay bricks
- IS:2180 Burnt clay building bricks, heavy duty.
- IS:3495 Methods of sampling and testing clay building bricks.
- IS:2691 Burnt clay facing bricks.
- IS:2212 Code of practice for brickwork.
- IS:2185 Load bearing hollow concrete blocks
- IS:1597 Code of practice for construction of stone masonry (Part I)
- IS:2394 Code of practice for application of lime plaster finish.
- IS:2645 Integral cement water proofing compounds.
- IS:2114 Code of practice for laying in site terrazzo floor finish.
- IS:4021 Timber door, window and ventilator frames.
- IS:1003 Timber panelled and glazed shutters. (Parts I & II)
- IS:4020 Methods of tests for wooden flush doors: Type tests
- IS:4351 Steel door frames.
- IS:1038 Steel doors, windows and ventilators,

- 4.3 Brick work : Bricks used in works shall conform to the relevant Indian Standard. They shall be sound, hard, homogenous in texture, well burnt in kiln without being vitrified, table moulded, deep red; cherry or copper coloured, of regular shape and size and shall have sharp and square edges and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing unground particles and/ or which absorb water more than 1/6th of their weight when soaked in water for twenty four hours shall be rejected. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 35 kg/sq.cm unless otherwise noted in drawings.
- 4.3.1 The size of the brick shall be 23.0 x 11.5 x 7.5cm unless otherwise specified; but tolerance upto ± 3 mm in each direction shall be permitted. However, bricks conforming in size to IS-1077 could be used. Bricks shall be provided with frogs. Only full size bricks shall be used for masonry work. Bricks bats shall be used only with the permission of the OWNER to make up required wall length or for bonding. Sample bricks shall be submitted to the OWNER for approval and bricks supplied shall conform to approved samples. If demanded by OWNER, brick sample shall be got tested as per IS 3495 by CONTRACTOR at no extra cost to the OWNER. Bricks rejected by OWNER shall be removed from the site of works within 24 hours.
- 4.3.2 Mortar: Mortar for brick masonry shall be prepared as per IS 2250. Mix for cement mortar shall be as specified in the respective items of work. Gauge boxes for sand shall be of such dimensions that one completed bag of cement containing 50 kgs. Of cement forms one unit. The sand shall be free from clay, shale, loam, alkali and organic matter shall be of sound, hard, clean and durable particles. Sand shall be approved by the OWNER. If so directed by the OWNER, sand shall be thoroughly washed till it is free of any contamination.
- 4.3.3 For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall preferably be machine mixed, though hand mixing in a thorough manner may be allowed. The mortar so mixed shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected.

Section 6.4.1 DG Set

1.0 GENERAL

- 1.1 The diesel generator shall be designed to deliver maximum power output possible at site conditions specified in project information.
- 1.2 All necessary auxiliaries with adequate capacities to make the plant complete such as fuel forwarding and injection system, lubricating oil system, governing system, cooling water system, start-up system, intake and exhaust gas systems, fuel oil treatment plant, if required etc., shall be provided and these shall be complete in all respects.

2.0 DIESELENGINE

- 2.1 The diesel engine shall be of high speed type(1500rpm).
- 2.2 The engine shall be of four-stroke type with either in line or V-type cylinder arrangement.
- 2.3 The major moving parts such as crankshaft and connecting rods shall be of drop forged design and shall have high degree of mechanical reliability.
- 2.4 The pistons shall be manufactured with heat treated steels or other equivalent proven materials. The cylinder liners shall be of proven wear resistant materials designed for fuel under consideration.
- 2.5 The cylinder head shall be of proven material. The cylinder head shall house inlet and exhaust valves and fuel injector. A forced cooling arrangement shall be provided around the exhaust valve seats and the fuel injectors.
- 2.6 The fuel injectors shall have easy accessibility and it should be possible to remove them using simple methods.
- 2.7 The inlet and exhaust valves shall be precisely controlled via roller tappets, short push rods and forked rocker arms.
- 2.8 The exhaust valves shall be made of high temperature hot corrosion resistant material. The inlet and exhaust valves shall have hard chromium plated or equivalent proven material stems.
- 2.9 Governing system
 - a. The diesel engine shall be provided with an electronic type of speed governor. The governor and the speed governing system shall be capable of controlling and regulating the diesel engine speed in accordance with the requirements of class **A1** governing as stipulated in ISO 3046 part IV.

- b. An over speed trip mechanism shall be provided to automatically shut off fuel in case the engine speed reaches 110% of the rated speed. The speed at which the mechanism trips the engine shall be adjustable. An engine mounted emergency stop push button shall be provided, which when operated will trip the engine.

2.10 Layout

- a. The engine and generator shall be provided on a common base frame. The supply of supporting springs, foundation bolts etc., shall be in Bidder's scope.
- b. The engine shall be provided with adequate number of anchor bolts, foundation bolts and anti vibration pads, alignment shims, as stipulated by the Bidder.
- c. Necessary acoustic enclosure for the complete Diesel engine generator set shall also be provided to minimize the noise level.

2.11 Fuel System

2.12 High Speed Diesel Oil confirming to IS 1460 is proposed to be used as load carrying fuel in the diesel engine.

2.13 Intake air system

- a. The air intake system shall be provided with a silencer to reduce the noise produced by the intake system (if required).
- b. A flexible connection shall be provided in the intake system to minimize the vibration.
- c. The intake system shall be complete with interconnection ducting between air filter and turbocharger, nuts, bolts, flange joints and supports required for installation.
- d. The air from the air filter shall be charged into the engine cylinders by means of a turbocharger powered by an exhaust gas driven turbine. The turbo charger bearings shall be cooled by the engine lube oil system.

2.14 Exhaust Gas System.

- a. The exhaust system shall be complete with all the accessories specified herein and shall ensure safe disposal of the exhaust gases through the individual stack located outside the DG house.
- b. The stack height shall meet the requirements of currently applicable pollution standards and regulations.

- c. Suitable expansion joint shall be provided on the exhaust ducting to take care of the expansion due to the high working fluid temperature.
- d. The complete duct including silencer shall be insulated to maintain the surface temperature of the external cladding to within 20° C above the ambient temperature.

2.15 Exhaust Stack:

- a. Independent Stacks (Refer Section-3 and /or Data Sheet-A catering to DG Sets shall be supplied. The exhaust from the DG Sets shall be suitably connected to the Stack.
- b. Stack design shall conform to IS 6533 Part I & II.
- c. Necessary access ladder with landing platforms having toe guards shall be provided (with minimum width of 800mm). The access ladder shall be lockable type.
- d. All plates & sections shall conform to IS 2062 of fusion welding quality or IS 8500. Necessary corrosion allowance shall be provided in the stack design.
- e. Wind load as per IS 8500 and earthquake as per IS 1893 shall be considered for structural design.
- f. Stack lightning protection shall be provided.
- g. Stack shall be provided with aviation warning lights.
- h. Stack surface finish shall be hot dip galvanised.
- i. Necessary hopper and drain point at the bottom of the stack shall be provided.
- j. Necessary sampling points as per the emission regulations shall be provided.

2.16 Lubrication system:

- a. The lubrication system complete with all the accessories shall ensure good distribution of lubricating oil to all moving parts of the engine.
- b. Bidder shall specifically indicate in his bid whether it is necessary to establish adequate lube oil system pressure before starting and during coasting down of the diesel engine.

2.17 Cooling System:

- a. The DG sets shall be designed for water cooling with set mounted radiator. All accessories required for the cooling scheme shall be supplied.
- b. Supply of the DG set shall include the first fill of coolant.

2.18 Piping:

- a. The design of pipe lines, pipe assemblies, pipe fittings, flanges and components, valves and specialties and any other pressure retaining part in a piping system shall be carried out in accordance with the applicable power codes and standards.
- b. Pipelines shall be designed adequately to meet the system requirement of flow, pressure drop, etc., under all operating modes of the plant.
- c. While routing piping, the following requirements shall be taken into account:
 - i. The piping shall be arranged to provide clearance for the removal of equipment requiring maintenance and for easy access to valves and other piping accessories required for operation.
 - ii. Overhead piping shall have a minimum vertical clearance of 2.3metres above walkways and working areas and 6metres above roadways.
 - iii. Sufficient upstream and downstream lengths shall be provided for flow measuring devices, control valves,etc.
 - iv. At all the screwed valves and screwed connections on equipment, unions shall be provided to facilitate disassembly.
 - v. The hangers and supports shall be spaced in accordance with the standard engineering practice as outlined in applicable codes and standards.
- d. Instrument Connections complete with:
 - i. All thermo well stubs shall have an internal threading toM33x2.
 - ii. Pressure measurement stubs on fuel oil lines shall be of NB 25mmsize.
 - iii. Drain connections on pipelines shall be at least of NB 25size.

3.0 GENERATOR ANDACCESSORIES

3.1 Performances:

- a. The generator system shall be as shown in enclosed Single Line Diagram / Data Sheets.
- b. Each generator shall be rated as detailed at Section-7.4 Data sheet.
- c. The generator shall have overload capacity as per applicable standards.
- d. The generator shall be capable of withstanding a three phase short circuit at the generator terminals for 3 seconds when operating under rated condition.

e. The generator shall be suitable for continuous parallel operation with each other.

3.2 Excitation System:

- a. The excitation shall be of the brushless type complete with permanent magnet generator, automatic voltage regulator field discharge system and all other accessories.
- b. The AVR and other excitation system devices shall be mounted on the AMF panel or in a separate panel.

3.3 Enclosure:

The generator shall have enclosure type IP 23 to IS-4169

3.4 Insulation:

- a. The stator, rotor and exciter winding insulation shall be class F.

3.5 Terminal Boxes:

- a. Adequately sized phase segregated type cable spreading box shall be provided to bring out all 6 winding terminals
- b. The cable box shall be suitable for bus way or cable connection as per SLD.

3.6 Neutral Current Transformers:

- a. Current transformers shall be provided on each neutral side lead inside the neutral terminal box / neutral isolating panel before formation of the neutral. The CT parameters shall be as shown in SLD.

3.7 Neutral end connection:

- a. The star point of neutral end winding shall be brought out for solid / resistance earthing through isolator with contactor or motorised isolator as indicated in SLD/Data Sheets.
- b. Current Transformer(s) shall be provided after formation of neutral as shown in the SLDs for generator earth fault protection

3.8 Space Heater:

- a. The generator shall be provided with space heater suitable for 240V, single phase, and 50Hz supply. Space heater shall have adequate capacity to maintain internal temperature of machine above dew point to prevent moisture condensation during shut down periods.
- b. The space heaters shall be humidistat controlled duly protected by 30mA ELCB.
- c. The space heater supply shall be obtained from the DG Auxiliary MCC.

3.9 Duplex type embedded Temperature Detectors with alarm and trip contact shall be provided as follows:

- | | |
|------------------------|---------------|
| a. Stator Windings | 6 Sets |
| b. DE and NDE Bearings | 1 Set/bearing |
| c. Cold air path | 2 |
| d. Hot air path | 2 |

3.10 Other Equipment

The following equipment shall be supplied as part of the contract.

- i) One (1) set – Maintenance free Battery and Battery Charger of adequate capacity for starting duty, one set for each DG set.
- ii) One (1) set – Maintenance free Battery and Battery charger of adequate capacity for the control supply for AMF and control panel, if called for in Data sheet /Section-7.3.
- iii) All power and control cables and other control cables required for the installation.
- iv) All control cable terminations as required consisting of removable gland plates. Double compression type cable glands and crimp type heavy duty Dowell's tinned copper cable legs.
- v) All earthing conductors, earth pits etc. All glands shall be earthed.

4.0 COOLINGSYSTEM

4.1 The Diesel engine shall be water cooled with set mounted radiators. All accessories required for the cooling system shall be furnished.

5.0 FUEL OILSYSTEM

5.1 Buffer tank will supply the diesel oil to the individual HSD day tanks located at an elevation of 0.5m near each engine through gravity flow. Facility for automatically filling the day tanks from buffer tank is in the scope of DG vendor. Necessary level controllers, valves etc shall be provided.

- 5.2 All pipe work as required for the above system shall be provided complete with pipes, fittings, flanges, gaskets, fasteners, valves, strainers expansion joints, flexible hoses, hangers, supports and all other accessories as applicable / as may be required.

6.0 HSD DAYTANKS

6.1 Scope:

The Scope covers the design, materials, fabrication, testing and erection of One (1) No. 990 litre HSD Day tank for each DG Set and one (1) buffer tank.

6.2 Codes and Design:

The design and fabrication of storage tanks shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable Indian/British/USA/IEC standards.

6.3 Design requirement:

Storage tanks shall be designed based on the applicable codes in respect of corrosion allowance, minimum thickness, connection and appurtenances, roof and structures, Earthing cleats, fabrication tolerances etc. The main parameters and requirement are indicated in the data sheet. The storage tanks shall be effectively earthed.

7.0 THERMALINSULATION

- 7.1 Thermal insulation using mineral wool/glass wool shall be provided for exhaust piping and for all other hot surfaces for personnel protection.

8.0 PAINTING

- 8.1 All equipment supplied under the contract shall be suitable for operation under the climatic and operating conditions prevailing at the site. All parts and surfaces which are subject to corrosion shall be made of such materials, and shall be provided with such protective finishes, as are appropriate to protect the installed equipment from deterioration or injury due to the climatic

conditions or operating environment. All electrical and auxiliary equipment shall be specially treated for tropical conditions.

8.2 Bidder shall specify the details of the painting, and special treatment for tropical conditions, in his offer.

9.0 PERFORMANCEREQUIREMENT

9.1 The DG sets shall be capable for start up from cold condition reaching synchronous speed and rated voltage in less than 10 seconds from the start impulse.

9.2 Thereafter shall also be capable of taking the full rated load, within 30 seconds without undue vibration and overheating of the engine.

9.3 The maximum permissible voltage and frequency of output supply for the DG set shall be limited ± 1.0 percent and ± 3 percent respectively

9.4 Manual facilities shall be provided to start the DG set for test purposes.

9.5 The generator shall be capable of carrying an unbalanced load of 25% without injurious heating of any part, provided the rated current is not exceeded.

9.6 The diesel engine shall be capable of operating continuously with High speed diesel oil as available commercially.

9.7 The diesel generator shall be capable of giving a net output at specified nominal voltage at the generator terminals after de-rating, if any.

9.8 Performance tests shall be carried out at shop floor and at site to prove the performance for the offered equipment.

10.0 MAINTENANCE

10.1 As Built drawing and operation and maintenance manual:

10.2 Vendor shall provide as built drawings and operation and maintenance manuals for complete facilities.

10.3 The Vendor shall prepare, and keep up-to-date, a complete set of "As Built" records of the execution of the Works, showing the exact "as built" location, sizes and details of the work as executed, with cross-references to relevant specifications and data sheets. Two copies shall be

submitted to the Institute/Project Engineer cum Estate Officer prior to the commencement of the tests.

10.4 Prior to the issue of any Taking-over certificate, the Vendor shall submit one soft copy, one full-size original copy and six printed copies of the relevant "As Built Drawings" and any further Construction Documents that may be specified by Institute/Project Engineer cum Estate Officer.

10.5 The Vendor before commencement of trial run of the equipment shall submit 6 (six) copies of the operation and maintenance manuals, in English language, containing descriptions, illustrations, sketches, drawings, sectional drawings, sectional arrangement view and manufacturers' part numbers to enable the connections, functions, operation and maintenance of all components of the complete plant to be easily followed and for all parts to be easily identified to facilitate ordering of the replacement parts. Exploded views where appropriate shall be used for clarity.

10.6 The operation manual shall also include the following:

- Technical data of each instrument and their performance.
- Instructions for servicing and overhauling.
- Particulars of lubricating oil and grease to be used, also alternative indigenous commercial lubricating oils suitable for use.
- Performance curves
- List of tools supplied.
- List of spares provided.
- Spare parts list, with manufacturers' part numbers.

10.7 These manuals shall be submitted before commencement of trial run.

10.8 Supervision of operation and maintenance during defect liability period:

10.9 The Vendor shall be responsible to provide suitably qualified and experienced personnel for the **24** month Defect Liability Period following successful completion of the trial run period and issuance of the Taking-Over Certificate by the Institute/Project Engineer cum Estate Officer. The personnel provided by the Vendor shall be fully experienced in managing, operating and maintaining all aspects of the plant and facilities, shall be responsible to monitor and ensure the successful performance of the system throughout the Defect Liability Period and shall be responsible to ensure that the Institute's personnel are provided with on-the-job training as may

be necessary to ensure uninterrupted satisfactory performance of the plant and facilities by the Institute's personnel after completion of the Defect Liability Period and issuance of the Performance Certificate. These personnel shall be available to be deputed to the site as and when required.

10.10 The bidder shall submit separately, as a part of his technical proposal, details of the qualifications and experience of the personnel he proposes to provide for supervision of operation and maintenance during the defect liability period. All costs for the bidder's personnel shall be included in the bid prices. All costs for the Institute's personnel during this period will be borne by the Institute.

10.11 The above notwithstanding, the Vendor will be required to rectify any deficiencies which are attributable to defects in the workmanship or quality of materials.

11.0 TESTING AND COMMISSIONING AND TRIAL RUN INCLUDING MAINTENANCE

11.1 Immediately after the erection of the equipment, the Vendor shall carry out testing and commissioning of the equipment to demonstrate the suitability of the equipment workmanship, and operational aspects to the requirements of the contract, to the satisfaction of the Institute/Project Engineer cum Estate Officer. This stage shall be commenced within 7 days of completion of erection and shall precede the trial run period.

11.2 Duration of the testing & commissioning period shall not exceed 15 days. After completion of commissioning, vendor shall run the DG sets for 8 hours/day for 15 days to demonstrate satisfactory performance to the Institute/Project Engineer cum Estate Officer prior to taking over by the Institute. Cost of this inclusive of any spares shall be indicated separately in the quoted price.

11.3 If called for by the Institute, the vendor shall depute his personnel for operation and maintenance of the DG sets on 24 hour basis for a period of 3 months. Monthly cost for this shall be shown separately in the price bid. For operation of the DG sets for part of the month, payment will be made on pro rata basis.

11.4 In the event that the equipment do not satisfactorily achieve the required performance standards during this period, the trial run period will be extended until such time as the Vendor has satisfactorily rectified any deficiencies as may be necessary to satisfy the performance requirements. No additional compensation will be paid to the Vendor for such extension.

12.0 SPARES

- 12.1 BIDDER shall furnish a list of essential spares with item wise prices for the equipment / systems covered under this specification for three years operation of the DG set. BIDDER shall also furnish a list of recommended spare parts along with the item wise prices. The prices of the essential and recommended spares will not be considered in the bid evaluation. However, all start –up spares as required during commissioning and up to handing over of the plant to the Institute shall be supplied by BIDDER and cost of the same shall be included in the quoted price.

13.0 INSPECTION AND TESTING

- 13.1 The DG Sets shall be subjected to Institute/Project Engineer cum Estate Officer's inspection and witness testing.

- 13.2 A mutually agreed quality assurance plan shall be developed which provides for inspection and certification by Institute/Project Engineer cum Estate Officer at specified times during the manufacture and fabrication of such items. All costs for independent inspection or testing will be borne by the Vendor, and the Vendor shall be fully responsible to ensure that adequate provisions are made in his tendered rates to cover independent inspections and testing for the equipment and plant.

13.3 Tests at manufacturer's works

In addition to inspection and testing at various stages of manufacture, following minimum tests shall be carried out on fully assembled DG sets

- i) Verification of test reports / certificates of major components.
- ii) Visual inspection of DG sets and accessories and verification of dimensions as per drawings
- iii) Insulation resistance test on all winding
- iv) No Load running for 15 minutes and checking Voltage balance, phase sequence
- v) Load test at 25%, 50%, 75% and 100% loads for 15 minutes each and checking voltage and speed regulation, vibration etc.
- vi) Load test at 100% load for 4 hours and measurement of Voltages, currents, kW, kVA, rpm, winding and bearing temperatures, coolant temperatures, vibration, noise etc.
- vii) Load test at 110% load for 1 hour after test at 100% load.

- viii) Specific fuel consumption test
- ix) Simulated test for all protections
- x) High voltage test on allwinding
- xi) Noise measurement test

Notes: Each and every measuring equipment used during the above test shall have valid calibration and calibration certificates shall be submitted for verification. In case instruments built into DG controllers are used for measurements, calibrations certificates of controllers shall be made available.

14.0 TRAINING INSTITUTE'S PERSONNEL IN OPERATION ANDMAINTENANCE

14.1 The Vendor shall be responsible to provide practical training in all aspects of the operation. Maintenance and repair of the equipment and facilities to all personnel deputed by Institute who will ultimately be responsible for the operation, maintenance and repair of the equipment and its facilities.

15.0 CODES ANDSTANDARDS

15.1 The design, manufacture and performance of DG Sets shall comply with all currently applicable status, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable Indian / British/ USA standards / or equivalent international standards. Some of the relevant standards are:

ISO 3046	Specification for Reciprocating Internal Combustion Engine (Part I To IV)
ISO 8528	RIC engine driven generating sets
VDI 2063	Measurement and evaluation of Mechanical vibration of reciprocating engine and compressors
IS-4722	Rotating Electrical Machinery
IS 13364	Specification for ac generators driven by reciprocating IC engine

IS 12065	Permissible limits of noise level for rotating electrical machines.
IS 12075	Measurement and evaluation of vibration of rotating electrical machines
IS 12063	Classification of degrees of protection provided by enclosures of electrical equipment.
IS 1460	Diesel fuels

Section 6.4.2 DG Set Data Sheets

DATA SHEET –A1			
SL. No	DESCRIPTION	UNIT	DATA
1.0	General		
1.1	No. of DG Sets	Nos	2
1.2	Mode of operation		Back up Power to KPTCL source
1.3	Installation		indoor
2.0	Design Considerations		
2.1	Rating	kVA/kW	2000 /1600kW e (PRP rating as per ISO 8528)
2.2	Overload Capacity	%	As per ISO: 8528
2.3	Design ambient data for engine a) Ambient temp. b) Altitude above mean sea level c) Humidity	°C m %	Refer Section-7.2 (Project Information) -do- -do-
2.4	Type of Fuel		High Speed Diesel (HSD) as per IS:1460
2.5	Type of Engine		Stationary four stroke Vertical
2.6	Rated Speed		1500 RPM
2.7	Governor type		Electronic
2.8	Maximum amplitude of vibration (peak to peak)		As per VDI 2063
2.9	Noise level at a distance of 1m from DG	dB (A)	75

DATA SHEET –A1			
SL. No	DESCRIPTION	UNIT	DATA
	set		
2.10	Cooling water quality		Normal Potable water
3.0	Auxiliaries / Accessories		
3.1	Lube Oil system		Required
3.2	Radiator / Heat Ex-changer		Required
3.3	Intake air silencer		Vendor to indicate if required
3.4	Intake air expansion joint		Required
3.5	Exhaust gas expansion joint		Required
3.6	Exhaust gas silencer		Required
3.7	Insulation		Required
3.8	Exhaust pipe with mineral wool insulation with aluminium cladding		Required
3.9	Type of start-up		Electric
3.10	HSD Day tank (990 litres) with inlet and outlet connections, filling cap and drains		Required
3.11	Fuel oil feed / booster pumps		Required
3.12	Complete fuel, lube oil, and water piping systems		Required
3.13	Foundation / anchor bolts / AVMs with nuts for all equipment		Required
3.14	Automatic fuel filling system with buffer		Required

DATA SHEET –A1			
SL. No	DESCRIPTION	UNIT	DATA
	tank, level controllers etc.		
4.0	Tests a) Performance test to determine power, fuel consumption, etc. at 50%, 75%, 100% and 110%load b) Over speed test c) Noise level d) Vibration		Required & to be witnessed (Please see PCPL-3-S4-101 clause 13)
5.0	Test certificates for major components		Required for review by owners/ owner's representative
6.0	Generator Main Parameters		
6.1	Rating	kVA/kW	2000 /1600kW e
6.2	Rated terminal voltage	V	11kV, 3Phase, 3 Wire
6.3	Rated frequency	Hz	50
6.4	Rated power factor		0.8 Lag
6.5	Degree of protection of the enclosure for Diesel Generator		IP23 to IS 4691
6.6	Class of Stator winding insulation		Class F
6.7	Class of rotor winding insulation		Class F
6.8	Class of exciter winding insulation		Class F
6.9	Excitation System		Self excited and self regulated/ Brushless with PMG

DATA SHEET –A1			
SL. No	DESCRIPTION	UNIT	DATA
6.10	Current Transformer to be mounted On the Phase and Neutral Cubicle		As shown in the Drg No. PCPL-1850-4-SLD-001
6.11	Line Side Load Break Switch Rated Control Voltage for closing and opening		NA
6.12	Accessories Required for Generator a) RTDs for Bearings b) RTDs for Windings c) RTDs for Core		1 No. Duplex/bearing Six Nos. Duplex NA

DATA SHEET – A2		
APPLICABLE STANDARDS		
1	DEGREES OF PROTECTION PROVIDED BY ENCLOSURES FOR ROTATING ELECTRICAL MACHINES.	IS 4691
2	ROTATING ELECTRICAL MACHINES. SPECIFICATION	IS 4722
3	TERMINAL MARKING & DIRECTION OF ROTATION FOR ROTATING ELECTRICAL MACHINERY.	IS 4728
4	METHOD OF DETERMINATION OF EFFICIENCY OF ROTATING ELECTRICAL MACHINES	IS 4889
5	REQUIREMENTS AND THE METHODS OF SAMPLING AND TEST FOR BONDED MINERAL WOOL FOR THERMALINSULATION.	IS 8183
6	MECHANICAL VIBRATION OF ROTATING ELECTRICAL MACHINES, ELEVATION AND LIMITS OF VIBRATION SEVERITY.	IS 12075
7	TEMPERATURE RISE MEASUREMENT OF ROTATING ELECTRICAL MACHINES.	IS 12802
8	TYPE OF DUTY AND CLASSES OF RATINGS ASSIGNED TO ROTATING ELECTRICAL MACHINE	IS 12824
9	RECIPROCATING INTERNAL COMBUSTION ENGINES PERFORMANCE	ISO 3046
10	AIRBORNE NOISE EMITTED BY MACHINE TOOLS - OPERATING CONDITIONS FOR METAL-CUTTING MACHINES	ISO 8525
11	RECIPROCATING INTERNAL COMBUSTION ENGINE DRIVEN ALTERNATING CURRENT GENERATING SETS - PART 9: MEASUREMENT AND EVALUATION OF MECHANICAL VIBRATIONS	ISO 8528
12	RECIPROCATING INTERNAL COMBUSTION ENGINES EXHAUST EMISSION MEASUREMENT	ISO 8978
13	ROTATING ELECTRICAL MACHINES.	IEC 60034
14	SPECIFICATION FOR ROTATING ELECTRICAL MACHINES OF PARTICULAR TYPES OR FOR PARTICULAR APPLICATIONS. GENERATORS TO BE DRIVEN BY RECIPROCATING INTERNAL COMBUSTION ENGINES	BS 5000

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
1.0	Engine General		
1.1	Name of the manufacturer		
1.2	Country of manufacture		
1.3	Model		
2.0	Design Condition		
2.1	Type of Engine		
2.2	Rated speed	rpm	
2.3	No of cylinders		
2.4	Engine configuration		
2.5	Aspiration		
2.6	Bore x Stroke	mm	
2.7	Displacement	m ³	
2.8	Standard ISO Rated output	kW	
2.9	Over load capacity	%	
2.10	Site conditions a) Ambient temp. b) Altitude above mean sea level c) Humidity	°C m %	
2.11	De rating factor for site conditions	%	
2.12	Derated output - Gross	kW	
2.13	Fan power	kW	
2.14	Power consumed by other auxiliaries	kW	
2.15	Net power available	kW	

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
2.16	Block Load Capability	kWm	
2.17	BMEP	kPa	
2.18	Fuel a) Type of fuel b) Fuel consumption i) At 110%load ii) At 100%load iii) At 75%load iv) At 50%load v) At 25%load	(g/kWh & l/hr)	
2.19.1	Air required for Combustion i) At 110%load ii) At 100%load iii) At 75%load iv) At 50%load v) At 25%load	m ³	
2.19.2	Air required for Cooling vi) At 110%load vii) At 100%load viii) At 75%load ix) At 50%load x) At 25%load	m ³	
2.20.1	Governor type/Make		

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
2.20.2	Class of governing to ISO 3046		
2.21	Maximum amplitude of vibration (peak to peak)	μm	
2.22	Noise level without silencer	dB	
2.23	Cooling Tower	NA	
2.23.1	Make	NA	
2.23.2	Model	NA	
2.23.3	Capacity	NA	
2.23.4	Fans-Nos & rating	NA	
2.23.5	Cooling water quality required	NA	
2.23.6	Cooling water flow rate	NA	
2.23.7	Cooling water inlet temperature	NA	
2.23.8	Cooling water outlet temperature	NA	
2.23.9	Cooling water pressure	NA	
2.24	Engine Block Design – Material and type		
2.25	Piston Design – Material and construction		
2.26	Cylinder Liner Design – Material & Construction		
2.27	Auxiliaries/ Accessories		
2.27.1	Turbo Charger		
2.27.1.1	No of turbochargers		
2.27.1.2	Make		
2.27.1.3	Model		
2.27.1.4	Operating speed	rpm	
2.27.2.	Lube Oil system		

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
2.27.2.1	Lube oil system capacity	l	
2.27.2.2	Lube oil pump make and type		
2.27.2.3	Lube oil cost/l	Rs	
2.27.2.4	Lube oil consumption at 100% output	ml/kWh	
2.27.2.5	First Fill of Lube Oil included in the scope	Yes/No	
2.27.2.6	No of lube oil filter		
2.27.2.7	Lube oil change period		
2.27.2.8	Lube Priming Pump provided	Yes/No	
2.27.3	Fuel system		
2.27.3.1	Type of filter		
2.27.3.2	Make		
2.27.3.3	Model		
2.27.3.4	No of fuel filters	Nos	
2.27.3.5	Fuel Filter Life	hrs	
2.27.3.6	Efficiency		
2.27.4	Air filters		
2.27.4.1	Intake air filter type		
2.27.4.2	Make		
2.27.4.3	Model		
2.27.4.4	No of intake filters		
2.27.4.5	Air Cleaner/ Filter Life	Hrs	
2.27.4.6	Intake air silencer	Yes/No	
2.27.4.7	Intake air expansion joint	Yes/No	

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
2.27.5	Exhaust gas silencer		
2.27.5.1	Type		
2.27.5.2	Make		
2.27.5.3	Model		
2.27.5.4	No of units		
2.27.5.5	Sound attenuation capacity	dB	
2.27.5.6	Exhaust pipe with Mineral wool insulation with aluminium cladding	Yes/No	
2.28	Type of start-up		
2.29	HSD Day tank with inlet and outlet connections, filling cap and drains	Yes/No	
2.30	Fuel oil feed / booster pumps	Yes/No	
2.31	Complete fuel, lube oil, and water piping systems	Yes/No	
2.32	Foundation / anchor bolts with nuts for all equipment	Yes/No	
2.34	Fuel Pump/ Injector inspection & calibration to be carried out after	Hrs	
3.0	Tests a) Performance test to determine power, fuel consumption, etc. at 50%,75%, 100% and 110%load b) Over speed test c) Noise level d) Vibration	Yes/No Yes/No Yes/No Yes/No	
4.0	Alternator - Main Parameters		

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
4.1	Name of the manufacturer		
4.2	Country of manufacture		
4.3	Model		
4.4	Rated output under standard conditions	kVA	
4.5	De rating for higher ambient temperature	%	
4.6	De rating for Class of insulation	%	
4.7	Total derating		
4.8	Output under site conditions	kVA	
4.9	Synchronous speed	rpm	
4.10	Rated frequency	Hz	
4.11	Rated terminal voltage	V	
4.12	AVR type and model		
4.13	Voltage regulation – no load full load	%	
4.14	Manual voltage regulator model		
4.16	Voltage regulation with MVR	%	
4.17	Rated stator current	Amps	
4.18	Rated power factor		
4.19	Number of phases	Nos.	
	a) Line terminals brought out	Nos.	
	b) Neutral terminals brought out	Nos.	
4.20	Type of stator winding connection		
4.21	Degree of protection of the enclosure for generator.		

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
4.22	Generator efficiency at rated power factor a) 110%load b) 100%load c) 75%load d) 50%load e) 25%load	% % % % %	
4.23	Minimum guaranteed short circuit ratio corresponding to maximum capability		
4.24.1	Designation for method of cooling as per IS/IEC standards		
4.24.2	Air required for Cooling i) At 110%load ii) At 100%load iii) At 75%load iv) At 50%load v) At 25%load	m ³	
5.0	Alternator Reactance – Saturated & unsaturated		
5.1	Direct axis reactance X_d	pu	
5.2	Direct axis transient reactance X'_d	pu	
5.3	Direct axis reactance X''_d	pu	
5.4	Negative sequence reactance	pu	
5.5	Zero sequence reactance	pu	
6.0	Alternator Temperature Rises		

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
6.1	Guaranteed temperature rise considering the ambient air temperature as 45 deg. C		
	a) Stator (By resistance)	°C	
	b) Rotor (By resistance)	°C	
7.0	Alternator losses at full load 0.8 pf	kW	
8.0	Class of stator winding insulation		
9.0	Class of rotor winding insulation		
10.0	Class of exciter winding insulation		
11.0	Alternator Miscellaneous Particulars		
11.1	Direction of rotation of alternator as seen from Engine end		
11.2	Vibration amplitude (peak to peak)		
	a) Stator frame vibration	µm	
	b) Rotor vibration	µm	
	c) Bearing vibration	µm	
11.3	Excitation System		
12.0	Current Transformers		
12.1	Line CTs:		
12.1.1	Core-1		
	a) Ratio		
	b) Accuracy class		
	c) Burden		
	d) ALF		

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
12.1.2	Core-2		
	a) Ratio		
	b) Accuracy class		
	c) Burden		
	d) ISF		
12.1.3	Core-3		
	a) Ratio		
	b) Accuracy class		
	c) Burden		
	d) ISF		
12.2	Neutral CTs		
12.2.1	Core-1		
	a) Ratio		
	b) Accuracy class		
	c) Burden		
	d) ALF		
12.2.2	Core-2		
	a) Ratio		
	b) Accuracy class		
	c) Burden		
	d) ALF		
13.0	Neutral MCCB / Neutral Isolator.		
13.1	Make		

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
13.2	Type		
13.3	Rated Voltage		
13.4	Rated Current		
13.5	Rated Ultimate Breaking Current		
13.6	Rated Control Voltage for		
	a)Closing motor		
	b)Shunt Trip		
14.0	Tests		
14.1	All type and routine tests as specified		
15.0	Diesel Generator Control / Relay AMF / Synch / Load Sharing Panel		
15.1	Degree of protection for enclosure of panel		
15.2	Mounting of Relays		
15.3	Operating temperature range	⁰ C	
15.4	Finish painting External Internal		
15.5	Make of the panel		
16.0	Engine Generator Control & Protection(EGCP)		
16.1	Type of the electronic governor offered for the engine control		
16.2	Type of AVR with droop control offered		
16.3	Purchaser's Voltage Supply VA required:		

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
	a) Protection	VA	
	b) AVR, Metering Synchronising Equipment	VA	
16.4	Engine -Control Details		
16.4.1	Engine fuel solenoid control		
16.4.2	Engine pre-glow control		
16.4.3	Engine starter control		
16.4.4	Water temperature monitoring		
16.4.5	Battery voltage monitoring		
16.4.6	Speed monitoring with over speed protection		
18.5	Engine – Protection		
16.5.1	Over speed		
16.5.2	High/ Low Oil pressure		
16.5.3	High/ Low coolant temperature		
16.5.4	Start Failure		
16.5.5	Battery voltage		
16.6	Generator – Control		
16.6.1	Auto Synchronisation with multiple generators and mains		
16.6.2	Manual synchronisation facility with manual voltage and speed adjustments.		
16.6.3	Dead bus closing logic		
16.6.4	Base load control for optimum fuel efficiency		
16.6.5	kW Droop control both for auto and manual		
16.6.6	Load sharing feature for 4 units.		

DATA SHEET –B			
(DATA TO BE FURNISHED ALONG WITH THE BID)			
SL. No	DESCRIPTION	UNIT	DATA
16.6.7	Engine speed control based on load bias		
16.6.8	PF or VAR control when running on base load		
16.7	Generator – Protection		
16.7.1	Restricted earth fault(64R)		
16.7.2	Generator Differential (87G)		
16.7.3	Inverse time over current(51)		
16.7.4	Inverse time earth fault(51N)		
16.7.5	Under Voltage (27)		
16.7.6	Reverse Power (32)		
16.7.7	Field Failure(40)		
16.7.9	Under/Over Frequency (81)		
16.7.10	Over Voltage(59)		
16.7.11	PT Fuse Failure (60)		
16.7.12	Low Forward Power (37)		
16.7.13	Negative Sequence Current (47)		
16.7.14	Master Trip (86)		

Section 6.4.3 Acoustic Enclosure

1.0 SCOPE OF SUPPLY

- 1.1 This Specification covers the design, engineering, manufacture, testing at manufacturer's works, and delivery to site of the complete Acoustic Enclosure for the Diesel Generator set of rating indicated at Section – 4 and Data sheet -A.

2.0 EQUIPMENT TO BE SUPPLIED BY THE CONTRACTOR

- 2.1 The design, engineering, manufacture, testing at manufacturer's works and delivery to site of the complete Acoustic Enclosure for the above referred Diesel Generator sets.

3.0 CODES AND STANDARDS

- 3.1 All equipment covered under this Specification shall comply with all current statutes, regulations and safety codes in the locality where the equipment will be installed. All equipment shall comply in all respects with the requirements of the latest editions of applicable Indian, American, British Codes and Standards.

4.0 SPECIFIC REQUIREMENT

- 4.1 The design, materials, fabrication, construction, testing and certification of the Acoustic Enclosure shall be to applicable Standards and in compliance with the relevant statutory requirements. The VENDOR shall supply the equipment / systems from the approved vendors or equivalent.
- 4.2 The CONTRACTOR shall plan the various activities specified in the specification in conformity with the Institute's requirement and availability of the front. No extra claim by CONTRACTOR will be entertained for non-availability of front.
- 4.3 CONTRACTOR shall ensure no damage to Institute's property while executing this contract. In the event of any damage to Institute's property, due to CONTRACTOR'S negligence the Institute has to be compensated, the value of which will be mutually discussed and agreed.

5.0 PERFORMANCE REQUIREMENTS

- 5.1 The performance of Acoustic Enclosure shall be as specified in Data Sheet 'A'

6.0 GUARANTEES

- 6.1 TENDERER shall guarantee the Acoustic Enclosure performance parameters.
- 6.2 Should the performance test results deviate from the guaranteed value including the tolerances stipulated by relevant Indian Standards, the VENDOR shall correct his equipment at no cost to the Institute, or have the option to reject the same.

Section 6.4.4 Acoustic Enclosure Data Sheets

DATA SHEET-A			
Sl. No	DESCRIPTION	UNIT	DATA
1	Enclosure application		Indoor
2	Enclosure panels.		Detachable type
3	Roof type		Taper both sides
4	Access door(s)		Swing with pad locking feature
5	Enclosure over all dimensions (desired)	mm	Length *
		mm	Width *
		mm	Height *
6	Guaranteed sound level		75 dB at 1 m distance around the enclosure.
7	Exhaust fan Capacity	m ³ /hr	*
7.1	Motor	kw	*
7.2	Voltage/Ampere/ Frequency		*
7.3	Bird screen Etc.		Required
8	External M.S sheet panel Thickness (Corrugated)		14 SWG
9	Internal G.S sheet panel. Thickness (Corrugated)		24 SWG
10	Insulation material.		Mineral wool / rock wool
10.1	Insulation density		*
10.2	Insulation thickness	mm	*

11	Internal lighting		To be provided with lighting system designed for 200LUX, complete with MCB & RCCB protection.
12	Panel openings with louvers for radiator.	mm	Required. (Size. *)
13	Painting External		Finish shade of RAL ## powder coated.
14	Internal paint finish		Finish shade of glossy white or galvanised sheet finish.
15	Openings on the panels.		Fuel piping and electrical cables to control panels
16	Enclosure fixing to the floor.		*
17	No. of DG Sets to be housed in one enclosure	Nos	Each DG Set shall be housed in a separate enclosure

Note:

* - To be furnished by the Bidder along with the Bid.

##-External Paint shade shall be matched with existing DG-1&2

All other details shall be reviewed by Bidder and conform.

DATA SHEET B			
(Bidders shall fill in the Data Sheet-B and return with their bids)			
Sl. No	DESCRIPTION	UNIT	DATA
1	Enclosure application		
2	Enclosure panels.		
3	Roof type		
4	Access door(s)		
5	Enclosure over all dimensions (desired)	mm	
		mm	
		mm	
6	Sound level		
7	Exhaust fan Capacity		
7.1	Motor	HP	
7.2	Voltage/Ampere/ Frequency		
7.3	Bird screen Etc.		
8	External M.S sheet panel Thickness (Corrugated)	mm	
9	Internal G.S sheet panel. Thickness (Corrugated)	mm	
10	Insulation material.		

10.1	Insulation density		
10.2	Insulation thickness	mm	
11	Internal lighting details		
12	Panel openings with louvers for radiator.	mm	
13	Painting - External		
14	Painting - Internal		
15	Openings on the panels.		
16	Enclosure fixing to the floor.		
17	No. of DG Sets to be housed in one enclosure	Nos	ONE
18	Hardware		
18.1	Material		
18.2	Plating		

Section 6.4.5 HV SWGR – General Specification

SCOPE

- 1.1 This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR'S/his SUB-VENDOR'S Works, delivery to Site of MV Indoor Metal-Clad switchgear.

2.0 CODES AND STANDARDS

- 2.1 The design, material, construction features, manufacture, inspection, testing and performance of indoor metal clad switchgear shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.

- 2.2 Indoor Metal-clad switchgear shall conform to the latest applicable standards specified in **Data Sheet –A1**. In case of any conflict between the standards and this specification, more stringent requirement of the two shall govern.

3.0 MAJOR PARAMETERS

- 3.1 The major parameters of the switchgear and associated equipment are specified in enclosed Data Sheet A1. The Bidder shall confirm compliance of these data in full. Deviations, if any, shall be specifically brought out in the schedule of Technical Deviations.
- 3.2 The bill of material for each type of cubicle is given in enclosed single line diagram/module drawings/ Bill of material. The scope of supply shall include all these items.

4.0 CONSTRUCTIONAL FEATURES

- 4.1 Metal-clad switchgear shall comprise metal-enclosed switchgear and control gear in which components are arranged in separate compartments with metal-enclosure intended to be earthed. The metal-clad switchgear and control gear shall have separate compartments for the following components:
- a) Each set of busbars
 - b) Switching device (Circuit Breaker/Contactor/Load Break switch/Fuses).
 - c) Power Cable Terminations.
 - d) Metering, control & auxiliary switching devices and relaying devices.
- 4.2 The switchgear shall be totally dust, moisture and vermin-proof. The degree of protection shall be as specified in Data sheet A1.
- 4.3 The current transformers shall be fitted on the fixed portion of the switchgear and not on the Breaker truck.
- 4.4 The Cable compartment shall fully house all power cable connections along with associated cable terminations. Wherever zero sequence current transformers are provided for earth fault protection, these shall also be located inside the cable compartment.

- 4.5 All doors of panels, removable covers shall be gasketed all around with neoprene gaskets of proper size. All louvers shall have screen and filter. Vent openings shall be covered with grills so arranged that hot gases or other material cannot be discharged through them in a manner that can injure the operating personnel. The screens and grills shall be made of either brass or galvanised iron wire mesh.
- 4.6 Metal-clad unit shall comprise of rigid welded structural frame enclosed completely by metal sheets smoothly finished, levelled and free from dents and uneven surfaces. The thickness of sheet steel shall be as specified in Data Sheet A1.
- 4.7 Painting
- 4.7.1 All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with relevant standards for phosphating iron and steel.
- a) Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
 - b) Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with slightly alkaline hot water and drying.
 - c) After phosphating, thorough rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and oven drying.
- 4.7.2 After phosphating, the sheet metal shall be subjected to powder coating process. The powder coating shall be carried out by spraying Polyester Epoxy powder (60/ 40) or equivalent using electrostatic or corona gun. After uniform deposition of the powder to the required thickness on to the object, it shall be transferred to a curing oven.
- 4.7.3 The final finished thickness of paint film on steel shall not be less than 100 microns, and shall not be more than 150 microns.
- 4.7.4 Finished painted equipment shall present an aesthetically pleasing appearance, free from dents and uneven surfaces with unique colour shade.
- 4.8 Switchgear design shall comprise fully compartmentalised execution having separate vertical sections for each circuit. Compartments with doors for access to operating mechanism shall be so arranged as not to expose high voltage circuits. Switchgear cubicles shall be provided with hinged doors on the front with facility for padlocking door handles.
- 4.9 Structures, busbars and control wiring troughs shall be so designed and arranged to make future extensions readily feasible on either side.
- 4.10 Instruments, relays and control devices shall be mounted flush on hinged door of the metering compartment located in the front portion of cubicle. Panel door shall be supported by strong hinges and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.
- 4.11 Switchgear cubicles shall be provided with bottom sheet metal plates of 3 mm thick (minimum). Cubicles shall be fitted with removable gland plates in the cable termination chamber at bottom for entry of cables. The gland plates shall be of non-magnetic material, if single core cable terminations are specified.
- 4.12 Mounting sills in the form of mild steel channels properly drilled shall be supplied along with anchor bolts for mounting the switchgear cubicles. These shall be despatched in advance so that they may be installed and levelled when concrete foundations are poured.

4.13 All corresponding components of cubicles of same rating shall be interchangeable with one another.

4.14 Each switchgear cubicle shall be fitted with a label on the front and rear of the cubicle. Each switchgear shall also be fitted with label indicating the switchgear designation, rating and duty. Each relay, instrument, switch, fuse and other devices shall be provided with indelibly marked individual designation labels with proper sized letterings at both front & rear of the mounting door sheet. Size and wording of the labels shall be subject to the PURCHASER'S approval.

5.0 TYPES OF PANELS

5.1 The following type of panels shall be supplied as specified in Data Sheet A1.

a) Circuit Breaker Panel

b) Contactor panel: The panel shall comprise contactor with load break isolator and HRC Fuses.

c) Switch-Fuse Unit (SFU): Panel comprising load break isolator and HRC Fuses.

5.2 Off load isolators shall be supplied with circuit breaker for double bus bar system. The isolators shall be operated only when the breaker is open.

6.0 SAFETY INTERLOCKS & FEATURES

Switchgear shall be provided with following inter locks:

6.1 Withdrawal or engagement of a circuit breaker or isolator shall not be possible unless it is in the open position.

6.2 Operation of a circuit breaker or isolator shall not be possible unless it is fully in service position, withdrawn to test position or fully drawn out.

6.3 Compartment door of a breaker or isolator shall not be possible to open unless the associated breaker or isolator is in open position.

6.4 Circuit breaker/isolator cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker/ isolator carriage, to cover the stationary isolated contacts when the breaker/ isolator is withdrawn. Padlocking facilities shall be provided for locking the shutters positively in the closed position. It shall, however be made possible to open the shutters intentionally against spring pressure for testing purposes only.

6.5 A breaker/ isolator of given rating shall be prevented from engaging with a stationary element of other / higher rated one.

6.6 The breaker/ isolator carriage shall be earthed before the main circuit breaker/isolator controls are plugged in the stationary contacts, i.e. before the control circuit is completed. Positive earthing of circuit breaker/isolator truck shall be maintained in the connected position.

6.7 Caution name plate, "**Caution Live Terminal**" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end, i.e. incoming terminals of main breaker / isolator.

- 6.8 The closing and tripping circuit of each feeder controlling device will be interlocked electrically with the PURCHASER'S equipment to be specified later and the VENDOR shall arrange for the necessary wiring.

7.0 MAIN BUSBARS

- 7.1 **Main busbars shall be of electrolytic grade copper** (tough pitched-99% purity) or Aluminium Alloy, E91E-grade as specified in Data Sheet-A1, conforming to relevant standards specified there in.
- 7.2 Bus-bars shall be located in air insulated enclosures and segregated from all other compartments of the cubicle. Direct access or accidental contact with busbars and primary connections shall not be possible. To provide a seal between adjacent cubicles, busbars shall be taken through seal-off bushings or insulating pads.
- 7.3 Bus-bars shall either be air insulated or encapsulated in epoxy and phase segregated by means of insulated phase barriers as specified in Data Sheet-A1. The insulating material for phase barriers shall be made of non-hygroscopic material such as glass reinforced plastic or epoxy, which shall provide adequate insulation for the specified voltage class.
- 7.4 All busbar joints and bus tap joints shall be silver faced. Plain and spring washers shall be provided to ensure good surface contacts at the joints and taps. Wherever copper to dissimilar materials connections are required, suitable bimetallic connectors or clamps shall be used at joints & taps.
- 7.5 Bus-bars shall be rated in accordance with the service conditions and the rated continuous and short time current ratings specified in Data Sheet – A. Calculations shall be submitted for the busbar sizing taking into account ambient, enclosure and proximity de-ratings.
- 7.6 Bus-bars shall be adequately supported on insulators to withstand dynamic stresses due to short circuit current specified in Data Sheet-A1. Busbar support insulators shall conform to relevant standards specified in Data Sheet–A.
- 7.7 The busbar clearances in air shall be as specified in DataSheet-A1.
- 7.8 Busbars shall not be painted and all performance characteristics specified shall be obtained with unpainted busbars.

8.0 CIRCUITBREAKERS

- 8.1 Circuit breakers shall be of Vacuum or SF6 type as specified in Data Sheet-A1. These shall conform to relevant standards specified in Data Sheet-A1 and shall be of the horizontal draw-out type. Circuit breakers shall comprise three separate identical single pole units operated through a common shaft by the operating mechanism.
- 8.2 Circuit breakers shall be suitable for switching duty of devices (Transformer / Motor / Capacitor or Cable Feeder) as specified in DataSheet-A1.
- 8.3 Circuit breaker along with its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow smooth movements. Isolating plugs and sockets for auxiliary power as well as control circuits shall be of robust design and fully self-aligning. Plugs and sockets for auxiliary power circuits shall be silver faced and shall be insulated with FRLS PVC or similar insulating material shrouds.
- 8.4 There shall be 'Service', 'Test' and 'Fully withdrawn' distinct positions for the breakers in its housing. In the 'Test' position, the circuit breaker shall be capable of being tested for operation without energising the power circuits, i.e. the control circuits shall remain undisturbed while the power contacts shall be disconnected. Separate limit switches each having a minimum of 3 NO + 1 NC contacts shall be provided for both 'Service' and 'Test' positions of the circuit breakers as spares. These contacts shall be rated for 10A, 240V AC and 0.5A (inductive breaking) at 220V DC.
- 8.5 Connection of the control circuit between the fixed portion of the cubicle and the breaker carriage shall be by means of a 24-pin plug and socket arrangement. If a 24-pin arrangement is inadequate for the control and interlock scheme offered by the VENDOR, the VENDOR shall provide plug and socket having adequate number of pins. The plug and socket shall be so designed that, it shall be possible to engage or disengage the plug into the socket in 'test' position only, thereby eliminating the possibility of faulty insertion and wiring connections. The plug, after insertion, shall remain secured in position by spring clamps, which need considerable force to operate. The length of the plug chord shall be such that plug can be inserted into the socket only when the breaker is in 'test' and move further to 'Service' position. But it shall be necessary to withdraw the plug from the socket before the breaker truck can be pulled out into the "Fully Withdrawn" position. It shall not be possible to move the circuit breaker into service or fully in position unless plug and socket be inserted in position.
- 8.6 Vacuum breakers shall have completely sealed interrupting units for interruption of arc inside the vacuum chamber. The breakers shall be provided with "contact wear indicator" visible from the front of the equipment, without requiring opening of the cubicle door, allowing the operator to access the conditions of the interrupters whilst the unit is in service. It shall be possible to isolate easily the vacuum interrupter unit from the breaker operating mechanism when in drawn out position for mechanical testing of the interrupter to check loss of vacuum.
- 8.7 The vacuum breakers shall be complete with integral surge arrestors to provide protection to the equipment controlled by the breaker, against switching surges.
- 8.8 SF6 circuit breakers shall operate on puffer or rotating arc principle. The breaker shall have, SF6 gas pressure 'low' and 'very low' alarm and trip contacts.

9.0 OPERATING MECHANISM

- 9.1 Circuit breaker shall be power operated, either by pneumatic or by a motor charged spring operated mechanism. Main poles of the breakers shall be such that unless otherwise specified, the maximum difference between instants of contacts touching during closing shall not exceed quarter a cycle of the rated frequency.
- 9.2 Operating mechanism shall be non-pumping electrically and either mechanically or pneumatically under every method of closing (except during manual closing of a breaker for maintenance). Electrical anti-pumping feature shall be obtained by means of an auxiliary relay only and use of a contactor to achieve this feature shall not be acceptable.
- 9.3 Main poles of the breakers shall operate simultaneously.
- 9.4 Closing and Trip Circuits
 - 9.4.1 Closing and trip coils shall be rated for satisfactory operation on the control supply voltage specified in Data Sheet A1.
 - 9.4.2 Close and trip coils shall operate satisfactorily under the following conditions of supply voltage variations:-
 - a) Closing Coils - 85% to 110% of rated voltage
 - b) Trip Coils - 50% to 110% of rated voltage.
 - 9.4.3 Electrical anti-pumping feature shall be provided.
 - 9.4.4 Trip circuit supervision relay shall be provided to indicate 'trip circuit healthy' in the switchgear and remote panel and to provide alarm for 'trip circuit faulty'.
- 9.5 Spring Operating Mechanism
 - 9.5.1 Spring charging motor shall be universal type suitable for operation on AC and DC control voltages specified in Data Sheet A1 with voltage variation of 80% to 110% of rated voltage.
 - 9.5.2 Spring operated mechanism, shall be complete with spring charging motor, opening spring, closing spring with limit switch for automatic charging and all necessary accessories to make the mechanism a complete operating unit.
 - 9.5.3 As long as power is available to the spring charging motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply to the motor, at least one open-close-open operation of the circuit breaker shall be possible.
 - 9.5.4 Breaker operation shall be independent of the spring charging motor, which shall be used solely for compressing the closing spring.
 - 9.5.5 Closing action of the circuit breaker shall compress the opening spring ready for tripping. When closing springs are discharged, after closing a breaker, closing springs shall automatically be charged for the next operation.
 - 9.5.6** Motor shall be such that it requires a maximum of about 30 sec for fully charging the closing spring.
- 9.6 Operating Mechanism Control
 - 9.6.1 Operating Mechanisms shall normally be operated by remote electrical control when the breaker is in "**Service**" position. Electrical tripping shall be performed by shunt trip coils. Provision shall be

made for local electrical control when the breaker is in “**Test**” position by a control switch on the switchgear cubicle door. Also, “**Local/ Remote**” selector switch lockable in “**Local**” position shall be provided on the cubicle door.

9.6.2 The following indicating lamps shall be provided on the front panel:-

- a) ‘Red’, ‘Green’, and ‘Amber’ lamps for breaker ‘on’, ‘off’ and ‘auto trip’ indication.
- b) ‘Red’ lamps for test and service position.
- c) ‘White’ lamp for trip circuit healthy
- d) ‘Blue’ lamp for spring charged.

9.7 Breaker Accessories

The following accessories shall be provided with each breaker.

9.7.1 Mechanical trip and close push buttons for manual operation under emergency. The mechanical trip button shall be provided on the front door with a shrouded cover. The mechanical close button shall be accessible after opening the front door.

9.7.2 Mechanical position indicator for ON/OFF status of the breaker.

9.7.3 Mechanical position indicator for Test and Service position of the breaker.

9.7.4 Breaker auxiliary switches mounted on the fixed portion of the cubicles and directly operated by the breaker operating mechanism. 6 ‘NO’ and 6 ‘NC’ potential free contacts shall be provided for purchasers use. These contacts shall be in addition to those utilized in the control circuit of the breaker by the vendor.

9.7.5 Mechanical position indicator for closing spring charged.

9.7.6 Manual spring charging facility.

9.7.7 Operation Counter

9.7.8 All Mechanical position indicators shall be so located that they are visible to the operator standing in front of the switchgear with cubicle door closed.

9.7.9 All electrical contacts provided for purchasers use shall be potential free contacts rated 10A, 240V AC and 0.5A (inductive breaking) 220VDC.

10.0 CONTACTORS

10.1 The contactor shall be triple pole, vacuum type.

10.2 The contactor shall be suitable for Direct On Line (DOL) switching of AC Induction motor and of utilisation category AC3 unless otherwise stated in Data Sheet.

10.3 The contactor shall be suitable for ‘local’ and ‘remote’ closing and opening.

10.4 The contactor shall provide 6 ‘NO’ and 6 ‘NC’ auxiliary contacts for purchaser’s use.

10.5 The contactor along with load break switch isolator and fuses shall be mounted on a with drawable carriage similar to circuit breakers.

- 11.1 The switch isolator shall be load break type capable of breaking the load current specified in Data Sheet A1.
- 11.2 The switch shall be manually operated or motor operated as specified in Data Sheet A1.
- 11.3 The switch shall be able to make and carry for specified duration the fault currents specified in Data Sheet A1.
- 11.4 The switch shall provide 4 'NO' and 4 'NC' auxiliary contacts for purchaser's use.
- 11.5 The fuses shall be single pole, HRC type suitable for the fault duty specified.
- 11.6 The high voltage fuses shall be of striker pin type. On blowing of fuse in any phase, the switch unit shall open out to prevent single phase operation.
- 11.7 The switch fuse unit shall be draw out type.

12.0 CURRENT TRANSFORMERS

- 12.1 Each panel shall be provided with metering and protection current transformers (CTs) as shown in the single line diagrams.
- 12.2 The CT parameters are given in the single line diagrams and Data Sheets. The BIDDER shall ensure that the specified ratings are adequate for the relays and meters furnished by him. If specified ratings are not adequate, the BIDDER shall offer CTs of required rating.
- 12.3 The CTs shall be of cast resin type and completely encapsulated.
- 12.4 The CTs shall withstand the momentary and short time fault current rating specified for the switchgear.
- 12.5 The core balance CTs shall be suitable for the respective outgoing feeder and suitably supported.
- 12.6 Test links shall be provided in the secondary leads of CTs to carry out current and phase angle measurement tests.
- 12.7 All CTs shall be earthed through a separate earth link on the terminal block to permit measurement of CT insulation resistance.
- 12.8 The CT shall have polarity indelibly marked on each CT and associated terminal block.

13.0 VOLTAGE TRANSFORMERS

- 13.1 Each panel shall be provided with metering and protection voltage transformers (VTs) as shown in the single line diagrams.
- 13.2 The VT parameters are given in the single line diagrams and Data Sheets. The bidder shall ensure that the specified ratings are adequate for the relays and meters furnished by him. If specified ratings are not adequate, the BIDDER shall offer VTs of required rating.
- 13.3 The VTs shall be of cast resin type and completely encapsulated.
- 13.4 The VTs shall be single phase, draw out type.
- 13.5 Each single pole VT shall be housed in a separate sheet metal compartment.

13.6 The VT shall have a continuous over voltage factor of 1.2 and short time over voltage factor as follows:-

- a) 1.5 for 30 seconds in case of effectively earthed system.
- b) 1.9 for 8 hours in case of non-effectively earthed system.

13.7 The VT shall be protected by HRC fuses on the primary side and RCBO on the secondary side.

13.8 The VT shall have polarity indelibly marked on each VT and associated terminal block.

14.0 INDICATING INSTRUMENTS & METERS

14.1 Instruments and meters shall be supplied as shown in single line diagram/ data sheets Indicative instruments shall be analogue or digital type as specified.

14.2 Digital multifunction power monitor (MF) shall be supplied when specified in single line diagram/Data sheet. The multifunction meter shall include monitors for voltage, current, frequency, power factor, power(kVA, kW, kVAR) and energy (kVAh, kWh, kVARh inductive and capacitive) The MF shall have class of accuracy 0.5. The MF shall have RS 485 port connection for communication with PLC / SCADA.

15.0 INDICATING LAMPS

15.1 Indicating lamp shall be: of the cluster LED type and of low watt consumption, provided with step-down transformer and provided with translucent lamp covers of colours as required in the control wiring diagrams.

15.2 Bulbs and lenses shall be easily replaceable from the front

16.0 CONTROL & SELECTOR SWITCHES

16.1 Control and selector switches shall be: of the rotary type with enclosed contacts, adequately rated for the purpose intended (min. acceptable rating is 10A continuous at 240V AC and 1A (inductive break) 220V DC and provided with escutcheon plates clearly marked to show the positions

16.2 Control switches shall be: of the spring return to normal type and provided with pistol grip type handles

16.3 Control switches for circuit breaker control shall be provided with contact development.

16.4 Wherever specified in data sheets, control switches with built-in flashing type discrepancy lamps shall be provided to control circuit breakers in lieu of the normal control switch, red, green and amber indicating lamps. The discrepancy lamp shall be replaceable from the front of the module door.

16.5 Selector switches shall be: Of the maintained contact stay put type. Switches in ammeter circuits shall have make-before-break type contacts Provided with oval handles

17.0 PUSHBUTTONS

17.1 Push buttons shall be:

Of the momentary contact, push to actuate type rated to carry 10A at 240V AC & 1A (inductive breaking) at 220V DC

Fitted with self reset, 2 NO and 2 NC contacts

Provided with integral escutcheon plates marked with its function

17.2 'Start', 'Open', 'Close' push buttons shall be green in colour

17.3 'Stop' push buttons shall be red in colour

17.4 All other push buttons shall be black in colour

18.0 PROTECTION RELAYS

18.1 All protection relays shall be supplied as shown in single line diagrams/ Data sheets.

18.2 All relays shall be numerical type. Multi function relays shall be provided wherever applicable. Multifunction relays shall have provision for communication with PLC/SCADA.

18.3 Multifunction numerical relays shall have the following features:-

All Currents and Voltages measured in true RMS values.

A LCD screen that shall show all the values measured by the relay as well as the preset parameters.

Programmable LED indications.

Programmable scheme logic which shall allow the user to customise the protection and control functions.

Independent protection settings for each relay element.

Self supervision of the relay with alarm for relay failure.

Trip circuit supervision of the breaker in both breaker open and closed states.

Voltage transformer supervision to detect loss of one, two or three phase VT signals.

Current transformer supervision to detect loss of phase CT signals and inhibit the operation of current dependent protection elements.

Post Fault Analysis

The numerical relays shall have events, fault and disturbance recorders with the following features:-

All records shall be time lagged to a resolution of 1 ms using internal real time clock.

A lithium battery shall provide a back up for the real time clock and all records in the event of supply failure. The battery shall be supervised and shall easily be replaced from the front of the relay.

The event recorder shall store events in non-volatile memory which can be extracted using the communication ports or viewed on the front panel display. The number of events stored shall be in accordance with the functions of the relay.

The fault recorder shall maintain records for at least last 5 faults in non-volatile memory. Oscillographic fault records shall be provided.

The disturbance recorder shall store at least 20 disturbance records of up to 10.0 seconds in non-volatile memory. The data shall be sampled 12 times a cycle. All channels and trigger sources shall be user configurable.

Local and Remote Communications

The numerical relays shall provide the following communication facilities

The local communication shall be designed to fully support all the functions within the relay such as programme the settings, configure the programmable scheme logic, extract and view events, disturbances and fault records, view the measurement information dynamically and perform control functions.

The remote communication shall be provided by RS 485 port connection and communication protocol suitable for Communication with SCADA. All internal information such as measurements, adjustments, settings, post fault analysis records shall be available via the communication network.

Relays shall be suitable for flush mounting with only flanges projecting.

All protective relays shall be in draw out cases with built in test facility. Necessary test plugs shall be supplied loose and shall be included in VENDOR's scope.

High speed tripping relays shall be supplied when shown in single line diagrams/Data sheets. The tripping relay shall be hand reset type.

Auxiliary relays and time delay relays shall be supplied as shown in single line diagrams/Data sheets/ Schematic drawings.

Auxiliary relays for multiplying equipment status/ position contacts shall be of Areva make type VAJCorequivalentbistablerelayandshallnotbeeithercontactortypeormonostablerelay.

19.0 EARTHING

19.1 An earth bus shall be provided and extended through out the length of the switchgear to facilitate dual point earthing. It shall be brazed/ bolted to the frame work of each panel and each breaker earthing contact bar.

- 19.2 The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current for the duration as specified in Data Sheet-A1, without exceeding maximum allowable temperature rise.
- 19.3 Suitable clamp type terminals at each end of the earth bus shall be provided to suit the size of the PURCHASER's earthing conductor.
- 19.4 All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus.
- 19.5 Bolted joints, splices, taps etc. to the earth bus shall be made with at least two bolts.
- 19.6 Hinged doors shall be earthed through flexible earthing tinned Cu braid of suitable size.
- 19.7 Positive earthing of circuit breaker frame shall be maintained when it is in the connected position and in all other positions whilst the auxiliary circuits are not totally disconnected.
- 19.8 The circuit breaker frame contacts/ control circuit contacts are plugged in the associated stationary contacts.
- 19.9 Circuit/ Busbar Earthing Facility
- 19.9.1 It shall be possible to connect each circuit or set of 3 phase busbars of the switchgear to earth either through earthing switches or through truck mounted earthing devices (in the Incoming/ Bus PT panel with suitable arrangement to earth only the dead bus).
- 19.9.2 Integral earthing switches shall be mechanically interlocked with the associated breaker / isolator to prevent earthing of live circuit of busbars.

20.0 CUBICLE ACCESSORIES AND WIRING

Cubicle accessories and wiring shall include following:

- 20.1 Inter-cubicle wiring between cubicles of same switchgear shall be carried out by the VENDOR. Separate schematics, internal and inter-cubicle wiring diagrams and external cable connection diagrams for each cubicle shall be furnished by the VENDOR. The external connection drawings shall indicate all external connections to be made by the PURCHASER to the respective cubicles from the PURCHASER'S remote equipment. Necessary data for remote connections will be furnished by the PURCHASER to the VENDOR.
- 20.2 It shall be the responsibility of the VENDOR to select motor protection relays whose characteristics shall match with motor characteristics for the motor feeders.
- 20.3 One common two pole miniature circuit breaker of adequate rating for controlling DC supplies to tripping and closing circuits of breaker.
- 20.4 10% spare terminals of each size in each Terminal blocks in addition to those used to complete internal wiring and inter-cubicle wiring shall be made available for purchaser's use.
- 20.5 All accessories such as Local / Remote selector switch, breaker control switch with indicating lamps, 'Tests' and 'Services' position limit switches with position indicating lamps etc. as per attached specifications and drawings shall be included in the VENDOR'S scope of supply.
- 20.6 Inter-cubicle looping of control and cubicle space heating supplies for all the panels of switchgear shall be carried out by the VENDOR.

- 20.7 Terminals suitable to receive cables for motor space heater shall be provided in each cubicle by the VENDOR for the motor feeders.
- 20.8 Segregation of auxiliary and control terminals for AC & DC shall be followed in allocations.
- 20.9 Wiring inside the switchgear shall be carried out with 650/1100 V grade, FRLS PVC insulated, stranded conductor wires. Control circuits shall be wired with copper conductor of at least 2.5 sq.mm for CT circuits and 1.5 sq.mm for VT and other circuits, the number and size of strands shall be 7 of 0.67 mm and 0.5 mm dia meter respectively.

21.0 CABLE BOXES & GLANDS

- 21.1 Cables boxes/ pot heads and glands shall be provided in the switchgear.
- 21.2 Cable boxes/ pot heads for power cables shall be suitable for stranded aluminium conductor, cross linked polyethylene insulated cables, as specified in Section-C and / or DataSheet-A1.
- 21.3 Cable terminating boxes shall be supplied complete with all accessories (excluding heat shrinkable sleeves and kits) required for terminating PURCHASER's cables should be furnished by the VENDOR.
- 21.4 The accessories shall include but not be limited to armour clamps, brass glands, pig tails etc.
- 21.5 Connecting leads of adequate size with terminal clamps for connecting cable box terminal to switchgear equipment terminals shall be included.
- 21.6 Cable box shall withstand the short circuit rating of the switchgear.
- 21.7 Necessary number of cable glands shall be provided for terminating auxiliary power and control supply cables.
- 21.8 Glands shall be of heavy-duty brass castings, machine finished and complete with check nut, washers, neoprene compression ring etc.

22.0 MISCELLANEOUS ACCESSORIES

22.1 Heater

Each switchgear cubicle shall be equipped with heaters to prevent moisture condensation within the enclosure and shall be complete with MCB unit for power supply. Heaters shall be suitable for continuous operation on 240V, 1 phase, 50Hz. AC supply and shall be controlled by a humidistat.

22.2 Plug Point

A 240V, 1 phase, 50 Hz. AC plug point shall be provided in the interior of each cubicle with an MCB for connection of hand lamps.

22.3 Spare parts

Whether included in the VENDOR'S recommendations or not, unit prices of the following items shall be quoted together with their suggested quantities for three (3) years satisfactory operation and catalogue numbers.

- a) One complete pole of the breaker.
- b) Closing coil.

- c) Tripping coil.
- d) Spring charging motors along with closing and tripping springs.
- e) Set of gaskets.
- f) Busbar support insulators.
- g) Auxiliary switch assemblies.
- h) Operating mechanism rods.
- i) Limit position switches.
- j) Local/remote selector switches
- k) Breaker control switches.
- l) Bus seal –off bushings.
- m) Various types of relays.
- n) Indicating lamps.
- o) Cable boxes/ pot heads of different types.
- p) Fixed and moving plug contact assemblies.
- q) Different types of CTs & PTs. Main Fixed and moving contact assemblies for breakers.

23.0 TESTS AND TEST REPORTS

- 23.1** The VENDOR shall completely assemble, with all the associated equipment including bought out items mounted and wired and test each cubicle as per relevant standards specified in Data Sheet-A1. All type and routine tests shall be carried out as per this standard. Type test reports for short circuit and temperature rise shall be submitted along with the bid.
- 23.2** Type tests and routine tests shall be carried out on all associated equipment as per relevant standards specified in DataSheet-A1.
- 23.3** Copies of the test certificates shall be submitted for the PURCHASER'S approval before despatch of the switchgear. The switchgear shall not be despatched unless the test certificates are approved. Bound copies of complete test results as specified in the distribution schedule shall be furnished with the switchgear. These shall include complete reports and results of the routine tests as also certified copies of type tests carried out on equipment of identical design.
- 23.4** Oscillographic test records for closing and tripping timings of the breakers shall also be furnished.

24.0 DRAWINGS AND DATA

As part of the proposal, the VENDOR shall furnish relevant descriptive and illustrative literature on breakers, contactors and associated equipment and the following for preliminary study.

- a) Complete assembly drawings of the switchgear showing plan, elevation and typical sectional views and locations of cable boxes/pot heads, busbar chamber, metering and relay compartment and terminal blocks for external wiring connections.

- b) Typical and recommended schematic diagrams for control and supervision of circuit breakers.
- c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for all cables entry etc.
- d) Type test certificates along with oscillograms for breakers of identical ratings.

Section 6.4.5 HV SWGR – Data Sheet

DATA SHEET - A1									
Sl. No.		Description			Unit		Data		
1.0 SWITCHGEAR CUBICLES AND BUS BARS RATING	1.1	Rated Voltage/ Phases/ Frequency			kV/ No./ Hz		11kV / 3Ph / 50Hz		
	1.2	System Neutral Earthing	Effectively earthed		Yes/ No		No		
			Non- Effectively Earthed.		Yes/ No		Resistance Earthed		
	1.3	Maximum System Voltage.			kV		12		
	1.4	One minute power frequency withstand voltage			kV (rms)		28		
	1.5	1.2/50 μSec impulse withstand voltage			kVp		75		
	1.6	Short circuit withstand atrated voltage	Current		kA 25				
			Time		Sec 3				
	1.7	Dynamic rating			kAp		65.75		
	1.8	Reference ambient temperature.			°C		40		
	1.9	Continuous current rating of busbars under site reference ambient temp.			A 800A				
	1.10	Maximum temperature of (final) busbars, droppers, connectors & contacts at continuous current rating under site reference ambient temperature.			°C		85		
1.11	Maximum temperature final of Cable termination Point			°C		85			
1.12	Applicable standards					As per Data Sheet A2			
2.0 SWITCHGEAR PARTICULARS		Designation	Busbars		Cable Entry Top / Bottom (T/B)		Total no. of CB/ SFU cubicles per Switch board	No of Bus PT	No of Line PT
			A	Cu / Al	Power	Control			
	2.1	11kV Switchgear (IC) with Control Box	6300	u		B	2	NA	2

DATA SHEET - A1					
Sl. No.		Description	Unit	Data	
3.0	BILL OF QUANTITIES	By Bidder as per enclosed Single Line Diagrams			
4.0	CONSTRUCTIONAL REQUIREMENT	4.1	Thickness of sheet steel enclosure, doors & covers	Cold Rolled / Hot Rolled	Cold Rolled
				Thickness	2.5mm
		4.2	Degree of enclosure protection		IP 4X
		4.3	Form of internal Separation		LSC2B-PM as per IEC-62271
		4.4	Colour finish shade.	Interior	RAL (To Match Existing Switch Board)
				Exterior	RAL (To Match Existing Switch Board)
		4.5	Earth bus.	Material	Tinned Copper
				Size	50 x 6
		4.6	Purchaser's Earthing conductor	Material	75 x 10
				Size	GS
		4.7	Bus duct/ bus trunking connections required	Yes/No	NA
		4.8	Minimum Clearances in air of live part	Phase to Phase	120
				Phase to Earth	120
4.9	Bus bar insulation		Fully Insulated with heat shrinkable sleeves		
5.0	BREAKER PARTICULARS	5.1	Circuit breaker type		VCB
		5.2	Voltage, frequency & no of phases.		11kV / 50Hz / 3 Ph
		5.3	Rated operating duty.		0-0.3sec-CO-3min-CO
		5.4	Rated current at site reference ambient temperature	A	630
		5.5	Rated breaking capacity	MVA	500
				kA (rms)	25
		5.6	Rated making current	kA (Peak)	65.75
		5.7	Short time current withstand	kA (rms)	25
				Sec 3	
		5.8	Asymmetrical breaking current	AC Component kA (rms)	25
				DC Component %	≥ 40
5.9	Total break time	ms	3 cycles (60 ms)		
5.1	Total make time	ms	4 cycles (80 ms)		
5.11	Trip free operating mechanism.	Yes/ No	Yes		

DATA SHEET - A1				
Sl. No.	Description	Unit	Data	
	5.12	Minimum no of auxiliary contacts		6 NO + 6NC through Bi-stable relay
	5.13	Minimum No. of contacts in each position switch		Test Position: 3NO + 1 NC
				Service Posn. 3 NO + 1 NC
	5.14	Withstand test voltage		
	a)	One minute power frequency	kV (rms)	28
	b)	Impulse (1-2/50µSec wave)	kV(peak)	75
	5.15	Auxiliary control voltage		
	a)	For closing/ tripping coil	V AC/DC	110V DC
	b)	For spring charging motor	V AC/DC	110V DC / 240V AC
	c)	For space heaters and lighting	V AC	240V AC
	5.15	Breaker application		
	a)	Generator control	Yes/ No Yes	
	b)	Transformer control	Yes/ No	No
	c)	Motor control	Yes/ No	No
	d)	Capacitor control	Yes/ No	No
	e)	Cable Feeder	Yes/ No	No
	5.16	Breaker Auxiliaries required		
	a)	Operation counter	Yes/ No	Yes
	b)	Mechanical position indicator	Yes/ No	Yes
	c)	Mechanical close & trip push button	Yes/ No	Yes
6.0 SWITCH FUSE UNITS	5.17	Breaker Classification for electrical endurance as per IEC 62271-100	E1 / E2	E2
	5.18	Breaker classification - mechanical operations as per IEC 62271-100	M1/ M2	M2
	5.19	Breaker classification for Capacitor Switching as per IEC 62271-100	C1/ C2	NA
	6.1	Switch Type		NA
	6.2	Motor operated	Yes/ No	
	6.3	Voltage Frequency & No of phases		
	6.4	Rated Current at site reference Ambient temperature	A	
	6.5	Rated Breaking Current	kA (rms)	
	6.6	Rated Making Current	kA (Peak)	
	6.7	Short Time withstand	kA (rms)	

DATA SHEET - A1				
Sl. No.	Description	Unit	Data	
	Current/Duration		NA	
	Duration	s		
	6.8 Trip free operating mechanism	Yes/ No		
	6.9 Minimum No of Auxiliary contacts			
	6.1 One Minute power frequency with stand voltage	kV		
	6.11 1.2/50 μ s Impulse withstand Voltage	kVp		
	6.12 Auxiliary Control Voltage			
	a) Switch operating Motor	V AC/ DC		
	b) Indicating Lamps	VAC/DC		
	6.13 Switch Application			
	a) Transformer Control	Yes/ No		
	b) Motor Control	Yes/ No		
	c) Capacitor Control	Yes/ No		
	d) Cable Feeder	Yes/ No		
	6.14 Type of HV Protection			
	6.15 Type of HRC Fuse			
	6.16 HRC Fuse Rating			
	6.17 Tripping Details			
	a) Type			
	b) Shunt Trip	Yes/ No		
	c) Voltage of Shunt Trip	V DC		
7.0 HV CONTRACTORS	7.1 Type		NA	
	7.2 Rated Voltage, No of phases & frequency			
	7.3 Contractor Application			
	a) Motor Control	Yes/ No		
	b) Capacitor Control	Yes/ No		
	7.4 Rated Current at site reference Ambient Temperature	A		
	7.5 Rated Operating Duty			
	7.6 On/ Off Operation	Auto/ Manual		
	7.7 Control Voltage			
	a) Coil Voltage	V AC/DC		
	7.8 No of Auxiliary Contacts			
CURRENT TRANSF	8.1 Type		Cast Epoxy Resin	
	8.2 System voltage & frequency		11kV & 50Hz	
	8.3 Class of insulation		Class B or better	

DATA SHEET - A1				
Sl. No.	Description	Unit	Data	
	8.4	Rated primary current & ratio ref. Dwg. Nos.		Refer SLD
	8.5	Accuracy class & burden		Refer SLD
	8.6	Short time Current rating & dynamic rating	25 kA for 3 sec & 65.75 kA	
9.0 VOLTAGE TRANSFORMERS	9.1	Type		Cast Epoxy Resin
	9.2	Rated Voltage	11kV/	$\sqrt{3} / 110V / \sqrt{3} / 110V / \sqrt{3} / 110V / 3$
	9.3	Method of connection		Star-Star-Star-Delta
	9.4	Rated voltage factor		1.2 Continuous and 1.5 for 30 Sec
	9.5	Class of insulation		Class B or better
	9.6	Accuracy class & burden		Refer Corresponding SLD
10.0 H.V. FUSES	10.1	Rated current	A	4A (For VT primary Protection)
	10.2	Voltage class	V	11kV AC
	10.3	Symmetrical interrupting Current	kA	25 kA
11.0 METER	11.1	Accuracy class		Refer SLD
	a)	Indicating meters		
	b)	Energy meters		
	c)	Multifunction meters		
12.0 MIMIC DIAGRAM	12.1	Mimic Diagram required	Yes/ No	Yes
	12.2	Colour of mimic		Sea Green (Shade 217 of IS 5) for 11kV
13.0 WIRING DETAILS	13.1	Material of conductor	Stranded Cu/Al	Stranded Cu
	13.2	Size of wires		
	a)	CT circuits	Sq. mm	2.5
	b)	PT circuits	Sq. mm	2.5
	c)	Auxiliary circuits	Sq. mm	2.5
	13.3	Voltage grade	V	1100
	13.4	Type of insulation		FRLS PVC
	13.5	Terminal block details		Screw Type Finger Touch Proof
14.0 NOTES		Note 1: All indicating instruments and meters shall be supplied as shown in Single Line Diagram and as per Clause 14.0 of specification PCPL-4-S4-151.		
		Note 2: Protection relays shall be microprocessor based numerical relays as shown in Single Line Diagram and shall be as per Clause 18.0 of specification PCPL-4-S4-151.		
		Note 3: Composite numerical relays shall be offered wherever individual relays are specified/ indicated.		

DATA SHEET – A2		
APPLICABLE STANDARDS		
Sl. No.	Description	Standards
1.	HV Circuit breakers	IEC 62271-100, IS 13188
2.	Switches & switch Isolators	IEC 60265, IS 9920
3.	HV Fuses	IEC 60282, IS 9385
4.	Degree of Protection	IEC 60529
5.	Insulators	IEC 168, IS 2544
6.	Bushings	IEC 60137, IS 2099, IS 10314, IS 5621
7.	Current transformers	IEC 61869, IS 2705
8.	Potential transformers	IEC 61869, IS 3156
9.	Meters	IEC 62056, IEC 62053-21, IS 722, IS 13010, IS 13779, IS 11448, IS 8530
10.	Clamps & connectors	IEC 305, IS 5561
11.	High Voltage Switchgear and Control gear Assemblies.	IEC 62271-202
12.	AC Metal enclosed switchgear and Controlgear for rated Voltages above 1kV and upto and including 52kV	IS 2427
NOTES: 1. Equipment, associated accessories, component/parts raw material and tests shall conform to the above and applicable latest IEC/BS/IEEE standards.		

DATA SHEET – B (To be filled in by the BIDDER and submitted with the BID)				
Sl. No	Description		Unit	Bidder's Data
1.0 SWITCHGEAR CUBICLES AND BUS BARS RATING	1.1	Rated Voltage , Phase & Frequency		kV & Hz
	1.2	System Neutral Earthing	Effectively Earthed.	Yes/ No
			Non Effectively Earthed.	Yes/ No
	1.3	Maximum System Voltage.		kV
	1.4	One minute power frequency withstand voltage		kV (rms)
	1.5	1.2/50m Sec impulse withstand voltage		kVp
	1.6	Short circuit withstand at rated voltage	Current	kA
			Time	Sec
	1.7	Dynamic rating		kAp
	1.8	Reference ambient temperature.		°C
	1.9	Continuous current rating of busbars under site reference ambient temp.		A
	1.10	Maximum temperature of (final) busbars, droppers, connectors & contacts at continuous current rating under site reference ambient temperature.		°C
	1.11	Maximum temperature final of Cable termination Point		°C

DATA SHEET – B									
(To be filled in by the BIDDER and submitted with the BID)									
Sl. No		Description	Unit		Bidder's Data				
2.0 SWITCHGEAR PARTICULARS	1.12	Applicable standards							
		Designation	Bus Bars		Cable Entry Top/Bottom (T/B)		Total no. of CB cubicles per Switch board	No of Bus PT	No of Line PT
			A	CU/ AL	Power	Control			
	2.1								
	2.2								
	2.3								
	2.4								
	2.5								
	2.6								
	2.7								
2.8									
3.0 BILL OF QUANTITIES		Bill of Quantities enclosed with the bid	YES/NO						
4.0 CONSTRUCTIONAL REQUIREMENT	4.1	Thickness of sheet steel enclosure, doors & covers	Cold Rolled/ Hot Rolled						
			Thickness						
	4.2	Degree of protection							
	4.3	Form of internal Separation							
	4.4	Colour finish shade.	Interior						
			Exterior						
	4.5	Earthing bus.	Material						
			Size						
	4.6	Purchaser's Earthing conductor	Material						
			Size						
	4.7	Bus duct/bustrunking connectionsprovided	Yes/No						
	4.8	Clearances in air of live part	Phase to phase						
Phase to Earth									
4.9	Bus bar insulation								

DATA SHEET – B				
(To be filled in by the BIDDER and submitted with the BID)				
SI. No	Description	Unit	Bidder's Data	
5.0 BREAKER PARTICULARS	5.1	Circuit breaker type		
	5.2	Voltage frequency & no of phase.		
	5.3	Rated operating duty.		
	5.4	Rated current at site reference ambient temperature	A	
	5.5	Rated breaking capacity	MVA	
			kA (rms)	
	5.6	Rated making current	kA (Peak)	
	5.7	Short time current withstand	kA (rms)	
			Sec	
	5.8	Asymmetrical breaking current	AC Component kA (rms)	
			DC Component %	
	5.9	Total break time	Milli second	
	5.10	Total make time	Milli second	
	5.11	Switching over voltages	Per unit (peak)	
	a)	Maximum switching over voltage when switching off the breaker under any load condition	Yes/ No	
	b)	Surge arresters provided to limit switching over voltages	Yes/ No	
	5.12	Trip free operating mechanism.	Yes/ No	
	5.13	Minimum no of auxiliary contacts		
	5.14	Withstand test voltage		
a)	One minute power frequency	kV (rms)		
b)	Impulse (1.2/ 50µs wave)	kV (peak)		

DATA SHEET – B (To be filled in by the BIDDER and submitted with the BID)				
SI. No	Description	Unit	Bidder's Data	
5.0 BREAKER PARTICULARS	5.15	Auxiliary control voltage		
	a)	For closing / tripping coil	V AC/DC	
	b)	For sprig charging motor	V AC/DC	
	c)	For space heaters and lighting	V AC	
	5.16	Breaker application		
	a)	Transformer control	Yes/ No	
	b)	Motor control	Yes/ No	
	c)	Capacitor control	Yes/ No	
	d)	Cable Feeder	Yes/ No	
	5.17	Breaker Auxiliaries provided		
	a)	Operation counter	Yes/ No	
	b)	Mechanical position indicator	Yes/ No	
	c)	Mechanical close & trip push button	Yes/ No	
	5.18	Breaker Classification for electrical endurance as per IEC 62271-100		
	5.19	Number of mechanical operations as per IEC 62271-100		
	5.20	Rated Capacitor Switching Duty as per IEC 62271-100		NA
6.0 SWITCH FUSES	6.1	Switch Type		NA
	6.2	Motor operated	Yes/ No	
	6.3	Voltage Frequency & No of phases		
	6.4	Rated Current at site reference Ambient temperature	A	
	6.5	Rated Breaking Capacity	kA	
	6.6	Rated Making Current	kA (Peak)	
	6.7	Short Time Current	kA	

DATA SHEET – B				
(To be filled in by the BIDDER and submitted with the BID)				
Sl. No		Description	Unit	Bidder's Data
		withstand	Sec	
	6.8	Trip free operating mechanism	Yes/ No	
	6.9	Minimum No of Auxiliary contacts		
	6.10	One Minute power frequency with stand voltage	kV	
	6.11	1.2/50μsImpulse withstandVoltage	kVp	
	6.12	Auxiliary Control Voltage		
	a)	Switch operating Motor	V (AC/DC)	
	b)	Indicating Lamps	V (AC/DC)	
	6.13	Switch Application		
	a)	Transformer Control	Yes/ No	
	b)	Motor Control	Yes/ No	
	c)	Capacitor Control	Yes/ No	
	d)	Cable Feeder	Yes/ No	
	6.14	Type of HV Protection		
	6.15	Type of HRC Fuse		
	6.16	HRC Fuse Rating		
	6.17	Tripping Details		
	a)	Type		
	b)	Shunt Trip		
	c)	Voltage of Shunt Trip	V (dc)	
7.0 HV CONTRACTORS	7.1	Type		NA
	7.2	Rated Voltage, No of phases & frequency		
	7.3	Contractor Application		
	a)	Motor Control	Yes/ No	
	b)	Capacitor Control	Yes/ No	
	7.4	Rated Current at site reference Ambient Temperature	A	
	7.5	Rated Operating Duty		
	7.6	On/ Off Operation	Auto	
			Manual	

DATA SHEET – B				
(To be filled in by the BIDDER and submitted with the BID)				
Sl. No		Description	Unit	Bidder's Data
	7.7	Control Voltage		
	a)	Coil Voltage	V (AC/DC)	
	7.8	No of Auxiliary Contacts		
8.0 CURRENT TRANSFORMERS	8.1	Type		
	8.2	System voltage & frequency	V & Hz	
	8.3	Class of insulation		
	8.4	Rated primary current & ratio ref. Dwg. Nos.		
	8.5	Accuracy class & burden		
	8.6	Short time Current rating & dynamic rating		
9.0 VOLTAGE TRANSFORMERS	9.1	Type		
	9.2	Rated Voltage	V	
	9.3	Method of connection		
	9.4	Rated voltage factor		
	9.5	Class of insulation		
	9.6	PF Withstand test voltage	kV	
	9.7	Accuracy class & burden		
10.0 H.V. FUSES	10.1	Rated current	A	
	10.2	Voltage class	V	
	10.3	Symmetrical interrupting rating	kA	
11.0 METER	11.1	Accuracy class		
	a)	Indicating meters		
	b)	Energy meters		
	c)	Multifunction meters		
12.0 MIMIC DIAGR AM	12.1	Mimic Diagram available	Yes/ No	

DATA SHEET – B				
(To be filled in by the BIDDER and submitted with the BID)				
Sl. No		Description	Unit	Bidder's Data
	12.2	Colour of mimic		
13.0 WIRING DETAILS	13.1	Material of conductor	Stranded Cu / Al	
	13.2	Size of wires		
	a)	CT circuits	Sq. mm	
	b)	PT circuits	Sq. mm	
	c)	Auxiliary circuits	Sq. mm	
	13.3	Voltage grade	Volts	
	13.4	Type of insulation		
	13.5	Terminal block details		
14.0 DIMENSIONS & WEIGHTS	14.1	Dimensions of each type of panel (L x W x H)	mm	
	14.2	Total dimensions of each switch gear (L x W x H)	mm	
	14.3	Weight of each type of panel	kgs	
	14.4	Total weight of each switchgear	kgs	
15.0 DRAWINGS & DOCUMENTS	15.1	Single Line Diagram of each switchgear attached	Yes/ No	
	15.2	General arrangement drawing of each switchgear attached	Yes/ No	
	15.3	List of type tests enclosed	Yes/ No	
	15.4	Type test certificates enclosed	Yes/ No	
			Cert. Nos.	
16.0 SPARES	16.1	Have unit price for spares mentioned in specification furnished	Yes/No	
	16.2	List of recommended Spares for these years operation furnished	Yes/No	

1.0 SCOPE OF SUPPLY

- 1.1. This specification cover the requirements of neutral grounding resistors required for connecting to the neutral of generators and power transformers to obtain a resistance grounded system.

2.0 CODES AND STANDARDS

- 2.1. The design, manufacture and performance of the equipment shall comply with all currently applicable statues, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to receive the VENDOR of this responsibility.
- 2.2. Unless otherwise specified, equipment shall conform to the latest applicable standards specified in data sheet-A.

3.0 DESIGN REQUIREMENTS

3.1. RESISTORELEMENTS:

- 3.1.1. The resistors shall be non-inductive, of cast grid or stainless steel punched grid resistance element type as specified in the data sheet A. the cast grid resistor elements shall be heavy duty cast iron or similar alloy of uniform thickness. Steel punched grid resistance shall be stainless steel resistorsheets.
- 3.1.2. The grid shall be securely supported at sufficient number of points so that no damage is caused to the grids due to vibrations and no mechanical stresses are developed. The resistor elements shall be insulated from supporting bars by mica tubes. The grid elements shall be given a protective coat of a suitable heat resistantpaint.
- 3.1.3. The insulating material used in the construction shall be heat resistant such asmica.
- 3.1.4. The BIDDER shall clearly indicate the maximum temperature rise permissible for the type of resistor to be supplied without exceeding the safe temperature for theinsulation.
- 3.1.5. All the resistor elements comprising one stack shall be internally connected and end terminal shall be brought out of tank enclosure in the form of bushing. If resistor taps are specified in the data the sheet A, all taps shall also be brought out of the tank enclosure in the form of bushings.

3.2. ENCLOSURE:

- 3.2.1. Unless indicated otherwise specified in the data sheet A, for both indoor and outdoor applications, the grid resistor element shall be enclosed in the tank type enclosure. The enclosure shall be enclosed in tank type enclosure. The enclosure shall be one made of one piece welded construction rigid frame rusting and deterioration due to exposed conditions by antirust coating and a final aluminium covers on all sides, top and bottom. The enclosure shall be completely weatherproof for out-door application. The louvered openings shall be provided with fine galvanised wire mesh.
- 3.2.2. Cap and pin type, stand insulator shall be provided for supporting the enclosure and isolating it from ground. Insulators shall be complete with the required hardware for supporting resistor enclosure and fixing it with the PURCHASER'S mountingstructure.

3.2.3. The resistor tank will normally be mounted by the PURCHASER at a minimum height of 2.44 meters. In case this is not possible, the VENDOR shall supply, if indicated in data sheet A, a free standing safety screened enclosure, for bolting to the floor to surround the resistor enclosure at top and sides with an adequate electrical clearance from the enclosure frame to provide personnel protection. The screens shall be galvanised, shall prevent entry of rodents/vermin and sides be removable for maintenance.

3.2.4. Only if specifically indicated in sheet A, tank type resistor enclosure for indoor applications may be fitted with galvanised, removable screen covers instead of the aluminium covers stated in item 3.2.1. The screen shall prevent entry of rodents/vermin.

3.3. TERMINAL CONNECTIONS:

3.3.1. Terminal connection arrangement shall be provided on the enclosure for the PURCHASER'S use.

3.3.2. Incoming and outgoing conductors specified in Data Sheet-A. All terminals shall be insulated from ground as well as the body of the resistor.

3.3.3. For resistor incoming neutral and earthing terminal connections; bushings type stud connections shall be provided complete with cable lugs, non-ferrous lock nuts and lock-washers.

3.3.4. For the outgoing connections from resistors, all taps of resistors shall be brought out through bushings into a terminal box shall contain a 10A HRC fuse. The fuse shall connect any one of the resistor tap terminals by bolted links to the outgoing cable to remote ground relay. The terminal box shall be complete with necessary cable glands.

4.0 GENERAL

4.1. The bidder shall submit with his proposal a general outline drawing showing all accessories, total dimensions and weight.

5.0 TESTS

5.1. The following tests on resistors shall be performed and test certificate shall be furnished prior to dispatch:

- a) High voltage withstand test for insulation.
- b) Ohmic value tests on off-load on complete resistor.
- c) Heat run test on complete assembly

5.2. Test certificates of the MANUFACTURERS of bushings, insulators, mica, etc., shall be submitted for approval prior to dispatch of the resistors.

DATA SHEET– B

(To be filled in by the bidder and submitted along with bid)

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NEUTRAL ISOLATING SWITCH

Sl. No	Description		Unit	Bidder's Data
1	Type			
2	Voltage Rating		Volts	
3	Current Rating		A	
4	Control Voltage	Motor	Volts (AC/DC)	
		Closing & Opening Contactors	Volts (AC/DC)	
5	Accessories	j) Mechanical Position Indicator		
		k) Auxiliary Contacts for purchasers use		
		l) Local / Remote selector switch	Nos	
		m) Push Buttons for closing and opening operation	Nos	
		n) Provision for manual operation		
		o) Space Heater with Humidistat control (240V AC)		
		p) Cubicle Light with door switch, 240V AC		
		q) MCB, Indicating Lamp etc.	Set	
		r) Terminal Block	Set	

DATA SHEET – A1				
NEUTRAL ISOLATING SWITCH				
Sl. No	Description		Unit	Data
1	Type			Single pole, Load Break, Motor operated isolator
2	Voltage Rating		Volts	11000
3	Current Rating		A	250
4	Control Voltage	Motor	Volts (AC/DC)	110V DC
		Closing & Opening Contactors	Volts (AC/DC)	110V DC
5	Accessories	a) Mechanical Position Indicator		Required
		b) Auxiliary Contacts for purchasers use		6 NO + 6 NC
		c) Local / Remote selector switch	Nos	1 (One)
		d) Push Buttons for closing and opening operation	Nos	2 (Two)
		e) Provision for manual operation		Required
		f) Space Heater with Humidistat control (240V AC)		Required
		g) Cubicle Light with door switch, 240V AC		Required with 11W CFL Tube
		h) MCB, Indicating Lamp etc.	Set	1
		i) Terminal Blocks	Set	1

Note: 1

3 Nos Current transformers for metering and protection and other associated accessories which are not listed above shall be as per SLD: PCPL-1850-4-SLD-001 and specification and shall be mounted before Star point.

Note: 2

1 No Current transformers for protection and other associated accessories which are not listed above shall be as per SLD: PCPL-1850-4-SLD-001 and specification d shall be mounted after Star point.

DATA SHEET – B			
(To be filled in by the bidder and submitted along with the bid)			
NEUTRAL GROUNDING RESISTOR			
Sl. No.	DESCRIPTION	UNIT	VALUE
1.0	Name of manufacturer		
2.0	Resistor Material		
3.0	Outdoor/Indoor		
4.0	Type of enclosure		
5.0	Rated continuous current	A	
6.0	Rated ohmic value	Ω	
7.0	Resistor taps	%	
8.0	Maximum current carrying capacity for 60 seconds	A	
9.0	Rated voltage	kV	
10.0	Insulation grade	Volts	
11.0	Rated power	kW	
12.0	Temperature rise (not exceeding safe temperature of insulation), when carrying:-		
	a) Maximum current for 60 seconds	$^{\circ}\text{C}$	
	b) Continuous rated current	$^{\circ}\text{C}$	
13.0	Change in resistance with temperature	% Increases	
14.0	Voltage class of stand insulators	kV	
15.0	List of tests to be carried out enclosed	Yes/No	
16.0	Applicable standard		
17.0	Total weight of each Resistor	kg	
18.0	General outline dimensioned drawing enclosed with the bid, showing the resistor with all its fittings and accessories in plan, front and side elevations and other relevant details.	Yes/No	
		Dwg. No	

DATA SHEET– B (To be filled in by the bidder and submitted along with bid)				
NEUTRAL ISOLATING SWITCH				
Sl. No	Description		Unit	Bidder's Data
1	Type			
2	Voltage Rating		Volts	
3	Current Rating		A	
4	Control Voltage	Motor	Volts (AC/DC)	
		Closing & Opening Contactors	Volts (AC/DC)	
5	Accessories	j) Mechanical Position Indicator		
		k) Auxiliary Contacts for purchasers use		
		l) Local / Remote selector switch	Nos	
		m) Push Buttons for closing and opening operation	Nos	
		n) Provision for manual operation		
		o) Space Heater with Humidistat control (240V AC)		
		p) Cubicle Light with door switch, 240V AC		
		q) MCB, Indicating Lamp etc.	Set	
		r) Terminal Block	Set	

Section 6.4.8 Control and Relay Panel

1.0 SCOPE

- 1.1 This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR's/his SUB-VENDOR's Works, delivery to site and performance testing of control panels for control of equipment.

2.0 CODES AND STANDARDS

- 2.1 The design, material, construction, manufacture, inspection, testing and performance of control panel shall comply with all currently applicable statutes, regulations and safety codes as noted below. The equipment shall also conform to the latest applicable standards mentioned here under. Nothing in this specification shall be constructed to relieve the VENDOR of this responsibility.
- 2.2 Supply items which are bought out by the VENDOR shall be procured from approved manufacturers acceptable to the PURCHASER/ENGINEER.

3.0 CONSTRUCTIONAL FEATURES

- 3.1 Control Panels shall be sheet steel enclosed and shall be dust, weather and vermin proof providing an enclosure degree of protection of IP 54 for indoor use and IP 55 for outdoor use. Sheet steel used shall be cold rolled and at least 2.0mm thick and properly braced to prevent wobbling.
- 3.2 Control Panels shall be provided with hinged door(s) with locking arrangement and suitable channels shall be provided for floor mounting.
- 3.3 The top surface must be suitable for lifting the panel and lifting eyes shall be fitted. Adequate strengtheners must be incorporated and longer panels (over 2000mm, depending on the panel structure) shall have a lifting beam fitted across the whole length of the panel.
- 3.4 All doors, removable covers and plates shall be gasketed all round with neoprene gaskets. All accessible live connections shall be shrouded and it shall be possible to change individual switches, MCBs without danger of contact with live metal. Component access shall be front and rear, unless front access only has been agreed.
- 3.5 Doorlocks shall be key operated to open. The doors shall lockit self on closure. Preferred lock is flush T type. Safety interlock switches to be fitted to all doors of sections that are not intended to permit access to non-electrical personnel. Note that standard micro switches are not permitted to be used for door interlock switches.

Section 6.4.8 Control and Relay Panel

- 3.6 All live parts shall be provided with at least phase to phase and phase to earth clearances in air of 25 mm and 20 mm respectively.
- 3.7 Adequate interior cabling space and suitable removable cable gland plate shall be provided. Necessary number of cable glands shall be supplied and fitted on to this gland plate. Cable glands shall be screwed-on single compression type and made of brass.
- 3.8 All sheet steel work shall be powder coated inside and outside after 7 tank cleaning process. Colour shall be as specified. For chemical/corrosive areas epoxy powder coating shall be used wherever specified.
- 3.9 Fans and Filters to be fitted if the static heat dissipation inside the panel is insufficient to keep components below critical temperature level. It is preferred that panels are sized to preclude the fitting of fans.
- 3.10 Fans to be wired to a terminal block so that a single volt free contact can be used to inhibit all fan operation during gas discharge from panel fire detection system.
- 3.11 Double tone siren to be fitted to provide separate warning signal for starting of plant in 'automatic' mode and to announce plant faults.
- 3.12 In areas with high ambient temperature heat exchangers might be required to provide adequate cooling for components inside the panel. The type of component used and the duty imposed on them will also have an effect on whether heat exchanger is required. Once the figure for likely maximum ambient temperatures has been provided in this specification, it will be the responsibility of supplier to decide whether heat exchangers are required.
- 3.13 Fire protection where applicable will be specified later.
- 3.14 The installation of smoke detectors if required will be inside the top of panel. Therefore, clear areas must be provided.

4.0 MCB's

- 4.1 MCB's shall be hand operated, air break, heavy duty, quick make, quick break type conforming to applicable standards.
- 4.2 MCBs shall be provided with overload/short-circuit protective devices.
- 4.3 MCBs shall be provided with locking facility in OFF position.

5.0 CONTROL SUPPLY

Section 6.4.8 Control and Relay Panel

- 5.1 All AC control equipments shall be suitable for operation on 110V AC, 1 phase, 50Hz, centre tap earthed system (i.e., 415/55-0-55V Transformer). This supply may be obtained from 415V main supply shall be protected on the primary side by MPCB/ MCCB and by MCB on secondary side.
- 5.2 Basic control supply, if required shall be suitable for 110V AC. DC control supply shall be derived from battery charger system specified under Section-3 & Data sheets.

6.0 AUXILIARY POWER SUPPLY

- 6.1 A separate feeder controlled by a DP RCBO shall be taken for 1Ø, 240 V, 50Hz supply for panel space heating and lighting accessories.

7.0 RELAYS

- 7.1 Necessary auxiliary relays for alarm, as required shall be mounted inside the panel. Relays shall be equipped with hand reset, positive action operation indicator.
- 7.2 Auxiliary relays shall be rated to operate satisfactorily between 80% and 110% of the rated voltage.
- 7.3 Each relay shall be provided with at least two potential free contacts for the PURCHASER's use.
- 7.4 Make and type of relay shall be subject to the PURCHASER's approval.

8.0 CONTROL AND SELECTOR SWITCHES

- 8.1 Control and selector switches shall be of the rotary type provided with properly designated escutcheon plates clearly marked to show the operating positions. Control switches shall have momentary contacts, spring return to centre, with pistol grip handle. Selector switches shall have stay put contacts with oval handles. The number of contacts and their operation in each switch shall be as indicated in control schematic the switches shall be rated for minimum 10A at 110V AC. The breaker control switch shall be provided with sequence interlocking device and with 2N/O NAC and 2N/C NAT contacts to use in the interlocking circuit.

9.0 INDICATING LAMPS

Section 6.4.8 Control and Relay Panel

- 9.1 Indicating lamps shall be of multiple LED type and low watt consumption. Lamps shall be provided with built in transformers/resistors.

10.0 SPACEHEATER

- 10.1 Strip type space heaters of adequate capacity shall be provided inside each panel. Heaters shall be complete with a single-pole MCB with overload and short circuit protection on phase side, a link on the neutral and a humidistat to cut off the heater at RH55.

11.0 INTERIOR LIGHTING AND RECEPTACLE

- 11.1 Control panel shall be provided with a 110V, 1 phase, 50 Hz, 40W incandescent lighting fixture with 15Watts power saver bulb for interior illumination controlled by a door limit switch and 110 V, 1 phase, 5 Amp, 2pin and earth Reyrolle type receptacle.

12.0 PANEL INTERNAL WIRING

- 12.1 Control panel shall be supplied completely wired, ready for the PURCHASER's external connections at the terminal blocks. All control and auxiliary wiring shall be carried out with 650V grade, FRLS PVC insulated, flexible multi stranded Cu conductors. Power circuits shall be wired with flexible multi stranded copper conductors of adequate sizes to suit the rated circuit current. The minimum size shall be 4sq.mm. Control, alarm and indication circuits shall be wired with flexible multi stranded copper conductors of sizes not smaller than 1.5sq.mm.
- 12.2 Engraved identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire. All wiring shall be terminated on terminal blocks. Terminals shall be adequately rated for the circuit current, the minimum rating shall be 10A.
- 12.3 Clearance between terminal blocks and gland plate and between two rows of terminal blocks shall be minimum of 200 mm, if two or more rows are required. Terminals for AC & DC circuits with different voltages have to be grouped and separated by barriers. No live surfaces shall be exposed (covers or recessed terminals shall be provided).
- 12.4 Power circuits and control circuits must not be mixed - their components shall be separated by means of layouts and barriers.
- 12.5 Wiring for controls and power shall be kept separate as far as is practicable.
- 12.6 All cable ends to be separately terminated with the appropriately sized and shaped crimps. As far as practicable, crimps will be of the compression type (as opposed to the soldered type) being fitted using the correct crimping tool.

Section 6.4.8 Control and Relay Panel

- 12.7 If terminal blocks of the “spring clamp technology” are being used the cable ends shall be prepared by removing correct length of insulation and terminating the exposed copper conductor into terminal block ensuring that no bare copper conductor is exposed outside the terminal block.
- 12.8 Cable shall be run continuously from terminal to terminal without joints or splices. Grouping of conductors at one terminal will not be accepted, a separate terminal shall be provided for each cable.
- 12.9 The number of wires put through trunking inside the panel must not exceed the maximum number permitted by regulation of manufacturers.
- 12.10 Wires inside trunking must be arranged in a tidy manner with cable ties and must be firmly supported so that they do not fall out when the cover is removed. Adequate spare capacity of at least 10% available space must be left within each trunking for future expansion, if any.
- 12.11 Unless requested otherwise cable colour shall comply with relevant Indian Standard Specifications which is summarised in the following table

DUTY	COLOUR
Control Ckt.(AC)	Red
Interlocking Ckt.	Orange
Control Ckt.(DC)	Blue
Earth Ckt.	Green/Yellow
Neutral Ckt.	Black
3 Ph Power Ckt.	Red/Yellow/Blue

13.0 EARTHING

- 13.1 Main Busbar: One main copper busbar each of size as specified shall be provided. The busbar shall be indelibly marked with green and yellow to identify it as earth busbar (stripes or dots).
- 13.2 Earth Lead: Earth terminal of control gear components mounted inside the panel shall be connected to main earth busbar by means of earth leads of adequate sizes. VENDOR shall submit calculations for the same.

Section 6.4.8 Control and Relay Panel

13.3 Earth connections: For termination on to main earth bus bar lug and stud type terminals shall be used with adequate number of pre-drilled holes of appropriate sizes. Insulated wires used for earthing shall be of green or yellow colour.

13.4 Main earth stud: 2 Nos. of main earth studs one at each end shall be braced or welded to the structure of panel. It must withstand the short circuit current specified.

13.5 Auxiliary Earth Rails: Auxiliary Earth Rails (e.g., component mounting DIN rails) can be used under the following conditions:

- a) They are directly connected to main earth bar via a suitably sized earth lead
- b) Internal earthing and bonding must only be done on main earth busbar.
- c) Signal terminations for outgoing/incoming to be mounted on such rails.

13.6 Earth Terminals: All earth terminals shall be green or yellow colour or provided with earth symbol for easy identification.

14.0 ELECTRO MAGNETICCOMPATIBILITY

14.1 EMC compliance for panels housing sensitive electronic equipment like Controller, VFDs and PLCs shall be provided by means of additional shielding to panel, with high conductivity copper sheets. Earth leads for EMC purposes shall be of flexible copper braids. Cross bonding between different parts of panel is allowed to ensure equi-potential within the panel. Any source of interference like transformers and chokes mounted in panel shall have an EMC enclosure. The panel shall be designed for EMC compatibility.

15.0 SAFETYCIRCUITS

15.1 The function of these circuits is to effect for safe disconnection of power to those Plant parts which give rise to danger. This shall include emergency stop device, safety interlocks, high temperature of windings etc. High speed trip relays shall be used for operation of protection indicated above.

15.2 Emergency push buttons provided in the panel shall be wired to a high speed trip relay and provided with contacts for tripping all the plant at once.

16.0 LABELS AND DIAGRAMPLATE

16.1 Every equipment mounted in the panel shall be provided with individual labels with equipment designation/rating. In addition, the panel shall be provided on the front with a non-rusting label engraved with the designation of the panel as furnished by the PURCHASER.

Section 6.4.8 Control and Relay Panel

16.2 Inside the door a circuit diagram engraved on non-rusting metal/PVC shall be fixed for reference.

17.0 DRAWINGS AND DATA

17.1 The following information is furnished:

- a) Panel general arrangement drawing showing dimensioned views, cable entry location and mounting details.
- b) Schematic wiring diagram of the control panel, with ferrule and terminal numbers
- c) Bill of material listing equipment designation, make, type, ratings etc., of the various equipment mounted on the control panel.
- d) O & M Manuals shall be given along with panels.

Bidders shall indicate deviations, if any, in the Bid.

18.0 TESTS AND TEST REPORTS

18.1 Acceptance and routine tests for all supply equipment/component parts shall be carried out as per the relevant standards for the respective equipment. These test reports shall be submitted to the PURCHASER before despatch of the equipment.

18.2 Panel shall be subjected to following tests:

- a) High voltage test (2000 volts for 1 minute)
- b) Megger test

Electrical control, interlock and sequential operation tests.

Section 6.4.8 Control and Relay Panel

DATA SHEET A1 – GENERAL INFORMATION			
1.1	Designation		CRM Panel with AMF Generator Control Synch & Load Share
1.2	Location		INDOOR
1.3	Design ambient temperature °C		40
1.4	Degree of protection		IP 52
1.5	Type of mounting & construction		Floor mounted, single front type with lockable doors
1.6	Cable entry		Top through glands.
1.7	Purchaser's earthing conductor	Material Size	GS 50 x 6 mm
1.8	Painting :		
	a) Colour finish	Outside Inside	RAL 7032 (To match existing panel) Glossy White
	b) Type of paint		Powder Coated
1.9	Control scheme & bill of material, enclosed		Bill Of Material, enclosed
2.0	Supply voltage		
2.1	Power devices, motor drives, etc		415 V, 3 PH / 3 PH-N, 50Hz
2.2	Control voltage :		110V DC / 55-0-55 V AC
2.3	Space heater / lighting supply voltage		1Ph, 240V, 50Hz AC
2.4	Power socket outlet		1Ph, 240V, 50Hz AC
3.0	Terminal blocks		Screw type with min. 4 sq mm.
3.1	Wiring details		
	Current carrying circuits		2.5 Sq. mm
	Potential circuits		1.5 Sq. mm
	Type of conductor		Multi strand cu. with FRLS PVC insulation of 650V grade
4.0	Earth BusinPanel	Material	Copper
		Size	50 x 6 mm

Section 6.4.8 Control and Relay Panel

DATA SHEET – A2		
APPLICABLE STANDARDS		
1	SWITCHGEAR GENERAL REQUIREMENTS	IS 4237
2	FACTORY BUILT ASSEMBLIES OF SWITCHGEAR AND CONTROL GEAR FOR VOLTAGES UP TO AND INCLUDING 1000V A.C. & 1200V D.C.	IS 8623
3	MINIATURE CIRCUIT BREAKERS	IS 8828
4	STARTERS	IS 8544
5	CONTROL SWITCHES / PUSH BUTTONS	IS 6875
6	RELAYS	IS 3231
7	ARRANGEMENT FOR BUS BARS, MAIN CONNECTIONS & ACCESSORIES	IS 11353
8	DEGREE OF PROTECTION	IS 2147
9	CODE OF PRACTICE FOR INSTALLATION AND MAINTENANCE OF SWITCHGEAR.	IS 3072
10	CLIMATE PROOFING OF ELECTRICAL EQUIPMENT	IS 3202
11	CODE OF PRACTICE FOR PHOSPHATING IRON & STEEL	IS 6005
12	WROUGHT COPPER & COPPER ALLOYS FOR ELECTRICAL PURPOSES	IS 5082
13	CONTACTORS	IS 2959

Section 6.4.8 Control and Relay Panel

DATA SHEET –A3: CONTROL PANEL (Easy Gen-3200-XT)

The cubicle shall be sheet steel fabricated, totally enclosed dust and vermin proof, degree of protection IP-52 suitable for floor mounting and incorporates the following:

- The electronic governor for the engine control
- AVR package with droop control
- Microprocessor based Engine Generator controller with following capabilities:

ENGINE - Control

- Engine fuel solenoid control
- Engine pre-glow control
- Engine starter control
- Oil pressure monitoring
- Water temperature monitoring
- Battery voltage monitoring
- Speed monitoring with over speed protection

ENGINE – Protection

- Overspeed
- High/ Low Oil pressure
- High/ Low coolant temperature
- Start Failure
- Battery voltage

GENERATOR – Control

Controller shall be preferably Woodward make Easygen-XT 3200

Auto Mains Failure

- Auto Synchronisation with multiple generators

Section 6.4.8 Control and Relay Panel

- Manual synchronisation facility with manual voltage and speed adjustments.
- Dead bus closing logic
- Base load control for optimum fuel efficiency
- kW Droop control both for auto and manual
- Load sharing feature for all the units
- Engine speed control based on load bias
-

GENERATOR – Protection

Numerical Generator Protection Relay with Protections as mentioned in Single Line Diagram.

Section 6.4.8 Control and Relay Panel

<u>DATA SHEET B</u>			
PANELS CONSTRUCTION			
SL #	Item	Unit	Value
1	Panels Designations		
2	Make and country of manufacture		
3	Type of construction: a) Simplex / Duplex /Desk-cum-panel b) To be matched with existingpanels	Yes / No	
4	Type of sheet steel (Hot rolled / cold rolled)		
5	Thickness of sheet steel Front Back Sides	mm mm mm	
6	Paint treatment and colour shades (external & internal)		
7	Weight of each panel section	kg	
8	Dimension of each panel section (width x depth x height)	mm	
9	Mimic bus, material & colour		
10	Space required for installation of all panels Length Width	mm mm	
	Height	mm	

Section 6.4.8 Control and Relay Panel

11	General Arrangement drawing attached to (a) Individual Panelsection (b) Overall arrangement of complete panels showing floorspace	Yes/ No	
12	Largest package for transport Weight Dimension	kg mm	
13	Instruments, Components, etc, transported mounted on panels or separately packed.		

Bidder to fill in the Data Sheet B and submit with his bid.

Section 6.4.8 Control and Relay Panel

GENERAL			
SL #	Item	Unit	Value
1	Cable glands included	Yes/No	
2	Special interconnecting Cables if required, include	Yes/No	
3	Special tools & devices for maintenance included. (attached list)	Yes/No	
4	Testing facility for static systems included:	Yes/No	
5	<u>Spares</u> List of recommended spares for normal maintenance for a period of 3 years furnished. (Attached list)	Yes/No	
6	<u>DRAWINGS / LITERATURE</u> Following submitted:		
7	Component's list of each panel.	Yes/No	
8	Block / Circuit diagrams of control interlock schemes	Yes/No	
9	Technical and descriptive literature of all the components supplied	Yes/No	
10	<u>Tests</u> All test certificates as specified shall be furnished	Yes/No	
11	<u>Deviations</u> All the deviations from the specifications submitted separately. Compliance will be taken for granted if the deviation is not specifically mentioned.	Yes/No	

Section 6.4.8 Control and Relay Panel

AUXILIARY / INTERFACE RELAY			
SI #	Item	Unit	Value
1	Make		
2	Type designation		
3	Nominal voltage & % variation	V \pm %	
4	Contacts, Head Reset / Self reset		
5	No. of pairs of contacts a) Makecontacts b) Breakcontacts		
6	Speed of operation of relay	m-sec	
7	Pick –up / drop off ratio		
8	Burden of Relay	VA	
9	a) Contact Rating(Continuous) b) Voltages c) Making Current &duration d) Breakingcurrent: i) Resistive ii) Inductive, 0.3P.F. iii) Inductive, $L=10\text{m sec}/40\text{m sec}$ R	A Volts A, AC / DC A A, AC A, DC	
10	Detailed literature furnished	Yes / No	

Section 6.4.8 Control and Relay Panel

TIMERS			
SL#	Item	Unit	Value
1	Make		
2	Type designation		
3	Nominal voltage & % variation	V + %	
4	Range of time delay		
	a) On energisation	m sec	
	b) On de-energisation	m sec	
5	Accuracy class as per IS		
6	Resetting time	m sec	
7	No. of pairs of contacts		
	c) Makecontact		
	d) Breakcontact		
8	Contact Rating:		
	e) Continuouscurrent	A	
	f) Voltages	V	
	g) Making current &duration	A, AC /DC	
	h) Breaking current:		
	i) Resistive	A	
	ii) Inductive, 0.3P.F.	A, AC	
	iii) Inductive, $\underline{L}=10\text{m sec}/40\text{msec}$	A, DC	

Section 6.4.8 Control and Relay Panel

	R		
9	Detailed literature furnished	Yes / No	

CONTROL SWITCHES			
SL#	Item	Unit	Value
1	Make & Front Dimensions		
2	Type of switch (Stay put/ Spring returns / Spring return with sequence/discrepancy)		
3	Type of handle (Pistol grip/Spade or ‘T’ / Knob/Ball handle)		
4	Contact development type No. As per data sheet A3		
5	Integral Escutcheon plate or circuit label provided	Yes / No	
6	Contact Rating: i) Continuouscurrent j) Voltages k) Making current &duration l) Breaking current: i) Resistive ii) Inductive, 0.3P.F. iii) Inductive, <u>L</u> =10m sec/40m sec R	A Volts A, AC/DC A A, AC A, DC	

Section 6.4.8 Control and Relay Panel

7	Elec. Life Expectancy based on 120 switching operation cycles per hour.	No. of operations	
8	Detail literature furnished	Yes / No	

PUSH BUTTONS			
SL#	Item	Unit	Value
1	Make		
2	Actuator type: a) Momentary /maintained b) Shrouded to prevent inadvertent operation	Yes / No	
3	Whether integral engraved inscription plates provided	Yes / No	
4	Type and No. of NO /NC contacts		
5	Contact Rating: m) Continuouscurrent n) Voltages o) Making current &duration p) Breaking current: i) Resistive ii) Inductive, 0.3P.F. iii) Inductive, $\underline{L}=10\text{m sec}/40\text{m sec}$ R	A V A, AC /DC A A, AC A, DC	

Section 6.4.8 Control and Relay Panel

6	Elec. Life Expectancy based on 300 switching operation cycles per hour	No. of operations	
7	Detail literature furnished	Yes / No	

INDICATING LAMPS			
SL#	Item	Unit	Value
1	Type		
2	Ratings: a) Voltage b) Wattage	V W	
3	Series resistors are provided	Yes / No	
4	Seriesresistors Value Watts	Ohms	
5	Life of lamp in burning hours	Hrs	

ANNUNCIATOR			
SL #	Item	Unit	Value
1	Make		
2	Dimensions of each window (L x W x H)		
3	No. of lamps per window		
4	Lamps Volts		

Section 6.4.8 Control and Relay Panel

	Watts		
5	Auxiliary supply voltage & permissible variation	V %	
6	Is the sequence of operation as per specification	Yes / No	
7	Initiating contact requirement a) Making current b) Impulseduration	A m sec	
8	Details of components, literature and write-up scheme furnished.	Yes / No	

INDICATING METERS			
SL#	Item	Unit	Value
1	Make		
2	Type of movement		
3	Type of designation		
4	CT/VT Sec. current / Volt	A, V	
5	Burden: a) Currentcoil b) Voltagecoil	VA VA	
6	Details of shunt, if any c) Ratedcurrent d) Rated voltagedrop	A V	

Section 6.4.8 Control and Relay Panel

	Accuracy class & standard		
8	Total deflection angle	Degrees	
9	Total Scale length	mm	
10	Overall dimensions (front)	mm	
11	Suitable for specified reference operating conditions	Yes / No	
12	Detail literature furnished	Yes / No	

ENERGY METERS			
SL#	Item	Unit	Value
1	Make		
2	Type of measurements (3 phase, 3 wire unbalanced power / 3 ph.4 wire unbalanced power)		
3	Measuring range in primary watts		
4	CT ratio	A/A	
5	VT ratio	V/V	
6	Accuracy & Standard to which meter conforms		
7	Burden: a) Currentcoil b) Voltagecoil	VA VA	
8	No, of digits in the meter		
9	Impulse contact for remote summation or printing		

Section 6.4.8 Control and Relay Panel

	provided.	Yes / No	
10	Details of impulse contacts c) Impulse frequency d) Duration e) Contact rating	No. per sec. m sec W, V	
11	Mounting details & testing facilities.		
12	Literature with connection diagram furnished	Yes / No	
RECORDING METERS			
SL#	Item	Unit	Value
1	Make		
2	Type, designation		
3	Range of parameter to be recorded		
4	Range of basic movement (In case of transducer operated relays)		
5	Accuracy & Standard to which the meter conforms		
6	Range of speed available		
7	Required Auxiliary supply & variation	V \pm %	
8	No. of hours of spring reserve in case of auxiliary supply failure	Hrs	
9	Burden: a) Current coil b) Voltage coil	VA VA	
10	Detailed literature giving mounting, type of case, etc. furnished.	Yes / No.	

Section 6.4.11-11kV XLPE Cable

- 1.0** Note: Bidder to note that the above items and quantity. specified form only a guidance. Vender shall develop detailed schematic and wiring diagrams, to meet the various control/Interlock requirements specified and finalize the B.O.Q. for the Control panel **SCOPE**
- 1.1** This specification covers requirements of stationary lead acid storage battery complete with battery racks inter cell and inter tier connectors and all other accessories.
- 1.2** In case of conflict between any section or clause of this specification and Data Sheet-A, the requirements of Data Sheet-A shall govern

2.0 CODES & STANDARDS

- 2.1** The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve VENDOR of this responsibility.
- 2.2** The equipment shall conform to the latest edition of standards mentioned in Data Sheet-A.

3.0 TYPE

- 3.1** The battery offered shall preferably be one of the following types as mentioned in **Data sheet – A**.
- a) Stationery Lead Acid Battery of the following type :-
- ~~1. Vented type~~
 2. Value regulated type
- ~~b) Nickel – Cadmium Battery~~

4.0 FEATURES OF CONSTRUCTION

4.1 GENERAL

The equipment offered shall be complete with all parts that are necessary or usual for the efficient operation of the equipment, whether specifically mentioned or not

4.2 STATIONERY LEAD ACID BATTERY-VENTED TYPE

- 4.2.1** The general feature of construction shall be as specifies below.

4.2.2 Plante' Positive Plates.

The plante' positive plate shall be cast solid in pure lead in one piece and shall have adequate mechanical strength. It shall be electrochemically formed and shall be capable of operating under normal working condition without buckling or cracking. Welding together of small size lead castings or fully formed plates to form larger sizes will not be accepted.

- 4.2.3** Tubular Positive plate shall consist of suitable bar with spines cast of suitably alloyed lead to give adequate mechanical strength. Porous, acid resistant and oxidation resistant tubes shall be inserted one over each spine. After insertion, the tubes shall be adequately filled and packed with active material before their lower ends are closed by a common bar. The construction and material of the tubes shall be such as to reduce loss of active material and to withstand normal internal stresses developed during service.

4.2.4 Pasted Positive Plates

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The pasted positive plates shall consist of either pure lead, low antimonial lead alloy or lead calcium positive grids; having double separation with a glass wool retainer mat or any other suitable material placed against the surface of the positive plates, for good service life.

4.2.5 Negative Plates

The negative plates shall normally be of the box type. End negative plates, if of box type may be of the half pasted type. Pasted plates shall have adequate mechanical strength and shall be so designed that the active material is maintained in intimate contact with the grid under normal working conditions.

4.2.6 Containers

The containers shall be made of plastics, or fibre reinforced plastics (FRP). The container shall be spill proof and leak proof, explosion resistant and increased safety type enclosure.

4.2.7 Separators

The plate separators shall consist of a micro porous matrix, which shall serve as the mobilised for the electrolyte. The battery separator shall maintain the electrical insulation between the plates and shall allow the electrolyte to permeate freely. The VENDOR shall indicate the material of the separator.

4.3 STATIONARY LEAD ACID BATTERY – VALVE REGULATED TYPE

4.3.1 Valve regulated lead acid (VRLA) type battery shall have immobilised electrolyte in the form of absorbent glass mat (AGM) or gel or other equivalent method.

4.3.2 The VRLA cell shall be closed under normal conditions but shall be provided with a control valve which shall allow escape of gas if the internal pressure exceeds the predetermine value. The valve shall not allow gas/air to enter into the cell. The cell shall not require addition of electrolyte and shall be maintenance free.

4.3.3 Under recommended operating condition, the temperature of VRLA cells shall be sufficiently low to prevent thermal runaway. The manufacture shall furnish

- a. The temperature limit
- b. The recommended measures to reduce risk of thermal runaway.

4.3.4 Under recommended operating condition, all the oxygen and hydrogen gases produced in positive and negative plates shall recombine internally to form water and no gas shall be evolved.

4.3.5 The battery shall be normally operated in float charging mode. The manufacturer shall advise the following to select the battery charger parameter:-

- a) The float charging voltage and current under normal condition when the battery is fully charged.
- b) The maximum float charging voltage to recharge a partially/fully discharged battery without the risk of higher gas evolution.
- c) The maximum allowable float charging current
- d) The recommended mode of charging such as:-
 - i) Constant voltage
 - ii) Constant voltage- constant current etc.
- e) The limiters to be provided to avoid over charging shall be advised.

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4.4 CONNECTORS AND TERMINAL POSTS

Inter cell and inter-tier connectors and terminal posts shall be of copper. Terminal posts shall be designed to accommodate external bolted connection conveniently and positively. Each terminal post shall have two bolt holes of the same diameter, preferably at right angles to each other. The bottom hole shall be used to terminate the inter cell connection. The top hole shall be left for PURCHASER'S terminal connections. All the metal parts of the terminals shall be lead coated if necessary. The VENDOR shall indicate this in the bid. The junction between terminal posts and cover and between cover and container shall be so sealed as to prevent any seepage of electrolyte.

4.5 ELECTROLYTE

The electrolyte shall be battery grade sulphuric acid conforming to latest editions of relevant standards.

4.6 NICKEL-CADMIUM BATTERY

4.6.1 The battery shall comprise vented Nickel-Cadmium rechargeable cells.

4.6.2 The battery container and lid shall be alkali resistant non-aging material with high impact strength. It shall have smooth sides except for receptacles, hold down bar, vent tubes, name plate, latches and polarity marking.

4.6.3 The cell container shall be of high strength alkali resistant material either nickel plated mild steel/stainless steel or non-porous plastic as specified in Data Sheet-A

4.6.4 The connector covers shall be of hard PVC to prevent external short circuiting.

4.6.5 The venting device shall be of anti splash type and shall allow the gases to escape freely and shall effectively prevent the electrolyte from coming out. Provisions shall be made for drawing electrolytes samples, checking and topping of the electrolyte.

4.6.6 The electrolyte used shall be a solution of potassium hydroxide in distilled water or de-mineralised made up to the specific gravity at 27°C.

4.6.7 Cell Designation.

Vented Nickel-Cadmium prismatic rechargeable cells shall be designated by letter 'K' followed by a letter L, M, H, or X which signifies the following:

L - Low rate of discharge (below 0.5 Cs)

M - Medium rate of discharge (0.5 Cs to 3.5 Cs)

H - High rate of discharge (3.5 Cs to 7 Cs)

X - Very high rate of discharge (above 7 Cs)

4.6.8 The group of two letters shall be then followed by a group of figures indicating Amp-hour capacity. Cells in plastic material shall be marked with letter 'P'.

4.6.9 Separators used for the cells shall be porous alkali resistant and high insulating capacity to avoid shorting on leakage of the current between the plates of opposite polarity. The separator shall be dimensionally stable without deformation at the room temperature.

4.6.10 The normal voltage of a single cell shall be 1.2 volts.

4.7 ACCESSORIES

The battery shall be complete with accessories and devices, including but not limited to the following as applicable for the type of battery.

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- i) Battery racks
- ii) Porcelain insulators, rubber pads etc.
- iii) Set of inter cell, inter-tier and inter bank connectors as required for the complete installation.
- iv) Electrolyte for first filling +10% extra in plastic bottles or drums, for Ni-Cd battery.
- v) Accessories for testing and maintenance.
 - a) One - -3, 0, +3 volts DC Voltmeter with suitable leads for measuring cell voltage.
 - b) One -Hydrometer for measuring specific gravity of electrolyte in steps of 0.002.
 - c) One - Filler hole thermometer fitted with plug and cap and having specific gravity correction scale.
 - d) Three -Pocket thermometers
 - e) Two sets - Funnels or siphon hydrometer and plastic jugs for topping up.
 - f) Two – Graduated plastic level test tube for electrolyte level checking.
 - g) Two – PVC aprons
 - h) Four- PVC GLOVES and any other protective wearing apparel to be specified by VENDOR
 - i) Two- Cell lifting straps
 - j) One set – Terminals and cable boxes with glands for connecting cable as required.
 - k) Spare connectors
 - l) Spare vent plugs
 - m) Spare nuts and bolts
 - n) Suitable set of spanners
 - o) PVC spill trays under the Battery cells
 - p) One set - Cell topping up apparatus (for large sizes of NI-CD cells) VENDOR shall list the items.
 - q) Insulated wrenches (for sealed lead acid battery).

5.0 BATTERY LAYOUT

- 5.1 Unless otherwise specified the battery shall be complete with battery racks and preferably mounted in single tier arrangement. VENDOR shall furnish dimensioned drawings of the battery layout for Project Engineer cum Estate Officer/ Institute's approval. For smaller units, utilising sealed-in type of batteries, mounting of the battery in the same sheet metal cubicle as the associated equipment, for instance battery charger, will also be acceptable.

5.2 BATTERY RACKS

Battery racks shall be constructed from good quality teakwood and painted with two coats of approved acid resisting paint. The construction of the racks unless otherwise mentioned in Data Sheet-A shall be suitable for fixing to a flat concrete floor. The racks shall be rigid, freestanding type and free from warp and twist. The completed racks shall be suitable for being bolted end to end to form a continuous row. Insulators shall be provided below the legs of the stands.

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5.3 VENTILATION

THE bidder shall INDICATE IN THE TENDER REQUIREMENTS OF VENTILATION IN THE BATTERY ROOM. The battery shall operate satisfactorily over the entire range of temperature indicated in Data Sheet without affecting its normal life. BIDDER shall indicate the percentage reduction in battery capacity at the lowest temperature compared to standard temperature of 27°C. If any special ventilation requirements are necessary, the same shall be indicated.

6.0 CAPACITY

- 6.1 The standard ampere-hour capacity at specified rate of discharge of the battery has been based on the requirements of loads mentioned in Data Sheet-A and the minimum ambient temperature specified. BIDDER SHALL Guarantee that the capacity of the battery offered by him is adequate for the duty specified (all loads being co-incident from the instant of supply failure even at the minimum ambient temperature specified in Data Sheet-A). The end cell voltage after discharge shall be as mentioned in Data Sheet A.

7.0 CHARGING

- 7.1 The proposed method of charging of the battery is indicated in the Data Sheet –A. However, the bidder shall indicate the recommended mode of charging.
- 7.2 BIDDER shall state whether an equalising charge is recommended for the battery. If so, the equalising charging voltage, current, duration and the interval between the equalising charging shall be specified in Data Sheet-B. BIDDER SHALL also indicate the requirements for boost charging.

8.0 LIFE

The BIDDER shall quote in his offer the guaranteed life of the battery when operating under the conditions specified

9.0 TESTS

- 9.1 All tests shall be conducted as per the relevant standards. Tests shall include following Type & acceptance tests:

- i) Type Tests: Performed at MANUFACTURER'S works
- ii) Acceptance Test: Performed at site after installation and commissioning of the battery. All tests shall be witnessed by the Project Engineer cum Estate Officer/ Project Engineer cum Estate Officer's authorized representative. Details of tests to be performed are given below:

9.2 TYPE TESTS

- 9.2.1 Type tests shall comprise the following as applicable for the type of battery.

- a) Physical inspection
- b) Dimensional, mass and layout checks
- c) Polarity check
- d) Ampere-hour Capacity tests
- e) Retention of charge test

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- f) Discharge performance at low temperature
- g) Ampere-hour and watt-hour efficiency tests.
- h) Test for short circuit current and internal resistance
- i) Endurance test in discharge-charge cycles
- j) Life cycle test

9.2.2 For VRLA batteries the following additional type tests shall be carried out:-

- a) Test for seal integrity
- b) Test for gas emission

9.2.3 Type tests shall be conducted on a minimum of one sample cell typical and identical with the cells forming the complete battery offered. However, the test cell shall not be one of the cells in the battery offered.

9.2.4 In applications where the first momentary discharge stated in Data Sheet-A is high and lasts for several minutes a high discharge test shall be conducted, in addition to the above tests, as a type test. This test shall ensure that at the end of the high discharge rate duty, end cell voltage does not fall below 1.6 V for lead acid and 1.1/1.05 V for Ni-Cd and the temperature rise of electrolyte shall be within 10°C.

9.3 ACCEPTANCE TESTS

Acceptance tests shall be conducted at site on completion of installation and commissioning and immediately prior to putting the battery in service. These tests shall comprise of:

- a) Physical inspection
- b) Dimensional, mass and Layout
- c) Polarity and absence of short circuit
- d) Ampere-hour capacity test
- e) Test for voltage during discharge
- f) Retention of charge
- g) Insulation resistance

9.4 ROUTINE TESTS

Routine tests shall be carried out as per applicable standards.

9.5 TEST REPORTS

A copy of routine and type test results shall be submitted for approval before the dispatch of batteries. Specified number of bound copies of complete test results shall be furnished with the batteries.

10.0 SPARE PARTS

10.1 BIDDER shall include the following items in his recommended list of spares along with item wise unit prices:

- a) Inter cell connectors
- b) Battery stand insulators and cell insulators

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- c) Nuts, bolts, washers etc.
- d) Vent plugs cum level indicators
- e) Complete set of spare cell (without electrolyte for Ni-Cd cell)
- f) Battery inter row connector
- g) Battery intercell connector

11.0 IDENTIFICATION

11.1 Each cell shall be marked in a permanent manner to indicate the following information:

- a) Cell number
- b) Type of positive plate
- c) AH capacity at specified rate of discharge
- d) Type of container
- e) MANUFACTURER'S name
- f) Month and year of manufacture.

12.0 CO-ORDINATION WITH BATTERY CHARGER VENDOR

12.1 When battery charger is procured separately, VENDOR shall coordinate with battery charger VENDOR in regard to layout, connections, charging voltage requirements etc.

13.0 TRANSPORT

- 13.1 The Ni-Cd battery shall be transported without electrolyte in preferably dry charged condition. The electrolyte shall be supplied separately in non-returnable containers.
- 13.2 The VRLA battery shall be transported with the electrolyte immobilized, sealed and fully charged.

14.0 WARRANTY

VENDOR shall give a warranty period of 10 years for the battery and indicate the warranty terms and conditions

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DATA SHEET – A1		
SI. NO.	DESCRIPTION	REQUIREMENT
1	Application	Control Supply(Plant substation)
2	Type of Battery	SMF VRLA Lead acid
3	Number of battery banks required	One
4	Number of cells in each bank in series (Approximate)	Nominal 12V X 9 Nos
5	Ambient conditions	40°C
6	Type of Nickel-Cadmium battery	NA
7	Cell container (Ni-Cd)	NA
8	D.C. System voltage	110V
9	Momentary load/duration	
10	Emergency load/duration	
11	Continuous load/duration	
12	Sketch NO.(If any) showing load on battery	NA
13	Ampere hour capacity calculated on the basis of	
	a. Reference temperature	27 °C
	b. Rated duration of discharge	10Hrs
	c. End cell voltage at the end of discharge cycle	1.85
14	Cell voltage-initial /final	1.85V / 2.00V
15	Calculated ampere hour for above duty at 27 ° C	65Ah minimum (Bidder to calculate the DC loads)
16	Specified ampere hour at site ambient temperature.	
17	Tentative size of cables to connect battery to external circuit	Manufacturer to specify and supply

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18	Available area in battery room L X B	Vendor to specify space requirement with Battery rack layout drawing with his bid
19	Layout drawing No.(if any)	NIL
20	Mounting arrangement	Multi tier
21	High discharge test requires Yes/ No	Yes
22	Charging method proposed	
	a. Vented lead acid battery	
	b. VRLA battery	Float cum boost charging
	c. Nickel cadmium battery	

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DATA SHEET – A2		
APPLICABLE STANDARDS		
1	General requirements and methods of tests for Sealed lead acid storage batteries	IS-8320, 1652
	a. Vented type lead acid battery	IS 8320, 1651 IEC 60896-1
	b. VRLA type lead acid battery	IS 1652 IEC 60896-2
	c. Nickel-cadmium battery	IS 10918 IEC 60623
2	Quality Tolerance for Water for storage battery	IS-1069
3	Sulfuric acid	IS-266
4	Sealing compound for lead acid batteries	IS-3116

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DATA SHEET – B				
(To be filled in and submitted with the bid)				
SI. NO.	DESCRIPTION	UNIT	DETAILS	
1.0	a) Manufacturer's Name			
	b) Type of battery			
2.0	Standards to which battery is manufactured			
3.0	Capacity			
3.1	At 27 Deg. C			
3.1.1	Initial	Ah		
3.1.2	Rated	Ah		
3.1.3	End of life	Ah		
3.2	Rated capacity at minimum Ambient temperature	Ah		
3.3	Rated capacity at maximum ambient temp.	Ah		
3.4	Ah Capacity and discharge current at high discharge rate 27Deg. C	Ah	Amps	End cell Voltage
3.4.1	5 minutes	Ah		
3.4.2	30 minutes	Ah		
3.4.3	45 minutes	Ah		
3.4.4	1 hour	Ah		
3.4.5	2 hour	Ah		
3.4.6	3 hour	Ah		
3.4.7	4 hour	Ah		
3.4.8	5 hour	Ah		
3.4.9	6 hour	Ah		
3.4.10	7 hour	Ah		

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3.4.11	8 hour	Ah		
3.4.12	9 hour	Ah		
3.5	Maximum Momentary current 1 minute	Amps		
3.6	Expected life of battery	Years		
4.0	Recommended charging rate			
4.1	Float charging Voltage/ Current	V A		
4.2	Trickle charging Voltage/ Current	V A		
4.3	Boost charging Voltage/ Current			
4.4	Equalizing charge			
	a) Voltage/current	V/A		
	b) Duration	Min.		
	c) Interval between successive equalising charges	Hrs.		
5.0	Expected fault level at bus due to battery	kVA		
6.1	Short circuit current at battery terminals			
6.2	Time for which battery can withstand short circuit at terminals	Sec		
7.0	Allowable voltage ripple			
7.1	During float charging			
7.2	During boost charging			
8.1	Total resistance of battery	Ohms		
8.2	Resistance of inter cell Connectors	Ohms		
9.1	AH efficiency at rated load			
9.2	Watt-hour efficiency			

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10.0	No. of charge-discharge cycle battery can give during its entire life		
11.0	Amount of hydrogen evolved during normal operation		
12.1	Type of positive plate	Pocket / Sintered	
12.2	No. of positive plates/ cell		
12.3	No. of cells required to give rate D.C. voltage		
12.4	No. of spare cells		
12.5	Whether positive plates of individual cells are inter changeable	YES/NO	
12.6	Whether negative plates are interchangeable	YES/NO	
12.7	Type of containers		
12.8	Type of cell		
13.0	Overall dimensions		
13.1	Each cell L x W x H	mm	
13.2	Complete battery L x W x H	mm	
14.0	Weight		
14.1	Each cell	Kg	
14.2	Complete battery	Kg	
15.0	Whether explosion vents are offered		
16.0	Ventilation requirements		
16.1	Cubic content of battery room	M ³	
16.2	Exhaust fans		
	a) Number		
	b) Rating of each	kW	
17.0	Whether there would be any harmful effect on the life of battery if discharged as per load cycle	Yes/no	

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	specified above, after being maintained in float charging condition		
18.0	List of spare/accessories enclosed		
19.0	List of deviations enclosed		

Section 6.4.11-11kV XLPE Cable

1.0 SCOPE

- 1.1 This specification covers requirements of Battery Charger & DC Distribution Board (DCDB) equipment comprising of rectifier, rectifier transformer and auxiliary equipment.

2.0 CODES & STANDARDS

- 2.1 The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve VENDOR of this responsibility.
- 2.2 Unless otherwise specified, equipment shall conform to the latest applicable standards as mentioned in Data Sheet-A2.

3.0 TYPE

- 3.1 The battery charger shall be static type composed of silicon controlled rectifiers (SCRs) connected in three-phase full wave bridge circuit. Transducer control may be offered as an alternative for large sets if SCRs are not feasible.
- 3.2 The rectifier transformer shall be indoor dry type, double wound with adequate number of primary and secondary taps.

4.0 RATING

- 4.1 The float charger shall be designed for supplying:
- a) The DC loads specified in Data Sheet-A.
 - b) The float charging current of the battery.
- 4.2 The boost charger shall be designed for supplying the boost charging current of the battery.
- 4.3 When a composite (float/Boost) charger is specified it shall be designed to meet the requirements specified in Clauses 4.1 and 4.2.
- 4.4 It shall be the responsibility of VENDOR to co-ordinate with the battery MANUFACTURER and ascertain the float and boost charging currents and voltages required by the battery.

5.0 CHARGER & DCDB CUBICLE & WIRING

- 5.1 Cubicle accessories and wiring shall conform to the requirements as stated in the following clauses and in the companion specification for Control Cabinets.

6.0 ACCESSORIES

- 6.1 Each battery charger shall include the following:

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- 6.2 One (1) set - silicon controlled rectifiers connected in three phase full wave bridge circuit with ripple filtering device.
- 6.3 One (1) set - double wound dry type main transformer of suitable rating with adequate primary and secondary taps for the charger output voltage control.
- 6.4 One (1) set - booster transformers as required.
- 6.5 One (1) set - automatic voltage regulator unit (for float chargers) with manual/auto control switch and output current limiter.
- 6.6 One (1) set - course and fine control knobs for manual control.
- 6.7 One (1) - selector switch for modes of charging i.e. float charging/boost charging. This shall be as indicated in the diagram referred to in Data Sheet-A.
- 6.8 One (1) - off load tap changing switch for changing the primary taps of the transformer.
- 6.9 One (1) - D.C. voltmeter with MCB and selector switch for measuring the output voltage.
- 6.10 One (1) - D.C. ammeter with shunt
- 6.11 One (1) TPN incoming MCCB unit on A.C. side of each charger along with SC, OL & EF releases and alarm contacts.
- 6.12 One (1) DP MCCB on D.C. output side of each charger with SC, OL, EF and alarm contacts.
- 6.13 One (1) - centre zero ammeter with shunt for battery circuit.
- 6.14 Two (2) sets - silicon diodes arranged in series for connection between the end cell tap on the battery and the positive bus of charger output.
- 6.15 One (1) - cubicle space heater with control switch and MCB suitable for 240V AC 50 Hz. single phase supply.
- 6.16 One (1) - 240 V AC lamp for cubicle internal lighting.
- 6.17 Two (2) - On - Off switch with MCB for items 6.14 and 6.15.
- 6.18 Two (2) - silicon diodes in series in the float charger circuit.

7.0 INDICATION & PROTECTION

Each battery charger shall be provided with the following indication and protective devices:

- 7.1 Three (3) cluster LED type indicating lamps on the AC supply of the charger.
- 7.2 One (1) cluster LED type indicating lamp on the DC output side.
- 7.3 Two (2) AC under voltage relays connected across fuses on the AC supply side with alarm contacts for Annunciator.
- 7.4 Thermal overload elements on each phase of the AC contactor on the supply side with alarm contacts for remote Annunciator.

8.0 PERFORMANCE

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- 8.1 The automatic constant voltage regulator shall regulate the DC voltage within 1% of the set value from no load to full load under the supply voltage and frequency fluctuations of +/- 10% and +/- 5% respectively.
- 8.2 The float charger shall have built-in current limiting feature to drop the output voltage on currents more than 110% of the rated current.
- 8.3 Suitable ripple filtering circuits shall be provided to give a smooth DC output. The ripple content shall be limited to less than +/- 1% or less to meet the requirement of battery manufacturer on resistive load.
- 8.4 For VRLA battery, the float charging voltage and maximum float and maximum float charging current shall be limited as per battery manufacturer requirement to avoid over charging.

9.0 DCDB:

- 9.1 Battery charger shall include a DCDB for distribution of DC supply to various essential loads. DCDB shall be provided with MCCB for incomer & outgoing control. The detailed feeder ratings shall be as detailed at Data Sheet A

9.2 DCDB CONSTRUCTION DETAILS:

- 9.2.1 Switchgear shall be designed in such as way that all component equipment operate satisfactorily without exceeding their respective maximum permissible temperature rises under temperature conditions prevailing within the switchgear cubicles. Reference ambient temperature outside the switchgear cubicles is specified in Data Sheet –A.
- 9.2.2 Ventilating louvers are generally not preferred. If ventilating louvers are considered essential by the Vendor, these may be provided. However, all ventilating louvers shall be of G.I or non-ferrous metal and shall be provided with fine-screened meshes to prevent entry of Vermin.
- 9.2.3 Switchgear shall be provided with two bus bars. Bus bars shall be uniform cross section throughout the length of the switchgear and up to the incoming terminals of feeder circuit breaker/switch.
- 9.2.4 Except when otherwise noted in Data Sheet-A all bus bars shall be made of high conductivity aluminium.
- 9.2.5 All bus bars, bus taps and joints shall be PVC taped.
- 9.2.6 Positive and negative bus bars shall be completely segregated from each other by sheet steel partition.
- 9.2.7 Bus bars shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents for the associated switchgear. Bus bar supports shall be made of Hylam sheets, moulded plastic material or permali wood.
- 9.2.8 Separate supports shall be provided for bus bar of each polarity. If a common support is provided for both the bus bars, anti-tracking barriers shall be provided.
- 9.2.9 Bus bar joints shall be of the bolted type complete with Belleville washer. Bus bars shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.

10.0 MOULDED CASE CIRCUIT BREAKER

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- 10.1 Incomer and outgoing feeder control shall be with MCCB's of suitable rating as specified in Data Sheet-A. Moulded case circuit breakers shall comply with the requirements of the specification.

11.0 MINIATURE CIRCUIT BREAKERS

- 11.1 Miniature circuit breakers shall be provided in all control circuits in place of HRC fuses. MCB's shall be suitable for DC application and shall comply with the requirements of the specification.

12.0 CONTROL AND SELECTOR SWITCHES

- 12.1 Control and selector switches shall be:
- i) Of the rotary type with enclosed contacts
 - ii) Adequately rated for the purpose intended (minimum acceptable rating is 10A)
 - iii) Provided with escutcheon plates clearly marked to show the positions.

13.0 INDICATING INSTRUMENTS AND METERS

- 13.1 Electrical indicating instruments shall be of the taut band type with 110-mm square dial and 240° scale.
- 13.2 Indicating instruments shall have provision for zero adjustment outside the cover.
- 13.3 Instrument dials shall be parallax free with black numerals on white dial.

14.0 INDICATING LAMPS

- 14.1 Indicating lamps shall be:
- a) Of the cluster type LED type and of low watt consumption.
 - b) Provided with translucent lamp covers of colours 'Red', 'Green' and 'Amber' as specified in Data Sheet-A Control wiring diagrams

15.0 PUSH BUTTONS

- 15.1 Push buttons shall be:
- i) Of the momentary contact, push to actuator type, rated to carry 6A at 220V D.C.
 - ii) Fitted with self reset NO and NC contacts
 - iii) Provided with integral escutcheon plates marked with its function.
 - iv) 'Start' push button shall be green in colour.
 - v) 'Stop' push button shall be red in colour.
 - vi) All other push button shall be black in colour.
 - vii) 'Emergency stop' push button shall be of the lockable in the pushed position type and shall be shrouded to prevent accidental operation.

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16.0 SPACE HEATERS

16.1 Space heaters shall be:

- a) Suitable for operation on 240 V, single phase, 50 Hz supply.
- b) Provided with rotary type 'ON-OFF' switches, double pole MCB's with overload and short circuit releases on the plain side.
- c) Provided with Humidistat to control the space heater, in order to maintain switchgear interior temperature above the ambient.

17.0 CABLE TERMINATIONS

- 17.1 Suitable compression type of brass cable glands mounted on a removable gland plate shall be provided to support all power and control cables entering the switchgear. Cable glands shall incorporate built-in facilities for earthing the wire armour of cables.
- 17.2 All cable cores shall be adequately supported at regular intervals inside the cable alleys by means of suitable, rubber or PVC lined clamps, up to the respective terminal blocks.
- 17.3 Necessary crimping type of cable lugs for connecting the individual cores to the respective terminals shall be provided.

18.0 INTERNAL WIRING

- 18.1 All wiring inside the switchgear shall be carried out with 1100/650V grade, FRLS PVC insulated, stranded conductor wires. Minimum size of conductor for power circuits is 6 sq. mm copper. Control circuits shall be wired with copper conductor wires of at least 2.5 sq. mm size.
- 18.2 Engraved identification ferrules, marked to correspond with the enclosed wiring diagrams shall be fitted to each wire. Ferrules shall be of yellow colour with black lettering.
- 18.3 All wires forming part of a tripping circuit shall be provided with an additional red ferrule marked 'T'.
- 18.4 Spare auxiliary contacts of all equipment forming part of the switchgear shall be wired up to the terminal blocks.
- 18.5 All wiring for equipment supplied by the Purchaser for which Vendor has to provide cut outs (where indicated in the Data Sheets) shall be provided up to the terminal blocks.
- 18.6 Spare and unassigned modules shall be complete with internal wiring.
- 18.7 All wiring shall be terminated on terminal blocks using crimping type of lugs.

19.0 TERMINAL BLOCKS

- 19.1 All terminal blocks (both for power and control circuits) shall be of the 650V grade stud type, comprising finely threaded pairs of brass studs of at least 6 mm diameter, links between each pair of studs, washers, nuts and lock nuts. The studs shall be securely locked within the mounting base to prevent its turning. Insulated barriers shall be provided between adjacent terminals.

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- 19.2 All terminals for circuits with voltage exceeding 110V shall be shrouded. Terminal blocks shall be grouped and suitably segregated depending on circuit voltage. Different voltage groups of terminal blocks shall be segregated.
- 19.3 Terminal blocks shall be adequately rated to carry the current of the associated circuit. Minimum rating of the terminal block shall be 10A
- 19.4 Provision shall be made to insert terminal labels between two successive insulating barriers.
- 19.5 Terminals shall be numbered for identification and grouped according to function. Engraved white-on-black labels shall be provided on the terminal blocks, describing the function of the circuit.
- 19.6 Where duplication of a terminal block is necessary, it shall be achieved by solid bonding links.
- 19.7 Terminal blocks for CT secondary lead wires shall be provided with short-circuiting and earthing facilities.
- 19.8 Terminal blocks shall be arranged with at least 100-mm clearance between two sets of terminal blocks.

20.0 LABELS

- 20.1 All labels shall comprise white letters on a black background.
- 20.2 Labels shall be made of non-rusting metal or 3-ply lamicoid.
- 20.3 Labels shall be properly fixed, with provision to prevent distortion due to expansion.
- 20.4 Sizes of labels and lettering are subject to Purchaser's approval.

21.0 EARTHING

- 21.1 The switchgear shall be provided with an earth bus bar running along the entire length of the board. Material and size of the earth bus bar shall be as specified in Data Sheet-A.
- 21.2 Earth bus bars shall be supported at suitable intervals.
- 21.3 Positive connection between all the frames of equipment mounted in the switchboard and earth bus bar shall be provided by using insulated copper wires/bare bus bars of cross section equal to that of the bus bar or equal to half the size of circuit load current carrying conductor.
- 21.4 All instrument and relay cases shall be connected to the earth bus bar using 1100/650V grade PVC insulated 2.5 sq. mm stranded, tinned copper earthing conductor.

22.0 TESTS

22.1 FACTORY TESTS

All type and routine tests as listed in applicable standards shall be carried out at MANUFACTURER's works.

22.2 ACCEPTANCE TEST

Routine tests as per applicable standards will also be carried out on the assembled unit at site.

Section 6.4.11-11kV XLPE Cable

DATA SHEET A1			
1. GENERAL PARTICULARS	1.1	Designation	Battery Charger with DCDB
	1.2	Quantity/Application	i) One No. Battery charger for 110V Supply for HT Switch Board, NIS/NGR Panel and CRM Panel
	1.3	Type Boost / Float / Composite	Composite (Dual FCBC)-Minimum rating of 30A DC
	1.4	DC System voltage	110 V
	1.5	Location	Indoor
	1.6	Design Ambient Temperature	40°C
	1.7	Type of mounting (floor/Pedestal/ column/wall)	FLOOR
	1.8	Cable Entry- Top/Bottom	Top
		Glands/Conduits	Glands
	1.9	Purchaser's Earthing conductor Material Size	GS 50 x 6 mm
	1.10	Painting:	
		Colour Outside Inside	RAL 7032 Glossy White
	1.11	Control scheme & Bill of Material, enclosed Yes Ref No.	No, to be furnished by Vendor
	1.12	Degree of enclosure protection and grade of the cubicle. IP class as per IS	IP 52
	1.13	Thickness of Sheet Steel Cold Rolled Hot rolled	Frame 2 mm ; Others 1.5 mm NA
	1.14	Earthing Bus Material Size	Copper 40 x 6
2. DC BUS LOAD	2.1	Momentary	*
	2.2	Emergency	*
	2.3	Continuous	*

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3. AC SYSTEM DATA	3.1	Supply:	
		Volts	415V
		Phase	3Ø 4wire
		Frequency	50Hz
	3.2	Variation in supply	
		Voltage	+ /- 10%
		Frequency	+ /- 5%
	3.3	Short circuit level	36 MVA
	3.4	Type of earthing	Effectively earthed
	3.5	Auxiliary supply if available	Yes
4. PERFORMANCE	3.6	Control Transformer	Required
	3.7	Space Heater/Lighting Supply Voltage	240V
	4.1	Automatic voltage regulator	Yes
	4.2	Voltage Regulation with AVR	+ /- 2%
	4.3	Permissible harmonics at rated continuous load	+ /- 3%
	4.4	Minimum permissible power factor at rated continuous load	0.9

* Data by bidder

Section 6.4.11-11kV XLPE Cable

DATA SHEET A2 APPLICABLE STANDARDS		
01	Factory built assemblies of SW. Gear and control gear for voltages up to and including 1000V AC & 1200V DC.	IS : 8623
02	Air break switches	IS : 4064
03	Indicating instruments	IS : 1248
04	Arrangement for busbars main connections and accessories	IS : 5578 IS: 11353
05	Degree of protection	IS : 2147
06	The performance of AC control gear equipment rated up to 600V for use on high prospective fault current system	
07	Code of practice for installation and maintenance of switchgear	IS : 10118
08	Climate proofing of electrical equipment	
09	Code of practice for phosphating iron & steel	IS : 6005 BS : 3189
10	Wrought aluminium & aluminium alloys for electrical purposes	IS : 5082
11	Control transformer for switchgear and control gear for voltage not exceeding 1000V AC	IS : 12021
12	Switchgear general requirements, contactors, motor starters, Disconnectors, switches	IS: 13947
13	AC circuit breakers	IS : 13947, Part 2
14	Contactors	IS : 2959
15	Control switches / push buttons	IS : 6875
16	Current transformers	IS : 2705
17	Voltage transformers	IS : 3156
18	Relays	IS : 3231
19	Indicating instruments	IS : 1248

NOTE: Equivalent IEC standards are also acceptable.

Section 6.4.11-11kV XLPE Cable

DATA SHEET B - BATTERY CHARGER			
(Bidder to fill the data sheet 'B' completely and submit the bid)			
SL #	DESCRIPTION	UNIT	BIDDER
1	Manufacturer's name		
2	Indoor/outdoor application		
3	Thickness of sheet steel	mm	
4	Degree of protection provided (as per IS:2147 or equivalent)		
5	Bill of material for the various equipment giving make, type, ratings etc., enclosed	Yes/no	
6	Colour of finish paint		
	Outside		
	Inside		
7	Bus bars for power devices (when applicable)		
	a) Material		(Insulated/Bare)
	b) Continuous current rating	A	
8	Control Wiring/Power Wiring		
	a) Material of conductor and size	Cu/Al mm ²	
	b) Conductor- Solid/Stranded		
9	AC input power rating of charger		
	a) Float mode +DC loads	KW	
	b) Boost mode + DC loads	KW	
10	Regulation of charger	%	
11	Harmonics generated by charger (THD)		
12	Ripple content in the output	%	
13	PF of the charger at rated DC load & boost charging		
14	Efficiency of charger		
15	Float charging transformer data		
	a) Type		
	b) Rating		
16	Boost charging transformer data		
	a) Type		
	b) Rating		
17.1	List of indications provided on charger		
	a)		
	b)		
	c)		
17.2	List of protections provided on charger		
	a)		
	b)		
	c)		
18	Dimensions and weight of transformer		
	Length	mm	
	Width	mm	

Section 6.4.11-11kV XLPE Cable

DATA SHEET B - BATTERY CHARGER			
(Bidder to fill the data sheet 'B' completely and submit the bid)			
SL #	DESCRIPTION	UNIT	BIDDER
	Height	mm	
	Weight	Kgs.	
19	Typical GA drawings enclosed Yes / No		
20	List of routine tests to be done on charger		
	a)		
	b)		
	c)		
21	List of type test carried on charger		
	a)		
	b)		
	c)		

Section 6.4.11-11kV XLPE Cable

1.0 SCOPE

This specification covers the requirements of high voltage cross-linked polyethylene cables and associated accessories like straight joints, and terminations, etc. for working voltages from 3.3 kV up to and including 33 kV.

2.0 CODES AND STANDARDS

2.1 The design, manufacture and performance of the cables shall comply with all currently applicable statutes, regulations, and safety codes in the locality where they will be installed. Nothing in this specification shall be construed to relieve bidder of his responsibility in this regard.

2.2 The cables shall conform to the latest applicable standards as specified in the relevant Data Sheet A1. In case of conflict between the standards and this specification, the stringent of the two shall apply. Equipment complying with other authoritative standards such as British, American, VDE will also be considered, if offered.

3.0 DESIGN AND PERFORMANCE REQUIREMENTS:

3.1 Cable Construction:

3.1.1 Three Core Cables:

- a) Conductor Well compacted, stranded Copper or Aluminium circular shaped as mentioned in data sheet A.
- b) Conductor screen Conductor screen shall be provided over the conductor by extrusion of non – metallic semiconducting compound.
- c) Insulation Cross-linked polyethylene applied by extrusion. The XLPE shall be gas cured. The thickness of the insulation shall be as per applicable standards.
- d) Insulation Screen Shall consist of two parts, namely metallic and non metallic.
 - i) The non metallic part shall be applied directly over the insulation of each core by extruded semiconducting compound.
 - ii) The metallic part shall consist of non magnetic metallic tape (preferably copper tape) applied over the non metallic part.
- e) Core identification By colouring of XLPE insulation up to 3.3kV cables. By numerals printed on the cores for cables above 3.3kV
- f) Inner sheath The laid up cores shall be provided with extruded PVC compound inner sheath. The shape of the cable shall be as circular as possible. The thickness of the inner sheath shall be as per applicable standard.
- g) Armouring Single/ double galvanised steel wire/ strip armouring shall be provided as mentioned in Data

Section 6.4.11-11kV XLPE Cable

sheet A. The thickness of galvanised steel wire or strip shall be as per applicable standards.

- h) Outer Sheath The outer sheath shall be applied by extrusion. The thickness of the outer sheath shall be as per applicable standards.

The outer sheath shall be:-

- i) With PVC/FRLS PVC compound type ST2 as specified in data sheet A.
- ii) With reduced flame propagation property.
- iii) Resistant to termite, fungus and rodent attack.
- iv) Black in colour.

3.1.2 Single Core cables

The cable construction shall be similar to three-core cable except the following:-

- a) The armouring shall constitute the metallic part of screening.
- b) The armour shall be of non – magnetic material.

3.2 Requirement of special FRLS-PVC sheath:

- 3.2.1 Outer sheath for FRLS cables shall meet the following test requirements related to flame retardance, low smoke emission, low acid and toxic gas emission. The BIDDERS shall have proper test apparatus to conduct all the relevant tests as per the applicable standards mentioned herein.

3.2.2 Test for Flame Retardance

- a) Oxygen Index

The critical oxygen index value shall be minimum 29 at 250°C when tested for temperature index test as per ASTM-D-2863.

- b) Flammability

- I. Cables shall pass test under fire conditions as per IEC-332-1.
- II. Cables shall also pass tests as per Swedish standard S5424-1475 for Chimney tests for Class-F3.
- III. Fire survival (FS) cables in addition to tests I and II above shall pass tests as per IEC-331.

3.2.3 Test for Smoke Generation

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The smoke density rating shall be in accordance with the values specified under notes in Data Sheet-A or as agreed to between Purchaser and Vendor before placement of order. The tests shall be conducted in accordance with the following Standards/ Test methods:

- a) ASTM-D-2843
- b) ASTM-E-662
- c) 3 metre cube test chamber.

3.2.4 Tests for Acid Gas Generation

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than the values specified under notes in Data Sheet-A or as agreed to between Purchaser and Vendor before placement of order. Suitable test methods shall be agreed upon between PURCHASER and VENDOR before placement of order with regard to tests for other toxic and corrosive gases

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generated from the sheath under fire conditions.

3.2.5 Tests for Resistance to Ultra Violet Radiation

These shall be as specified under notes in Data Sheet-A or as agreed to between PURCHASER and VENDOR before placement of order.

3.2.6 Tests for Water Absorption

Outer sheath shall be subjected to tests for water absorption as per IS:10810. When additional characteristics are required, the tests shall be carried out as agreed to between PURCHASER and VENDOR before the placement of order.

3.2.7 Any other special tests on the sheath in addition to the above shall be as indicated under notes in Data Sheet-A or as agreed to between PURCHASER and VENDOR before placement of order.

3.3 **General** - The cables shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.

4.0 TEMPERATURE RISE AND CURRENT RATINGS:

4.1 **Maximum conductor temperature** - The maximum conductor temperature shall not exceed 90°C during continuous operation at full rated current. The temperature after a short circuit for 1.0 second, shall not exceed 250°C, with initial conductor temperature of 90°C

4.2 **Current Ratings**

4.2.1 The bidder shall furnish the following current ratings for the given ambient temperature, ground temperature and soil resistivity:-

- a) Rated continuous current
- b) Rated 1.0 second current

4.2.2 For multicore cables, the rated currents shall be furnished for both installation in air and in ground

4.2.3 For single core cables, the rated currents shall be furnished for the following installation conditions:-

- a) Laid in ground and in air
- b) Laid flat and laid in trefoil formation
- c) The metallic screens with both ends bonding and with single point bonding/cross bonding.

4.3 **Rating factors** - Rating factors shall be given by the bidder for the following:

- a) Variation in ground temperature
- b) Variation in soil thermal resistivity
- c) For two cables laid side by side at 300, 600 and 900 mm centres.

4.4 The bidder shall indicate the percentage overload that the cable can carry, its duration and final conductor temperature when operating initially at a conductor temperature of 90°C.

5.0 CABLE ACCESSORIES

5.1 Bidder shall include in his offer, the equipment and materials required for making cable splices and cable termination. The terminations may be taped type for lower voltages up to 22 KV and prefabricated type for higher voltages. Full details of the splicing and terminating procedures shall be given in the tender.

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- 5.2** The total creepage distance of the outdoor porcelain insulators of cable sealing ends shall be suitable for heavily polluted saline atmosphere and shall not be less than 25 mm per kV of highest line to line voltage. The protected creepage distance shall be half of the total creepage distance. The insulators shall be washable under live conditions by hot-line washing equipment.

6.0 CABLE DRUMS:

- 6.1** Cables shall be supplied in non-returnable drums of sturdy construction. All ferrous and other metal parts of drum shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.
- 6.2** The length of cable on each drum shall be determined by the manufacturer considering the transport limitations from manufacturer's works to the site.
- 6.3** Bidders shall indicate in the offer, the maximum length for each size of cable, which can be furnished on one drum. However before packing the cables on drums, the successful bidder shall obtain Purchaser's approval for the drum length of cable in the drum

7.0 TESTS AND TEST REPORTS:

- 7.1** Bidder shall give a complete list of routine and type tests proposed to be performed in his tender.
- 7.2** Routine Tests shall be performed on each drum length. All tests as per applicable standard shall be performed.
- 7.3** Type Tests: Bidder shall furnish full particulars of the type tests as per applicable standard proposed to be carried out by him. Valid type test reports not older than 5 years shall be submitted with the bid. If such reports are not available, the tests shall be carried out without any extra cost.
- 7.4** Acceptance Tests: Acceptance tests shall be carried out in accordance with the applicable standard.
- 7.5** All test reports shall be subject to Purchaser's approval.

8.0 INFORMATION TO BE GIVEN BY BIDDER:

In addition to information called for in the Data Sheet B and Price Schedule enclosed with this specification, the bidder shall give the following information with the offer:

- 8.1** Detailed drawings with dimensions of the cable and all accessories, including –
- a) Cross sectional view of cable, indicating the material used in each type of construction.
 - b) Splices, straight joints and trifurcating boxes
 - c) Terminations, showing mounting arrangement
- 8.2** Complete specifications of covering used to protect sheath and reinforcing tapes co corrosion
- 8.3** Descriptive information regarding cable and accessories and test of installations of similar cables now in service with description, cable performance, outages suffered and cause of outages.
- 8.4** Recommended method for locating conductor faults, apparatus required for locating the faults and their price.

9.0 ERECTION & MAINTENANCE TOOLS & EQUIPMENT AND SPARE:

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9.1 Whether included in the bidder's scope or not, unit prices for the following items shall be quoted together with their suggested quantities and catalogue numbers. The Purchaser reserves the right to select any or all the items offered without assigning any reason.

9.2 Equipment:

- a) Capacitance Bridge: This shall be suitable for operation on both A.C. mains and storage batteries. Facilities shall be provided for both audio and visual indications of the balance of the bridge.
- b) Fault Locating equipment:
 1. Digital fault locating equipment along with the accessories like surge generator etc.
 2. Acoustic detector for locating underground fault by capacitor discharge method.
 3. Equipment for locating PVC Sheath fault

DATA SHEET – A1

SL. NO.		DESCRIPTION		UNIT	DATA			
1.0 GENERAL	1	Application/ designation			Power Cable			
	1.2	Installation	Above Ground		Yes			
			Below Ground		Yes			
	1.3	Design ambient temperature		°C	40			
	1.4	Ground Temperature		°C	30			
	6	Minimum drum length		m	NA			
2.0 SYSTEM DATA	2.1	Number of phases & frequency			3Ph / 50Hz			
	2.2	Nominal system voltage		kV	11			
	2.3	Highest system voltage		kV	12			
	2.4	Impulse (1.2/50 μ sec wave)withstand voltage		kV _p	75			
	2.5	Power frequency withstand voltage		kV	28			
	2.6	System neutral						
	2.7	System Fault Level		kA(rms)	25			
	2.8	CB Breaking capacity		kA(rms)	25			
	2.9	Relay & CB Opening time		m sec	-			
3.0 DE SC	3.1	Cable type			H1	H2	H3	H4
	3.2	No. of cores			3	3		

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SL. NO.	DESCRIPTION	UNIT	DATA			
3.3	Conductor size	Sq. mm	300	240		
3.4	Conductors					
a)	Material	Cu/Al	Al	Al		
b)	Stranded	Yes/No	Yes	Yes		
3.5	Conductor screen		Extruded non-metallic semi conducting compound			
3.6	Core insulation					
a)	Material		XLPE applied by extrusion. XLPE shall be gas cured			
b)	Thickness of insulation		As per applicable standards			
3.7	Insulation screen					
a)	Non-metallic part		Extruded semi conductive compound			
b)	Metallic part					
i)	For single core cables		The armour shall be metallic part			
ii)	For multi core cables		Copper tape			
3.8	Core identification					
a)	Up to 3.3 kV cables		By colouring of XLPE insulation			
b)	Cables above 3.3 kV		By numerals printed on the cores			
			Cable type			
			H1	H2	H3	H4
3.9	Inner sheath					
a)	Material		PVC			
b)	Thickness of inner sheath		As per applicable standards			
3.10	Armouring					
a)	Material Galvanised steel/Aluminium	GS/AL	GS	GS		
b)	Type	Single wire/strip Double wire/strip	Double Wire	Single wire		
c)	Dimension of wire/strip		As per applicable standards			
3.11	Outer sheath					
a)	Material PVC/FRLS PVC		FRLS PVC			
b)	Thickness of outer sheath		As per applicable standards			
c)	Colour		Black			
3.12	Temperature rise		90 °C			
a)	Maximum conductor temperature during continuous operation at rated current					
b)	Temperature rise for short circuit rating with initial conductor temperature of 90		250 °C			
3.13	Quantity					

DATA SHEET – A2

APPLICABLE STANDARDS		
SL #	DESCRIPTION	IS

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1	Rubber insulated cables: Part 1 With Copper conductor	IS 434 : Part I : 1964
2	Rubber insulated cables: Part 2 With aluminium conductor	IS 434 : Part 2 : 1964
3	Flexible Trailing Cables for use in Coal Mines	IS 691:1984
4	Paper insulated lead-sheathed cables for rated voltage up to and including 33kV Specification	IS 692 :1994
5	Varnished cambric insulated cables (Revised)	IS 693 :1965
6	PVC insulated cables for working voltages up to and including 1100 V	IS 694 :1990
7	Code of practice for installation and maintenance of power cable up to and including 33kV rating (Second Revision)	IS 1255 :1983
8	PVC insulated (heavy duty) electric cables: Part 1 for working voltages up to and including 1100 V	IS 1554 : Part 1: 1988
9	Specification for PVC Insulated (Heavy duty) Electric cable -Part 2: For working voltage from 33kV up to and including 11kV	IS 1554 : Part 2: 1988
10	Polyethylene insulated cable for working voltage up to and including 1100 V	IS 1596: 1977
11	Aluminium conductor for insulated cables	IS 1753 :1967
12	Specification for Cotton Selvage Tape for Electric Cables	IS 2847: 1964
13	Copper conductor is insulated cables and cords	IS 2982 :1965
14	Thermoplastic insulated weather proof cables : Part 1 PVC insulated and PVC sheathed	IS 3035 :Part1: 1965
15	Recommended current rating for cables : Part 4 Polyethylene insulated cables	IS 3961 : Part4 :1968
16	Recommended current rating for cables : Part 5 PVC insulated light duty cables	IS 3961 : Part5 :1968
17	Mild steel wires, formed wires and tapes for armouring of cables	IS 3975 :1999
18	PVC insulated (heavy duty) electric cables with solid aluminium conductor for voltages up to and including 1100 V	IS 4288 : 1988
19	Recommended short circuit rating of high voltage PVC cables	IS 5819 : 1970
20	PVC insulation and sheath of Electric Cables	IS 5831 :1984
21	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-1 for working voltages up to and including 1100V	IS 7098 : Part 1 : 1988
22	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-2 for working voltages from 3.3kV up to and including 33kV	IS 7098 : Part 2 : 1985
23	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-3 for working voltages from 66kV up to and including 220kV	IS 7098 : Part 3 : 1993
24	Elastomeric insulation and sheath of electric cables	IS 6380 :1984
25	Polyethylene insulation and sheath of electric cables	IS 6474 : 1984
26	Brass glands for PVC cables	IS 12943 : 1990
27	Conductors of insulated electric cables and flexible cords (First revision)	IS 8130 :1984

DATA SHEET –B**To be filled in by the BIDDER and submitted with the bid.**

SL #	Description	Unit	Bidder's Data			
1.0	Cable Type as per Data sheet A		H1	H2	H3	H4
2.0	Name of manufacturer					
3.0	Whether IS marked?	Yes/No				
4.0	Voltage grade					
5.0	Number of cores					
6.0	Conductor size	Sq. mm				
7.0	Conductors					
a)	Material					
b)	Number & diameter of wires					
8.0	Conductor screen					

Tender document for Supply, Installation and Commissioning of 2 Nos. of 2000 KVA, 11 KV of D.G. Sets at IISc, Bangalore

Section 6.4.11-11kV XLPE Cable

SL #	Description	Unit	Bidder's Data			
	per core per Km of cable					
25.0	Maximum charging current per conductor per Km of cable at nominal voltage	A				
26.0	Maximum dielectric loss of cable per km of 3 phase circuit, laid direct in ground, at normal voltage, frequency and maximum conductor temperature					
27.0	Impedance per km of 3 phase circuit at normal power frequency and maximum conductor temperature: i. Positive and negative sequence ii. Zero sequence	Ohm Ohm				
28.0	Normal drum length of cable	m				
29.0	Approximate shipping weight & size of drum	kg. m				
30.0	Rated current for standard condition of laying					
			Cable Type			
			H1	H2	H3	H4
31.0	Derating factors for variations in					
a)	Ambient air temperatures					
b)	Ground temperatures					
c)	Ground thermal resistivity					
d)	Depth of burial of 0.5 m, 0.75 m, 1.25 m, 1.5m					
e)	for two cables laid side by side in ground at centre distances 300, 400, 600mm ,900 mm					
32.0	Furnish chart showing derating factor for different spacing of cables considering multicore cables installed in horizontal formation in single row as well as in different tiers under the following methods of laying: i. Cables laid in formed concrete trenches with removable covers ii. Cables laid in cable trays iii. Cables laid in ground one meter below the ground level iv. Cables laid in pipes or ducts					
33.0	Recommended operating temperatures: i. Continuous	°C				

Section 6.4.11-11kV XLPE Cable

SL #	Description	Unit	Bidder's Data			
	ii. Emergency	°C				
	iii. After short circuit	°C				
34.0	Short circuit capacity for 1 second, for initial and final conductor temperatures as per item 15	kA (RMS)				

Section 6.4.12-1100V XLPE Cable

1.0 SCOPE

- 1.1 This specification covers the requirements of Cross linked Polyethylene (XLPE) insulated cables for working voltages up to and including 1100 Volts.

2.0 CODES & STANDARDS

- 2.1 The design, construction, manufacture and performance of cables shall comply with all currently applicable statutes, regulations and safety codes in the locality where cables will be installed. Nothing in this Specification shall be construed to relieve the VENDOR of this responsibility.
- 2.2 The cables shall conform to the latest applicable standards as specified in the relevant Data Sheet A2. In case of conflict between the standards and this specification, the stringent of the two shall apply. Equipment complying with other authoritative standards such as British, American, VDE will also be considered, if offered.

3.0 DESIGN AND PERFORMANCE REQUIREMENTS

3.1 Cable Construction

3.1.1 Multi Core Cables

The cable construction shall be as follows:-

- a) Conductor Well compacted, stranded copper or aluminium as stated in Data sheet A.
- b) Insulation Cross linked Polyethylene (XLPE) applied by extrusion. The nominal thickness of insulation shall be as per applicable standards.
- c) Inner Sheath The laid up cores shall be provided with Extruded PVC inner sheath. It shall be as Circular as possible. The thickness of inner sheath shall be as per applicable standards.
- d) Armouring Shall be provided when specified in Data sheet A and shall be applied over the inner sheath.
- e) Outer Sheath Extruded outer sheath shall be applied over inner sheath in case of unarmoured cables and over the armouring in case of armoured cables.

3.1.2 Single Core Cables

The cable construction shall be similar to three core cables except the following:-

- a) The armouring shall be applied over the insulation and shall be with non magnetic material as stated in data sheet A.
- b) The extruded PVC outer sheath shall be applied over the insulation in case of unarmoured cables and over the armouring in case of armoured cables.

3.1.3 Core Identification

Cables up to 5 cores shall be identified by colouring of insulation. For cables more than 5 cores,

Section 6.4.12-1100V XLPE Cable

the identification shall be done by numerals printed on the cores.

3.1.4 Armouring

- a) The armouring shall comprise the following:-
 - i) For multi core cables – Single / double galvanised steel wire / strip as stated in data sheet A.
 - ii) For Single core cables – Single / double Aluminium or copper wire / strip as stated in data sheet A.
- b) The dimensions of wire/strip shall be as per applicable standards.

3.1.5 Outer Sheath

- a) The outer sheath shall be as follows:-
 - i) With PVC / HR PVC / FRLS - PVC Compound as stated in Data sheet A.
 - ii) Black in colour.
 - iii) Shall have reduced flame propagation property.
- b) The thickness of outer sheath shall be as per applicable standards.

3.2 Requirements of special FRLS – PVC sheath:

3.2.1 Outer sheath for FRLS cables shall meet the following test requirements related to flame retardance, low smoke emission, low acid and toxic gas emission. The BIDDERS shall have proper test apparatus to conduct all the relevant tests as per the applicable standards mentioned herein.

3.2.2 Test for Flame Retardance

- c) Oxygen Index

The critical oxygen index value shall be minimum 29 at 250°C when tested for temperature index test as per ASTM-D-2863.
- d) Flammability
 - IV. Cables shall pass test under fire conditions as per IEC-332-1.
 - V. Cables shall also pass tests as per Swedish standard S5424-1475 for Chimney tests for Class-F3.
 - VI. Fire survival (FS) cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.

3.2.3 Test for Smoke Generation

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The smoke density rating shall be in accordance with the values specified under notes in Data Sheet-A or as agreed to between Purchaser and Vendor before placement of order. The tests shall be conducted in accordance with the following Standards/ Test methods:

- d) ASTM-D-2843
- e) ASTM-E-662
- f) 3 metre cube test chamber.

Section 6.4.12-1100V XLPE Cable

3.2.4 Tests for Acid Gas Generation

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than the values specified under notes in Data Sheet-A or as agreed to between Purchaser and Vendor before placement of order. Suitable test methods shall be agreed upon between PURCHASER and VENDOR before placement of order with regard to tests for other toxic and corrosive gases generated from the sheath under fire conditions.

3.2.5 Tests for Resistance to Ultra Violet Radiation

These shall be as specified under notes in Data Sheet-A or as agreed to between PURCHASER and VENDOR before placement of order.

3.2.6 Tests for Water Absorption

3.2.7 Outer sheath shall be subjected to tests for water absorption as per IS:10810. When additional characteristics are required, the tests shall be carried out as agreed to between PURCHASER and VENDOR before the placement of order.

3.2.8 Any other special tests on the sheath in addition to the above shall be as indicated under notes in Data Sheet-A or as agreed to between PURCHASER and VENDOR before placement of order.

3.3 Temperature Rise

- a) The maximum conductor temperature shall not exceed 90°C during continuous operation at rated current.
- b) The short circuit rating (current and withstand time) of cables shall be as specified in Data Sheet A. The temperature shall not exceed 250°C with initial conductor temperature of 90°C.
- c) The bidder shall furnish charts for derating factors under different conditions of laying in air and in ground

3.4 The Cables shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.

4.0 TESTS AND TEST REPORTS

4.1 The cables shall be tested in accordance with the latest applicable standard. The tests shall include Type tests, Acceptance tests and Routine tests as per applicable standard.

4.2 Valid type test reports not older than 5 years shall be submitted with the bid. If such reports are not available, the tests shall be carried out without any extra cost.

4.3 All test reports shall be subject to Purchaser's approval.

5.0 CABLE DRUMS

5.1 Cables shall be supplied in non-returnable wooden drums of heavy construction. The wood used for construction of the drum shall be properly seasoned, sound and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.

5.2 The BIDDERS shall indicate in the offer, the maximum length for each size of cable, which can be furnished on one drum. The actual length supplied on each drum shall be within tolerance limit of +/- 5% unless otherwise indicated in Data Sheet A1. However, before packing the cables on drums, the VENDOR shall obtain the PURCHASERS approval for the drum lengths.

Section 6.4.12-1100V XLPE Cable**6.0 CABLE LENGTH**

- 6.1** Cable lengths specified in Data Sheet-A are approximate. Actual requirements will be advised to the successful BIDDER at the time of placing the order. Unless otherwise stated by the BIDDER, the unit rates shall apply for the actual lengths required. Cable length shall be marked on the outer sheath of the cable.

7.0 DATA TO BE FURNISHED

- 7.1** The BIDDER shall furnish technical data as required in Data Sheets B and also furnish technical and descriptive literature giving details of the insulation, sheathing, testing, etc., of the offered cables.

Section 6.4.12-1100V XLPE Cable

DATA SHEET – A1

SL. No.	Description	Unit	Data
1.0	SYSTEM PARTICULAR		
1.1	Nominal Power system Voltages	Volts	415V
1.2	Maximum system voltage for continuous operation	Volts	
1.3	System neutral earthing	UE/E	E
1.4	Ground temperature	°C	30
1.5	Design ambient temperature	°C	40
2.0	TYPE OF CABLE LAYING		
a)	Laid side by side touching	Above Ground Below Ground	Above Ground
3.0	DESCRIPTION OF CABLES		
SL. No.	Description	Unit	Data
3.1	Cable Type		A B C D E
3.2	Application	Power Control	Power Power Power Power Power
3.3	Voltage Grade	Volts	1100 1100 1100 1100 1100
3.4	No. of cores		4 4 4 4 4
3.5	Conductor size	Sq.mm	4 6 10 16 25
3.6	Conductors		
a)	Material	Cu/ Al	Cu Cu Cu Cu Cu
b)	Stranded/ solid		Stranded Stranded Stranded Stranded Stranded
3.7	Core insulation		
	Material		XLPE
	Thickness of insulation		As per applicable standard
3.8	Core identification		By colour coding of XLPE insulation up to 5 cores. For more than 5 cores, by numerals printed on the core
3.9	Inner sheath for multicore cable		
a)	Material		PVC applied by extrusion
b)	Thickness of inner sheath		As per applicable standard
3.10	Armouring		
a)	Required	Yes/No	yes yes yes yes yes
b)	Material: Galvanised steel/ Aluminium	GS	
c)	Type	Single wire/ strip Double wire/ strip	Yes As per applicable standard
d)	Dimension of wire/ strip		

Section 6.4.12-1100V XLPE Cable

SL. No.	Description	Unit	Data				
3.11	Outer sheath		As per applicable standard				
a)	Material:		FRLS-PVC	FRLS-PVC	FRLS-PVC	FRLS-PVC	FRLS-PVC
	PVC	Type ST1					
	HR-PVC	Type ST2					
	FRLS PVC	FRLS-PVC					
b)	Application process		By extrusion				
c)	Thickness of outer sheath		As per applicable standard				
d)	Colour		Black				
3.12	Short circuit withstand capacity						
a)	Current	KA (rms)					
b)	Duration	Second					
3.13	Temperature rise						
a)	Maximum conductor temperature during continuous operation at rated current		90 °C				
b)	Temperature rise for short circuit rating with initial conductor temperature of 90 °C		250 °C				
3.14	Quantity						

Section 6.4.12-1100V XLPE Cable**DATA SHEET – A2**

APPLICABLE STANDARDS		
SL. NO.	DESCRIPTION	STANDARDS
1	Rubber insulated cables: Part 1 With Copper conductor	IS 434 : Part I : 1964
2	Rubber insulated cables: Part 2 With aluminium conductor	IS 434 : Part 2 : 1964
3	Flexible Trailing Cables for use in Coal Mines	IS 691:1984
4	Paper insulated lead-sheathed cables for rated voltage up to and including 33kV Specification	IS 692 :1994
5	Varnished cambric insulated cables (Revised)	IS 693 :1965
6	PVC insulated cables for working voltages up to and including 1100 V	IS 694 :1990
7	Code of practice for installation and maintenance of power cable up to and including 33kV rating (Second Revision)	IS 1255 :1983
8	PVC insulated (heavy duty) electric cables: Part 1 for working voltages up to and including 1100 V	IS 1554 : Part 1: 1988
9	Specification for PVC Insulated (Heavy duty) Electric cable -Part 2: For working voltage from 33kV up to and including 11kV	IS 1554 : Part 2: 1988
10	Polyethylene insulated cable for working voltage up to and including 1100 V	IS 1596: 1977
11	Aluminium conductor for insulated cables	IS 1753 :1967
12	Specification for Cotton Selvage Tape for Electric Cables	IS 2847: 1964
13	Copper conductor is insulated cables and cords	IS 2982 :1965
14	Thermoplastic insulated weather proof cables : Part 1 PVC insulated and PVC sheathed	IS 3035 :Part1: 1965
15	Recommended current rating for cables : Part 4 Polyethylene insulated cables	IS 3961 : Part4 :1968
16	Recommended current rating for cables : Part 5 PVC insulated light duty cables	IS 3961 : Part5 :1968
17	Mild steel wires, formed wires and tapes for armouring of cables	IS 3975 :1999
18	PVC insulated (heavy duty) electric cables with solid aluminium conductor for voltages up to and including 1100 V	IS 4288 : 1988
19	Recommended short circuit rating of high voltage PVC cables	IS 5819 : 1970
20	PVC insulation and sheath of Electric Cables	IS 5831 :1984
21	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-1 for working voltages up to and including 1100V	IS 7098 : Part 1 : 1988
22	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-2 for working voltages from 3.3kV up to and including 33kV	IS 7098 : Part 2 : 1985
23	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-3 for working voltages from 66kV up to and including 220kV	IS 7098 : Part 3 : 1993
24	Elastomeric insulation and sheath of electric cables	IS 6380 :1984
25	Polyethylene insulation and sheath of electric cables	IS 6474 : 1984
26	Brass glands for PVC cables	IS 12943 : 1990
27	Conductors of insulated electric cables and flexible cords (First revision)	IS 8130 :1984
28	Thermocouple compensating cable	IS 8784 :1987

Section 6.4.12-1100V XLPE Cable

DATA SHEET-B

(To be filled in by BIDDER and submitted with the BID)

SL. NO.	DESCRIPTION	UNIT	Bidder's Data				
			A	B	C	D	E
1.0	Cable type as per Data sheet A1						
2.0	Name of Manufacturer						
3.0	Whether IS marked?	Yes/No					
4.0	Application	Power Control					
5.0	Voltage grade						
6.0	No. of cores						
7.0	Conductor size	Sq.mm					
8.0	Conductor						
8.1	Material	Cu/Al					
8.2	Stranded/ solid						
9.0	Core Insulation						
9.1	Material						
9.2	Thickness of Insulation						
10.0	Core identification						
11.0	Inner Sheath						
11.1	Material						
11.2	Thickness of Inner sheath						
11.3	Dielectric strength	kV/cm					
12.0	Armouring						
12.1	Required						
12.2	Material: Galvanised steel/ Aluminium	GS/ Al					
12.3	Type	Single wire/ strip Double wire/ strip					
12.4	Dimension of wire/ strip						
13.0	Outer Sheath						
13.1	Material:						
	PVC/ HR-PVC/						
	FRLS PVC	FRLS PVC					
13.2	Application process						
13.3	Thickness of outer sheath						
13.4	Colour						
13.5	IS Marking	Yes/ No					
13.6	Length marked at one meter interval	Yes/ No					
13.7	Fungicidal and termite proof	Yes/ No					
14.0	Short circuit withstand capacity						
14.1	Current	kA (rms)					
14.2	Duration	Second					
15.0	Temperature rise						
15.1	Maximum conductor temperature during continuous operation at rated current	°C					
15.2	Temperature rise for short circuit rating	°C					

Section 6.4.12-1100V XLPE Cable

SL. NO.	DESCRIPTION	UNIT	Bidder's Data				
	with initial conductor temperature of 90°C						
16.0	Quantity						
17.0	Rated current for various conditions of laying						
18.0	Derating factors for variations in:						
18.1	Ambient air temperature						
18.2	Ground temperature						
18.3	Depth of laying						
18.4	Soil resistivity						
18.5	Method of laying						
19.0	Other parameters of cables:						
19.1	Minimum bending radius	mm					
19.2	Diameter under armour	mm					
19.3	Diameter over armour	mm					
19.4	Overall diameter	mm					
19.5	Weight/ M	kg					
19.6	Resistance/ km	Ohm					
19.7	Reactance/ km	Ohm					
19.8	Capacitance/ km	µF					
20.0	Cable drum						
20.1	Maximum length per drum and weight of drum for cable sizes:						
a)	Up to 10mm ²	m, kg					
b)	Up to 70mm ²	m, kg					
c)	For sizes >70mm ² (indicate for each specified size)	Sizes drum i) Length ii) Weight mm ² m kg					
20.2	Tolerance on drum length	± m					
21.0	Tests						
21.1	All tests will be carried out as per applicable standards and any other tests if specified in Section '3' or Data sheet A1 & 2 of the specification	Yes/ No					
21.2	If 'No', give separate details or deviations here						
21.3	All tests for FRLS-PVC sheaths will be carried out as per specification.	Yes/ No					

Section 6.4.14-Instrumentation Cable

1. SCOPE

- a) This specification covers the requirements of PVC insulated control cables for working voltages up to and including 1100 Volts.

2. CODES & STANDARDS

- a) The design, construction, manufacture and performance of cables shall comply with all currently applicable statutes, regulations and safety codes in the locality where cables will be installed. Nothing in this Specification shall be construed to relieve the VENDOR of this responsibility.
- b) The cables shall conform to the latest applicable standards as specified in the relevant **Data Sheet- A**. In case of conflict between the standards and this specification, the stringent of the two shall apply. Equipment complying with other authoritative standards such as British, American, VDE will also be considered, if offered.

3. DESIGN AND PERFORMANCE REQUIREMENTS

4. Cable Construction

- a) The Control Cables shall be multicore with number of cores as stated in Data Sheet A.
- b) The Construction of the cables shall be as follows:
 - c) Conductor
 - d) Material Shall be annealed high conductivity, stranded copper.
 - e) Size The cross sectional area of the conductor shall be as stated in Data Sheet A
 - f) Core Insulation Shall be Extruded PVC compound Type A as per IS 5831. The thickness of insulation shall be as per applicable standards.
 - g) Inner Sheath The laid up cores shall be provided with Extruded PVC inner sheath. The thickness of inner sheath shall be as per applicable standards.
 - h) Armouring Shall be provided when specified in Data sheet A. The armouring shall be by single galvanised steel round wire or strip in accordance with the relevant standards.
 - i) Outer Sheath Extruded outer sheath shall be applied over the inner sheath for unarmoured cables and over the armouring in case of armoured cables. The outer sheath shall be with PVC/ HR PVC/ FRLS PVC Compound as stated in Data Sheet A and shall have reduced flame propagating properties. It shall be black in colour. The thickness of outer sheath shall be as per applicable standards.
 - j) Core identification Shall be in accordance with the relevant standards. Cables up to 5 cores shall be identified by colouring of PVC insulation. For cables more than 5 cores, the identification shall be done by numbers printed on the cores.

5. Requirement of special FRLS - PVC sheath:

- a) Outer sheath for FRLS cables shall meet the following test requirements related to flame retardance, low smoke emission, low acid and toxic gas emission. The BIDDERS shall have proper test apparatus to conduct all the relevant tests as per the applicable standards mentioned herein.

Section 6.4.14-Instrumentation Cable

- b) Test for Flame Retardance
- c) Oxygen Index
- d) The critical oxygen index value shall be minimum 29 at 250°C when tested for temperature index test as per ASTM-D-2863.
- e) Flammability
- f) Cables shall pass test under fire conditions as per IEC-332-1.
- g) Cables shall also pass tests as per Swedish standard S5424-1475 for Chimney tests for Class-F3.
- h) Fire survival (FS) cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.
- i) Test for Smoke Generation
- j) The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The smoke density rating shall be in accordance with the values specified under notes in Data Sheet-A or as agreed to between Purchaser and Vendor before placement of order. The tests shall be conducted in accordance with the following Standards/ Test methods:
- k) ASTM-D-2843
- l) ASTM-E-662
- m) 3 metre cube test chamber.
- n) Tests for Acid Gas Generation
- o) The hydrochloric acid generation when tested as per IEC 754-1 shall be less than the values specified under notes in Data Sheet-A or as agreed to between Purchaser and Vendor before placement of order. Suitable test methods shall be agreed upon between PURCHASER and VENDOR before placement of order with regard to tests for other toxic and corrosive gases generated from the sheath under fire conditions.
- p) Tests for Resistance to Ultra Violet Radiation
- q) These shall be as specified under notes in Data Sheet-A or as agreed to between PURCHASER and VENDOR before placement of order.
- r) Tests for Water Absorption
- s) Outer sheath shall be subjected to tests for water absorption as per IS:10810. When additional characteristics are required, the tests shall be carried out as agreed to between PURCHASER and VENDOR before the placement of order.
- t) Any other special tests on the sheath in addition to the above shall be as indicated under notes in Data Sheet-A or as agreed to between PURCHASER and VENDOR before placement of order.

6. Temperature Rise

- a) The maximum conductor temperature shall not exceed 70 °C during continuous operation at rated current.
- b) The temperature under short circuit condition shall not exceed 160 °C with initial conductor temperature of 70 °C.

7. TESTS

- a) The cables shall be tested in accordance with the latest applicable standard. The tests shall include Type tests, Acceptance tests and Routine tests as per applicable standards.

Section 6.4.14-Instrumentation Cable

- b) Valid type test reports not older than 5 years shall be submitted with the bid. If such reports are not available, the tests shall be carried out without any extra cost.
- c) All test reports shall be subject to Purchaser's approval.

8. CABLE DRUMS

- a) Cables shall be supplied in non-returnable wooden drums of heavy construction. The wood used for construction of the drum shall be properly seasoned, sound and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.
- b) The BIDDERS shall indicate in the offer, the maximum length for each size of cable, which can be furnished on one drum. The actual length supplied on each drum shall be within tolerance limit of +/- 5% unless otherwise indicated in Data Sheet A1. However, before packing the cables on drums, the VENDOR shall obtain the PURCHASERS approval for the drum lengths.

9. CABLE LENGTH

- a) Cable lengths specified in Data Sheet-A are approximate. Actual requirements will be advised to the successful BIDDER at the time of placing the order. Unless otherwise stated by the BIDDER, the unit rates shall apply for the actual lengths required. Cable length shall be marked on the outer sheath of the cable.

10. DATA TO BE FURNISHED

- a) The BIDDER shall furnish technical data as required in Data Sheets B and also furnish technical and descriptive literature giving details of the insulation, sheathing, testing, etc., of the offered cables.

	Description	Unit	Data
1.0	SYSTEM PARTICULAR		
1.1	Nominal Power system Voltage	Volts	415
1.2	Maximum system voltage for continuous operation	Volts	
1.3	System neutral earthing	UE/E	E
1.4	Control System Voltages	AC	220V
		DC	110VDC
1.5	Ground temperature	°C	30
1.6	Design ambient temperature	°C	40
2.0	TYPE OF CABLE LAYING		
a)	Laid side by side touching	Above Ground	In Cable Trays
		Below Ground	Directly Buried

Section 6.4.14-Instrumentation Cable

3.0	DESCRIPTION OF CONTROL CABLES						
Sl. No	Description	Unit	Data				
3.1	Type of control cable		C ₁	C ₂	C ₃	C ₄	C ₅
3.2	Voltage grade	Volts	1100V	1100V	1100V	1100V	1100V
3.3	No. of cores		3	5	7	12	18
3.4	Size of Conductor	Sq. mm	2.5	2.5	2.5	2.5	2.5
3.5	Conductors		Stranded Copper				
a)	Material						
3.6	Core insulation						
	a) Material		PVC Type A				
	b) Thickness of insulation	mm	As per applicable standard				
3.7	Core identification	By colour coding of PVC insulation up to 5 cores. For more than 5 cores, by numerals printed on the core					
3.8	Inner sheath						
a)	Material	PVC applied by extrusion					
b)	Thickness of inner sheath	mm	As per applicable standard				
3.9	Armouring						
a)	Required	Yes/No	Yes	Yes	Yes	Yes	Yes
b)	Material						
c)	Type	Wire/ strip	Wire/ strip	Wire/ strip	Wire/ strip	Wire/ strip	Wire/ strip
d)	Dimension of wire/strip	mm	As per applicable standard				
3.10	Outer sheath						
a)	Material		FRLS - PVC	FRLS - PVC	FRLS - PVC	FRLS - PVC	FRLS - PVC
	PVC - Type ST1						
	HR PVC - Type ST2						
	FRLS - PVC						
b)	Application process		By extrusion				
c)	Thickness of outer sheath						
d)	Colour		Black				

3.11	Maximum conductor temperature during continuous operation at rated current	°C	70 °C				
3.12	Quantity						

DATA SHEET – A2

APPLICABLE STANDARDS		
SL #	DESCRIPTION	IS
1	Rubber insulated cables: Part 1 With Copper conductor	IS 434 : Part I : 1964
2	Rubber insulated cables: Part 2 With aluminium conductor	IS 434 : Part 2 : 1964
3	Flexible Trailing Cables for use in Coal Mines	IS 691:1984
4	Paper insulated lead-sheathed cables for rated voltage up to and including 33kV Specification	IS 692 :1994
5	Varnished cambric insulated cables (Revised)	IS 693 :1965
6	PVC insulated cables for working voltages up to and including 1100 V	IS 694 :1990
7	Code of practice for installation and maintenance of power cable up to and including 33kV rating (Second Revision)	IS 1255 :1983

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8	PVC insulated (heavy duty) electric cables: Part 1 for working voltages up to and including 1100 V	IS 1554 : Part 1: 1988
9	Specification for PVC Insulated (Heavy duty) Electric cable -Part 2: For working voltage from 33kV up to and including 11kV	IS 1554 : Part 2: 1988
10	Polyethylene insulated cable for working voltage up to and including 1100 V	IS 1596: 1977
11	Aluminium conductor for insulated cables	IS 1753 :1967
12	Specification for Cotton Selvage Tape for Electric Cables	IS 2847: 1964
13	Copper conductor is insulated cables and cords	IS 2982 :1965
14	Thermoplastic insulated weather proof cables : Part 1 PVC insulated and PVC sheathed	IS 3035 :Part1: 1965
15	Recommended current rating for cables : Part 4 Polyethylene insulated cables	IS 3961 : Part4 :1968
16	Recommended current rating for cables : Part 5 PVC insulated light duty cables	IS 3961 : Part5 :1968
17	Mild steel wires, formed wires and tapes for armouring of cables	IS 3975 :1999
18	PVC insulated (heavy duty) electric cables with solid aluminium conductor for voltages up to and including 1100 V	IS 4288 : 1988
19	Recommended short circuit rating of high voltage PVC cables	IS 5819 : 1970
20	PVC insulation and sheath of Electric Cables	IS 5831 :1984
21	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-1 for working voltages up to and including 1100V	IS 7098 : Part 1 : 1988
22	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-2 for working voltages from 3.3kV up to and including 33kV	IS 7098 : Part 2 : 1985
23	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-3 for working voltages from 66kV up to and including 220kV	IS 7098 : Part 3 : 1993
24	Elastomeric insulation and sheath of electric cables	IS 6380 :1984
25	Polyethylene insulation and sheath of electric cables	IS 6474 : 1984
26	Brass glands for PVC cables	IS 12943 : 1990
27	Conductors of insulated electric cables and flexible cords (First revision)	IS 8130 :1984

DATA SHEET-B

(To be filled in by BIDDER and submitted with the BID)

SL. NO.	Description	Unit	Bidder's Data				
1.0	Cable type as per Data sheet A1		C ₁	C ₂	C ₃	C ₄	C ₅
2.0	<u>Name of Manufacturer</u>						
3.0	Whether IS marked?	Yes/No					
4.0	Voltage grade						
5.0	No. of cores						
6.0	Size of Conductor	Sq. mm					
7.0	Conductor material						
8.0	Core Insulation						
8.1	Material						
8.2	Thickness of insulation	mm					

Section 6.4.14-Instrumentation Cable

SL. NO.	Description	Unit	Bidder's Data				
9.0	Core identification						
10.0	Inner sheath						
10.1	Material						
10.2	Thickness of inner sheath	mm					
11.0	Armouring						
11.1	Required	Yes/No					
11.2	Material						
11.3	Type	Wire/ strip					
11.4	Dimension of wire/strip	mm					
12.0	Outer sheath						
12.1	Material PVC / HR PVC / FRLS - PVC						
12.2	Application process						
12.3	Thickness of outer sheath						
12.4	Colour						
12.5	IS Marking	Yes/No					
12.6	Length marked at one meter interval	Yes/No					
12.7	Fungicidal and termite proof	Yes/No					
13.0	Quantity						
14.0	Minimum bending radius	mm					
15.0	Cable drum						
15.1	Maximum length per drum for each size of cable	metre					
15.2	Weight of drum for each size of cable	Kg					
15.3	Tolerance on drum length	± m					
16.0	Other Parameters of Cables:						
16.1	Thickness of insulation	mm					
16.2	Diameter under armour	mm					
16.3	Diameter over armour	mm					
16.4	Overall diameter	mm					
16.5	Weight/ M	kg					
16.6	Resistance/ kM	Ohm					
16.7	Reactance/ kM	Ohm					
16.8	Capacitance/ kM	µF					
17.0	Derating factor for variations in:						
17.1	Ambient air temperature						
17.2	Ground temperature						
17.3	Depth of laying						
17.4	Soil Resistivity						
17.5	Method of laying						
16.0	Tests						
16.1	Type test reports enclosed with the Bid	Yes/No					
16.2	All tests for FRLS-PVC sheaths will be carried out as per specification	Yes/No					

Section 6.4.14-Instrumentation Cable

1.0 SCOPE

- 1.1 This specification covers the requirements of PVC insulated instrumentation cables for working voltages up to and including 1100 volts.

2.0 CODES & STANDARDS

- 2.1 The design, construction, manufacture and performance of cables shall comply with all currently applicable statutes, regulations and safety codes in the locality where cables will be installed. Nothing in this Specification shall be construed to relieve the VENDOR of this responsibility.
- 2.2 The cables shall conform to the latest applicable standards as specified in the relevant Data Sheet A2. In case of conflict between the standards and this specification, the stringent of the two shall apply. Equipment complying with other authoritative standards such as British, American, VDE will also be considered, if offered.

3.0 DESIGN AND PERFORMANCE REQUIREMENTS

Instrumentation Cable Construction

Conductor –Material Annealed, high conductivity, tinned, copper in stranded construction. The number of strands shall be minimum 7.

Size The cross sectional area of the conductor shall be as stated in Data Sheet A
Insulation PVC type A applied by extrusion process.

Cable Elements.

Type One of the following types as specified in data sheet A

A 'Pair' of two insulated conductors twisted together, designated by alphabet 'p'.

A 'Triple' of three insulated conductors twisted together, designated by alphabet 't'.

A 'Quad' of four insulated conductors twisted together, designated by alphabet 'q'.

No. of cable elements As stated in Data Sheet A.

Lay 60 mm to 80 mm staggered for twisted pairs. 50 mm for triple and quad cable elements. Shield

Shield Type Shall be one of the following types as specified in Data Sheet A
i) Type 1 each pair and cable assembly shielded separately.

Hundred percent coverage over pair assembly Shield tape on pair assembly shall give total shield isolation from all other pair shields. ii) Type 2 Overall cable assembly shield.

Shield Material

Combination aluminium Mylar tape and tinned copper drain wire of minimum 0.5 sq mm cross section. Inner sheath Extruded PVC. Armouring Galvanised steel wire armouring as per applicable standards. Outer sheath The outer sheath shall be with PVC/ HR PVC/ FRLS PVC Compound as stated in Data sheet A. The colour shall be grey. The sheath shall have reduced flame propagation property. Pair identification Each pair numbered at regular intervals of 250 mm. Cable identification A durable marking shall be provided on the surface of the cable at regular intervals not exceeding 625mm providing manufacturers name, conductor material and size, number of pairs, insulating material etc.

Thermocouple Compensating Cable

The thermocouple compensating cables shall conform to IS 8784

The cable construction shall be as follows:-

Section 6.4.14-Instrumentation Cable

Conductor – shall be as per Table 3 of IS 8784

Insulation – PVC type C

Shielding – With 15 mils thick heat resistant aluminium polyester foil, having 25 percent overlap and copper drain wire.

Outer sheath – PVC type ST2 or FRLS – PVC as specified in Data sheet A.

3.3.3 The cable construction otherwise shall be similar to instrumentation cable.

3.1 Requirement of special sheath for FRLS/ FS cable:

Outer sheath for FRLS/ FS cables shall meet the following test requirements related to flame retardance, low smoke emission, low acid and toxic gas emission. The BIDDERS shall have proper test apparatus to conduct all the relevant tests as per the applicable standards mentioned herein.

Test for Flame Retardance

Oxygen Index

The critical oxygen index value shall be minimum 29 at 250°C when tested for temperature index test as per ASTM-D-2863.

Flammability

Cables shall pass test under fire conditions as per IEC-332-1.

Cables shall also pass tests as per Swedish standard S5424-1475 for Chimney tests for Class-F3.

Fire survival (FS) cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.

Test for Smoke Generation

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The smoke density rating shall be in accordance with the values specified under notes in Data Sheet-A or as agreed to between Purchaser and Vendor before placement of order. The tests shall be conducted in accordance with the following Standards/ Test methods:

ASTM-D-2843

ASTM-E-662

3 metre cube test chamber.

Tests for Acid Gas Generation

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than the values specified under notes in Data Sheet-A or as agreed to between Purchaser and Vendor before placement of order. Suitable test methods shall be agreed upon between PURCHASER and VENDOR before placement of order with regard to tests for other toxic and corrosive gases generated from the sheath under fire conditions.

Tests for Resistance to Ultra Violet Radiation

These shall be as specified under notes in Data Sheet-A or as agreed to between PURCHASER and VENDOR before placement of order.

Tests for Water Absorption

Outer sheath shall be subjected to tests for water absorption as per IS:10810. When additional characteristics are required, the tests shall be carried out as agreed to between PURCHASER and VENDOR before the placement of order.

Section 6.4.14-Instrumentation Cable

Any other special tests on the sheath in addition to the above shall be as indicated under notes in Data Sheet-A or as agreed to between PURCHASER and VENDOR before placement of order.

4.0 TESTS

- 4.1 The cables shall be tested in accordance with the latest applicable standard. The tests shall include Type tests, Acceptance tests and Routine tests as per applicable standards.
- 4.2 Valid type test reports not older than 5 years shall be submitted with the bid. If such reports are not available, the tests shall be carried out without any extra cost.
- 4.3 All test reports shall be subject to Purchaser's approval.

5.0 CABLE DRUMS

- 5.1 Cables shall be supplied in non-returnable wooden drums of heavy construction. The wood used for construction of the drum shall be properly seasoned, sound and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.
- 5.2 The BIDDERS shall indicate in the offer, the maximum length for each size of cable, which can be furnished on one drum. The actual length supplied on each drum shall be within tolerance limit of +/- 5% unless otherwise indicated in Data Sheet A1. However, before packing the cables on drums, the VENDOR shall obtain the PURCHASERS approval for the drum lengths.

6.0 CABLE LENGTH

- 6.1 Cable lengths specified in Data Sheet-A are approximate. Actual requirements will be advised to the successful BIDDER at the time of placing the order. Unless otherwise stated by the BIDDER, the unit rates shall apply for the actual lengths required. Cable length shall be marked on the outer sheath of the cable.

7.0 DATA TO BE FURNISHED

- 7.1 The BIDDER shall furnish technical data as required in Data Sheets B and also furnish technical and descriptive literature giving details of the insulation, sheathing, testing, etc., of the offered cables.

Section 6.4.14-Instrumentation Cable

DATA SHEET – A1

1.0	SYSTEM PARTICULAR						
1.1	Nominal Power system Voltages		Volts	415V			
1.2	Maximum system voltage for continuous operation		Volts				
1.3	System neutral earthing		UE/E				
1.4	Ground temperature		°C				
1.5	Design ambient temperature		°C				
2.0	TYPE OF CABLE LAYING						
a)	Laid side by side touching	Above Ground		In Cable Trays			
		Below Ground		Directly Buried			
3.0	DESCRIPTION OF INSTRUMENTATION CABLES						
Sl. No	Description	Unit	Data				
3.1	Type of instrumentation cable		I _n 1	I _n 2	I _n 3	I _n 4	I _n 5
3.2	Voltage grade	Volts	650V	650V	650V	650V	650V
3.3	No. of cable elements a) Twisted pair (p) b) Twisted triple (t) c) Twisted quad (q)		2p	4p	2t	6t	12t
3.4	Conductor						
a)	Material	Cu/Al	Copper				
b)	Stranded/solid		Stranded				
c)	If stranded, minimum no. of strands	Nos.					
d)	Size	sq mm					
3.5	Core insulation						
a)	Material	PVC Type A applied by extrusion					
b)	Thickness of insulation	As per applicable standard					
3.6	Shielding						
3.6.1	Type of shielding						
a)	Each pair and cable assembly shielded separately (Type1)						
b)	Overall cable assembly shielded (Type2)						
3.6.2	Shielded material	2.35 mil thick Aluminium Mylar tape in combination with stranded tinned copper drain wire of minimum 0.5 sq. mm cross section					
3.7	Inner sheath						
a)	Material	Extruded PVC					
b)	Thickness of inner sheath	As per applicable standard					
3.8	Armouring						
a)	Required	Yes/No					
b)	Material						
c)	Type						
d)	Dimension of wire/strip		As per applicable standard				
3.9	Outer sheath						
a)	Material		FRLS -	FRLS -	FRLS -	FRLS -	FRLS -

Section 6.4.14-Instrumentation Cable

	PVC- Type ST1		PVC	PVC	PVC	PVC	PVC
	HR PVC Type ST2						
	FRLS - PVC						
b)	Application process		By extrusion				
c)	Thickness of outer sheath		As per applicable standard				
d)	Colour		Grey				

Sl. No	Description	Unit	Type of Cable				
			I _n 1	I _n 2	I _n 3	I _n 4	I _n 5
3.10	Pair identification		Each pair numbered at regular interval of 250mm				
3.11	Cable identification		A durable marking provided on the surface of the cable at regular intervals of 600 mm. The marking shall include manufacture's name, conductor material and size, number of pairs, insulating material				
3.12	Quantity						

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DATA SHEET – A2

APPLICABLE STANDARDS		
SL #	DESCRIPTION	STANDARDS
1	Rubber insulated cables: Part 1 With Copper conductor	IS 434 : Part I : 1964
2	Rubber insulated cables: Part 2 With aluminium conductor	IS 434 : Part 2 : 1964
3	Flexible Trailing Cables for use in Coal Mines	IS 691:1984
4	Paper insulated lead-sheathed cables for rated voltage up to and including 33kV Specification	IS 692 :1994
5	Varnished cambric insulated cables (Revised)	IS 693 :1965
6	PVC insulated cables for working voltages up to and including 1100 V	IS 694 :1990
7	Code of practice for installation and maintenance of power cable up to and including 33kV rating (Second Revision)	IS 1255 :1983
8	PVC insulated (heavy duty) electric cables: Part 1 for working voltages up to and including 1100 V	IS 1554 : Part 1: 1988
9	Specification for PVC Insulated (Heavy duty) Electric cable -Part 2: For working voltage from 33kV up to and including 11kV	IS 1554 : Part 2: 1988
10	Polyethylene insulated cable for working voltage up to and including 1100 V	IS 1596: 1977
11	Aluminium conductor for insulated cables	IS 1753 :1967
12	Specification for Cotton Selvage Tape for Electric Cables	IS 2847: 1964
13	Copper conductor is insulated cables and cords	IS 2982 :1965
14	Thermoplastic insulated weather proof cables : Part 1 PVC insulated and PVC sheathed	IS 3035 :Part1: 1965
15	Recommended current rating for cables : Part 4 Polyethylene insulated cables	IS 3961 : Part4 :1968
16	Recommended current rating for cables : Part 5 PVC insulated light duty cables	IS 3961 : Part5 :1968
17	Mild steel wires, formed wires and tapes for armouring of cables	IS 3975 :1999
18	PVC insulated (heavy duty) electric cables with solid aluminium conductor for voltages up to and including 1100 V	IS 4288 : 1988
19	Recommended short circuit rating of high voltage PVC cables	IS 5819 : 1970
20	PVC insulation and sheath of Electric Cables	IS 5831 :1984
21	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-1 for working voltages up to and including 1100V	IS 7098 : Part 1 : 1988
22	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-2 for working voltages from 3.3kV up to and including 33kV	IS 7098 : Part 2 : 1985
23	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-3 for working voltages from 66kV up to and including 220kV	IS 7098 : Part 3 : 1993
24	Elastomeric insulation and sheath of electric cables	IS 6380 :1984
25	Polyethylene insulation and sheath of electric cables	IS 6474 : 1984
26	Brass glands for PVC cables	IS 12943 : 1990
27	Conductors of insulated electric cables and flexible cords (First revision)	IS 8130 :1984
28	Thermocouple compensating cable	IS 8784 :1987

DATA SHEET-B

(To be filled in by BIDDER and submitted with the BID)

SL. #	Description	Unit	Bidder's Data				
1.0	Cable type as per Data sheet A1		I _n 1	I _n 2	I _n 3	I _n 4	I _n 5
2.0	<u>Name of Manufacturer</u>						
3.0	Whether IS marked?	Yes/No					
4.0	Voltage grade						

Section 6.4.14-Instrumentation Cable

SL. #	Description	Unit	Bidder's Data				
5.0	No. of cable elements a) Twisted pair (p) b) Twisted triple (t) c) Twisted quad (q)						
6.0	Conductor						
6.1	Material						
6.2	Stranded	Yes/No					
6.3	If stranded, minimum no. of strands	Nos.					
6.4	Size	sq mm					
7.0	Core Insulation						
a)	Material						
b)	Thickness						
8.0	Lay of twisted cores						
9.0	Shielding						
9.1	Type of shielding						
a)	Each pair and cable assembly shielded separately (Type1)						
b)	Overall cable assembly shielded (Type2)						
10.0	Inner sheath						
10.1	Material						
10.2	Thickness of inner sheath						
11.0	Armouring						
11.1	Required	Yes/No					
11.2	Material						
11.3	Type						
11.4	Dimension of wire/strip						
12.0	Outer sheath						
12.1	Material PVC/ HR PVC/ FRLS - PVC						
12.2	Application process						
12.3	Thickness of outer sheath						
12.4	Colour						
12.5	IS Marking						
12.6	Length marked at one meter interval	Yes/No					
12.7	Fungicidal and termite proof	Yes/No					
13.0	Pair Identification						
14.0	Cable identification						
15.0	Quantity						
16.0	Minimum bending radius	mm					
17.0	Maximum length per drum and weight of drum for cable sizes specified in Data Sheet A:						
	a) Sizes	mm ²					
	b) Drum						
	i) Length	m					
	ii) Weight	kg					
18.0	Tolerance on drum length	± m					
19.0	Other Parameters of Cables:						

Section 6.4.14-Instrumentation Cable

SL. #	Description	Unit	Bidder's Data				
19.1	Diameter under armour	mm					
19.2	Diameter over armour	mm					
19.3	Overall diameter	mm					
19.4	Weight/ Mtr	kgs					
19.5	Resistance/ kM	Ohm					
19.6	Reactance/ kM	Ohm					
19.7	Capacitance/ kM	µF					
20.0	a) All tests will be carried out as per applicable standards and any other tests if specified in Section '3' or Data Sheet A1 & 2 of the Specification	Yes/No					
	b) If 'No', give separate details or deviations here						
	c) All test for FRLS-PVC sheath will be carried out as per specification	Yes/No					

Section 6.4.15-Earthing

1.0 SCOPE

- 1.1 This specification covers the requirement of installation, testing and commissioning of earthing and lightning protection systems. The work shall be carried out in accordance with relevant project layout drawings and typical; drawings enclosed.

2.0 CODES AND STANDARDS

- 2.1 The earthing systems shall comply with all currently applicable standards regulations and safety codes of the locality where the installation is to be carried out. Nothing in this specification shall be constructed to relieve the CONTRACTOR of this responsibility.
- 2.2 The installation work shall conform to the latest applicable Electricity Rules standards and codes of practice as specified at Data Sheet – A.

3.0 SCOPE OF SUPPLY

- 3.1 The earthing and lightning protection conductors and earth electrodes shall be supplied by the CONTRACTOR when specifically indicated in Data Sheet A. Conductors shall be free from rust scale and other electrical and mechanical defects and all materials used shall conform to relevant standards or approved by the PURCHASER. The sizes, materials and quantity shall be as listed in Data Sheet A.
- 3.2 Test links in suitable weather proof enclosures as shown in enclosed drawing shall be supplied by the CONTRACTOR for connection between each lightning conductor down comer and earth electrode.

4.0 SCOPE OF INSTALLATION WORK

- 4.1 The installation work shall include unloading, storing, laying, fixing, and jointing/termination, testing and commissioning associated with the safety earthing system of the plant and lightning protection system for auxiliary buildings. All welding/brazing equipment, necessary tools and testing equipment shall be furnished by the CONTRACTOR.
- 4.2 The CONTRACTOR shall be responsible for any installation materials which are lost or damaged during installation. All damages and thefts shall be made good by the CONTRACTOR till the installation is handed over to the PURCHASER.
- 4.3 The CONTRACTOR shall carryout the lightning protection and earthing of all structures as indicated in the PURCHASER'S drawings.
- 4.4 The CONTRACTOR shall install bare conductors, braids, etc., required for system and individual equipment earthing. All work such as cutting, bending, supporting, painting, coating, drilling, brazing soldering, welding, clamping, bolting and connecting onto structures, equipment frames, terminals, rails or other devices shall be in the CONTRACTOR'S scope of work. All incidental hardware and consumables such as fixing cleats/clamps anchor fasteners, lugs, bolts nuts washers, bitumen compound, adhesive, anti-corrosive paint as required for the complete work shall be deemed to be included by the CONTRACTOR as part of the installation work.
- 4.5 The quantities sizes, and material of earthing conductors and electrodes to be installed shall be as indicated in Data Sheet A1, and routes of the conductors and locations of electrodes shall be shown on the project drawings. The alignments of conductors are approximately shown in the earthing drawings and these may be suitably shifted / finalized in consultation with the site ENGINEER / PURCHASER to avoid any interference. If earth connection to any device is not shown specifically in the relevant earthing drawings, it shall be field routed.

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- 4.6 The tap connections (earthing leads) from the floor embedded main earthing grid to the equipment of more than 500mm long shall be embedded in floor by the CONTRACTOR where required, together with associated civil work such as excavation/chasing, concreting and surfacing, if not already done by the civil contractor. The concrete cover over the conductor shall not be less than 50mm.
- 4.7 The depth of burial of earth conductors in outdoor areas shall be as per data sheet A1 and project drawings. The scope of installation of earth conductors in outdoor areas, buried in ground shall include excavation in earth up to 600mm deep and 450mm wide (unless otherwise stated in Data sheet A1), laying of conductor at 600mm depth (unless stated otherwise), brazing / welding as required of main grid conductor joints as well as risers of 50mm length above ground at required locations and backfilling. Back filling material to be placed over buried conductor shall be free from stones and other harmful mixtures. Backfill shall be placed in layers of 150mm uniformly spread along the ditch, and tampered utilizing pneumatic tampers or other approved means. If the excavated soil is found unsuitable for backfilling, the CONTRACTOR shall arrange for suitable soil from outside.
- 4.8 The scope of installation of earth connection leads on steel structures/walls shall include laying the conductors, welding/cleating at specified intervals, welding/brazing to the main earth grids risers, coating welded/brazed joints by bituminous paint.
- 4.9 The scope of installation of electrodes shall include installation of these electrodes as indicated in Data Sheet A1 and connecting to main buried earth grid, as per enclosed drawings / relevant standards. The scope of work shall include excavation, construction of the earth pits including all materials required for construction of the earth pits, placing the pipe, providing and fixing test links on those pipes in test pits and connecting to main earth grid conductors.
- 4.10 The scope of installation of lightning Protection Conductors on the roofs of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods where necessary, laying, fastening /cleating/welding of the down comers on the walls/columns of the building and connection to the test links above ground level.
- 4.11 Support Cleats used for roof conductors at tiled roof area shall be fixed to the tiles using water proof adhesive as the same cannot be fixed by screws.
- 4.12 The scope of installation of the test links shall include mounting of the same at specified height on wall/column by suitable brackets and connections of the test link to the earth electrode.
- 4.13 All earth pits shall be interconnected using buried ground grid conductor.

5.0 EARTHING SYSTEM:

- 5.1 The installation work shall be carried out in accordance with the following specification:-
 - a) Earthing and lightning protection system – Installation notes.
- 5.2 Wherever main earthing conductor crosses cable trenches, they shall be buried below the trench floor.
- 5.3 Suitable earth risers approved by the PURCHASER shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of the main earth conductors. The minimum length of such riser inside the building shall be 200mm and outdoors shall be 500mm above ground level. The risers to be provided shall be marked in project drawings.
- 5.4 Wherever earthing conductor passes through walls, galvanized iron sleeves shall be provided for the passage of the earthing conductor. The pipe ends shall be sealed by the CONTRACTOR by suitable water proof compound.

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5.5 Water stops shall be provided wherever earthing conductor enters the building form outside below grade level. Water stops and above mentioned sleeved shall be provided by the civil contractor.

5.6 Metallic conduit and pipes shall be connected to the earthing system unless specified otherwise.

5.7 Earth Electrodes

- a) The type of earth electrodes shall be as indicated in Data sheet A1
- b) Electrodes shall as far as practicable, be embedded below permanent moisture level
- c) Some electrodes shall be housed in test pits with concrete covers for periodic testing of earth resistivity. Installation of rod/pipe/plate electrodes in test pits shall be convenient for inspection, testing and watering.
- d) Earth pits shall be treated with salt and charcoal if average. resistivity of soil is more than 20 ohm. Metre.

5.8 COPPER PLATE EARTH STATION

Plate electrodes shall be made of 3mm thick copper plate of 600X 600mm size. The plate shall be buried vertically in ground at a depth of not less than 2.5 meters to the top of the plate. The pit should be filled with charcoal/ and salt in such a way that the electrode is encased to a minimum thickness of 300mm all round. The electrode, to the extent possible, should be buried in a depth where subsoil water is present. Earth leads to the electrode shall be laid in a heavy-duty GI pipe and connected to the plate electrode with brass bolts, nuts and washers. A GI pipe of not less than 40mm dia shall be clamped with bolts vertically to the plate and terminated in a wire meshed funnel. The funnel shall be enclosed in a masonry chamber of

450mm x 450mm dimensions. The chamber shall be provided with GI frame and CI inspection cover. The earth station shall also be provided with a suitable permanent identification label tag.

6.0 TESTING OF EARTHING SYSTEM

6.1 The CONTRACTOR shall ensure the continuity of all conductors and joints. The CONTRACTOR shall carry out earth continuity tests, earth resistance measurements and other tests which in his opinion are necessary to prove that the system is in accordance with the design specifications, code of practice and Electricity Rules. The CONTRACTOR shall have to bear the cost of all such tests.

7.0 CONTRACTOR'S LICENCE

7.1 It will be the responsibility of the CONTRACTOR to obtain necessary License/Authorization permit for work from the Licensing Board of the locality/state where the installation is to be carried out. The persons deputed by the CONTRACTOR'S firm shall also hold valid permits issued or recognized by the Licensing Board of the Locality/State where the work is to be carried out.

8.0 WORKMANSHIP

8.1 The CONTRACTOR shall ensure workmanship of good quality and shall assign qualified supervisors/engineers and competent welders/labour who are skilled, careful and experienced

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in their traders. The PURCHASER.ENGINEER shall reserve the right to reject non competent persons employed by the CONTRACTOR, if the workmanship is not of good order.

9.0 SAFETY

- 9.1 The CONTRACTOR shall ensure adherence to all safety norms such as use of Safety Shoes, Belts, Helmets, Gloves etc. and sign acceptance of OWNER's Safety Conditions for work at site.

DATA SHEET - A1				
SL.NO	Description		Unit	Data
1.0 GENERAL	1.1	Type of Soil		As per Site Survey by bidder
	1.2	Soil Restivity	Ohm-m	As per Site Survey by bidder
2.0 CONDUCTORS BURIED IN EARTH	2.1	Material		Galvanized Steel /Copper
	2.2	Size	mm x mm	50 x 6
	2.3	Quantities	Meter	As per BOQ
	a)	Required to be supplied	Yes/No	Yes
	b)	Required to be installed	Yes/No	Yes
	2.4	Depth of Burial	mm	
	2.5	Excavation in earth	Depth	
			Width	
	2.6	Type of Jointing: Welding/ Brazing / CADD Welding		Welding for GS Brazing for Copper
3.0 CONDUCTORS EMBEDDED IN CONCRETE	3.1	Material		NA
	3.2	Size	mm x mm	
	3.3	Quantities	meters	
	a)	Required to be supplied	Yes/No	
	b)	Required to be installed	Yes/No	
	3.4	Type of Jointing: Welding / Brazing / CADD Welding		
4.0 CONDUCTOR S ABOVE GROUND	4.1	Material		Galvanized Steel
	4.2	Size		50 x 6, 75 X 10
	4.3	Quantities	Meters	As per BOQ
	a)	Required to be supplied	Yes/No	Yes
	b)	Required to be installed	Yes/No	Yes

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	4.4	Special paint or coating required			
	4.5	Type of Jointing			
	a)	At Riser Connection			
	b)	At equipment connections			
DATA SHEET - A1					
5.0 EARTH ELECTRODES	5.1	Type of Earth Pit			Treated pits complete with chamber as per IS 3043
	5.2	Type of Electrode	GS /MS Rod (See Note 1)		
			CI Pipe		
			GS /MS Plate (see Note 1)		
	5.3	Size of GS /MS Rod	Diameter	mm	
			Length	mm	
	5.4	Size of CI Pipe	Inner diameter	mm	
			Thickness	mm	
			Length	mm	
	5.5	Size of Plate	Length x width	mm x mm	
			Thickness	mm	
	5.6	Quantities		Nos	Refer
a)	Required to be Supplied		Yes/No		
b)	Required to be Installed				
DATA SHEET-A2					
1.0 APPLICABLE STANDARDS					
SL.NO	DESCRIPTION			IS	IEC
1	CODE OF PRACTICE FOR EARTHING			3043	
2	PROTECTION OF BUILDINGS AND ALLIED STRUCTURES AGAINST LIGHTENING			2309	61024/61312
3	ELECTRICAL WIRING INSTALLATIONS (SYSTEM VOLTAGE NOT EXCEEDING 650 V)			732	
4	HOT DIP GALVANISING			2629,2633	
5	CODES FOR WELDING				
6	GALVANISED ROUND STEEL WIRE			3975	
7	COPPER CONDUCTORS			191,2982	
8	ELECTRICAL INSTALLATIONS IN BUILDINGS				60364
NOTES:					

SL NO	ITEM	UNIT	BIDDER'S DATA
1.0	ITEMS OF SUPPLY (Whenever applicable)		
1.1	CONDUCTORS		
1.1.1	Copper		NA
	a) Applicable Standards		
	b) Copper purity	%	
	c) Annealed /Hard Drawn		
	d) sizes Flats	mm x mm	
	Round Conductor	Sq.mm	
	Flex Braids	Sq.mm	
1.12	Steel		
	a) MS /Galvanised /Painted		
	b) Sizes Flats	mm x mm	
	Round Conductor	Dia in mm	
	G.S. Flex. Braids	Sq.mm	
	Wires	SWG/ Sq.mm	
1.1.3	Aluminium		
	a) Applicable standard		
	b) Type		
	c) Purity		
	d) Sizes : Flats	mm x mm	
1.2	ELECTRODES		
	a) Rod /Pipe /Plate		
	b) Material		
	c) Sizes (Dia. X length)(L x W x Th for Plate)	mm x mm	
1.3	TEST LINKS ABOVE GROUND		
	a) Material of Links		
	b) Size of Link	mm x mm	
	c) Material of enclosure		
1.4	CADD WELD JOINTING EQUIPMENT		
	a) Name of Manufacturer		
	b) Descriptive/Tech. Write-up or Catalogue enclosed	Yes/No	
2.0	INSTALLATION WORK ITEMS		
DATA SHEET - B			
2.1	Cleats:		
	a) Material and thickness		
2.2	Compound for water proofing		
2.3	Joints/Bimetallic connections		

Section 6.4.15-Earthing

2.4	Paint (if applicable), for steel conductors		
	a) Type of primer and No. of Coats		
2.5	Tools:		
	Following Provided		
	a) All necessary installation tools, welding/brazing equipment	Yes / No	
	b) Necessary Testing Equipment	Yes/ No	

Section 6.5-Schedule of Deviations from Technical Specification

1.0 SCOPE:

- 1.1. These notes cover specific requirements for cabling system installation work and shall be read and construed in conjunction with the specification for cabling system and OWNER's/ENGINEER's cable layout drawings and typical installation drawings.

2.0 GENERAL REQUIREMENTS:

- 2.1. Standard cable grips & reels shall be utilised for cable pulling. Maximum pull tension shall not exceed recommended value for the cable measured by tension dynamometer. In general, any lubricant that does not injure the overall covering & does not set up undesirable conditions of electrostatic stress or electrostatic charge may be used in pulling insulated cables in conduits & ducts. In particular soap shall not be used as lubricant. After pulling cable, the CONTRACTOR shall record cable identification & date pulled, neatly with waterproof ink on linen tags at all cable ends. This is in addition to the cable identification tags to be tied by GI wire at each end of the cable as shown in enclosed drawing.
- 2.2. Cable take-off from drums shall be so planned as to avoid using joints & splices in the run of the cable. Cable splices shall be made only after obtaining permission of the ENGINEER. Splice shall be made by the CONTRACTOR for each type of wire or cable in accordance with the instructions issued by the cable MANUFACTURER and the Engineer.
- 2.3. When power cables are laid in the proximity of communication cables, minimum separation between power & communication cables shall be not less than 460 mm for single-core cables & 300 for multi-core cables. Power & communication cables shall, as far as possible cross at right angles to each other.
- 2.4. Un-armoured cables shall be protected in conduits up to 2.5 M from floor level.
- 2.5. The CONTRACTOR shall make connections to small electrically operated devices on equipment installed as accessories to, or assembled with other equipment & requiring 2 wire or 3 wire connections. Connections to recording instruments, float switches, limit switches, pressure switches, thermocouples, thermostats & other miscellaneous equipment shall be done as per the MANUFACTURER's / ENGINEER's drawings and schedules.
- 2.6. The CONTRACTOR shall be responsible for correct phasing of the motor power connections & shall interchange connections at the motor terminal box, if necessary, after each motor is test run.
- 2.7. The CONTRACTOR shall make terminations for each type of wire or cable in accordance with instructions issued by cable MANUFACTURER and the ENGINEER.
- 2.8. Control cable terminations shall be made in accordance with wiring diagrams/cable interconnection diagram & cable schedules furnished to the CONTRACTOR for this purpose. Where on testing, reversal or other rearrangement of connections turns out to be necessary, additional work of reconnecting and testing shall be performed by the CONTRACTOR at no extra cost to the OWNER.

Section 6.5-Schedule of Deviations from Technical Specification

- 2.9. Jointing of cables shall be carried out in accordance with relevant Standard Codes of practice specified in Data Sheet A2 & the MANUFACTURER's special instructions. The CONTRACTOR shall supply hardware like clips & clamps and tools required for cable jointing work. Cables shall be firmly clamped on either sides of a straight through joint at not more than 300 mm away from the joints. Identification tags shall be provided at each joint & at all cable terminations. Single core cable joints shall be marked so that phase identity at each joint shall be determined easily. The joints shall be located at the most suitable places. There shall be sufficient overlap of cables to allow for the removal of cable ends, which may have been damaged.
- 2.10. Where cables are to be installed at temperatures below 3°C, they shall be heated to about 10°C for not less than 24 hours (in a heated building or in a tent with protective coverings of the cables). The cable laying must be carried out swiftly so as not to allow the cable to cool down too much.

3.0 OUTDOOR CABLE INSTALLATION:

- 3.1. Directly buried cables shall be laid as per project cable layout drawings. The cables shall be laid on a bedding of minimum 75 mm sand at the bottom of the trench and covering it with additional sand of minimum 75 mm and protecting it by means of tiles, bricks or slabs. HV cables shall be protected by concrete slab. Cable route markers shall be put at 15 metre intervals. At least one marker shall be provided if the length of the buried cable is less than 15 meters. Bends shall be identified by route markers at both ends. Buried cables in trefoil formation shall be bound by plastic tapes or 3 mm dia. Nylon cord every 750 mm.
- 3.2. The minimum depth of laying from ground surface to the top of cable shall be as follows unless otherwise shown in cable layout drawings:-
 - a) High voltage cables,
3.3 kv to 11 kv 900 mm
 - b) High voltage cables,
22 kv and 33 kv 1050 mm
 - c) Medium voltage and
Low voltage cables 750 mm
 - d) Control cables 750 mm
- 3.3. Joints in directly buried cables shall be identified by joint markers at each joint location.
- 3.4. In each outdoor cable run greater than 60m, some extra cable length shall be kept at a suitable point to enable a straight through joint to be made should the cable develop fault at a later date.
- 3.5. Where cables cross roads and water, oil, gas or sewage pipes, the cables shall be laid in Hume or steel pipes. For road crossings, the pipe for the cable shall be buried at not less than 1000 mm unless otherwise noted in the drawings. Hume pipes shall be preferred to steel pipes from the point of view of corrosion.
- 3.6. Control cables and small power cables in trenches and tunnels shall be run in ladder type cable trays(maximum tray width 600 mm) supported on trench/tunnel carrier arms. The cables shall be tied to tray rungs by means of 3 mm dia. Nylon cord at an interval of 5000 mm and also at bends.

Section 6.5-Schedule of Deviations from Technical Specification

- 3.7. For good sealing arrangement at entry points, suitable pipe sleeves, adequate in number and of adequate sizes shall be provided in building walls/slabs for passage of cable into a building from cable trays/racks/cable trenches located outside the buildings. Details of sleeves and exact locations of such entry points will be available on relevant project drawings.

4.0 CABLE TRAYS – CONSTRUCTION:

- 4.1. Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows etc., shall be fabricated from 12 gauge (2.5 mm thick) mild steel sheets. Cable tray covers shall be fabricated from 16 gauge perforated (1.60 mm thick) M.S. sheets.
- 4.2. Typical construction details of Cable trays shall be as per drawings PCPL-4-S4-225 DWG 001 to 007.
- 4.3. The cable trays shall be supplied in standard lengths of 2500 mm and clear inside widths of trays shall be as follows:
 - a) Perforated type trays: 150, 300, 450 and 600 mm.
 - b) Ladder type trays : 300, 450, 600 and 750 mm.
- 4.4. Cable trays, accessories and covers shall be painted with one shop coat of red oxide zinc chromate primer and two site coats of aluminium alkyl paint for indoor use.
- 4.5. For outdoor use, cable trays, accessories and covers shall be either galvanised or made of aluminium as specifically mentioned in the layout drawings.
- 4.6. For use in corrosive atmospheres both indoors and outdoors, the cable trays, accessories and covers shall be as per note no. 4.5 above.
- 4.7. The spacing of rungs for ladder type of trays shall be 250 mm unless otherwise noted.
- 4.8. All finished cable trays and accessories shall be free from sharp edges, corners, burrs and unevenness.
- 4.9. The details of accessories shown in the enclosed standard drawings are typical and do not cover the entire range of the same. Fabrication of accessories not covered here shall be done with the help of relevant project drawings.

5.0 CABLE TRAYS – INSTALLATION:

- 5.1.1. Cable trays shall be installed generally at the elevations shown in respective cable tray layout drawings. If any major modifications in the drawings are envisaged in the field, these should be carried out after getting approval from design office. It shall be the responsibility of the electrical contractor to mark up all the field modifications on the latest issues of the drawings and return two copies of all such “as constructed” drawings to consultants design office for updating the relevant tracings.
- 5.2. Unless otherwise specifically mentioned, all cable tray mounting works shall be carried out as per dwgs. PCPL-4-S4-223-DWG-001 to 008.
- 5.3. When cable trays are used in trenches and tunnels, the carrier structure for mounting the trays shall be supplied and installed as per drawings PCPL-4-S4-223-DWG-001 to 008.

Section 6.5-Schedule of Deviations from Technical Specification

- 5.4. The type and size of tray to be used shall be as mentioned in the individual layout drawings.
- 5.5. The maximum size of cable tray when used in trenches and tunnels shall be of 600 mm width.
- 5.6. Cable trays shall be welded to the mounting/carrier structures.
- 5.7. Vertical trays (raceways) and all outdoor cable trays shall be provided with removable 16 gauge painted M.S. perforated sheet covers wherever shown in Project drawings/ BOQ.
- 5.8. Each continuous laid out length of cable tray shall be earthed at minimum two places by M.S. flats of minimum size 25x3 mm (unless otherwise noted) to the purchaser's earthing system. The distance between earthing points shall not exceed 10 metres.
- 5.9. All cable trays and vertical cable raceways shall have identification designation, as per drawings, painted at each end of the tray and raceways. For long lengths of trays, the identification shall be painted at intermediate points also.
- 5.10. The following shall be checked before laying the cables on trays.
 - a) Check for proper painting and identification nos. of the trays.
 - b) Check for continuity of cable trays over the entire route.
 - c) Check that all sharp corners, burrs and waste materials have been removed from the tray.
- 5.11. Obtain clearances from piping contractor/ engineer that no piping will be taken in the way of cable trays.
- 5.12. Check for earth continuity & earth connection of cable trays.

6.0 CABLES IN TRAYS/ON RACKS:

- 6.1. Different voltage grade cables shall be laid in separate trays when trays are arranged in tiers, HV cables shall be laid in top trays and cables of subsequent voltage grades in lower tiers of trays.
- 6.2. Control cables shall be run in a separate tray, similarly, Instrument cables shall be run in a separate tray.
- 6.3. The HV power cables of 3.3kV and above shall be laid in trays/on racks as follows:
 - a) In single layer only without exception.
 - b) 3 Core cables to be laid in touching formation.
 - c) Single core cables to be laid in trefoil groups with spacing equal to diameter of the cable between edges of the trefoils.
 - d) Cables in trefoil groups of the same circuit shall be laid as indicated below so as to ensure balanced current distribution:

			Y			Y		Y	Y
R	B	B	R	R	B	B	R and so on.		
			(1)			(2)		(3)	(4)

Section 6.5-Schedule of Deviations from Technical Specification

- 6.4. 1100V grade power cables of 120 mm² size and above shall normally be laid in single layer in trays/on racks. In exceptional cases, these may be laid in double layer if shown on the drawings or with the permission of the ENGINEER.
- 6.5. Smaller 1100V grade power cables below 120 mm² may be run in double layers, where required, due to space restrictions.
- 6.6. Control and instrumentation cables can be laid unto a minimum of three layers in each tray/rack.
- 6.7. Control cables and small power cables on racks shall be run in ladder type cable trays supported on rack carrier arms. The cables shall be tied to tray rung by means of 3 mm dia. nylon cord at an interval of 5 metre and also at bends.
- 6.8. Instrumentation cables shall be run in perforated type cable trays.

7.0 BENDING RADII FOR CABLES:

- 7.1. The bends radii for various types of cables shall not be less than those specified below, unless specifically approved by the ENGINEER:

Type and Voltage Grade of Cable		Minimum bending radius	
		Single core	Multi-core
a)	XLPE insulated up to 11 kV	20D	15D
b)	XLPE insulated up to 22 kV	20D	15D
c)	XLPE insulated 33 kV	20D	20D
d)	PVC insulated 1.1 kV	15D	15D
e)	XLPE insulated 1.1 kV	15D	15D
f)	Rubber insulated 600 V	-	10D
g)	Mineral insulated 300 V	8D	-

Where D is overall diameter of Cable

- 7.2. For High voltage XLPE insulated cables, recommendation of MANUFACTURERS shall be checked and followed if higher values are recommended.

8.0 TERMINATION, CLAMPING AND MISCELLANEOUS DETAILS

- 8.1. Cable entry to motors, push button stations and other electrical devices shall be from the bottom as far as possible or from the sides. Top entry shall be avoided particularly for outdoor equipment.
- 8.2. Identification tags made from aluminium sheet shall be attached to each end of each cable by means of GI binding wire as shown on drawing. Tags shall be additionally put at an interval of 30 meters on long runs of cables and in pull boxes.
- 8.3. **Cable glands**

Section 6.5-Schedule of Deviations from Technical Specification

- 8.3.1. The cable glands shall be made from solid drawn brass rods, machined for smooth finish, Cadmium, Nickel plated and passivity to protect against corrosion.
- 8.3.2. Cable glands for armoured cables shall be double seal cone grip compression (**Double compression**) type unless otherwise stated in Data Sheet A1. The cone and clamping ring for armour shall be suitable to accommodate armouring wire/strip/tape.
- 8.3.3. Cable glands for unarmoured cables shall be single seal compression type similar to above but without the cone and clamping ring for the armour.
- 8.4. Cable lugs
- 8.4.1. Cable lugs shall be tinned copper for both Copper and Aluminium cables. For Aluminium cables, bi-metallic paste shall be applied.
- 8.4.2. All cable terminations shall be soldering less crimping type. Whenever lugs are required to be supplied, adequate size crimping lugs of approved make shall be used by the CONTRACTOR. The crimping tools shall be adequate for the lugs sizes.
- 8.5. Saddle type clamps to suit number of cables to be clamped at a particular location shall be used to clamping cables running along walls, ceilings, structures, etc.. The interval between adjacent clamps shall be shown on the relevant project drawings.
- 8.6. Single core power cables for 3 phase AC circuits laid in trays/racks/trenches in trefoil groups shall be held in trefoil clamps placed at an interval of 3metre. The details of trefoil clamp shall be as shown in project drawing. The trefoil groups of cables shall be additionally tied by means of 3mm dia, Nylon cord at an interval of 750 mm.
- 8.7. Wooden cleats when required for vertically supporting one or more single core cables per phase, such as on vertical framework near transformer cable boxes, shall be made out of well seasoned wood and given two coats of fire retarding paint of approved quality.

9.0 CONDUIT AND PIPE INSTALLATION

- 9.1. All installed conduits/pipes shall have their ends temporarily closed by caps or other approved means until cables are pulled through them.
- 9.2. All conduit/pipe sleeves shall be sealed by cold setting compound at both ends against ingress of water after the cables have been pulled.
- 9.3. All conduit/pipes sleeves shall be extended at least 50 mm on both sides of wall/floor/ceiling.
- 9.4. Exposed conduit/pipe runs shall be adequately clamped at an interval of 2metre.
- 9.5. When two lengths of conduits are joined together through a coupling, running threads more than twice the length of coupling shall be provided on any one length to facilitate easy dismantling of the two conduits. Threads shall be painted with zinc rich paint.
- 9.6. GI pull wires of adequate size shall be laid in all conduits before installation.
- 9.7. After the installation of all the cables, the unused pipe inserts (spares/future) shall be cut to the floor level and plugged flush with brass plug.
- 9.8. Conduits embedded in floor shall have a minimum 50 mm concrete cover.

Section 6.5-Schedule of Deviations from Technical Specification

- 9.9. The internal area of the conduit/pipe, unless otherwise specified, shall be two and half times the total area of cables to be laid through the conduit/ pipe.

10.0 TESTING AND COMMISSIONING OF CABLES

- 10.1. Cables shall be checked for insulation resistance before and after jointing. The voltage rating of the meggers for cables of different voltage grades shall be as indicated below:

<u>Voltage grade of cable</u>	<u>Megger rating</u>
1.1 kV	500 V
3.3 kV, 6.6 kV and 11 kV	1000 V
22 kV and 33 kV	2.5 kV motorized meggar

10.2. High Voltage Testing

- 10.2.1. All cables of 1.1kV grade 400 mm² and above and all HV cables shall be subjected to DC or AC high voltage test after jointing and terminating but before commissioning as per the relevant standards. Testing with DC voltages should be preferred, as test equipment required is compact, easily portable and requires low power. The DC test voltages applicable in India shall be as per Table 6 in IS 1255. The cable cores must be discharged on completion of DC high voltage test and cable shall be kept earthed until it is put into service.
- 10.2.2. DC test voltage for old cables should be 1.5 times rated voltage or less depending upon the age of cables, repair or nature of jointing work carried out.
- 10.2.3. In each test, the metallic sheath/screen/armour should be connected to earth.
- 10.3. Continuity of all the cores, correctness of all connections, as per wiring diagrams, correctness of polarity and phasing of power cables and proper earth connection of cable gland, cable boxes, armour and metallic sheath shall be checked.

11.0 EARTHING

11.1. Earthing of cables

- 11.1.1. Metallic sheaths, screens and armour of all multicore cables shall be earthed at both equipment and switchgear end.

- 11.1.2. Sheath and armour of single core power cables shall be earthed at switchgear end only. If specifically indicated in project specification/drawings, for long lengths of cables multiple earthing such as cross bonding may have to be adopted to safeguard against the presence of standing voltages under normal as well as fault conditions.

- 11.1.3. Earthing of power cable with core balance CT shall be as shown in the drawing.

- 11.2. Earthing of CT neutral lead shall be at one end only, as indicated in respective control wiring drawings.

11.3. Earthing of cable trays

- Each cable tray section including elbows, tees, etc., shall be bonded together to form
- a continuous circuit for the flow of fault current. Cable trays shall be connected to the nearest main earthing grids at intervals of 10 metre along the run of the tray.

Section 6.5-Schedule of Deviations from Technical Specification**11.4. Earthing of Conduits and pipes**

Conduit runs shall be permanently connected to earth by means of approved type of earthing clamp effectively fastened to the conduit. The conduit systems shall be checked for electrical continuity.

12.0 PAINTING

12.1. Whenever MS items are to be supplied by the CONTRACTOR as indicated in installation specification, these shall be painted as follows:

- a) For indoor installations- one shop coat of red oxide zinc chromate primer and two site coats of aluminium alkyd paint as specified.
- b) For outdoor and corrosive atmosphere indoors/outdoors painting with a two pack epoxy coating.

12.2. Where any cuts or holes are made on the finished steelwork or welding is done, the affected portions of steelwork shall be painted as stated above. Galvanized structures, if damaged during welding, cutting etc., shall be touched up with two coats of zinc-rich paint.

13.0 DATA TO BE FURNISHED BY THE CONTRACTOR AFTER AWARD OF CONTRACT

13.1. The CONTRACTOR shall furnish sketches/marked up prints of the PURCHASER's project drawings indicating any changes in the cable routing and or cable carrier system arrangement.

13.2. Test certificates of cables tested at site.

13.3. Catalogue/material specification of the type of fireproof compound used.

Section 6.5-Schedule of Deviations from Technical Specification

All deviations from the Technical Specifications shall be filled by the BIDDER clause by clause in this schedule.

SECTION	SPECIFICATION NO	CLAUSE NO	DEVIATION

The bidder hereby certifies that the above mentioned are the only deviations from the PURCHASER's Technical Specifications for the enquiry. The BIDDER further confirms that in the event any other data and information presented in the BIDDER's proposal and accompanying documents including drawings, catalogue, etc., are at variance with the specific requirements laid out in the PURCHASER's Technical Specifications, then the latter shall govern and shall be binding on the BIDDER for the quoted price.

COMPANY SEAL SIGNATURE

NAME

DESIGNATION

COMPANY

DATE

7. GENERAL CONDITIONS

7.1 DEFINITIONS OF TERMS

In constituting these conditions and specifications, the following expressions shall have the meaning, therein assigned to them unless there is something repugnant in the subject of context in consisting with such meanings.

- 7.1.1 Institute shall mean the “Indian Institute of Science, Bangalore”.
- 7.1.2 “Office” shall refer to the Office of the Project Engineer cum Estate officer.
- 7.1.3 “Contractors” shall mean the tenderer whether a firm, registered company, partnership or any individual whose tender has been accepted by Institute or by an Officer (duly authorized in this behalf) on behalf of the Institute and who has entered into agreement with Institute for due fulfillment of the contract and shall include the legal representatives, successors, heirs and assignees of the tenderer.
- 7.1.4 “Engineer” shall mean the “Project Engineer cum Estate officer”, Indian Institute of Science, Bangalore or such other officer as may be appointed to call as the Project Engineer cum Estate officer for the purpose of the contract and shall also mean and include other officers of equivalent rank directly in charge of the work or any part thereof under administrative control of the Director, IISc, Bangalore-12.
- 7.1.5 When the Engineer is named as final authority, it includes all the above mentioned officers and in such matters, the contractors shall have the right of appeal against the orders up to the Director, IISc, Bangalore, whose decision shall be final and legally binding on all the parties concerned.
- 7.1.6 The Project Engineer cum Estate officer named as final authority for any decision taken, shall mean only the Director, IISc, Bangalore or his duly authorized assistant.
- 7.1.7 The Engineer in charge shall mean the Project Engineer cum Estate officer directly in charge of the work or his duly authorized assistants.
- 7.1.8 Plant shall mean and include any or all plants, machinery, tools and other implements of all description necessary for the execution of the work in a safe and workmen like manner.
- 7.1.9 The expression “Works” where used in these conditions shall unless thereby something in the subject or contract repayment to such construction, be construed to mean the work or the works constructed to be executed under or virtue of the contract whether temporary or permanent and whether original, altered, substituted or additional.
- 7.1.10 “Contract and contract document” shall mean and include the notice inviting tenders, proceedings of the pre bid meeting, the stamped agreement, conditions of contract, specifications and Schedules ‘B’, drawings and all other connected documents with tender schedule.
- 7.1.11 “Specifications” shall mean the specifications annexed and where these are not specifically mentioned shall be as may be detailed and necessary due to particular nature of work as approved by the Project Engineer cum Estate officer.
- 7.1.12 “Site” shall mean and include all the area in which operations in respect of the work are carried out. This shall also include materials stacking yards and the area where temporary structures are put up for installing any machinery etc.

- 7.1.13 “Tests” shall mean such tests as are required to be carried out either by the contractor or by the Project Engineer cum Estate officer from time to time on completion as detailed in the specifications before the work is certified as being satisfactory and is taken over by the Project Engineer cum Estate officer.
- 7.1.14 “Month” shall mean a Calendar month.
- 7.1.15 “**Prime contractor**” mean a firm that performs construction work itself and that the work is directly entrusted to the firm by the owner / Government / local body / Quasi Government / Government under taking.

Words used in singular shall also include the plural & vice-versa where the context so demands.

7.2 GENERAL NOTES & CONDITIONS

7.2.1 CONTRACTOR TO INSPECT SITE:

The contractor shall visit and examine the construction site and satisfy himself as to the nature of the existing roads or other means of communications, the character of the soil for the excavations, the extent and magnitude of the work and facilities for obtaining materials and shall obtain generally his own information on all matters affecting the execution of the work. No extra for charges made in consequence of any misunderstanding or incorrect information on any of these points or on the grounds of insufficient description will be allowed. All expenses incurred by the contractor in connection with obtaining information for submitting this tender including his visits to the site or efforts in compiling the tender shall be borne by the Tenderer and no claims for reimbursement thereof shall be entertained. .

7.2.2 ACCESS TO SITE:

The Contractor is to include in his rates for forming access to the site, with all temporary roads and gangways required for the works.

7.2.3 SETTING OUT:

The Contractor shall set out the building in accordance with the plans. All grid/centre lines shall be pegged out to the satisfaction of the Engineer. The Contractor shall be responsible for the correctness of the lining out and any inaccuracies are to be rectified at his own expense. He will be responsible for taking ground levels of the site before setting out and recording them without any extra charge.

The Contractor shall construct and maintain proper bench mark at the intersection of all main walls, columns, etc., in order that the lines and levels may be accurately checked at all times.

7.2.4 TREASURE TROVE:

Should any treasure, fossils, minerals, or works of art of antique interest be found during excavation or while carrying out the works, the Contractor shall give immediate notice to the Engineer of any such discovery and shall make over such finds to the Institute.

7.2.5 ACCESS FOR INSPECTION;

The Contractor is to provide at all times during the progress of the works and the maintenance period proper means of access, with ladders, gangways etc., and the necessary attendants to move and adapt as directed for the inspection of measurement of the works by the Engineer or their representatives.

7.2.6 ATTENDANCE UPON ALL TRADERS:

The Contractor shall be required to permit tradesmen/ Specialized agencies appointed by the employer to execute works like water supply, Sanitary, Electrical installation, lifts, air conditioning, hardware and other specialized works. The contractor shall also permit the above mentioned agencies to use his scaffolding and retain the scaffolding till such works are completed. The rates quoted by the contractor shall be inclusive of the above facility.

7.2.7 GATEKEEPER AND WATCHMAN:

The Contractor from the time of being placed in possession of the site must make arrangements for watching, lighting and protecting the work, all materials, workmen and the public by round the clock on all days including Sundays and holidays at his own risk and cost.

7.2.8 STORAGE OF MATERIALS:

The Contractor shall provide for necessary sheds of adequate dimension for storage and protection of materials like cement, steel, lime, timber and such other materials including tools and equipment which are likely to deteriorate by the action of sun, wind, rain or other natural causes due to exposure in the open. The cement

storage site shall be leak proof and shall hold at least 4 months requirement. All such sheds shall be cleared away and the whole area left in good order on completion of the contract to the satisfaction of the Engineer.

All materials which are stored on the site such as bricks, aggregates etc., shall be stacked in such a manner as to facilitate rapid and easy checking of quantities of such materials.

7.2.9 COST OF TRANSPORTING:

The Contractor shall allow in his cost for all transporting, unloading, stacking and storing of supplies of goods and materials for this work on the site and in the places approved from time to time by the Engineer. The Contractor shall allow in his price for transport of all materials controlled or otherwise to the site.

7.2.10 W.C. AND SANITARY ACCOMMODATION AND OFFICE ACCESSORIES AND ACCOMMODATION:

The contractor shall provide at his own cost and expense adequate closet and sanitary accommodation complying in every respect to the rules and regulations in force of the local authorities and other public bodies, for his workmen, for the workmen of nominated sub-contractors and other contractors / specified agencies working in the building, the Project Engineer of works and other Institute agents connected with this building project and maintain the same in good working order.

The Contractor shall also provide at his own expense adequate office accommodation for the Project Engineer of works preferably contiguous to his office and shall maintain the same in a satisfactory condition and shall provide light, fan and attendant etc., for the same and shall remove them after completion of the works. He shall arrange to provide latest survey Instruments and at all times maintain the same in good working order at site, to enable the Project Engineer of works or other representative of Institute to check the lines and levels of the work.

7.2.11 MATERIALS:

Materials shall be of approved quality and the best of their kind available and shall conform to I.S. specifications. The Contractor shall order all the materials required for the execution of work as early as necessary and ensure that such materials are on site well ahead of requirement for use in the work. The work-involved calls for high standard of workmanship combined with speed and to the entire satisfaction of the Project Engineer.

7.2.12 TO ASCERTAIN FROM CONTRACTORS FOR THE OTHER TRADES.

The Contractor shall ascertain from all agencies / Sub-contractors all particulars relating to their work with regard to the order of its execution and the position in which chases, holes and similar items will be required; before the work is taken in hand as no patch works shall be allowed for cutting away work already executed in consequence of any neglect to ascertain these particulars before hand.

7.2.13 SAMPLE APPROVAL:

Before ordering materials, the Contractor shall get the samples approved from the Project Engineer cum estate officer well in time.

7.2.14 TESTING OF WORK AND MATERIAL:

The Contractor shall, if required by the Engineer arrange to test materials and/or portions of the works at his own cost in order to prove their soundness and efficiency. If after any such test the work or portion of works is found in the opinion of the Engineer to be defective or unsound, the Contractor shall pull down and redo the same at his own cost. Defective materials shall immediately be removed from the site at his own cost.

7.2.15 MECHANICAL PLANT:

The Contractor will be required to provide and maintain in working order the following power-driven equipment's during the construction-work and number of equipment's shall depend on the volume of work involved pertaining to this project as and when required.

1. Concrete mixers of required capacity.
2. Concrete pumps.
3. Vibrators
4. Concrete testing equipment.
5. Stone cutting machines.
6. Jack Hammers.
7. Pumps with required capacity.
8. Air compressors with required capacity.
9. Diesel Generators.
10. Welding, cutting and bending equipment.
11. Builders hoist.
12. Tipper/Dumper.
13. Tractor with Trailer.
14. Earth Compactor.
15. Earth rammer
16. Steel tubular scaffolding.
17. Slab shuttering
18. Floor polishing machines.
19. Surveying instruments with total station.
20. Any other machinery required during the execution of work.

7.2.16 **FOREMAN AND TRADESMEN:**

All Tradesmen shall be experienced men properly equipped with suitable tools for carrying out the work of carpentry and joinery and other specialist trades in a first class manner and where the Engineer deem necessary, the Contractor shall provide such tools which are considered necessary for carrying out of the work in a proper manner.

All such tradesmen shall work under an experienced and properly trained Foreman, who shall be capable of reading and understanding all drawings, pertaining to this work and the contractor shall also comply with other conditions set out in different clauses of the conditions of the contract.

7.2.17 **PROJECT PROGRAMME OF WORKS AND WEEKLY PROGRESS REPORT:**

a) Organisation chart:

The contractor should submit the proposed organization chart for the project including the details of staff to be deployed full time on site to the approval of Project Engineer , where the PROJECT ENGINEER raises any objection to either the qualification or experience or required professionalism of any of the staff deployed by the contractor, the same shall be replaced by suitably competent person to the approval of PROJECT ENGINEER within 7 days.

b) Program chart:

The Contractor shall furnish the detailed programme of execution for timely completion of the project within 24 months (inclusive of rainy season). Such a detailed program of works prepared using Industry Standard Scheduling Software like **MS Project 2000 or Primavera** shall be submitted by the Contractor within ten days after receiving communication of tender acceptance. As per the detailed drawings and schedule of quantities; the contractor shall work out concurrent activities with start and finish times, integrating of all tasks with interface and mile stone event drawn and to evaluate for reduction in total project duration through improved over lapping of tasks and activities where feasible. The Contractor shall plan for improved planning and scheduling of activities and forecasting of resource requirements, ability to use the Computer effectively to produce timely valid information for Project Management purpose. Accordingly, PERT; CPM Networking shall be drawn. GANNT charts shall also be furnished. The Contractor shall also furnish necessary particulars to the

Project Engineer of works for compiling weekly progress reports in the form furnished by the Institute. A monthly financial programme shall also be submitted.

7.2.18 CLEARING OF SITE:

The contractor shall after completion of the work clear the site of all debris and left over materials at his own expense to the entire satisfaction of the Institute. The same should be carted out of the Institute at his own cost.

The contractor shall also clear the labour camp/RMC plant of all types of permanent/temporary structures, soak pits, sump, septic tanks or any other such installations as identified by the PROJECT ENGINEER to the entire satisfaction of the Institute. The debris/excess stuff shall be carted out of the Institute at his own risk and cost.

7.2.19 PHOTOGRAPHS:

The Contractor shall at his own expense supply to the Institute photographs in duplicate copies not less than 25 cm x 20 cm. (10" x 8") along with soft copy, of the works taken from all the portions of the building at intervals of not more than one week during the progress of the work, or at every important stage of construction, as directed by the Project Engineer of work.

7.2.20 PROVISION OF NOTICE BOARD:

The Contractor shall provide a notice board on proper supports 3m x 2m (10' x 6') in a position approved by the Engineer. He shall allow for painting and lettering stating name of work; name of Architects; Structural Consultants; General Contractor and Sub-Contractors. All letters except that of the name of the work shall be in letters not exceeding 5 cm. in height and all to the approval of the Engineer. Proper barricading shall be erected all-round the site before commencement of the work.

7.2.21 PROTECTION:

The contractor shall properly cover up and protect all work throughout the duration of work until completion, particularly masonry, moldings, steps, terrazzo or floor finishes, staircases and balustrades, doors and window frames, plaster angles corners lighting and sanitary fittings, glass, paint work and all finishing.

7.2.22 PREPARATION OF BUILDING FOR OCCUPATION AND USE ON COMPLETION:

The whole of the work shall be thoroughly inspected by the Contractors and all deficiencies and defects set right. On completion of such inspection, the Contractor shall inform the Engineer in writing that he has finished the work and it is ready for the Engineer's inspection.

On completion, the Contractor shall clean all windows and doors and all glass panes, including cleaning of all floors, staircases and every part of the building including oiling of all hardware. He will leave the entire building neat and clean and ready for immediate occupation and to the satisfaction of the Engineer.

7.3 OTHER CONDITIONS

- 7.3.1 The tenderer must understand clearly that the rates quoted are for complete items of works including charges due to materials, labour, all lead and lift, HOM of plant and machineries, scaffolding, supervision, service works, power, all types of royalties, sales tax, labor cess, all types of taxes payable to the Govt and local bodies, over head charges, etc., and includes all extra to cover the cost of night work if and when required and no claim for additional payment beyond the prices or rates quoted will be entertained for payment subsequently towards any claims on the grounds of misrepresentation or on point that he was supplied with information given by promise or guarantee by the Institute, or by any person whether member of or employee in Institute will not be entertained. Failure on the contractor's part to obtain all necessary information for the purpose of submitting his tender and quoting rates therein shall not absolve him of any risk or liability consequent upon the submission for tender.
- 7.3.2 All the works shall be carried out as per specifications prescribed by BIS, National Building code, KPWD specifications, relevant IS codes or as directed by the Project Engineer in the absence thereof.
- 7.3.3 deleted
- 7.3.4 In case there is any conflict in the specifications and drawings the decision of the Project Engineer cum Estate officer shall be final and binding on the contractor.
- 7.3.5 All the materials shall be got approved by the Project Engineer cum Estate officer before use.
- 7.3.6 The rates quoted for in individual items shall include labour, cost of materials conveyance and lift charges for all materials required for successful completion of work and all taxes payable to any authority as per rules in vogue from time to time.
- 7.3.7 Necessary pillars shall be constructed by the Contractor for benchmark at no extra cost as directed by the Project Engineer.
- 7.3.8 Site order book shall be maintained in the work spot and the contractor shall sign in the order book in token of having gone through the instructions issued by the inspecting officers and carryout the instructions promptly.
- 7.3.9 In the work spot the contractor shall provide suitable temporary office with a covered area of 1000 sft matching that of the Contractor's office with necessary furniture for use of Institute as directed by the Project Engineer for which no extra payment or compensation shall be claimed. The furniture however will after completion of the work, be the property of the contractor and shall remove them at the close of the contract.
- 7.3.10 The contractor shall take all precautions against damage from accident. No compensation will be allowed to the contractors for their tools and plant materials lost or damaged from any cause. The contractor is liable to make good the structure or plants damaged by any other cause at his own cost. The Institute will not pay the contractor for corrections or repairing any damaged portion of work done during construction.

7.3.11 **Storage of Cement:**

Large stocks of cement shall not be kept at the work spot. Only sufficient quantities to ensure continuity of the work shall be at stores. The contractor shall provide and maintain sufficient storage sheds for cement, steel etc., on the works. The cement shall be covered with tarpaulin or any other impervious materials in order to protect the cement bag from moisture

Cement bags shall be neatly stacked in an orderly manner so as to admit to easy recount. A regular day to day account of Cement received and used on the work together with the mention the particular portion and the quantity of the work in which it was used shall be maintained and shown to the Project Engineer cum Estate officer or his representative whenever he asks for it.

Cement that has been affected by the moisture shall be removed at once from the site.

Cement shall be used in order in which the consignments are received and not stored for unduly long period.

- 7.3.12 The contractor shall employ adequate no. of skilled & unskilled labours required for successful timely execution of work. He shall submit daily reports to the Engineer in charge regarding the strength of labour employed both skilled and unskilled.
- 7.3.13 The contractor shall furnish weekly medical report showing number of persons ill or incapacitated and nature of their illness, to the Project Engineer.
- 7.3.14 The contractor shall furnish a report of any accident which may occur, within 24 hours of its occurrence to the Project Engineer.
- 7.3.15 The contractor shall keep on site of work a qualified Engineer as required as per rules of registration as their authorized representative who will receive all instructions given from the Institute officers. The representative shall have permanent office at site of work where communications can be sent and notices can be served by the Project Engineer throughout the duration of work.
- 7.3.16 Prior approval should be obtained from the Project Engineer for the construction and location of the temporary site office, store sheds and labour quarters, within the premises of the site, similarly the contractor shall get approval of the Project Engineer regarding the areas to be utilized for stacking the materials etc., for the work.
- 7.3.17 Reference to detailed specifications are indicated against the items contained in the Schedule 'B', in case there is any item for which no detailed specifications is indicated, it shall be carried out as per specifications intimated by the Project Engineer. The contractor shall not be entitled for any extra claims or compensation on this account. In case of additional or extra items not covered by the Schedule 'B', the contractor shall carry out the work as per specifications intimated by the Project Engineer.
- 7.3.18 The Engineer shall have the right to direct the contractor to progress the various items of works in the manner prescribed by him.
- 7.3.19 Failure to adhere to any of the above will be sufficient cause for taking action under clause (2) or clause (3) or both along with their sub clauses of conditions of contract.
- 7.3.20 Contractor shall make arrangements at his own cost to construct approach road for conveyance of materials etc., preferably on the alignment accepted by the Institute to procure land etc. for housing, staff and workmen near the site of the work.
- 7.3.21 It is not possible for the Institute to release any quarry (metal and sand etc.,) for this work. The contractor has to make his own arrangements. No claim regarding leads and lift will be accepted.
- 7.3.22 The contractor has to make his own arrangements in regard to power supply and water required for construction and drinking water facilities.
- 7.3.23 Tool, Tax, Octroi, Royalty for collecting earth, gravel, sand, stone, excise duty, sales tax, labour cess or any other tax payable on account of this contract shall be met by Contractor.
- 7.3.24 The contractor shall be entirely responsible for sufficiency of the scaffolding, timbering, machinery, tools, implement and generally of all means used for fulfillment of the work. Whether such means may not be approved or recommended by the Project Engineer, the contractor must accept at his own cost all risks of accidents or damages.
- 7.3.25 ***After completion of the work, service drawings as per actual execution in Auto CAD should be submitted by the agency for services such as Electrical, Water supply and Sanitary before submission of final bill.***

7.4 GENERAL SPECIFICATIONS – PART A

Extra care shall be taken regarding the laborers by providing waist belt, Helmets scaffolding etc at your own cost and supervision and shall be carried out as per the directions of the Project Engineer.

7.4.1 EXCAVATION:

All specifications of various items of work pertain to Karnataka Public Works Department Handbook / CD, Bureau of Indian Standards (BIS) and 2016 National building Code (NBC). For the points not covered by these specifications for the portions thereof and if no mention be made there in, the written instruction of the Project Engineer cum Estate officer shall be binding on the contractor.

Before starting the work the contractor or his duly authorized agents shall be present while taking ground levels, along and across the alignment of the various works, etc., and shall have to sign the field book, and also working plans showing working longitudinal and cross sections of their alignment in token of having accepted the ground levels without which they will not be allowed to start the work.

Excavation for foundation shall be done up to required depth and in steps with sides properly sloped as shown on plans, without any charges etc., except when instructed in writing by the Project Engineer cum Estate officer. Only depths and widths according to plan or as per written orders of the Project Engineer shall be measured and paid for.

Any damage done to the work due to the contractor's operation beyond the excavation lines shall be repaired at the expense of the contractor. Any and all excess excavation or over breaking performed by the contractor for any purpose or reason except as may be ordered in writing by the Project Engineer and whether or not due to the fault of the contractor shall be at the expense of the contractor. Cost of refilling for all such excavation with materials as specified by the Project Engineer has to be done by the contractor at his expense.

7.4.2 WORKMANSHIP AND LABOUR:

The quality of all materials, tools, operators and labour used on the work shall be subject to the approval of the Project Engineer cum Estate officer or his authorized agent who shall have power to order immediate removal by the contractor any of the above that may not meet with his approval.

In case of failure to carry out orders of removal within the time specified, the Project Engineer or his authorized agents shall get the same removed at the contractor's expense.

7.4.3 KEEPING DRY AND PUMPING:

7.4.3.1 Unless otherwise provided for in the contract, the contractor will at his own expense keep all portions of the work free from undue water, whether due to springs, soakage or inclement weather and will use his own implements and machinery for this purpose.

7.4.3.2 BAILING OUT OR DEWATERING:

Adequate arrangements shall be made by the contractor for dewatering the foundation trenches and excavation and keeping the same dry while the masonry or concrete work is in progress and till the Project Engineer considers that the mortar is sufficiently set.

The rates for the various items include the cost of shoring, strutting, coffer dam, channels or other incidental devices necessary for diverting the water met within foundation. The cofferdam and the diversion channel shall, however, be maintained in good and working condition till the completion of the

structure or until such time, as in the opinion of the Project Engineer till the coffer dam or/and diversion channel is no longer necessary. Bailing out water necessitated by the failure to maintain the cofferdam and diversion channel will not be paid for separately under any conditions.

No extra rate shall be paid for removing any stuff outside, which might find excess due to rains or for reasons whatsoever from the sides or bottom of the foundation trenches and excavation or from also where when the dewatering operations are in progress.

The contractor must assure himself by making the necessary investigation regarding the depths to which foundations are likely to go. If any work is ordered to be done beyond dimensions or deviations marked in the drawings, no extra rate other than the rate for the Undertaking of work quoted by the contractor be paid.

The contractor will make himself arrangements for necessary plant such as Pump, engines, and other materials required in this connection.

7.4.4 FACILITIES FOR INSPECTION:

The work at all times be open for inspection by the Project Engineer or his duly authorized Assistant and the contractor shall arrange easy access to every part of the work and shall provide such ladders, scaffolding and lifts for this purpose as necessary at his own cost.

7.4.5 DELIVERY OF WORKS:

The final bill will be prepared after the work is handed over to the Project Engineer or his duly authorized representative in a thoroughly complete, clean, sound and workman like state.

7.4.6 EXTRA ITEM:

Whenever the contractor is ordered by the Project Engineer or the person duly authorized by him to execute any item of work, which is not in his tender, it shall be the contractors duty to see that the order is duly entered in the order book on the work, unless a separate communication to this effect is received by him, it shall be his duty to get the rates sanctioned for the item by the appropriate authority. For any extra item of work not thus ordered either by any entry in the order book or separate communication, the contractor shall have no claim to payment.

7.4.7 COMPLIANCE WITH BYELAWS AND PROTECTIONS AGAINST ACCIDENTS, ETC:

Contractor is responsible for complying with all acts, bye-laws, Municipal and other regulations for the provision and maintenance of lights during nights, barricading, providing any other protection that may be necessary and will be liable for all claims that may arise from accidents of nuisance caused by works.

7.4.8 DISPUTES:

Disputes on the points between the Project Engineer and the contractors shall be referred to the Center for campus management and Development, whose decision shall be given in writing and shall be final and binding on the contractor.

7.4.9 TOOLS ETC.,

The contractor shall unless otherwise specially stated in the contract, be responsible for the payment of all import duties, octroi duties, sales tax, quarry fees etc., on all materials and articles brought to site.

7.4.10 **CLEARANCE OF SITE:**

The site described and shown on the plan is to be cleared of all obstruction, loose stones and materials, rubbish of all kinds of shrubs and brushwood, the roots being entirely removed.

The products of the cleaning to be stacked in such a place and manner as ordered by the Project Engineer.

In jungle clearing all trees not marked for preservation, jungle wood and brushwood shall be cut down and their roots entirely removed up. All wood and materials from the clearings will be property of the Institute and should be stacked as the Engineer in charge directs. **Trees shall not be cut without prior permission of the Institute.**

All holes or hollow, whether originally existing or produced by digging up roots, shall be carefully filled up with earth well rammed to the required density and leveled off, as may be directed.

7.4.11 **LINE OUT:**

The contractor shall use necessary measuring instruments, theodolite, workstation and other materials like flags, strings, pegs, nails, pillars, paints, etc., and also Labour required for ascertaining of the initial ground levels at the different stages of excavation and construction of masonry or other structures at his own cost. Any dispute in regard to the accuracy of the measuring instruments and the device shall be subjected to the final decision of the Engineer-in charge of the work.

7.4.12 **ALL MATERIALS SHALL CONFORM TO BIS SPECIFICATION**

7.4.12.1 **STONES:**

Except where otherwise stated the word "Stone" mentioned in these specifications means best granite stone obtained from approved quarries by the Project Engineer. Stones obtained from unapproved quarries and inferior stones obtained from approved quarries will be rejected.

Stones having any skin or covers of earth shall not be used.

All stones shall be fine or medium grained bright in colour breaking with a clear structure making a ringing sound when struck with hammer.

7.4.12.2 **COARSE AGGREGATE:**

Coarse aggregate shall be as per BIS specifications. The coarse aggregate for concrete shall consist of hard, dense, durable, uncoated, coarse, rock fragment and shall be free from injurious amounts of friable, thin elongated or laminated process alkali, organic matter or other substances. Round pebbles, flaky and decayed stone shall not be used.

The broken stone shall be free from all dusts and dirt and washed if necessary, to ensure that all faces of the broken stones are perfectly clean.

7.4.12.3 **SAND:** The source and quality of the sand to be used shall have to be approved by the Project Engineer. The sand shall be as per BIS specifications. The sand shall consist of hard, durable, dense uncoated rock fragments, and shall be free from impurities with dust lumps, soft or flaky particles of shales, alkali, organic material, and other deleterious substances. Filter sand shall not be used.

7.4.12.4 **WATER:** Water to be used for the work shall be clear and free from alkali, acid, oil or other deleterious substances and generally fit for drinking.

7.4.12.5 CEMENT CONCRETE:

The material used, i.e., water, cement and aggregate shall be of approved quality and the grading of the aggregate shall be as specified at the time of concreting.

The design of concrete mix shall be done by trial mix and testing. The same has to be approved by the Project Engineer cum Estate officer before adopting at site.

7.4.12.5.1 PLACING CONCRETE:

Concrete shall be placed only in locations where authorized and no concrete or mortar shall be placed until formwork, installation of embedded parts, preparation of surface and necessary cleanup has been done and checked to be in conformity with specification and drawings. Earth foundation, on which concrete is to be laid shall be firm, drained soil free from any soft and other objectionable materials and on which there is no standing or running water. Rock surface or rigid masonry or concrete surface upon or against which, concrete is to be placed, shall be prepared in the same manner as rock foundation or old masonry or concrete surface over old masonry. All concrete shall be placed directly in its final position within 30 minutes after it is mixed. Concrete shall not be dropped from excessive distance and the free fall should be kept to a minimum to avoid segregation, air entertainment and damage to form work.

7.4.12.5.2 RATE OF PLACE:

Concreting shall be continued without interruption when it is unavoidable until the structure or section is completed or until satisfactory construction joint can be made. Concrete shall not be placed faster than the placing crew can compact it properly. The difference in elevation between adjacent block shall not exceed 15" inches.

7.4.12.5.3 CONSOLIDATION OF CONCRETE:

Each layer of concrete, where smooth surface are required and for all surfaces which will be permanently exposed to the weather, and for all surface next to embedded metal work, the concrete shall be worked, or vibrated to obtain concrete of maximum density and imperviousness and to assure proper contact of the concrete with the form and reinforcement bed. Ordinary hand methods consisting of ramming, tamping and skiing with suitable tools and tamping shall be permitted only in situation where it is impracticable to use power vibrators. Excessive vibrations sufficient to cause segregation tending to bring in excess of finer particles to the surface shall be avoided. Vibrators shall be inserted to lower course that has commenced final set.

7.4.12.5.4 CHIPPING AND ROUGHENING CONCRETE SURFACE:

Surface upon or against which additional concrete is to be placed shall be chipped and roughened to a depth not greater than one inch on the surface. The roughening shall be performed by chipping or other satisfactory method and in such a manner as not to loosen, crack or shatter any part of the concrete beyond roughened surface. After being roughened the surface of concrete shall be cleaned well thoroughly of all loose fragments, dirt and other objectionable substances and shall be sound and hard and in such conditions as to ensure good mechanical bond between old and new concrete. The old prepared surface shall be treated with epoxy and cured before concreting.

7.4.12.5.5 CURING AND PROTECTION:

All concrete shall be protected against injury until final acceptance. Concrete shall be kept continuously moist for not less than 21 days. Construction joint shall be cured. Separate labors to be engaged 24 x 7 exclusively for curing the concrete works.

7.4.13 MACHINERY:

7.4.13.1 All the machinery that will be employed on the work shall be approved, efficient and thoroughly, complying with the specifications of each machine or parts and shall have been manufactured by reputed and qualified firms. All the machinery employed on the work shall be open to inspection at all working hours, by the Project Engineer and any defect shall be rectified, repaired, replaced, renewed or remodeled so that its performance in the opinion of the Project Engineer is satisfactory. Any defective part of the machine, which requires replacement, shall be promptly replaced, failing which the Engineer-in-charge, shall be at liberty to cause the defective fittings removed from site of work at the cost of the contractor.

7.4.13.2 OPERATORS:

The machines shall be in charge of efficient and trained operators, which terms shall include drivers, mechanics or other personnel who are actually operating the machines. The Engineer in-charge has the right to test operators, etc., as deemed necessary by him for the class of machinery, which he is to operate and shall drive out such of the operators who fail in the tests.

7.4.14 SAFETY PRECAUTION :

All reasonable safety precautions for the safety of workers shall be taken. The contractors shall be responsible for the maintenance of all regulations under the Factory Act, workmen's compensation. Minimum wages act and other act for the safety and welfare of the workers employed by him. In addition, the contractors shall provide adequate protection to all workers employed by him against natural elements such as rain, sun, wind etc., during working hours and provide free, pure protected drinking water during working hours.

7.4.15 NON-STOP OPERATION:

In the continuous or non-stop operations suitable shifts or working hours for each shift shall be maintained. The contractor is liable for all reasonable extra payment for all extra hours of work done by the workers employed by him.

7.4.16 TESTS:

The Project Engineer cum Estate officer or his authorized representatives shall have full scope and right of entry at all times to examine and test, measure, count, weigh, take bores, or in any manner satisfy himself that the work executed is according to the specifications and required strength. Any portion of work got disturbed, during such tests, shall be made good by the contractors, without extra cost. The Engineer in charge has the right to change the design proportions, mixes within reasonable limits to ensure requisite strength of the structure. **Laboratory for requisite tests shall be established by the Contractor at site only, at his own cost.**

7.4.17 ADEQUATE ARRANGEMENTS TO ACHIEVE PROGRESS:

The Project Engineer shall have the right to advise the contractor on the strength, quality and nature of labour to be employed on work to maintain progress on the work, commensurate with the strength of structure. Similarly, he shall advise the contractor on the nature and adequacy of the machinery that are required on the work.

7.4.18 MEASUREMENTS:

Estimates of quantities contained in the attached schedule of work are based on the use of standard

methods of measurements applicable to the various items. The methods of measurements for some items are briefly described below.

- 7.4.18.1 **EXCAVATION:** All excavation shall be measured as the original volume in undisturbed condition in site.
- 7.4.18.2 **DRILLING:** The drilling holes shall be measured as the actual number of linear feet of holes drilled including linear feet drilled through concrete or masonry. The drilling holes for blasting shall be considered as the part of the excavation operation and no separate measurements of such holes will be made.
- 7.4.18.3 **CONCRETE:** Concrete shall be measured as the volume of concrete in place of the structure. This item shall include all materials in all forms, form lining and fixture, framing and scaffolding and all operations in connection with mixing, conveying, placing and curing of concrete. It shall also include batching and finishing operations except where finishing as defined in the specifications is required. In measuring concrete the **volume of openings, embedded pipes and metal work except reinforced bars and anchor bolts and bars will be deducted.**
- 7.4.18.4 **REINFORCEMENT:** Reinforcement shall be linearly measured and paid in terms of weight of steel reinforcement placed in the structure calculated as per IS Standards. It shall also include weight of metal chair supporters, clips used to set and fix reinforcement in place. Laps and wastage shall not be measured and paid.
- 7.4.18.5 **CEMENT POINTING:** The exposed faces shall be measured in superficial area.

General Specification - Part B

PART -1 Specifications for Civil Works

1.0 EXCAVATION

- 1.1 The places where excavation is directed to be done shall be cleared of all shrubs, weeds, grass and vegetation including roots, where necessary and if so directed, the excavated earth must be deposited in layers of 15 cms and the clods broken. During excavations, if so directed, 'dead-man' (of volume not more 5% of the excavation volume shall be left at the places directed for verification of the dimensions of excavation). These 'dead-man' shall be removed and earth deposited at places shown before full rate is paid, Alternatively or in addition to 'dead-man', block level at intervals as directed will be jointly taken and recorded by the contractors representative and employer's representative before starting of excavation and after completion. Recording of – block levels or leaving of 'dead-man' may be avoided in the case of narrow foundations and trenches, if so directed.
- 1.2 The rate quoted shall include bailing or otherwise removing all water which may accumulate in the excavation from all causes and removing of swish, trimming of all sides plumb or otherwise as directed, dismantling removing and stacking as directed any existing water pipes and or soil pipes etc., encountered within the excavation.

2.0 CONCRETE WORKS

- 2.1 Proportion of ordinary cement concrete will be expressed as 1:4:8, 1:3:6, 1:2:4 etc., The first figure will be quantity of ordinary Portland cement by volume, the second figure will be dry coarse sand (fine aggregate) by volume and the third figure will be the quantity of coarse aggregate by volume. Cement shall be measured by weight. The weight is to be derived on the basis that one cubic meter will weigh 1440 kg or one full bag of 50kg will be assumed to be 35 lts. When the sand is wet or moist suitable corrections for bulking is to be given while proportioning. The clerk of works may allow measuring cement by volume.
- 2.2 Unless otherwise specified, the rates for all RCC will be exclusive of reinforcements but including from work, Reinforcements will be measured and paid separately.
 - 2.2.1 Unless otherwise stated for all RCC work the size of coarse aggregate will be 20MM and down size.
 - 2.2.2 Concrete proposed for roof slab and roof beams is ready mixed concrete. The contractor should quote, his rate keeping in view that the rate should include for ready mixed concrete all as per specifications and directions of Engineer-in-charge.

2.3 READY MIXED CONCRETE (RMC) IS: 4926-1976

- a. The RMC from suppliers of ACC/L & T/Fletcher challenge should only be used.
- b. The rates are inclusive of all lead and lift. Additional lead and lift charges.
- c. The rate is inclusive of all necessary form work, centering and scaffolding capable of withstanding pumping of concrete.
- d. The rates are applicable to the materials with a maximum radius of 25 km from the city center.
- e. Test results of concrete for 28 days strength be obtained from the concerned RMC supplying firm.

2.4 MATERIALS.

2.4.1 Cement:-

2.4.1.1 Cement shall comply in every respect with the requirements of the latest publication of IS: 269 and unless otherwise specified, ordinary Portland cement shall be used. No other make of cement but that approved by the Architects/ Employers will be allowed on works and the source of supply shall not be changed without approval of the Architects/Employer in writing test certificates to show that the cement used fully complies with the relevant IS specifications shall be submitted to the Architects/ Employer and not withstanding this the architects may at their discretion order that the cement brought to site and which they may consider damaged or of doubtful quality for any reasons whatsoever shall be rested in an approved testing laboratory and fresh certificate of its soundness shall be produced, Cement ordered for retesting shall not be for any work pending results of retest.

2.4.1.2 Cement shall be stored neatly packed in piles not exceeding 10 bags high in weather-proof sheds with raised wooden plank flooring to prevent deterioration by dampness or intrusion of foreign matter. It shall be stored in such a way as to allow the removal and use of cement in chronological order of receipt, i.e., the first received being first used. Cement deteriorated and/or clotted shall not be used on work but shall be removed at once from the site daily record of cement received and consumed shall be maintained by the contractor in an approved form and a copy submitted to the employer once a month.

2.4.2 Fine Aggregates:

2.4.2.1 Sand shall conform to IS: 383 it shall pass through IS sieve 4.75mm (3/ from a 16" B S) test sieve, leaving a residue not more than 5%. It shall be from a natural source or crushed stone screenings it shall be washed, if directed, to reduce the percentage of deleterious substances to acceptable-limits. Sand

shall not contain any trace of salt and sand containing any trace of salt shall be rejected.

- 2.4.2.2 The fine aggregate for concrete shall be graded within limits as specified in IS: 383 and the fineness modules shall range between 2.60 to 3.20 the fine aggregates shall be stacked. Carefully, on a clear hard dry surface so that will not get mixed up with deleterious foreign materials. If such a surface is not available, a platform of planks or corrugated sheets or brick floor or concrete floor shall be prepared. Sand shall be added in the desired proportion as required for the strength specified, with suitable correction for “bulking”.
- 2.4.2.3 Coarse aggregates: Coarse aggregate shall conform to IS:383. It shall consist of crushed or broken stone, 95% of which shall be retained on 4.75 mm IS test sieve. It shall be obtained from crushed granite, trap, basalt or similar approved stones from approved quarry. Coarse aggregate shall be chemically inert when mixed with cement and shall be angular in shape and free from soft friable thin porous laminated or flaky pieces. It shall be free dust and other foreign matter. – Gravel/shingle of desired grading may be permitted as a substitute in part or full in plain cement concrete if the Architect/Employer is otherwise satisfied about the quality of aggregate.

2.5 MIXING OF CONCRETE:

- 2.5.1 Machine mixing:- Aggregates shall be accurately measured out in boxes and mixed dry along with required cement. Water shall then be added in measured quantity and mixing shall be continued until there is uniform distribution of the materials and the mass is uniform in colour and consistency but in no case shall the mixing be done less than two minutes. Only hopper loading mixer shall be used.
- 2.5.2 Hand mixing: when hand mixing is permitted with the approval of the Project-Engineer – Cum – Estate Officer, CCMD, it shall be carried out in water tight, mixing platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. If required by, the architect/consultant 10% extra cement has to be used at the contractor's cost if hand mixing is done.

2.5.3 Consistency:

- 2.5.3.1 Only sufficient water giving due allowance for the moisture content of aggregate shall be added to the cement and aggregate during mixing to produce a mixture of sufficient workability to enable it to be well consolidated to be worked in to corners of the shuttering and around the reinforcements (where there is reinforcements) to give the specified finish and to have the specified strength.

2.5.3.2 Normally for every 50 kg of cement in the concrete in the mix, total water including moisture content of aggregate should not be more than 34 lts for 1:3:6 mix, 32 lts for 1:2:4 mix 30 lts for 1:1 ½ :3 and 27 ltrs for 1:1:2 mix

2.5.3.3 If difficulty be experienced in placing concrete of specified mix and approved consistency between and below reinforcement bars, in the bottom of beams and similar situations, the concrete shall have improved workability by increasing the proportion of water with corresponding additional quantity of cement using aggregates of smaller size than specified as directed by the Architect/ Employer for which extra will be paid.

2.5.3.4 The consistency shall be determined by making trial mixtures with dried aggregates, or. When so instructed by test laboratory made test cubes under the direction of Architect/ Employer by slump – Test using a standard cone or the Architect/Employer may direct the use of any other means of testing the consistency.

2.5.3.5 If the apparatus used for the slump test is a standard cone, the cone when filled, shall be raised vertically – clear of the concrete: The ‘slump’ shall be 300mm minus the height of the slumped cone of concrete. Care shall be taken to prevent vibration of the samples being tested. The following slumps shall be adopted for different kinds of works:

		With Vibrator	Without Vibrator
A	Mass concrete in RCC foundations, footings and retaining walls	10 to 25mm	80 mm
B	RCC beam, slabs and columns	25 to 40 mm	100 to 125 mm
C	Thin RCC section or section with congested steel	40 to 50mm	125 to 150mm

2.5.4 Placing and Compacting

2.5.4.1 Method of placing concrete shall be such as to preclude segregation and as far as practicable the placing shall be continues.

2.5.4.2 Special care shall be taken in accordance with 18:456 while laying concrete under extreme weather. Concrete, during the operation of placing shall be thoroughly worked around the reinforcements, embedded fixtures, spaded against comers of the form work by punning, rodding or by any other approved means and thoroughly compacted by mechanical vibrators. The number and type of vibrator to be used, and in general immersion type vibrators shall be used.

2.5.4.3 Consolidation by using immersion vibrator will be in accordance with Is: 3558 sufficient number of reserve vibrators in good working condition shall be kept

on hand at all times, so as to ensure that there is no slacking or interruption in compacting.

2.6 ADMIXTURE

The use of admixtures may be allowed only if approved by the Architect/Consultant their decision in this regard shall be final.

2.7 TRANSPORTING

Concrete shall be conveyed from the place of mixing to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of any of ingredients? If segregation does occur during transport the concrete shall be remixed before being placed, normally not more than 30 minutes shall lapse between mixing and consolidation in position.

2.8 CURING:

All cement concrete after laying shall be protected from damages, till it sets and shall be cured thereafter for not less than ten days. The work shall be protected from direct wind and direct sun, rays. Water used for curing shall be free from sediments of any kind and generally fit for drinking.

2.9 STRENGTH OF ORDINARY CONCRETE:

2.9.1 The Contractor has to ensure that proper- materials in specified proportion are used and the correct water cement ratio, just sufficient for the workability is maintained to see that the minimum strength of concrete as provided under paragraph 3.9.2 (below) are obtained. To verify this, test cubes from the concrete pours should be made and tested. The frequency of testing and the acceptability criteria will be according to IS: 456.

2.9.2 Compressive strength of 15 cm cubes at 28 days after mixing shall be as follows: same as para 3.13.2

2.9.3 Six cubes shall be taken from any mix selected at random as directed by Engineer-in-charge three of these should be tested after 7 days and three after 28 days. The strength at 7 days must be 2/3 of the strength at 28 days. The criteria for acceptance are only the strength at 28 days.

2.10 FORMWORK AND CENTERING

2.10.1 The form: work shall conform to the shape, lines and dimensions of the faces of concrete shown on the drawings and be so constructed as to remain sufficiently rigid the placing and compacting of the concrete and shall be sufficiently water tight to prevent loss of cement slurry from the concrete. Form work shall be constructed of steel or timber or marine plywood and adequately designed to support the full weight of wet concrete (deflection

limited to 3mm) and retain its form during laying, consolidation and setting of concrete. Timber used shall be properly seasoned so as to prevent deformation when wetted.

- 2.10.2 Props shall be straight and of full height and no joints shall be allowed. Props shall be braced with bamboo's or wooden battens or other means in both directions at intervals of 1500mm and where additional staging is necessary, extra care shall be taken to use bigger size props with bracing at necessary levels. All the props shall be supported on sole plates double wedged. At the time of removing props these wedges shall be gently eased and not knocked out.
- 2.10.3 All rubbish, chipping, shavings, sawdust etc., shall be removed from the interior of the forms before concrete is placed. The form work in contact with the concrete shall be cleaned and thoroughly wetted and treated with non staining mineral oil or any other approved material. Care shall be taken that "oil or such similar material is kept out of contact with the reinforcement.
- 2.10.4 Officer, GGMD at convenient places for washing down all the rubbish. These are to be closed before concreting.
- 2.10.5 All form work shall be removed without shock or vibration and shall be eased off carefully in order to allow the structure to take up its load gradually. Forms shall not be disturbed until concrete has adequately hardened to take up its own weight and superimposed load coming on it and in no circumstances shall forms be struck until the concrete reaches its strength of at least twice the stress to which the concrete may be subjected to at the time of striking. The said forms shall be so fixed that while removing them the supporting forms and props are not disturbed.
- 2.10.6 In the case of folded plates and shell roofs the contractor should take prior approval of the pattern of centering and shuttering along with programme for deshuttering.
- 2.10.7 The tolerance of shuttering and stripping time will be as set forth in IS : 456 if directed, forms shall be given an upward camber to ensure that the beams do not have any sag. No honey combing will be permitted, however any honey combing of minor nature as specifically allowed by the clerks of works shall be repaired neatly with cement mortar 1:2
- 2.10.8 Any work showing signs of damage through premature or careless removal of centering or shuttering, shall be reconstructed by the contractor at his own cost. Surface that has to remain exposed after removal of forms shall be carefully examined and any fins, burrs, projections etc., that are detected shall be removed.
- 2.10.9 Centering and shuttering is specified to be paid for separately, measurement of such centering and shuttering will be taken according to IS: 1200

2.11 Steel Reinforcement

- 2.11.1 Reinforcement for all works shall be TMT steel bars, as specified in the drawings. TMT steel bars shall be of tested quality conforming to grade I of IS : 432 and high yield strength (of 550 N/sqmm) TMT bars shall be of IS:1786 or 1139 as appropriate. Reinforcement where called for shall be kept clean and free from pitting, loose rust millseale- oil, grease- earth paint or any material which may impair the bond between concrete and reinforcement or which may cause high corrosion of the reinforcement or deterioration of the concrete.
- 2.11.2 Reinforcement shall be accurately done to the dimensions, spacing and minimum cover as per structural drawings. The contractor shall submit to the clerk of work bar bending schedules, prior to the commencement of fabrication. All joints in TMT reinforcement upto and including 16mm dia shall be overlapped. The length of overlap for tension and compression joints in TMT steel reinforcement above 16mm dia may be welded subject to the approval of the project Engineer- cum estate officer.
- 2.11.3 Wherever specified and / or approved, welded laps shall be provided subject to the following.
- 2.11.3.1 Random samples of typical – welded joints shall be made and got tested in an approved laboratory at the contractor's expenses.
- 2.11.3.2 If the cold twisted deformed bar has an untwisted end at lapping joint, such portion – shall be cut off prior to welding.
- 2.11.3.3 bars shall be free from rust at the joints to be welded.
- 2.11.3.4 Bars can be aligned and kept in proper axis in order to minimize crookedness in bar welding.
- 2.11.3.5 Nothing extra shall be payable towards lap welding of joint unless specifically mentioned or agreed otherwise.
- 2.11.4 Reinforcement shall be rigidly held in place inside the form work using chairs (bent from steel bars) spacer bars and cement concrete blocks each block shall be secured to the reinforcement with wire or clip embedded in the center of block so that it shall not be in contact with form work. Intersections of reinforcement shall be bound together with 18 gauge annealed soft iron binding wire.
- 2.11.5 Before proceeding to place reinforcements the contractor shall ensure that appropriate cover between the bars and or the form work is available. Should any difficulty arise during the placing of steel in obtaining the required cover the contractor shall immediately draw the attention of the architect/

consultant to the difficulty and shall carryout such corrective measures as the architect/ consultant may instruct.

2.11.6 Reinforcement left projecting from newly placed concrete shall be supported in a way there is no risk of disturbance, which would cause damage to newly placed concrete.

2.11.7 The contractor shall ensure that movement of men and material subsequent to fixing in position of the reinforcement is organized such that displacement of the reinforcement will not occur.

2.11.8 The measurements recorded for reinforcements shall be including all laps and wastages as approved by the project Engineer- cum Estate officer's representative.

2.12 INSERTS IN CONCRETE

The contractor shall fix all necessary inserts such as steel – plates, pipes, sleeves, bolts etc., and shall make provisions in the form work for holes, pockets dowels, etc., at no extra cost (unless otherwise specified) to enable, subsequent fixing of supports, brackets or similar items. He shall also ensure that all conduits, inserts etc., are in position before placing concrete.

2.13 CONTROLLED CONCRETE

2.13.1 Controlled concrete shall be taken to mean that there shall be full field control of (a) predetermined grading of all aggregates that go into concrete and (b) Predetermined proportion of coarse aggregate, fine aggregate, cement and water for the required strength.

2.13.2 Strength shall mean the acceptable field strength after 28 days of curing on the tests conducted on 15 cm cubes from concrete taken during concreting in the manner set if forth in IS 456. A statement to acceptable minimum field strength is noted below.

Compressive Strength		
Grade	Preliminary test (Kg/ Sq Cm)	Work Test (Kg/Sq Cm)
M10	135	100
M15	200	150
M20	260	200
M25	320	250
M30	380	300
M35	440	350
M40	500	400

- 2.13.3 Arrive at the proportion to be adopted to obtain the grade of concrete, the mix should be based on laboratory tests conducted using the aggregate actually available at site which would be used for making/ concrete. The design mix should give suitable workability to enable it to be well consolidated to be worked into the corners of the shuttering and around the reinforcement.
- 2.13.4 Where difficulty is likely to be encountered in placing and compacting concrete and where there is crowding of reinforcements a separate mix is to be designed for required strength and used without extra cost, the mix design along with the workability obtainable with the designed mix should be furnished to the architect/employer before hand approval obtained. A laboratory is to be established at site to assess the moisture content of aggregate as frequently as necessary and as instructed by the Architect/employer based on which corrections is to be applied to the quantity of water to be used for mixing.
- 2.13.5 All aggregates are to confirm strictly to IS: 383. The aggregates will be tested as frequently as directed by the Architect/Employer to see that their specifications is the same as adopted in the mix design they must be stored on clean plat form made for the purpose.
- 2.13.6 Concrete shall be weigh batched, Dials of weigh batching unit to be used shall be checked with standard weights periodically. The conversions of weights volume will be allowed by Project Engineer cum Estate Officer, under special circumstances. Despite the design for several, mixes the following quantities of cement are the minimum to be used per cubic meter of the different grades of concrete.

Sl No	Grade of Concrete	Cement/ Cum (Bags)
1	M5	3.20
2	M7.5	3.60
3	M10	4.40
4	M15	4.80
5	M20	6.40
6	M25	6.80
7	M30	7.20

3.0 SIZE STONE MASONRY

- 3.1 Size stone shall be hard granite, basalt or trap stone obtainable from approved quarry, the stones shall be clean and wetted before they are used
- 3.2 Height of each course shall not be less than 15cm and all courses shall be of uniform height.
- 3.3 No face stone shall be less in depth than in height or shall tail into the work to a length less than the height stone shall break joints at least half the height of course faces of stones shall be hammers dressed such that the buildings are not more than 25mm thickness of joints shall not be more than 20mm. Edges of face stones of exposed faces shall be chiseled true to both longitudinal and vertical lines exposed faces of corner stones are to be two lines dressed 50mm wide.
- 3.4 Bond or through stones shall be provided not exceeding 2.0m apart in each course and shall be staggered bond stone shall be from the front to back of the walls fro walls upto 60cms thick; they shall either be in one piece (if available locally) or be in the series of headers; each header overlapping the adjoining one by not less than 150mm bond or through stones shall be marked as directed to enable easy detection even after having been built in position. The interior (or filling) shall be with flat bedded stones laid in mortar joints and shall not exceed 10% of the quantity of stone masonry. Care is to be taken that no dry work or hollow spaces shall be left anywhere in the masonry.
- 3.5 The work shall include.
 - 3.5.1 All scaffolding – platforms, staging etc.,
 - 3.5.2 Hacking and roughening of concrete or other surfaces for binding of the masonry.
 - 3.5.3 Raking out joints for plastering and / or pointing.
 - 3.5.4 Levelling up and preparing and pointing.
 - 3.5.5 Building in holdfasts or similar inserts.
 - 3.5.6 Keeping (the work) in damp condition for two weeks
 - 3.5.7 Construction watery situation.

4.0 BRICK MASONRY:

4.1 GENERAL

- 4.1.1 All brick work should be carried out as shown on the drawings with set backs, projections, cuttings, toothings etc., wherever the proportion of cement mortar has not been specifically mentioned, cement mortar in the proportion of 1:6 shall be used. Flat brick arches shall be provided, wherever required, without any extra cost. Brickwork shall be kept wet while in progress till mortar has properly set. On holidays or when the work is stopped top of all unfinished masonry shall be kept wet, should the mortar be dry, white or powdery, due to lack of curing work shall be pulled down and rebuilt at the contractors expense.
- 4.1.2 Table moulded bricks shall be locally available or brought from outside first quality having a minimum crushing strength of 40kg per sqcm and water absorption not more than 20% by weight. Bricks shall be thoroughly cleaned and well wetted. Table moulded bricks shall be soaked for atleast 12 hours in fresh water before being used on the work.
- 4.1.3 Unless otherwise specified, brickwork shall be done in English bond with frog upwards. The bricks shall be bedded and joined with mortar in such a manner as not to leave voids. Each brick shall be correctly into position by tapping with the handle of trowel. Grouting of mortar slurry will not be allowed except where necessary for special reasons and in such cases, prior permission of the Architect/ Employer shall be obtained.
- 4.1.4 A care shall be taken that each course of brick work is truly horizontal and perfect in bond and the face of the wall is straight, plumb and even. The mortar joints shall be 10mm in thickness, except where extra thickness is required for the purpose of bringing the work to the required height or level. Halfbricks or bats shall not be used except for obtaining the bond and where absolutely necessary.
- 4.1.5 Brickwork in 239 mm wall: If bricks are of size such that the width of the header course does not come equal to the width of the stretcher course, the difference shall be made up during construction of brickwork itself by same mortar as used for construction of masonry to provide a plane vertical surface. The surface should also be scarified to receive plaster.
- 4.1.6 All junctions of wall shall be carefully bonded into the main walls. The rate of laying masonry will be upto a height of 100cm per day if cement mortar is used greater heights may be built only if permitted by the Project Engineer-Cum Estate Officer.
- 4.1.7 During rains, the work shall be carefully covered to prevent mortar from being washed away. Should any mortar or cement be washed away the work shall be removed and rebuilt at the contractors expense.

4.2 HALF BRICK WORK:

This shall be set in cement mortar as specified. Unless otherwise specified, the walls be reinforced with 2 nos of 6mm mild steel bars with tie bars at 1m interval on the top of the first course and at every fifth course thereafter. The cost of the half brick work shall include the cost of reinforcement where reinforcement of half brick walls is specified.

5.0 Wood Works:

5.1 GRP Door shutters as per the Engineer-in-charge/ Architects approval

5.2 GLAZING WORKS

All glass shall be specified in the drawings and schedule of quantities and free from air bubbles, specks and scratches or other defects. All glass shall be cut to fit the sashes or other members as required. All glass, shall be properly bedded, securely fixed and finished as indicated on the drawings. T.W beading moulded as specified shall be provided for fixing the glass. No glazing shall be complete until all the stains and marks have been removed from the surface of glass.

6.0 ALLUMINIUM DOOR, WINDOWS ETC.,

6.1 GENERAL

6.1.1 These shall be custom-built units of approved established manufacturer using standard aluminum alloy extruded sections generally conforming to the relevant basic concept drawings of the Architects and Schedule of quantities including necessary glazings, fittings, fastenings, locking arrangements polysulphide sealants etc., to ensure water tightness.

6.1.2 Based on the Architects concept drawings, the contractor shall submit detailed fabrication/ assembly/ erection drawings for the approval of the Engineer-in-charge. Samples of each unit, based on the approved fabrication and assembly drawings shall be made by the contractor and got approved by the Engineer-in-charge before bulk fabrication and assembly of each unit.

6.2 STORAGE AND HANDLING:

The contractor shall take particular care to stack the fabricated frames etc., on the site under cover. These shall be handled with care and stacked on edge of level bearers and supported evenly.

6.3 Before erecting- the frames coming in contact with concrete, masonry, plaster or dissimilar metals, shall be treated with a coat of zinc chromate. The contractor shall cover the work with transparent lacquer based or methacrylates or cellulose butyrate, tithe surface from wet cement during installation. This coating shall be removed on completion. Before handing over,

the aluminium work shall be washed with mild solution of non-alkali soap and water.

- 6.4 The colour of anodizing shall be uniform mat natural finish otherwise stated and its sample shall be submitted for the Engineer-in-charge, approval before work commences. The section shall be anodized to a minimum thickness of 20 microns. The contractor must submit necessary evidence to the satisfaction of the Engineer-in-charge that the thickness of the anodisation is not less than 20 microns. In case of doubt the Engineer-in-charge may reject the materials.

6.5 TOLERANCE ON SIZE.

Frames should be made to fit the actual openings with not more than 5mm clearance all round. Discrepancies in overall width or height exceeding 5mm will not be allowed and frames will be rejected in such cases. Minor discrepancies acceptable to the Architect/ Employer shall have the gaps suitably filled. The sizes of frames, if noted in the drawings/ schedule of quantities, may vary up to plus or minus 50mm beyond which the rate payable will be increased or decreased proportionate to the changes, where the rate quoted is for one unit number, if the rate quoted is for superficial area, such area will be net finished size of the opening.

7.0 STEEL WORK:

The fabrication, supply and erection of the steel (Fe 500 N/mm²) work consists of accomplishing all related jobs like providing all labour, tools and plant, all materials and consumables such as welding electrodes, bolts and nuts, oxygen and acetylene gases, oils for cleaning etc., All of approved quality, the work shall be executed. In an expeditious and workmen like manner, as contemplated in the drawings and to the complete satisfaction of the project Engineer-cum – Estate Officer, CCMD, representative. The work shall also include providing shop primer coat of paint and grouting of hold down bolts.

8.0 PLASTERING- WORKS:

8.1 EXTENT AND INTENT

The contractor shall furnish all materials, labour, scaffolding, equipment, tools, plant and incidentals necessary as required for the completion of all plaster and wall finishes, subject to approval by the Project Engineer-cum- Estate Officer, CCMD.

8.2 GENERAL

- 8.2.1 Plaster as here in specified shall be applied to all internal and external surfaces where called for. Flazed tile dado, terrazzo dado and wall finishes other than plaster shall be provided where indicated on drawings and schedule of finishes. Areas called for on drawings and typical shall be considered to apply to appropriate adjoining area whether shown on same drawings or not whether indicated or not.

- 8.2.2 All plaster works and other wall finishes shall be executed by skilled workmen in a workman like manner and shall be of the best workmanship and in strict accordance with the dimensions on drawings subject to the approval of the project Engineer-Cum-Estate Officer, CCMD.
- 8.2.3 The primary requirement of plaster work shall be to provide absolutely water tight enclosure, dense, smooth, and hard and devoid of any cracks on the interior and / or exterior. The contractor shall do all that is necessary to ensure that this objective is achieved. All plastering shall be finished to the true plane, without any imperfections and shall be square with adjoining work and form proper foundation for finishing materials such as paints etc.,
- 8.2.4 Masonry and concrete surfaces, which call for applications of plaster, shall be clean, free from efflorescence, damp and sufficiently rough and keyed to ensure proper bond, subject to the approval of the Project Engineer-Cum- Estate Officer.
- 8.2.5 Wherever directed by the Project Engineer-cum-Estate Officer, CCMD, or other representative, all joints between concrete frames and masonry infilling shall be expressed by a groove cut in the plaster. The said groove shall coincide with the joints beneath as directed. Where grooves are not called for the joints between concrete members and masonry infilling shall be 24 guage galvanized chicken mesh strip 400mm wide or as called for on drawings/documents which shall be in position before plastering.

8.3 CHASING AND CUTTING:

All chasings, installations of conduits, insert boxes etc., shall be completed before any plastering or other wall finish is commenced on a surface. No chasing or cutting of plaster or other finish on a surface shall be permitted. Broken corners shall be cut back not less than 150mm on both sides and patched with plaster of paris as directed. All corners shall be rounded to a radius of 8mm or as directed by the Project Engineer-Cum-Estate Officer, CCMD.

8.4 SAMPLES:

Samples of each, type of plaster and other wall finish shall be prepared well in advance of undertaking the work for approval by the Project Engineer-Cum-Estate Officer, CCMD.

8.5 PROPORTIONS:

The materials used for plastering shall be proportioned by volume by means of gauge boxes.

8.6 PREPARATIONS OF SURFACES.

The joints in all walls, both existing and freshly built shall be raked to a depth of 15 cleaned with wire brushes, dusted and thoroughly wetted before starting plastering work. Concrete surfaces to receive plaster shall be roughened by hacking over the

entire surface so that the skin of the concrete is completely removed, as approved by the Architect/ Employer to ensure proper key for the plaster.

8.7 PLASTER TO WALLS:

Unless otherwise specified, all works shall be plastered and finished as follows:

Internal faces : 20mm thick with cement mortar 1:6 (one part of cement and six parts of fine river sand) finished smooth with lime rendering.

External faces: 12mm thick base coat with cement Mortar 1:4 (one part of cement and four part of fine river sand) finished rough to receive the final coat and 6mm thick final coat with cement mortar 1:3 (one part of cement and three parts of coarse river sand) sponge finished.

8.8 MORTAR MIXING

Mortar shall be prepared as specified in small quantities as required and applied within fifteen minutes of mixing.

8.9 Plaster application shall be commenced only after the preparatory work is approved by the Project Engineer- Cum- Estate Officer, CCMD. Correct thickness of plaster shall be obtained by laying plaster screeds (gauges) at intervals of 1.5 m as directed. Mortar shall be firmly applied, well pressed, into the joints, rubbed and finished to give a smooth and even surface to the satisfaction of the Project Engineer-Cum-Estate.

8.10 CURING

Finishing Plaster shall be kept wet for at least ten days after completion in hot weather, walls exposed to such shall be screened with matting kept constantly wet or by other approved means.

8.11 CLEANING PLASTERING:

Plaster to ceiling, so fits of stairs flight slabs and similar locations, where called for, shall be 12 mm thick comprising of one part cement and three parts of clean fine sand unless otherwise specified. The surface shall be brushed, swept clean and thoroughly wetted before plastering. Mortar shall be applied firmly pressed to the surface, rubbed and finished smooth evenly subject to the approval of the Project Engineer-Cum-Estate Officer, CCMD.

8.12 CEMENT MORTAR:

8.12.1 Cement mortar shall be of proportion specified for each type of work. It shall be composed of Portland cement and sand. The ingredients shall be accurately gauged and shall be evenly mixed together in a mechanical mixer. Care should be taken not to add more water than necessary. If hand mix is allowed, it shall be done on pucca waterproof platform. The gauged materials shall be put on platform and thoroughly mixed dry. Water shall then be added and the whole

mixed thoroughly until the mix is homogeneous and of uniform colour. Quantity of mortar mixed should not be more than what can be consumed within half an hour of mixing.

8.12.2 Cement mortar mix are specified in 1:2, 1:3, 1:4, 1:5 etc., the first figure will mean one part of Portland cement by volume and the second will mean so many parts of sand by volume. For example cement mortar 1:4 would mean

One part of cement and four parts of sand.

8.12.3 Cement and sand must conform to relevant I.S specification.

8.13 LIME RENDERING:

This will be prepared out of best quality fat lime slaked at site with fresh water not less than one week or not more than two weeks before use. All impurities, ashes and improperly burnt stuff shall be screened and picked out before slackening. Slaked lime shall be screened through to remove all unslaked materials, stones etc., so that only a fine creamy paste is available for rendering. Slaked lime is to be diluted with just sufficient water to give a thick consistent pulp suitable for effective covering of base surface. Before the base coat sets, the lime rendering is applied and finished smooth and the entire plastered surface is made truly plane.

9.0 FLOORING:

9.1 GRANOLITHIC FLOORING

9.1.1 General: The flooring shall be of specified thickness and shall consist of 1:2:4 concrete base or as specified and 12mm thick granolithic wearing coat. The granolithic flooring shall be laid in alternate panels. The size of panels shall be as decided by the Project Engineer-Cum-Estate Officer, CCMD

9.1.2 Laying of 1:2:4 concrete base:

9.1.2.1 The 1:2:4 concrete shall be of graded coarse aggregate of maximum size 10mm, coarse sand and cement. The ingredients shall be thoroughly mixed with sufficient water to obtain the required plasticity.

9.1.2.2 The free water on the surface of the base shall be removed and a coat of cement slurry of the consistency of thick cream shall be brushed on the surface.

9.1.2.3 The prepared 1:2:4 concrete shall be laid immediately after mixing on the fresh grouted base. The concrete shall be spread evenly and leveled carefully. Low places shall be filled, humps removed and the whole surface again leveled. The layer shall be compacted by ramming trowel led and allowed to set.

9.1.2.4 Mixing and laying of wearing coat: one part of cement in dry state shall be mixed with 1.5 parts by volume of well graded/crushed granite chips of

6mm maximum size. The ingredients shall be then mixed with sufficient water so for ordinary concrete. The wearing coat shall be laid 12mm thick over the base concrete immediately after it has set, compacted and leveled with a steel trowel. Just sufficient trowel ling shall be made to give a level surface. The surface should not be over trowelled as excessive trowelling will bring the cement to the surface which shall be strictly avoided. When the initial set takes place, further compaction by steel trowelling shall be done and final brushing shall be made before the topping becomes too hard.

9.1.3 Curing as soon as the surface is hard enough, it shall be covered with sacking or sand and kept continuously wet for a period of at least one week.

9.2 A bed of cement mortar 1:4 shall be laid and properly leveled to average thickness of 20mm and the surface kept slightly rough to form a satisfactory key for the tiles, neat cement paste of honey like consistency shall be spread over mortar bed, over such an area so that the paste will not harden before laying tiles. Slabs shall be soaked in water for 15 minutes and allowed to dry. The slab shall be then fixed as per approved pattern with thin coat of cement paste applied on back of each slab and tapped with a wooden mallet till it is properly bedded in level with adjoining slabs. Joints shall be not more than 1:5 mm wide. The surplus cement grout that may have come out of the joints has to be wiped off gently and joints cleaned. The joints shall, be filled up with grey or white cement with an admixture pigment to match the shade of the slab. The flooring shall be cured for 14 days. Then it shall be polished according to IS: 1443, and pointed with cement mortar: 1:1 (1 part of cement and 1 part of fine screened sand) mixed with matching colour pigment.

9.3 GRANITE SLAB WORK:

9.3.1 General: The slab must be of uniform thickness as specified, the variation in the thickness not exceeding 12 mm and must be from the same source. They shall be of uniform texture and colour free of any veins and streaks. All the edge shall be chiseled true to line, square and shape. The surface should be rough dressed/ one line dressed. Three line dressed pulman dressed/mirror polish as specified.

9.3.2 Rough Dressing: The stone surface to be chisel dressed to one plane by removing all bushings so that the maximum depression is not more than 6 mm.

9.3.3 One Line Dressing: This is done after the rough dressing is completed by point chiseling so that the variations are not more than 4mm. Work includes rough dressing also.

9.3.4 Two Line Dressing: This is done after, one line dressing is done by chiseling so that variations are not more than 2.5mm work includes rough and one line dressing also.

- 9.3.5 Three Line Dressing: This is done after two lines dressing is over by chiseling so that variations are not more than 1.5mm work includes rough, one line dressing also.
- 9.3.6 Pulmane Dressing: After the three line-dressing is over, the surface is smoothened by using a special pulmane tool to further even out three line dressed surface so that the maximum variation in surface evenness is not more than 1.0mm work includes rough, one line, two line and three line dressing also unless otherwise stated.
- 9.3.7 Mirror polishing: The surfaces are to be polished by grinding using manual or mechanical process to give a smooth even perfect plane surface or as may be directed. The polished surface should reflect light like a mirror and must be free from scratches and depressions.

9.4 GLAZED TILING

- 9.4.1 Glazed tiles shall be from an approved manufacture conforming to IS.777 of specified size, thickness and colour, All specials viz coves, internal and external angels, corners beads etc., shall be used wherever directed. Under layer of 12mm average thickness of cement mortar 1:3 proportion shall be laid tiles shall be well soaked in water washed clean and set in cement grout each tile being gently tapped with wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints should be kept as thin as possible and in straight lines or to suit the required pattern after tiles have been laid surplus cement grout shall be cleaned off the depth of % mm and all dust and loose mortar removed joints shall then be flush pointed with white cement if necessary mixed with pigment to match the colour of the tile. The floor / dado shall be kept wet for 14 days, after curing the surface shall be washed with mild hydrochloric acid and clean water, the finished floor/ dado shall not sound hollow when tapped with wooden mallet, the rate will include the cost of under layer of cement mortar.

10.0 PAINTING

- 10.1 The specifications covers the various types of all surfaces thought the interior and exterior of the building the number of coats required in various situations and also the type of finish required for the several items of work such as cement based paint, plastic emulsion point, oil bound distemper etc., are specified in the schedule of quantities and specifications.
- 10.2 Before commencement of the work, the contractor shall provide sample panels of painting at this own cost for the approval of the Project Engineer-Cum-Estate Officer-CCMD, to enable him to keep an accurate check on the materials supplied and final shade to be painted. It is however, the responsibility of the contractor to provide any deviations and defects shall have to be Rectified by the contractor at his own cost.
- 10.3 Contractor shall protect not only his own work at all times but also all the adjacent work and materials by suitable covering, protection or other methods

acceptable to the Project Engineer-Cum-Estate Officer, CCMD during progress of painting, it is of painting work to remove all paint and varnish spots from floors, walls, glass panes and other surfaces and restore them to original conditions. The work generally touched up shall be attended to after all workmen have left. Accumulated – material, rubbish etc., have to be cleared and the premises left in clean, orderly and acceptable conditions.

- 10.4 Contractor shall provide scaffolding wherever necessary erected on double supports tied together by horizontals. No ballies, bamboos or planks shall rest on or touch the surface, which is being painted. Contractor is demand to have considered the following while tendering and no extra claim on account of these will be entertained.
- 10.4.1 Supplying the paint and other materials required of approved colour and brand.
- 10.4.2 Preparing the surfaces to be painted.
- 10.4.3 Providing and erecting scaffolding and removing the same after completion of the
- 10.4.4 Lifting of materials to any height and painting at all levels.
- 10.4.5 Applications of painting as per the specification and to manufactures instruction.
- 10.4.6 Curing, protecting the painted surfaces and adjacent work and thoroughly cleaning of premises.
- 10.5 The paint shall generally conform to the chemical composition and other characteristics laid down in the relevant Indian standard specification. The entire materials required for painting work shall be obtained direct from approved manufactures or their authorized agents and brought to site in original manufactures containers with seals unbroken.
- 10.6 Paint shall be ready mixed of quality of the approved brand and manufacture. Mixing of paint by the contractor at site will not be allowed, except preparation and their quality shall be strictly maintained as per manufacture's instruction and all as directed by the Project Engineer-cum-Estate Officer, CCMD. All the materials shall be kept properly protected when not actually in use. Lids of containers shall be kept closed. Materials which have become stale or flat (in opinion of the project Engineer-Cum-Estate Officer, CCMD) shall not be permitted to be used on the works and shall be removed from site forthwith. Any materials found not conforming to the relevant specifications shall have to be removed by the contractor from the site at his own expenses.
- 10.7 Providing two coats of synthetic enamel paint of approved make colour over one coat of primer on plastered surfaces, wooden surfaces and steel surfaces: A fully putty coating has to be given after primer coat in the case of wooden

surfaces. The putty shall be made from pure whiting mixed to the proper consistency with new linseed oil, a little white lead being mixed to help hardening of putty. On no account putty is to be used before primary coat. Primers to be used shall be according to the manufacture specifications.

10.8 The manner of taking measurements will be in accordance with ISI: 1200.

11.0 WHITE WASHING

White wash shall be prepared from fat lime or shell lime slaked on site mixed with just enough water to make a thick paste and allowed to remain for atleast 7 days before use. At the time of using the paste shall be diluted with just sufficient water and strained through cloth. 4 kg of gun dissolved in hot water shall be added to each cubic meter of cream (115 GMS per cft). Ultra marine blue or other approved locally available colour pigment shall be added to give required whiteness. The number of coats as specified in the bill of quantities shall be added to give required whiteness. The number of coats as specified in the bill of quantities shall be applied by using flat brushes or spray pimps, on surface prepared. Each coat shall be allowed to dry before next coat is applied.

12 TREATMENT FOR SUNKEN FLOOR SLAB:

- A. Brick bat aggregate shall be from well burnt bricks. The proprietary water proofing compound and the quantity to be used shall be as per para 15.1
- B. The surface shall be thoroughly cleaned with wire brushes. All loose scales shall be removed and dusted off. The surface (bottom as well as sides) shall be treated with cement slurry admixed with proprietary water proofing compound to penetrate interstices and fill the pores in the surface.
- C. After the slurry coat is laid, a layer of well burnt brick bats/ aggregates of about 40mm size shall be laid in cement mortar of mix as specified by the specialist firm but not leaner than 1:5 (a cement : 5 coarse sand) admixed with proprietary water proofing compound the mortar being filled to half the depth of the aggregate. The brick bat/aggregate layer shall be rounded off at junctions with the beam all etc., and tapered towards top to a height of 100mm long beams/ wall, etc., curing of this layer shall be done for 3 days.
- D. After curing the surface shall be applied with a coat of cement slurry admixed with proprietary water proofing compound.
- E. Joints of brick bat/ aggregate shall be filled fully with cement mortar of mix as specified by the specialist firm but not leaner than 1:4 (1 cement. 4 coarse sand) admixed with proprietary water proofing compound and top finished with average 20mm thick layer of some water. This layer of mortar shall be continued to the sides of beam. Wall etc., the height upto which this treatment is to be extended on the sides shall be as directed by the Engineer-in-charge.

The surface shall be finished smooth with cement slurry admixed with proprietary water proofing compound.

- F. While the water proofing treatment is 3qrie it shall be ensured that the outlet pipes are properly fixed arid the gap between the wall and pipes are properly filled with brick/stone aggregate and cement mortar admixed with proprietary water proofing compound and grouted with cement slurry admixed with proprietary water proofing compound by injection process.
- G. Water proofing treatment shall be cured for 10 days
- H. Measurements: measurements for the floor treatment shall be taken on plain area of floor treated nothing extra shall be paid for rounding off at junctions and taking the treatment along sides of beams and walls for about 100mm sides of beam/wall etc., where the treatment is only with mortar shall be measured and paid separately , length and breadth shall be measured correct to once centimeter and area calculated correct to 0.01 sqm
- I. Rates: The rates shall include the cost of all labour and material involved in all the operations described above. Base treatment and sides treatment will be paid separately under respective items.

PART II: SPECIFICATIONS FOR WATER SUPPLY AND SANITARY WORKS

1.0 GENERAL

1.0 SCOPE OF WORK:

The general character and the scope of work to be carried out is illustrated in the drawings and specifications. The contractor shall carry out and complete the said work under this contract in every respect in conformity with the rules and regulations of the local authority. The contractor shall furnish all labour, supply and install all materials, appliances, tools, equipments etc., necessary for the complete provision and testing of the whole plumbing services installation as specified here as per the relevant ISI codes as shown on the drawings. This also includes any material, appliances, equipment not specifically mentioned herein or noted on the drawings as being furnished or installed but which are necessary and customary to make a complete installation as shown on the drawings or described herein, properly connected and in working order.

In general, the work to be performed under this contract shall comprise of the following:

- 1.1 All incidental jobs connected with water supply services installation, such as excavation in trenches and back filling, cutting chases in concrete, brick etc., and making good cutting drilling holes through walls, floors and grouting for embedding of fixtures, equipment and fixing of valves, pumps etc.,
- 1.2 Furnish and install a complete workable, service installation as shown on the drawings and as per the latest ISI specifications including all that which is reasonably inferred.
- 1.3 Complete installation of internal water supply system.
- 1.4 Complete installation of the sewerage and sewerage appurtenances internally and around the building.
- 1.5 Complete installation of all sanitary and plumbing fixtures.
- 1.6 Co-operation with other crafts in putting the installation in places. Any work without regard or consultation with other trades, shall be removed by the contractor without any traditional cost to the employer, to permit the proper installation of all other work, as prescribed by the architects.
- 1.7 Repair all damages done to the premises as a result of this installation and remove all debris arising there from to the satisfaction of Project- Engineer – cum- Estate Officer.

- 1.8 Cleaning of all plumbing “fixtures, testing and showing satisfactory performance all the fixtures at the time of handing over to the Project Engineer-cum-Estate Officer.
- 1.9 It is the responsibility of the contractor to safe guard and takes care of all the fixtures fitted until the time handing over to the Project Engineer-cum-Estate Officer.
- 1.10 Painting of all concealed and exposed pipes as specified.
- 1.11 Assume full responsibility of all statutory requirements.
- 1.12 At the completion of the work, furnish necessary information like invert levels and layout of pipeline etc., and prepare final completion drawings to the Project-Engineer-cum-Estate Officer.

2.0 REGULATIONS AND STANDARDS:

- 2.1 The installations shall conform in all respects to the following board list of standards in general:

IS 3114 – 1965	:	Code of practice for laying of CI pipes.
IS 1230-1968	:	Specifications for mild steel tube, tubular and other steel
		pipe fittings part I
IS 1536 – 1980	:	Centrifugally cast (spun) cast iron pressure pipes for water, gas and sewerage.
IS 780 – 1980	:	Sluice valve for water works purposes.
IS 1520 – 1980	:	Horizontal centrifugal – pumps.

- 2.2.1 The installation shall also be in conformity with the byelaws and requirement of the local authority in so far as these become applicable to the installation wherever this “specification calls for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards then this specification shall take precedence over the said regulations and standards. Wherever the specification require something which will violate the regulations, the regulations shall govern.

3.0 PERMITS AND TESTS:

On completion of the work, the Contractor shall obtain and deliver to the Project Engineer-cum-Estate Officer, CCMD certificates of final inspection and approval by the local authority as may be applicable. The Project Engineer-cum-Estate Officer, CCMD shall have full power to require the materials or work to be tested by any independent agency at the contractors expenses in order to prove their soundness and adequacy.

4.0 DRAWINGS AND SPECIFICATION

The drawings and specification shall be considered as part of this and any work or materials shown on the drawings and not called for in the specifications or vice versa shall be executed as if specifically called for in both. The contract drawings shall indicate the extent of general, arrangement of the fixtures, drainage system etc., and essentially diagrammatic. The drawings indicate the points of supply and termination of pipe runs and broadly suggest the routes to be followed. The work shall be installed as indicated on the drawings, however, any changes found essential to coordinate, this work with other trades shall be made without any additional cost. The data given herein and on the drawings is as exact as could be secured but its complete accuracy is not guaranteed. The drawings and specifications are of the assistance and guidance to the contractor and exact location distance and levels will be governed by the individual building and site condition, therefore approval of the Project Engineer-cum – Estate Officer, CCMD on tracing cloth.

5.0 MANUFACTURERS INSTRUCTIONS:

Where manufacturers have furnished specific instructions, relating to the materials used in this job, covering points not specifically mentioned in job, covering points not specifically mentioned in these documents. These instructions shall be followed in all cases.

6.0 CHANGE IN DIMENSION

If the size of the fixture mentioned is not available, then the nearest available size shall be fixed with due consent of the Engineer-in-chief, CCMD.

7.0 MATERIALS:

- 7.1 Materials shall be of the best quality obtainable and unless otherwise specified they shall conform to the respective Indian Standards Specification.
- 7.2 Samples of all materials shall be as per the list of approved branch manufacture. The samples shall be got approved before placing order and the approved samples shall be deposited with the Engineer-in-chief, CCMD.
- 7.3 In case of non availability of materials in merits, sizes, the nearest size of EPS units shall be provided with prior approval of the Engineer-in-chief Project Engineer-Cum-Estate Officer, CCMD, for which no extra will be paid.

8.0 TRENCHES FOR PIPE DRAINS:

- 8.1 Opening out trenches: In excavating the trenches etc., the road metalling pavement curbing etc., are to be placed on one side and preserved for reinstatement when the trench or other excavation shall be filled up at no extra cost.

Before any road metal is replaced, it shall be carefully shifted, the surface of all trenches and holes shall be restored and maintained to the satisfaction of the Architects. The contractor shall not cut or break down any live fence of trees in the one of proposed works but shall tunnel under them unless the Architects shall order to the contrary. The contractor shall scrub up and clear the surface over the trenches and other excavations of all stumps, roots and all other encumbrances affecting execution of the work and shall remove them from site to the approval of the Project Engineer-Cum-Estate Officer, CCMD.

- 8.2 Cutting of roads: All works across the roads, shall be carried out as per the directions of the Project Engineer-Cum Estate Officer, CCMD.
- 8.3 Excavation to be taken to proper depth: The trenches shall be excavated in all conditions of soil and to such a depth that the pipelines shall rest as described in the several clauses relating there to and so that the inverts may be at the levels given the drawings. In loose soil, the Project Engineer-cum-Estate Officer, CCMD. May order the contractor to excavate to a great depth than shown on the drawings to fill up the extra excavation with concrete, sand, gravel or other materials. For such authorized filling of materials the contractor shall be paid extra at the rates laid down under clause 20.0 of the general conditions of contract, if the extra work was ordered by the Project Engineer-Cum-Estate Officer, CCMD. If the contractor should excavate the trench to a greater depth than is required without a specific order to that effect in writing, the extra depth shall have to be filled up with concrete at the contractor's own cost to the requirements and satisfaction of the Project Engineer-Cum- Estate Officer, CCMD.
- 8.4 Refilling: After the pipes or other fittings has been laid and proved to be water tight, the trench or other excavation shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the pipes and other permanent works. Filling in the trenches and upto 50cm above the pipes shall consist of the finest selected materials placed carefully and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15cm layers with materials taken from the excavation each layer being watered and consolidated.
- 8.5 Settlement and Damages : The contractor shall, at his own cost make good promptly, during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, beams, footpaths, gardens, open spaces, etc., whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He also shall at his own expenses and charge, repair and make good any damage to the buildings and other properties.
- 8.6 Disposal of surplus soil: The contractor shall at his own cost and charge, dispose within the site all surplus excavated material not required to be used on the works to within a distance of 50cm.
- 8.7 Timbering of pipe line and trenches: The contractor shall at all times support efficiently and effectively the sides of the pipe trenches and other excavations by suitable timbering, piling, sheering etc., without any extra cost. All timbering, sheeting and piling with their wallings and supports shall be of adequate dimensions and strength and fully braced and strutted so that there is no risk of collapse or subsidence of the walls of the trench. The contractor shall be held accountable and responsible for the sufficiency of all timbering, bracing, sheeting and piling used and for all damages to persons and property

resulting from the improper quality, strength, placing, maintenance or removing of the same.

- 8.8 Removal of water from pipeline, trenches etc., : The contractor shall at all times during the progress of work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the work completed or in progress nor to the surface of any roads or streets nor cause any interference with the use of the same.
- 8.9 The width of the excavated trench shall be as per the table given below width at bottom

Excavation upto 90cms depth	33cm	33cm
90 to 150cm depth	60cm	60cm
150 to 300cm depth	75cm	75cm
300 to 500cm depth	90cm	100cm

- 8.10 Protection of existing services : All pipes, water mains, cables etc., met in the course of excavation shall be carefully protected and supported.
- 8.11 Concreting: All pipes at shallow road crossings and made up ground shall be laid on a bed of 15cm concrete with one part of cement, 4 parts of sand and 8 parts of 40mm gauge stone metal property consolidated. Concrete shall be laid to the full width of the trench and also in haunches.

8.12 CAST IRON PIPES AND FITTINGS

- 8.12.1 Cast – iron soil, waste and vent pipes and fittings shall be of heavy quality conforming to IS 1536-1967 and fittings to IS 1537-1960
- 8.12.2 Claying and Jointing: The pipes shall be laid, underground, under the floors, or on walls either buried or exposed as the case may be as shown on the drawings.
- 8.12.3 Cast Iron, Pipes: Cast iron pipes shall be laid and jointed in conformity with the code of practice for laying of cast iron pipes. Cast iron pipes shall be jointed by best quality caulking lead free from all impurities in wet trenches, joints shall be made with lead wool. The spigot shall be centered in the adjoining socket by tightly caulking in sufficient turns of tarred gaskin to leave unfilled the required depth of socket for lead. Where the gaskin has been caulking tightly home, a jointing ring shall be placed round and barrel and against the face of the socket. Molten lead shall then be poured into fill the remainder of the socket in one with suitable tools by hammering right-round the joint, to make up for the shrinkage of the molten metal on cooling and shall preferably finish 3mm behind the socket face. Lead for caulking shall conform to IS 782-1966. The quantity of lead to be filled per joint in various sizes of cast iron pipes. Shall be as follows:

Water main pipes: Lead /joint (Kg)

80mm (3") pipe	1.8
100mm (4") pipe	2.2
125mm (5") pipe	2.6
150mm (6") pipe	3.4
200mm (8") pipe	5.0

8.12.4 The joints and pipes laid for water supply systems shall be tested to a pressure of 12kg.sqcm for two hours without developing leaks/fall in pressure. The drainage pipelines and joints shall be tested to a head of 150cm for two hours without developing leaks/fall in pressure. In case of leaks the piping shall be redone in such portion and the test repeated till achieving satisfactory results.

8.12.5 Under ground piping shall be of CI tyton type confirming to IS class A 1536 the piping shall be laid not less than 1Mt below the ground level. Suitable masonry/ PCC support anchor blocks shall be provided at change in direction with soil conditions are unsatisfactory.

8.12.6 All fittings shall be CI flanged confirming to IS 1538. The flanges shall be drilled as per relevant Indian Standards Flanges shall be faced and cleaned and shall have jointing of rubber insertion or asbestos compound. In case of tytron pipes the joint shall be made by using rubber gaskets as per manufactures specification. The joint shall be capable of withstanding a pressure of 10.5 Kg/Sqcm.

9.0 SLUICE VALVES

Sluice valves shall conform to IS: 780 valves shall be of right hand type. Only flanged valves shall be used . Valve wheel shall have an arrow engraved or cast thereon showing the direction of turning open or close operation.

10.0 NON-RETURN VALVES

Non return valve shall be of cast iron with gun metal seat. Non return of valves shall be of flanged type. Spring loaded valves shall not be used. The valves shall be suitable for a test pressure of 21 kgs/Sqcm.

11.0 MODE OF MEASUREMENT

11.1 Excavation (General): the width of excavation shall be limited to as said earlier.

11.2 Cast iron pipes: Cast iron pipes shall be measured along the center line of the pipe including all specials in Rmt. The quoted rate for respective item shall be Rmt, and shall include the following:

- A. Cost of respective pipes and specials and jointing materials etc.,
- B. Laying fixing and jointing with necessary clamps, brackets, bolts, nuts and washers.
- C. Making good all damages to the parts of the building to suit the surroundings and making good the defects if any.
- D. Testing and making good the defects if any

Valves: Valves shall be per number only and shall include the following:

- A. Cost of valve and jointing materials
- B. Fixing and jointing with necessary bolts, nuts, rubber insertion etc.,
- C. Testing and making good the defects if any:

11.4 GI Pipes and Fittings:

The pipes shall be of the medium quality (class B) unless otherwise specified and shall be of galvanized iron, screwed socketed and shall conform to IS: 1239. They shall be manufactured by a firm of repute. All fittings shall be malleable iron galvanized fittings of approved best Indian make.

11.4.1 LAYING AND FIXING

11.4.1 Where pipes have to be cut or re-threaded, ends shall be carefully cut so that no obstruction to bore is offered. For internal work all pipes and fittings shall be fixed truly vertical and horizontal either by means of standard pattern holder bat clamps keeping the pipes (12mm) clear of the wall everywhere or concealed as re-directed.

11.4.1.2 For external work, G.I pipes and fittings shall be laid in trenches. The width of the trench shall be the minimum width required for working. The pipes laid underground shall not be less than 60cms. From the finished ground level. The work of excavation and refilling shall be done as specified elsewhere or concealed as directed.

11.4.2 Painting : The burred pipes shall be painted with two coats of bit mastic paint.

11.4.3 Testing: Before any pieces are painted or covered, they shall be tested to a hydrostatic pressure of 7 kg/sqcm pressure shall be maintained for atleast eight hours without appreciate drop in pressure, in addition to the sectional testing of water supply pipes, the contractor shall test the whole installation to the entire satisfaction of the Project Engineer-Cum – Estate Officer, CCMD. He shall rectify any leakages, failure of fittings or valves.

11.4.4 Mode of measurements: G.I pipes above and below ground shall be measured along the center line of the pipes and fittings the quoted rate for respective item shall be per Rmt and shall include the following:

- a) Cost of respective pipes and specials
- b) Laying, fixing and jointing with necessary clamps
- c) Cutting hole and chases in walls floors, etc., and making good the same
- d) Testing and making good the defects if any.

PART III: SPECIFICATIONS FOR ELECTRICAL INSTALLATION

1.0 LEGEND:

- 1.1 Internal electrification (general lighting and power) is for general lighting for fans, lugs, lights etc.

2.0 GENERAL

- 2.1 The electrical installation shall comply in all respects with the requirements of the Indian electricity act, 1916 as amended from time to time and the Indian Electricity rules and Regulations currently in force.
- 2.2 Materials, fittings and appliances shall be of the best quality and of approved make/ manufacture; conforming to the relevant Indian Standard Specifications. Samples must be attached to Project Engineer-Cum-Estate Officer, CCMD for their approval well in advance, atleast prior to execution of work, (tenderers tenders may specify the name of makers/manufactures of the materials, fittings and appliances which they propose to use, while tendering)
- 2.3 Workmanship shall be I Class, conforming to the requirements of the I.E Rules and regulations currently in force. 2.4 it shall be the contractors responsibility to prepare the necessary drawings/ chart, and submit the same through proper channel to the concerned authorities for approval of the installations:

3.0 GENERAL LIGHTING:

- 3.1 The wiring is to be done in concealed conduit for full unless otherwise specified. The distribution of circuit distribution boards and main board are as indicated in the layout.
- 3.2 The circuit distribution boards are all to be completely embedded in walls to make them flush to the surface.
- 3.3 The main control board to be fixed in position as indicated in the layout and in the manner indicated by the Project Engineer-Cum-Estate Officer, CCMD, the power supply is so be drawn from the existing overhead line through an underground cable system, using necessary size G.I pipe at the wall entry. The cable jointing work should be done by an experience person specially trained for such jobs. The scope of this work includes laying cables in trenches (the trenches to be prepared by the contractor himself) and the cable jointing using necessary compounds.
- 3.4 The scope of this work covers the supply and installation of fittings like lighting fixtures, ceiling fans, exhaust fans, complete in all respects like mounting accessories lamps, wiring etc.,

- 3.5 The wiring for lights, plugs, fans etc., shall be of “looping-in-system” and in each and every switch box a neutral point shall be made available for testing purpose.
- 3.6 Not more than two power socket outlets should be connected in the same circuit and the power plugs be wired with PVC insulated conductor wires drawn in conduit.

4.0 POWER:

- 4.1 Power wiring in conduits shall unless otherwise specified, also be of concealed type run on walls independent of general lighting wiring based on the principle of overhead bus bar systems.
- 4.2 The mains will be terminated and connected through immediate junction boxes as shown in the layout and type of termination shall be as detailed in the layout: The tapping connections to load circuit boards shall be from the individual intermediate junction boxes, which will be at suitable capacity fuse units. The neutral connection shall be direct without fuse.
- 4.3 The tapping connections to load circuit boards shall be from the individual intermediate junction boxes, which will be at suitable capacity fuse units. The neutral connection shall be direct without fuse.
- 4.4 The control boards for the load outlets shall be fixed at a height of not more than 5 ft from the floor level and shall be in such a position as will be indicated by the Project Engineer-cum-Estate Officer at the time of execution.
- 4.5 All the intermediate junction boxes and the load control boards shall be suitable for flush mounting on the walls.
- 4.6 A portion of the power main pipes shall be possible to run the same on walls.

5.0 EARTHING:

- 5.1 Earthing in the case of power wiring shall be with soft drawn bars copper wire of size not less than 10 SWG, in double run suitably fixed on to the surface of the conduit by means of copper earth clips to ensure perfect electrical contact and the earthing wire shall run throughout the length of the conduit. At the main board level of individual earth wire runs shall be suitably interconnected firmly by means of earth clips to ensure proper continuity of earth connections, as well as full electrical contacts with the conduit pipes of the intermediate junction box and the load control boards and any other metal works in the wiring system shall all be suitably connected for perfect earth connections with insulated copper wire of size not less than 22G interconnections to the main earth loads. All the above works shall be in conformity with IS 732-1963

Code of practice for electrical wiring installation (system voltage not exceeding 650v)

6.0 GENERAL LIGHTING:

- 6.1 Insulated copper wire of not less than 22 G shall be used for the running of continues earth wire all along with conduits and shall be firmly bounded by means of suitable size earth clips, externally in order to have good electrical contact Bare copper wire sizes not less than 4 SWG shall be used for the main earthing connections.
- 6.2 These two earthing point outside the building shall be according to the I.S specifications for pipe earthing (IS 732-1963) provision shall be made at the light and fan outlets for earthing connections, so that they can be used wherever found necessary instruction from the Project Engineer-Cum-Estate Officer, CCMD.

7.0 Materials:

- 7.1 The conduit pipes to be used shall be heavy guage not less than 2mm thick of PVC conduit and good quality. The minimum size of conduit to be used shall be $\frac{3}{4}$ " dia. The conduit fittings like bends, junction boxes etc., should be of standard quality and shall be with good deep matching threads to suit the conduit pipes and shall be free from burs etc.,
- 7.2 The switch boxes etc., shall be metal clad out of M.S Sheets not less than 16SWG either square or oblong in shape and in suitable sizes as per requirements and shall be provided with earthing terminal screws for body earthing connections. The depth of the boxes shall be such that they should fully be embedded in the wall, flush with the finished wall surfaces.
- 7.3 The top covers of these boxes be of either laminated sheets of thickness between 1/8" to 1/4" as required for perpex sheets.
- 7.4 The control switches for lights shall be hush type as specified 7.5 the 5 amps plugs and socket shall be 3 pin flush type
- 7.5 The 15 amps 3 pin power plugs shall be preferably flush mounting type with a combined switch and shall be controlled by a fuse or a miniature circuit breaker single pole type.

8.0 PARTICULAR SPECIFICATIONS:

- 8.1 Type/system of wiring : only loop in system of wiring with PVC in conduit (surface as per details in schedule) and junction boxes where absolutely necessary and only at the places approved by the Engineer-in-Chief, CCMD.
- 8.2 Wires: Single core multistrand copper PVC of approved make and conforming to ISI only should be used.

- 8.3 Conduit: Heavy gauge of 2mm thick PVC conduit pipe. Conduit drops must be laid to plumb. PVC bushings should be provided at all ends of conduits.
- 8.4 Workmen: All work must be executed by licensed electrical wiremen possessing valid licences.
- 8.5 Switches: All 5 amps switches and 3 pin wall plugs must be of good quality or equivalent approved make.
- 8.6 Florescent Fittings: Light fittings should be complete in all respects including clamps reflectors, tubes, chokes, condensers, starters and internal wiring, extras on this account not admissible. The rate quoted must include these elements as well. Any damage to these fittings during erection/ installation should either be made good or fitting replaced totally.
- 8.7 Cables: Cables shall be with aluminium conductor, PVC insulated conforming to IS specification.
- 8.8 The contractor should enclose the pamphlets, catalogues of various materials offered while submitting the tender. The tenderers are required to submit along with their tender the list of makes of all equipments, fittings, fans, lamps, switches, gear, fuse gear, conduits and accessories, wiring materials and accessories. Non compliance to this will subject to their tender for disqualification or rejection.
- 8.9 Earthing: All machine parts, metal covers, switches, panels, fittings should be I/P earthed as given in the schedule and this has to be approved by the electrical inspector. The procedure should be strictly from L.E.E Regulations and Indian Electricity Act. Earthing in continuity for conduit pipes throughout and at junction boxes should be maintained by check nuts on either side and earthing clamps where necessary.
- 8.10 Boards: The main board and the sub distribution boards should be metal clad. The M.S sheet used for the box should be 3 mm thick and holes of the required diameter for incoming and outgoing pipes should be drilled in it.
- 8.11 Wiring diagrams: The contractor shall, on completion of electrical works executed in the budding furnish in duplicate the wiring diagrams indicating the light, power, fan points/outlets etc., indicating the colour code also so as to enable easy identification of circuits.

8 (a) CONDITIONS/INSTRUCTIONS TO BE NOTICED BY TENDERER BEFORE QUOTING FOR THE WORK**I. DETAILS TO BE FURNISHED FOR ENGAGING SUB-CONTRACTOR FOR SPECIALISED WORKS.**

The tenderer shall be required to engage agencies of standing and repute who have experience in executing works of similar nature and magnitude. Such specialized trades cover electrical installation (HT/LT), Lifts, A.C. sanitary and water supply works, firefighting installation and any such other trades as may be directed by the Institute. The successful tenderer shall be required to engage Sub-agencies for such specialized trades only with the prior written approval of the Project Engineer cum Estate officer after giving an opportunity to the Project Engineer cum Estate officer to evaluate the experience and competence of the sub-agency for each trade. In order to ensure implementation of this requirement, it is required that each tenderer shall submit along with his tender, names of three sub-agencies for each trade amongst whom tenderer proposes to engage if successful in the tender. Along with names of sub-agencies for each trade, the tenderer shall furnish in detail the following particulars in respect of each sub-agency in the format furnished in Technical Bid.

All such information concerning sub-agencies shall be furnished along with the tender. Any tender containing insufficient information in this regard is liable for rejection. In the event of non-compliance of this requirement, the Institute shall have the right to nominate any sub-agency who in their opinion meets the selection criteria. In such event it would be incumbent on the successful tenderer, to accept and appoint the nominated sub-agency without demur and on this account, if there is any additional cost, such cost shall be borne by the successful tenderer. The Institute shall have no liability on this account.

The Institute has the right to evaluate the experience, reputation etc., of such sub-agencies and on their approval in writing to the successful tenderer, successful tenderer shall be required to engage only such approved agencies for execution. If the Institute is not satisfied with the performance or capability of the names in the panel furnished by the tenderer, the successful tenderer shall be required to engage an agency nominated by Institute.

In all these matters, there shall be no additional financial implication to the Institute. The successful tenderer shall be required to execute works within the accepted rates only and no claim will be accepted due to the Institute, insistence on engaging any sub-agency. The Institute further reserves the right to instruct the successful tenderer to terminate the work of sub-agency at any time during the contract, if the performance is found unsatisfactory. In such case, the successful tenderer shall be required to furnish a further panel of names from whom a similar selection can be made by the Institute. In this instance also, the Institute is not liable for any additional cost. Responsibility for the delay occurred in this process, if any shall rest with the successful tenderer.

- 8.1 It is the responsibility of the successful tenderer to ensure that the sub-agencies engaged in the work comply with all the clauses in the agreement between the Institute and the successful tender. It shall be responsibility of the successful tenderer to exercise first line supervision on the works executed by his sub-agencies including supervision on the quality of materials and workmanship and to ensure that the sub agencies comply with the technical specifications, drawings and bill of quantities. The successful tenderer shall also establish competent site organization technically and administratively to ensure that the works of various sub-agencies are supervised and well co-ordinate to ensure proper sequencing of construction, and finishing works and to ensure that the overall time schedule is fully complied with. The detailed construction programme schedule to be furnished by successful tenderer shall include action plan for procurement of materials and execution of works at site for each of the sub-agency and the detailed construction programme schedule shall reflect proper integration of each component of the building to ensure well-coordinated execution so as to complete the project including services within the stipulated time schedule.
- 8.2 Every tenderer shall furnish Line of Credit / Over Draft facility to the agency from any Public Sector Undertaking Bank/Scheduled commercial Bank/Nationalized Bank for a sum of ____ Lakhs as to their financial soundness without which such tender may not be considered further at the discretion of the Institute without questioning thereof.
- 8.3 Dismantling/Demolition of existing buildings/structures shall be commenced in the order of preference as approved by the Institute whose discretion in this regard is final and binding on the contractor.
- 8.4 Pre-measurements of all items of work shall be taken before demolition or dismantling and specification for deduction for voids, openings etc., shall be on the same basis as that adopted for new construction of the work.

- 8.5 Existing service lines such as electrical, water supply, sewer lines, telephone lines etc., shall be carefully protected and preserved before commencement and during excavation, dismantling /demolition operations. Details of UG facilities shall be provided to the successful tenderer. Any damage caused to the aforesaid service lines, etc., during excavation, demolition/dismantling shall be made good at Contractor's own expense/cost. Restoration of any service lines, which needs to be shifted and found in the proposed site, is the responsibility of the contractor and the agency shall carry out the work as per the direction of Project Engineer the cost of such work will be borne by the Institute.
- 8.6 Dust nuisance to neighbor shall be minimized by providing and erecting screens to the required height as per direction of Project Engineer cum Estate officer with Aluminum sheets or canvas or other suitable material before commencement of the work. The site shall be cleared off such protection arrangement after virtual completion of work. All the operations shall be carried out strictly in accordance to regulations of municipal and other local authorities and shall be restricted to normal working hours.
- 8.7 No debris or materials got from dismantlement/demolition the building(s) shall be thrown in the public road causing inconvenience to the traffic and any fine or penalty imposed by local authority for non-compliance of this provision shall be borne by the contractor.
- 8.8 ***Excess excavated earth including debris etc., collected at site during and after completion of the work shall be carted out of the Institute premises by the contractor. The road used for transportation shall be kept clean without any spillages.***
- 8.9 The Contractor shall be responsible for any injury to persons, animals, or things and for all structural damage to property which may arise from the operation or neglect of himself and or any nominated sub-contractors, contractor's Employees and or third party whether such injury or damage arising from carelessness, accident or any other cause whatsoever, in any way connected with the carrying out the construction/dismantling/demolition.
- The contractor shall take required insurance cover with an approved insurance company as provided in the contract and deposit with the Institute well before commencement of construction/ demolition / dismantling.
- 8.10 The successful tenderers shall make own arrangements to obtain all materials required for the work including **cement and steel** from approved vendors.
- 8.11 **The Agency shall bring the approved Ready-Mix Concrete from outside IISc for RMC works based on the approved design mix for which necessary certificate should be furnished. Regarding minimum cement content relevant IS specifications shall prevail. Only Ordinary Portland land cement shall be used for RMC works.**
- 8.12 **Preservation of trees:** The contractor shall preserve all existing trees in and adjacent to the site which does not interfere with the construction as determined by the Engineer-in charge.
- 8.13 Drawings and working Details: The work shall be carried out strictly in accordance with the approved plans and estimates and specifications and as per the instructions of the Engineer-in-charge, and no deviations or changes are permitted without the written order of the Engineer. The designs and drawings enclosed with the tender documents are only typical and tentative. The working drawings and the working details of the several components of works will be prepared and made available at the time of execution and the contractor shall carryout the work in accordance with such working drawings and working details.
- 8.14 **Omissions and discrepancies in drawings and instructions:**
- 8.14.1 In all cases of omissions, doubts or discrepancies in the dimensions or discrepancies in the drawings and item of work, a reference shall be made to the Project Engineer cum Estate officer, whose elucidation and elaboration shall be considered as authorized. The Contractor shall be held responsible for any error that may occur in the work through lack of such reference and precautions.
- 8.14.2 The contractor shall be responsible for accuracy for all shapes, dimensions and Alignments both vertical and horizontal etc., of all the components of the work.

8.15 Lands for the use of the Contractors Camp:

The contractor shall have to make his own arrangements at his own cost for construction of living accommodation outside the IISc premises. The Employee shall not provide any space / building for labour camp.

8.16 Undesirable Person to be removed from site:

The contractor shall not employ on site any person who is undesirable, if in the opinion of the Project Engineer the person or persons at site of work employed on behalf of the contractor is/are considered undesirable. The Project Engineer shall notify the contractor to this effect and the contractor will be bound by the decision of the Project Engineer to remove such person or persons from the site of work and from the labour camp. The contractor shall not be entitled to any damage or loss on this account. On the contrary, the contractor shall be liable to compensate the Institute for any loss or damage to the Institute property caused by the employment of such person.

8.17 Labour Statistics:

The contractor shall submit daily reports on the following:

(a) Total No. of labour employed in the working area.

8.18 Execution of work during night time:

The work shall normally be carried out between 08.00 hours and 17.00 hours with a break of one hour and when permitted during night period, the second shift shall be between 17.00 hours and 00 hours with a break of half an hour during night. When ordered to work at night, adequate provision for lighting the working area should be made by the contractor at his cost and got approved by Engineer. The agency shall not be paid extra for the works executed during night.

8.19 Safety code:

8.19.1 The Contractor at a prominent place at work spot should bring these safety provisions to the notice of all concerned by display on notice board. The persons responsible for compliance of the safety code shall be named therein by the contractor.

8.19.2 To ensure effective enforcement of the rules relating to safety precautions, the arrangement made by the contractor shall be open to inspection by the Labour Officer, Engineer or his representatives.

8.19.3 All necessary personal safety equipment's as considered adequate by the Engineer should be kept available for immediate use of persons employed at the site and maintained in the good condition and the contractor should take adequate steps to ensure proper use of equipment by those concerned.

8.19.3.1 Workers employed on mixing concrete, cement grout, cement mortar shall be provided with protective footwear protective goggles and protective gloves.

8.19.3.2 Those engaged in mixing or stacking cement or any materials injurious to the eye, nose and mouth shall be provided with a face mask and protective cover free of cost by the contractor.

8.19.3.3 Those engaged in welding work shall be provided with welder's protective eye Shield and gloves.

8.19.3.4 Stonebreakers shall be provided with protective goggle and protective clothing and seated at sufficiently safe intervals.

8.19.3.5 Those engaged in binding and fabricating steel shall be provided with protective gloves.

8.19.3.6 Those engaged in deep cuts, large rock excavation shall be provided with helmets.

8.19.3.7 All labour / persons at work shall wear helmet compulsorily

- 8.19.4 When the work is near any place where there is risk of drowning all necessary equipment's shall be kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provisions should be made for prompt first aid treatment of all injuries likely to be sustained during the course of work.
- 8.19.4.1 Adequate and suitable caution and danger signal boards shall be prominently exhibited at road/high tension overhead line/where heavy electrical machines are working where overhead cranes or hoist; derricks, winches are working where blasting zone is demarcated. The content of the board shall be in English and the local language for easy identification.
- 8.19.4.2 All scaffolding, ladder, stairways, gangways, staging, centering, form work and temporary support and safety devices etc., shall be sound in strength and constructed and maintained as such throughout its use. The agency shall obtain approval from Project Engineer cum Estate officer for scaffolding, formwork etc., before commencement of work.
- 8.19.4.3 No materials on any site of work shall be so stacked as to cause danger or inconvenience to any persons or public.
- 8.19.4.4 The Contractor shall provide all necessary fencing and lighting to protect the public/working men from accident and shall be bound to bear the expense of defense of every suit action or other proceedings of law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost, which may be awarded in any such suit action or proceedings to any such persons or which may with consent of the contractor be paid to compensate any claims by any such person.
- 8.19.4.5 No electric cables or apparatus, which is liable to be a source of danger to persons, employed shall remain electrically charged unless a caution Board is put into that effect and close approach to the same is prohibited.
- 8.19.4.6 All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosives. No floor, roof or other portion of any building used for residence shall be so over-loaded with debris or materials so as to render it unsafe.
- 8.19.4.7 The final disposal of water used for work or removed from work spot as well as the supply used for domestic consumption shall be as directed by the Engineer. The contractor shall make his own arrangement for purification of domestic water supply used by his staff and labour colony and used on the site of work to the satisfaction of the Engineer.
- 8.19.4.8 The source of drinking water supply/distribution system in workers colony shall be protected from chances of contamination by poisonous materials epidemic causing infections bacteria etc., by maintaining the source and system under adequate hygienic conditions.

Notwithstanding the above clauses from 8.19 (1) to (4) there is nothing in this to exempt the contractor to exclude the operations of any other Act or Rules in force of the Central Govt., State Govt.

8(b) CONDITIONS FOR ELECTRICAL WORK:

8.1 GENERAL

These conditions are meant to amplify the specifications and General Conditions of Contract. If any discrepancy is noticed between these conditions, Specifications, Bills of Quantities and Drawings, **the most stringent of the above shall apply for execution of the work.**

The materials, design and workmanship shall satisfy the specifications contained herein and Codes Referred to. Where the technical specifications stipulate the requirement in addition to those contained in the Standard Codes and specifications, those additional requirements shall also be satisfied. In the absence of any Standard/ Specifications covering any part of the work covered in this tender document, the instruction/ directions of Project Engineer will be binding on the contractor.

The scope of this section is to describe materials and systems for complete electrical installations of building which form together with the project documents, a complete volume of work and quality description. All electrical installation shall be of high quality, safe, complete and fully operational including all necessary items and accessories whether or not specified in detail. All electrical work shall be completed in accordance with the regulations and standards to the satisfaction of the Project Engineer. The general provisions, provisions and general requirements apply to the entire installation.

The work shall be carried out simultaneously with building work and shall be continued till it is completed satisfactorily along with the completion of essential portions of the building works.

During the progress of work, completed portion of the building may be occupied and be put to use by the owner but the contractor shall remain fully responsible for the maintenance of electrical installations till the entire work covered by this contract is satisfactorily completed by him and handed over to the institute.

8.2 SCOPE OF WORK:

8.2.1 The scope under this contract shall include the internal electrical installation for the work. The work to be carried out under this contract shall cover the supply, installation, testing and commissioning of the complete electrical installation as detailed herein under and shown in the drawings and specifications.

In general the work to be performed under this contract shall comprise of the following:

- a) Supply, installation, testing and commissioning of All Main Lighting panels, distribution panels and other miscellaneous panels.
- b) Supply, installation, testing and commissioning of mains and sub mains, distribution cables and cable trays etc.
- c) Supply, installation, testing & commissioning of all wiring/cabling for lights, fans and power outlets including point and circuit wiring along with wiring accessories etc.
- d) Supplying and drawing of cables/wires for telephone system including installation of terminal boxes etc.
- e) Supply, Installation, testing and commissioning of light fixtures as indicated in the BOQ and installation, testing and commissioning of lighting fixtures supplied by the owner, if

any.

- f) Supply, installation, testing and commissioning of external lighting poles, cables lighting fittings panels/feeder pillars etc.
- g) By only licensed Electrical Contractor holding valid 'A' grade license issued by Electrical Inspector to Govt. of Karnataka.

Contractor shall carry out and complete the said work under this contract in every respect in conformity with the current rules and regulations of the local electricity authority. The contractor shall furnish all labour and install all materials, appliances, equipment, necessary for the complete provision and testing of the whole electrical installation as specified herein and shown on the drawings. This also includes any materials, appliances, equipment not specifically mentioned herein or noted on the drawings as being furnished or installed but which are necessary and customary to make complete installation with all outlets for power, light, telephone conduits and other electrical systems/& Extra low voltage systems shown on the schedule and described herein, properly connected and in working condition.

The work shall include all incidental jobs connected with electrical installation such as excavation in trenches and back filling, cutting/drilling and grouting for fixing of fixtures, equipment, making good the damages etc.

8.3 RATES:

8.3.1.0 The rates quoted shall be deemed to allow for all minor extras and constructional details which are not specifically shown on drawings or given in the specifications but are essential in the opinion of the Project Engineer to the execution of works to conform to good workmanship and sound engineering practice. The Project Engineer reserve the right to make any minor changes during the execution without any extra payment.

8.3.1.1 The Project Engineer decision to clarify any item under minor changes, minor extras and constructional details shall be final, conclusive and binding on the Contractor.

8.3.1.2 The rates quoted by the Contractor shall be net so as to include all requirements described in the contract agreement and no claim whatsoever due to fluctuations in the price of material and labour will be entertained.

8.3.1.3 The rates quoted by the Contractor shall include for supplying material and labour necessary for completing the work in the best and most workmanship like manner to the satisfaction of the Project Engineer. The rates shall be complete in all respects including cost of materials, erection, fabrication, labour, supervision, tools and plant, transport, sales and other taxes, royalties, duties and materials, contingencies, breakage, wastage, sundries, scaffoldings, etc. on the basis of works contract. The rates quoted shall include all taxes, duties, transport, insurances, octroi, or any other levies applicable under the statute.

8.3.1.4 In case the rates of identical items under different sub-heads/parts are different, the lowest of these will be taken for the purpose of making the payments.

8.3.1.5 The rates for different items are for all heights, depths, widths and positions, unless otherwise specified against the item. No claim in respect of any leads/lifts for any item specified in the Schedule of Quantities, for which separate items for lead/lift do not exist in that schedule, will be entertained.

8.3.1.6 The work shall be executed as per the programme drawn or approved by the Project Engineer and

it shall be so arranged as to have full co-ordination with any other agency employed at site. No claim for idle labour shall be entertained nor shall any claim on account of delay in the completion of the work be tenable except extension of time secured by the contractor on request to be submitted to the Engineer-in-Charges.

8.3.1.7 The Contractor shall permit free access and afford normal facilities and usual convenience to other agencies or departmental workmen to carry out connected work or other services under separate arrangements. The Contractor will not be allowed any extra payment on this account.

8.3.1.8 The contractor shall provide all equipment's, instruments, labour and such other assistance required by the Project Engineer for measurement of the works, materials etc.

8.3.1.9 Even though the payment shall be effected under different items in the schedule of quantities, the various items in the schedule of quantities shall be deemed to cover all aspects of the work for the completion of the work as per drawings, from excavation to the finishing notwithstanding any space adjustment possible omission in the description of the item and specifications thereof regarding incidental items of work, without which the whole work cannot be deemed to have been included under the scope of the different items of the schedule of quantities. The Contractor is advised to keep this in mind while quoting rates as no claims in this regard shall be entertained.

8.4 AWARENESS OF SITE CONDITIONS AND CARRYING OUT OF SITE INSPECTION PRIOR TO TENDER SUBMISSION

Prior to the preparation and submission of his Tender, the Contractor shall make visits to the site and carry out all the necessary inspections and investigations in order to obtain all information and to make his own assessment of the conditions and constraints at site, including the means of access to it. The Contractor shall make himself aware of all the features of the site and the working conditions and space and shall, in general, be responsible for obtaining all the necessary and requisite information needed for him to prepare and submit his Tender.

Should the Contractor require any clarifications he shall seek these in writing from the Project Engineer before submitting his Tender. At no stage will any extra claims be entertained or allowed on any matter or for any reason arising from or as a consequence of the Contractor's failure to comply with all the requirements stipulated in this Clause.

8.5 WORK AND WORKMANSHIP

8.5.1 To determine the acceptable standard of workmanship, the Project Engineer may order the Contractor to execute certain portions of works and services under the close supervision of the Project Engineer. On approval, they shall label these items as guiding samples so that further works are executed to conform to these samples.

8.6 TEST CERTIFICATES

The contractor shall submit copy of test certificates for all the major electrical equipment such as circuit breakers, CTs, PTs, instruments, relays, busducts, rising mains, busbars, cables etc., and panel as a whole, confirming to relevant IS/BIS standards issued by manufacturers.

8.7 SAMPLES AND CATALOGUES

Before ordering the material necessary for these installations, the contractor shall submit to the Engineer-in-Charge/Consultants for approval, a sample of every kind of material such as cables, conductors, conduits, switches, socket outlets, circuit breakers, lighting fixtures, boxes etc., along with the catalogues with their dimensional details.

For major items such as sub lighting panels distribution boards, the submission of drawings/catalogues along with technical details shall be enough. Prior to ordering any electrical equipment/material/system, the contractor shall submit to the Engineer-in-Charge/Consultants the catalogues, along with the samples, where applicable, from the approved manufacturer. The contractor shall arrange inspection and testing at the manufacturer's factory or assembly shop for final approval. No material shall be procured prior to the approval of the Engineer-in-Charge/Consultant.

Also contractor shall ensure that the dimensional details of the equipment fit into the allotted space provided in the building.

8.8 COMPLETION CERTIFICATE

On completion of the electrical installation a certificate shall be furnished by the contractor countersigned by the licensed supervisor, under whose direct supervision the installation was carried out.

8.9 PERFORMANCE GUARANTEE

The contractor shall indemnify the Institute against defective materials and workmanship for a period of one year after completion of the work. The contractor shall also hold himself fully responsible during that period for reinstallation or replacement at free of cost to institute, the following :

8.9.1 Any defective work or material supplied by the Contractor.

8.9.2 Any material or equipment damaged or destroyed as a result of defective workmanship by the contractor.

8.10 RATE ANALYSIS

At anytime and at the request of the Project Engineer the contractor shall provide details or breakdown of costs and prices of any part or parts of the works.

8.11 The Project Engineer reserves the rights to delete any item from the contractor's scope of works.

9. CONTRACTOR'S LABOUR REGULATIONS

ANNEXURE I.

9.1 DEFINITION:

In these regulations unless otherwise, expressed or indicated the following words and expressions shall have the meaning hereby assigned respectively that is to say:

- 9.1.1 Labour means workers employed by the contractor or the Institute directly or indirectly through sub-contractor or any other person, or any agent on his behalf on a payment as per prevailing Karnataka State labour regulations and will not include supervisory staff like overseers etc.
- 9.1.2 Fair wages means whether for item or place of work notified at the time of inviting tenders for the work and where such wages have not been so notified, the wages prescribed by the Karnataka Public Works Department for the district in which the work is done.
- 9.1.3 Contractors shall include every person whether a sub-contractor head or agent employing labour on the work taken contract.
- 9.1.4 The relevant orders of Government of Karnataka in regard to payment of wages as amended from time to time shall be followed by the contractor.

9.2 WORKING HOURS:

- 9.2.1 Normally working hours of a labour employed should not exceed 8 hours a day. The working day shall be so arranged that inclusive of interval for rest if any, it shall not spread over more than 12 hours on any day.
- 9.2.2 When a worker is made to work for more than 8 hours on a day or for more than 48 hours in any week, he is entitled to double the ordinary rate of wages. Children shall not be made to work.
- 9.2.3 Every worker shall be given a paid weekly holiday normally on Sunday.

9.3 DISPLAY OF NOTICE REGARDING WAGES ETC.

The contractor shall (a) before he commences his work on contract, display and correctly maintain in a clean legible condition in conspicuous places on the work, notices in English and in the local language spoken by the majority of the workers, giving the rate of wages which have been certified by the Regional Labour Commissioner, as fair wages and the hours of work which such wages are earned, and a copy of such notices shall be sent to the certifying officers.

9.4 PAYMENT OF WAGES:

Wages due to every worker shall be paid to him direct.

9.5 FIXATION OF WAGES PERIODS:

- 9.5.1 The contractor shall fix the wages period of which the wages shall be payable.
- 9.5.2 Wages of every worker employed on the contract shall be paid.
 - 9.5.2.1 In case of establishments in which the wage period is one week, within three days from the end of the wage period wages shall be paid.
 - 9.5.2.2 In the case of other establishment before the expiry of the 7th day or 10th day from the end of the wage period according to the numbers of the workers employed in such establishment does not exceed 100 or exceeds 1000.

9.5.3 When the employment of any workers is terminated by or on behalf of the contractor the wages earned by him shall be paid before the expiry of the days succeeding the one which his employment is terminated.

9.5.3.1 All payment of wages shall be made on a working day except when the work is completed before the expiry of the wages period in which case final payment shall be made within 48 hours of the last working day at work site and during the time.

NOTE: The term working day means a day on which the labour is employed and the work is in progress.

9.6 FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES:

The Wages of workers shall be paid to him without any deductions of any kind except the following:

9.6.1 Deductions:

9.6.1.1 Deductions for absence for duty i.e., from the place or the places whereby the terms of his employment he is required to work. The amount of deductions shall be in proportion to the period for which he was absent.

9.6.1.2 Deductions for damage or loss of goods expressly entrusted to the employed person for custody or for loss of money or any other deduction which he is required to account, where such damage or loss is directly attributable to neglect or default.

9.6.1.3 Deduction for recovery of advance or for adjustment of over payment of wages, advance granted shall be entered in a register.

9.6.1.4 And other deductions which the Institute may from time to time allow.

9.6.2 Fines:

9.6.2.1 No fine shall be imposed on any worker save in respect of such acts and the Commissioner of Labour has approved omissions on his part as.

9.6.2.2 No fine shall be imposed on a worker and no deduction for damage or loss be made from his wages until the worker has been given an opportunity. Undertaking of showing cause against such fines or deductions.

9.6.2.3 The total amount of fines which may be imposed in any one wage period on a worker shall not exceed an amount equal to the wages payable to him in respect of that wage period.

9.6.2.4 No fine imposed on any worker shall be recovered from him by installments or after the expiry of sixty days from the date which it was imposed.

9.6.2.5 Every fine shall be deemed to have imposed on a day of the act or omission in respect of which it was imposed.

9.6.3 The contractor shall issue an employment card in Form III to each worker on the day of the worker's entry into the employment. If the worker has already any such card with him for the previous employment of contractor, he shall merely endorse that employment card with relevant entries. On termination of employment, the employment card shall again be endorsed by the contractor and returned to the worker.

9.7 REGISTER OF UNPAID WAGES:

The contractor should maintain a register of unpaid wages in such a form as may be convenient at the place of work but same shall include the following particulars:

9.8.1 Full particulars of the laborer's whose wages have not been paid.

9.8.2 Reference number of the muster roll and wage register

9.8.3 Rate of wages

9.8.4 The period

9.8.5 Total amount not paid

9.8.6 Reasons for not making payment

- 9.8.7 How the amount of unpaid wages was utilized
- 9.8.8 Acquaintance with dates.

9.8 REGISTER OF ACCIDENTS:

The contractor shall maintain a register of accidents in such form as may be convenient at the work place but the same shall include the following particulars.

- 9.9.1 Full particulars of the laborers who met with accidents.
- 9.9.2 Rate of wages
- 9.9.3 Sex
- 9.9.4 Age
- 9.9.5 Nature of accidents and cause of accident
- 9.9.6 Time and date of accidents
- 9.9.7 Date and time when admitted in Hospital
- 9.9.8 Date of discharge from the Hospital.

9.9 REGISTER OF FINES ETC.

- 9.9.1 The contractor shall maintain a register of fines and a register of deductions for damages or loss in form Nos. I and II respectively which shall be kept at the place of work.
- 9.9.2 The contractor shall maintain both in English and local language a list approved by Commissioner for labour clearly stating the acts and commissions for which penalty or fine may be imposed on a workmen and display it in a good condition in conspicuous place on the work.

9.10 SUBMISSION OF RETURNS:

The contractor shall submit periodical returns as may be specified from time to time.

9.11 AMENDMENTS:

The Government of Karnataka may from time to time add to or amend the regulations and on may question as to the application interpretation on effect if these regulations the decision of the Commissioner of Labour or Deputy Commissioner for Labour to Govt. in that behalf shall be final.

ANNEXURE II**Labour Clause 9.12**

Clause 12 A No labourers below the age of 15 years shall be employed on the work.

Clause 12 B Payments of wages of labourers.

The contractor shall pay not less than fair wage of labourers engaged by him on the work.

EXPLANATION:

- (a) The contractor shall notwithstanding the provision of any contract to the contrary cause to be paid wages to labourers indirectly engaged for the work including any labour engaged by his sub-contractors in connection with the same works if the labourers have been immediately employed by him.
- (b) In respect of all labours directly or indirectly employed in the works for the performance of the contractor's part of this agreement, the contractor shall comply with or cause to be complied with Karnataka Public Works Department Contractors Labour Regulations from time to time, in regard to payment of wages. Wage period, deductions from wages recovery of wages not paid and deductions unauthorized made, maintenance of wage book, wage slips, publication of scale of wage and other terms of employment, inspection and submission of periodical returns and all other matter of a like nature.

The Project Engineer cum Estate officer or In-charge Engineer concerned shall have the right to deduct from the money due to the contractors any sum required for making good the loss suffered by a worker or workers by reason of non-fulfillment of the conditions of the contract for the benefit of the workers, non-payment of wages or of deductions made from his or her wages which are not justified by their terms of the contract or non-observance of the regulations.

- (c) For payment of minimum wages the Contractor is bound to follow the relevant orders of Govt. of Karnataka from time to time.
- (d) Vis-à-vis the Institute the contractor shall be primarily liable for all payments to be made under and for the observance of the regulations aforesaid without prejudice to his right to claim indemnity from his sub-contractors. The regulations aforesaid shall be deemed to be part of this contract, and any breach thereof shall be deemed to be a breach of this.

Clause 12(c): In respect of all labour directly or indirectly employed in the work for the performance of the contractor's part of this agreement the contractor shall at his own expense arrange for the safety provisions as per Karnataka P.W.D. safety code framed from time to time and shall at his own expense provide for all facilities in arrangements and provide necessary facilities as aforesaid he shall be liable to pay penalty of Rs. 50/- for each default and in addition the Project Engineer cum Estate officer in charge shall be at liberty to make arrangements and provide facilities as aforesaid, and recover the cost incurred in that behalf from the contractor.

Clause 12(d): The contractor shall submit by the 4th and 19th of every month to the Project Engineer of true statement showing in respect of the second half of the preceding month and the first half of the current month respectively (1) the name of labourers employed by him on the work (2) their working hours, (3) the wages paid to them, (4) the accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage and injury caused to them and (5) the number of female workers who have been allowed, maternity benefit according to clause 19F and the amount paid to them, failing which the contractor shall be liable to pay the Institute a sum of not exceeding Rs. 50/- for each default or materially incorrect statement by deduction from any bill due to the contractor and amount levied as fine.

Clause 12(e): In respect of all labour directly or indirectly employed in the works for the performance of the contractor's part of this agreement, the contractor shall comply with or cause to be complied with all the rules framed by Institute from time to time for the protection of health and sanitary arrangements for workers employed by the Indian Institute of Science and its contractors.

Clause 12(f): Maternity benefit rules for female workers employed by contractor, leave and pay during leave shall be regulated as follows:

Leave (i) in case of delivery: Leave during maternity leave not exceeding 8 weeks up to and including the day of delivery and 4 weeks following that day.

(ii) In case of miscarriage, up to 3 weeks from the date of miscarriage.

9.13 **Pay:**

- i) In case of delivery: Leave pay during maternity leave will be at the rate of women's average daily earning calculated on the total wages earned on the days when full time work was done during the period of three months immediately preceding the date on which she gives notice that she expects to be confined.
- ii) In case of miscarriages: Leave pay at the rate of average daily earnings calculated on the total wages earned on the day's full time works was due during a period of 3 months immediately preceding the date of miscarriage.
- iii) Conditions for the grant of maternity leave: No maternity leave benefit shall be admissible to a woman unless she has been employed for a total period of not less than 6 months immediately preceding the date of delivery /miscarriage.

Model rules for the protection of Health and Sanitary arrangements for workers employed by the Indian Institute of Science or its contractors.

Applications: The rule shall apply to all building and construction work in charge of Indian Institute of Science

Definition (i): Work place means a place at which on an average fifty or more workers are employed in connection with construction work.

9.14 **First Aid:**

- (a) At every place, there shall be maintained in readily accessible place first aid appliance including the adequate supply sterilized dressing and sterilized cotton wool. The appliances shall be kept in good order and in large work places they shall be placed under the charge of responsible person who shall be readily available during working hours.
- (b) At large work place where hospital facilities are not available within easy distance of the works first aid posts shall be established and be run by a trained compounder with one bed for every 250 employers.
- (c) Where large work places are situated in cities, town or in their suburbs and no beds are considered necessary due to proximity of city or town hospitals, suitable transport shall be provided to facilitate of urgent cases to these hospitals at the work places, some conveyance facilities such as a car should be kept readily available to take injured persons suddenly taken seriously ill, to the nearest hospital.

9.15 **DRINKING WATER:**

- (a) In every work place there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.
- (b) Where drinking water is obtained from an intermittent public water supply each work place shall be provided with storage tank for drinking water to be stored.
- (c) Every drinking water supply storage tank shall be at distance not less than 50 ft. from any latrine, drain or other source of pollution. The tank shall be properly chlorinated before water is drawn from it for drinking. All such tanks shall be entirely closed with a trap door, which shall be dust and waterproof.
- (d) A reliable pump shall be fitted to each covered well. The trap door shall be kept locked and opened only for cleanings or inspection, which shall be at least once a month.

9.16 SCALE OF ACCOMMODATION TO LATRINES (L) AND URINALS (U):

There shall be provided within premises of every work place latrines and urinals in an accessible place, and the accommodation separately for each of them shall not be less than following scale:

	L + U
Where the No of persons does not exceed 50	– 3 + 3 Nos.
Where the No of persons exceeds 50 but does not exceed 100	– 3 + 3 Nos.
For every additional 100	- 3 + 3 Nos.

In particular cases the Project Engineer cum Estate officer shall have the powers to vary the scale wherever necessary.

9.17 LATRINES AND URINALS FOR WOMEN:

If women are employed separate latrines and urinals screened from those for men, and marked in the vernacular conscious letter “For women only” shall be provided on the scale in rule 9.17. Those for men shall be similarly marked for men only. A poster showing figures of men and women shall also be exhibited at the entrance of latrines for each sex. There shall be adequate supply of water closet for the urinals and latrines.

9.18 LATRINES AND URINALS:

Except in work provided with water flushed latrines connected with water borne sewerage all latrines shall be provided with receptacles on dry earth system which shall be cleaned at least four times daily and at least twice during working hours and kept in a strictly sanitary condition. The replaces shall be tarred inside and out side at least once a year.

9.19 CONTRUCTION OF LATRINES:

The inside walls shall be constructed of masonry or some suitable heat resisting non-absorbent materials and shall be cement washing noted in a register maintained for this purpose and kept available for inspection. Latrines shall not be of a standard lower than borned other system and should have thatched roofs.

9.20 PROVISIONS OF SHELTERS DURING REST:

At every work place there shall be provided free of cost two suitable sheds one for meals and other for rest separately for men and women for use of labour. The height of the shelter shall not be less than 11 ft. from the floor level to the lowest part of the roof. The shed should be roofed with at least thatch and mud flooring will be provided with dwarf wall around not less than 2.5 feet. Sheds shall be kept clean and space shall be on the basis of at least 5 square feet per head.

9.21 CRECHES:

At every place, at which fifty or more women are ordinarily employed there shall be provided two huts for the use of children under the age 6 years belonging to such women. One hut shall be used for infant games place and the other as their bedroom. The huts shall not be constructed of a lower standard than the following:

- (i) Thatched roofs
- (ii) Mud floor and walls
- (iii) Planks spread over the mud floor and covered with matting.

9.21.1 The huts shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean; there shall be two boys in attendance. Sanitary utensils shall be provided to the satisfaction of the Health Officer of the area concerned. The use of the hut shall be restricted to children, their attendants and mother of the children.

- 9.21.2 Where the number of women workers is more than 35 but less than 50, the contractor shall provide at least one hut and one attendant to look after the children of women workers.
- 9.21.3 The crèche shall be properly maintained and necessary equipments like toys etc., shall be provided.
- 9.21.4 The size of the crèches shall vary according to the number of workers.
- 9.22 **CANTEENS:**

A cooked food canteen on a moderate scale shall be provided for the benefit of workers wherever it is considered expedient.
- 9.23 The above rules shall be incorporated in the contract and in notices inviting tenders, and shall form an integral part of the contract.

10. CONDITIONS OF CONTRACT

Clause 1. Security Deposit

- (a) **Clause -1(a)** The person/persons whose tender may be accepted (hereinafter called the contractor which expression shall unless the context otherwise requires, include his heirs, executors, administrators and assigns) shall pay Earnest Money Deposit indicated in Column (ii) of the table given below and shall permit Institute (a) to deduct FSD at the percentage mentioned in Column (iii) of the table given below of all moneys payable of work done under the Contract, at the time of making such payments to him/them and (b) to hold such deductions as further Security Deposit. The EMD + FSD will be limited to % of the contract value.

Estimated cost of the work put to Tender	E.M.D. Percentage	F.S.D. Percentage
(i)	(ii)	(iii)
	1.5%	6.0%

Note : EMD + FSD to be limited to 7.5% of the contract value

E.M.D. - Earnest Money Deposit
F.S.D. - Further Security Deposit

No Interest will be paid on EMD / Security deposit.

(b) Additional or Reduction in Security Deposit.

The EMD for the tendered work and additional amount of Security Deposit at the rates mentioned in **Sub-clause 1(a)** above should be, paid by the contractor. The Project Engineer cum Estate officer may allow if a portion of the work is withdrawn from the Contractor under the provisions of Clause 12(a) a proportionate reduction in the amount of security Deposit.

- (1) ***EMD paid along with the tender shall be refunded only after the completion of the defect liability period without any interest.***
- (2) ***1% labour cess towards workers Welfare Fund on the works expenditure will be recovered from RA bills for depositing the same to the welfare board as per Karnataka Govt. Order. Rates quoted should be inclusive of cess.***

- (c) However if the Contractor desires, agency may furnish a BG issued by the Public Sector Undertaking Bank / Scheduled commercial Bank / Nationalized Bank in favour of the Registrar, Indian Institute of Science, payable at Bangalore amounting to 7.50% of the total contract value valid up to completion of defect liability period in which case EMD deposited by them will be refunded and no recoveries towards security deposit will be effected in the running account bills.

(d) Dues to Institute, to be set off against Security Deposit.

All compensation or other sums of money payable by the Contractor to Institute under the terms of this contract may be realized or deducted from any Security Deposit payable to him or from any sums which may be due or may become due by Institute to the Contractor on any account whatsoever and in the event of his security deposit being reduced by reason of any such realization or deduction as aforesaid, the Contractor shall, within ten days thereafter, make good in cash any sum or sums which have been deducted from his security deposit or any part thereof. Otherwise the amount will be treated as outstanding due from the agency.

(e) Refund of Security Deposit (EMD & FSD):

i) EMD paid by the contractor at the time of tendering and FSD deducted from the R.A.bills at the prescribed rates shall be refunded to the contractor immediately after the virtual completion of the work against production of bank guarantee for an equal amount from any of the Public Sector Undertaking Bank/Scheduled commercial Bank/Nationalized Bank valid for a period as mentioned in clause (ii) below.

ii) The bank guarantee received as stipulated in (i) above, will be treated as performance guarantee and shall be returned to the contractor after the final bill is paid or after **twenty four months including monsoon period** from the date of virtual completion of the work during which period the work should be maintained by the contractor in good order, whichever is later. The validity of the bank guarantee shall be maintained for the above period.

- iii) In case of BG's furnished towards security deposit same shall be returned after completion of the defect liability period.

Clause 2. PENALTY FOR DELAY

(a) Written Order to Commence Work

After acceptance of the tender, the Project Engineer cum Estate officer shall issue a written order to the successful tenderer to commence the work. The Contractor shall enter upon or commence any portion of work only with the written authority and instructions of the Project Engineer cum Estate officer. Without such instructions the Contractor shall have no claim to demand for measurements of or payment for, work done by him.

(b) Programme of work

The time allowed for carrying out the work as entered in the tender shall be strictly observed by the contractor. It shall be reckoned from the date of handing over the site to the Contractor not less than 75 percent of work site area comprising a continuous block. The work shall throughout the stipulated period of the contract be proceeded with, all due diligence (time being deemed to be the essence of the contract on the part of the Contractor). To ensure good progress during the execution of the work, the contractor shall be bound (in all cases in which the time allowed for any work exceeds one month) to comply with the time schedule according to the programme of execution of the work as agreed upon and enclosed by the contractor during execution of agreement.

(c) Review of progress and responsibility for delay etc.,

The Project Engineer cum Estate officer shall review the progress of all works with the contractor at least once every month. Such a review shall take into account the programme fixed for the previous week, obligations on the part of the Institute for issue of drawings etc, and also the obligations on the part of the Contractor. The review shall also examine the accumulated delays by the contractor if any and mitigation measures proposed by the contractor to overcome the delay.

Apportioning of responsibility for delay between Contractor and Institute.

In case the progress achieved falls short by more than 25 percent of the cumulative programme, the reasons for such shortfall shall be examined and a record made thereof apportioning the responsibilities for the delay between the contractor and the Institute. This record should be signed in full and dated both by the Project Engineer cum Estate officer and the Contractor. If the contractor refuses to sign the said record, approval of the reasons for delay may be submitted to CENTER FOR CAMPUS MANAGEMENT AND DEVELOPMENT (CCMD) for approval and such approval is binding on the contractor.

Shortfall in progress made up subsequently.

To the extent the shortfall is assessed, as due to the delay on the part of the contractor, a notice shall be issued to him by the Project Engineer cum Estate officer to make up the shortfall. If the shortfall is not made up before the progress of the work is reviewed during the second month succeeding the month in which the shortfall was observed, the Contractor shall be liable to pay penalty as indicated in **Clause 2(d)** below.

Grant of extension of time.

If the delay is attributable to reasons beyond the control of the Contractor, requisite extension of time shall be granted by the Project Engineer cum Estate officer in accordance with **Clause 5** after obtaining the approval of his higher authorities, wherever necessary.

Review of progress by Center for campus management and Development.

The Center for campus management and Development shall review the progress periodically, preferably more number of times as required. These reviews are in addition to the monthly reviews required to be done by the Project Engineer cum Estate officer. The results of such review by the CENTER FOR CAMPUS MANAGEMENT AND DEVELOPMENT (CCMD) shall, wherever necessary, be incorporated in the next review of the Project Engineer cum Estate officer.

If the Contractor stops the work for 45 days when no stoppage of work is shown on the current

Program and the stoppage has not been authorized by the Employer then The Employer may terminate the Contract at the risk and cost of the contractor.

Settlement of dispute regarding shortfall in progress.

In case of dispute between the Project Engineer cum Estate officer and Contractor regarding the responsibility for the shortfall in progress, the matter shall be referred to the Center for campus management and Development who shall thereupon give a decision within fifteen days from the date of receipt of reference. The decision of the Center for campus management and Development shall be final and binding on the contractor and the Project Engineer cum Estate officer.

(d) Penalty for delay

In respect of the shortfall in progress, assessed as due to the delay on the part of contractor as per **Clause 2(b)** and **2 (c)**, the contractor shall be liable to pay as penalty an amount equal to half percent of the contract value of the balance work assessed according to the programme, for every week that the due quantity of work remains incomplete; provided always that the total amount of penalty to be paid under the provisions of this clause subjected to a maximum of 10 percent of the contract value of the entire work as shown in the tender, provided further that in the event of the contractor making up the shortfall in progress within the stipulated or extended time of completion, the penalty so recovered may be refunded on an application in writing by the contractor.

Note: *If the Project Engineer cum Estate officer considers it necessary he shall be entitled to take action as indicated in **Clause 3 (d)** also.*

d.1 Liquidated damages

The Contractor shall pay liquidated damages to the Employer at the rate per day stated in the Contract Data for each day that the Completion Date is later than the Intended Completion Date (for the whole of the works or the milestone as stated in the Contract Data). The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages does not affect the Contractor's liabilities.

If the Intended Completion Date is extended after liquidated damages have been paid, the Employer shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment of bill.

(e) Adjustment of excess/over payments.

Excess/over payments as soon as they are discovered should be adjusted in the next running account bill of the contractor and in case the final bill has already been paid, the excess/over payment made shall be recovered from the Security Deposit of the contractor together with interest at such percentages as Institute may decide from time to time, from the date of such excess or over payment to the date of recovery.

ACTION WHEN WHOLE OF SECURITY DEPOSIT IS FORFEITED

Clause 3. In any case in which under any clause or clauses of this contract the contractor shall have rendered himself liable to pay compensation and/or penalty amounting to the whole of his security deposit including the amount deducted in installment from his bills as Further Security Deposit, the Project Engineer cum Estate officer on behalf of the Director, IISc shall have power to adopt any of the following courses as he may deem best suited in the interest of Institute.

(a) Forfeiture of Security Deposit

Without prejudice to Institute's right to recover any loss from the Contractor under **sub-clauses (b) and (c) of Clause 3** of the Contract, to rescind the contract (of which rescission notice in writing to the contractor under the hand of the Project Engineer cum Estate officer shall be conclusive evidence). And in that case, the security

deposit of the contractor including whole or part of the lump sum deposited by him and also the amount deducted from his bills as Further Security Deposit, shall stand forfeited and be absolutely at the disposal of the Institute.

(b) Debiting cost of labour and materials supplied.

To employ labour paid by the Institute and to supply materials to carry out the work or any part of the work, debiting the contractor with the cost of the labour and the price of the materials (as to the correctness of which cost and price the certificate of the Project Engineer cum Estate officer shall be final and conclusive against the contractor) and crediting him with the value of the work done; in all respects in the same manner and at the same rates as if it had been carried out by the contractor under terms of this contract, and in that case the certificate of the Project Engineer cum Estate officer as to the value of the work done shall be final and conclusive against the contractor.

(c) Recovery of extra cost on unexecuted work

To measure up the work of the contractor and to take such part thereof as is remaining unexecuted out of his hands and to give it to another contractor to complete it in which case any expenses which may be incurred in excess of the sum which would have been paid to the original contractor, if the whole work had been executed by him (as to the amount of which excess expenses the certificate in writing of the Project Engineer cum Estate officer shall be final and conclusive) shall be borne and paid by the original contractor and shall be deducted from any money due to him by Institute Otherwise the amount will be treated as outstanding due from the agency.

(d) Action against unsatisfactory progress

If the contractor does not maintain the rate of progress as required under **Clause 2** and if the progress of any particular portion of work is unsatisfactory even after taking action under **Clause 2(c)** and **2(d)**, the Project Engineer cum Estate officer shall be entitled to take action under **Clause 3(b)** or **3(c)** at his discretion in order to maintain the rate of progress after giving the contractor 10 days notice in writing whereupon the contractor will have no claim for any loss sustained by him owing to such actions.

(e) No compensation for loss sustained on advance action

In the event of any of the above courses being adopted by the Project Engineer cum Estate officer, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased, or procured any materials, entered into any agreements or made any advances on account of, or with a view to the execution of the work or the performance of the contract. And in case the contract shall be rescinded under the provision aforesaid the contractor shall not be entitled to recover or be paid any sum for any work thereof actually performed by him under his contract, unless and until the Project Engineer cum Estate officer shall have certified in writing the performance of such work and the amount payable in respect thereof, and he shall only be entitled to be paid the amount so certified.

(f) Recovery of 1% of the contract value towards the laborers welfare fund created by the Government of Karnataka will be effected in the running account bills of the contractor.

Clause 4. CONTRACTOR TO REMAIN LIABLE TO PAY COMPENSATION IF ACTION IS NOT TAKEN UNDER CLAUSE-3.

In any case in which any of the powers conferred upon the Project Engineer cum Estate officer by **Clause 3** thereof shall have become exercisable and the same shall not have been exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the contractor for which under any clause hereof he is declared liable to pay compensation or penalty amounting to the whole of his security deposit and the liability of the contractor for past and future compensation or penalty shall remain unaffected.

Power to take possession of or require removal of or sell contractor's properties.

In the event of the Project Engineer cum Estate officer taking action under **sub-clause (a) or (c) of Clause 3**, he may, if he so desires, take possession of all or any tools, plant, materials and stores, in or upon works or the site

thereof or belonging to the contractor, or procured by him and intended to be used for the execution of the work or any part thereof, paying or allowing for the same in account at the contract rates; or in the case of contract rates not being applicable, at current market rates, to be certified by the Project Engineer cum Estate officer whose certificate thereof shall be final. In the alternative, the Project Engineer cum Estate officer may after giving notice in writing to the contractor or his clerk of the works, foreman or other authorised agent, require him to remove such tools, plant, materials or stores from the premises within a time to be specified in such notice; and in the event of the contractor, failing to comply with any such requisition, the Project Engineer cum Estate officer may remove them at the contractor's expense or sell them by auction or private sale on account of the contractor and at his risk in all respect, and the certificate of the Project Engineer cum Estate officer as to the expense of any such removal; and the amount of the proceeds and expense of any such sale shall be final and conclusive against the contractor.

Clause 5. GRANT OF EXTENSION OF TIME

- (a) If the contractor shall desire an extension of the time for completion of the work, he shall apply in writing to the Project Engineer cum Estate officer before the expiry of the period stipulated in the tender or before the expiry of 30 days from the date on which he was hindered as aforesaid or on which the cause for asking for extension occurred, whichever is earlier and the Project Engineer cum Estate officer or other competent authority may if in his opinion, there are reasonable grounds for granting an extension, grant such extension as he thinks necessary or proper. The decision of such competent authority in this matter shall be final.
- (b) The time limit for completion of the work shall be extended commensurate with its increase in cost occasioned by alterations or additions and the certificate of the Project Engineer cum Estate officer or other competent authority as to such proportion shall be conclusive.

Clause 6. ISSUE OF FINAL CERTIFICATE – CONDITIONS REGARDING

On completion of the work the contractor shall report in writing to the Project Engineer cum Estate officer the completion of the work. Then he shall be furnished with a certificate by the Project Engineer cum Estate officer of such completion, but no such certificate shall be given nor shall the work be considered to be complete until the contractor shall have removed from the premises on which the work shall have been executed, all scaffolding, surplus materials and rubbish, and shall have cleaned thoroughly all wood work, doors, windows, wall, floor or other parts of any building, in or upon which the work has been executed, or of which he may have had possession for the purpose of executing the work, nor until the works shall have been measured by the Project Engineer cum Estate officer or other competent authority, or where the measurements have been taken by his Project Engineer until they have received the approval of the Project Engineer cum Estate officer or other competent authority, the said measurements being binding and conclusive against the contractor. If the contractor shall fail to comply with the requirements of this clause as to the removal of scaffolding, surplus materials and rubbish, and cleaning on or before the date fixed for the completion of the work the Project Engineer cum Estate officer or other competent authority may, at the expense of the contractor, remove such scaffolding, surplus materials and rubbish, and dispose of the same as he think fit and clean off such dirt etc., as aforesaid and contractor shall be liable to pay the amount of all expenses incurred but shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

Note: CLOSURE OF CONTRACT PENDING COMPLETION OF MINOR ITEMS.

In cases where it is not desirable to keep the building contract open for minor items, such as flooring in the bath rooms, etc., which can be carried out only after installation of sanitary work the main contract may be finalized after getting a supplementary agreement executed in the prescribed form by the same contractor for doing the residual work.

Clause 7. Contractor to submit bills monthly in printed form

- (a) A bill shall be submitted by the contractor on or before 15th of each month for all items of work executed in the previous month as required by IISc. The Running account bills will be paid within **three weeks** from the date of submission of the bill in complete acceptable form after duly checked and certified by concerned Engineer, under normal circumstances.

All bills shall be prepared in the prescribed printed and electronic form in PDF format in quadruplicate and handed over to the Project Engineer in charge of the work/ Project Engineer cum Estate officer's Office and acknowledgment obtained.

The charges to be made in the bills shall always be entered at the rates specified in the tender in full or in part as the case may be, in the case of any extra work ordered in pursuance of these conditions, and not mentioned or provided for in the tender, the charges in the bills shall be entered at the rates hereinafter provided for such work.

(b) Scrutiny of Bills and measurement of work

The details furnished by the Contractor in the bill will be completely scrutinized and the said work will be measured by the Project Engineer in the presence of the Contractor or his duly authorized agent. The countersignature of the contractor or the said agent in the measurement book shall be sufficient proof to the correctness of the measurements, along with the Test certificates to be produced with the bill, which shall be binding on the contractor in all respects.

(c) One copy of the passed bill shall be given to the Contractor without any charge.

Clause 8. PAYMENT PROPORTIONATE TO WORK APPROVED AND PASSED.

No payment shall be made for any work estimated to cost rupees five thousand or less until after the whole of the work shall have been completed and certificates of completion given. But in the case of works estimated to cost more than Rs. 5,000 the contractor shall on submitting the bill and after due verification by the Project Engineer as per **Clause 7(b)** entitled to necessary Payment proportionate to the part of the work then approved and passed by the Project Engineer cum Estate officer or other competent authority whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the contractor i.e. part payment of submitted RA bills is admissible to contractor. Any such reduced payment amount is admissible for adjustment in the successive RA Bills or Final Bill.

Payment at reduced rates

The rates for several items of works agreed to within shall be valid only when the items concerned are accepted as having been completed fully in accordance with the stipulated specifications. In cases where the items of work are not accepted as so completed, The Project Engineer cum Estate officer or other competent authority may make payment on account of such items at such reduced rates as he may consider reasonable in the preparation of final or on account bills.

Payment or intermediate certificates be regarded as advances:

All such intermediate payments shall be regarded as payments by way of advance against the final payments only and not as payments for work actually done and completed, and shall not preclude the Project Engineer cum Estate officer or other competent authority from requiring any bad, unsound imperfect or unskillful work to be removed or taken away and reconstructed or re-erected nor shall any such payment be considered as an admission for the due performance of the Contract or any part thereof in any respect or the accruing of any claim, nor shall it conclude determine or affect in any other way the powers of the Project Engineer cum Estate officer or other competent authority as to the final settlement and adjustment of the accounts, or otherwise or in any other way vary or affect the contract.

Submission of Final bill and its settlement

The contractor shall submit the final bill within one month from the date of actual completion of the work in all respects. His claims shall be settled within five months from the date of submission of the bill in complete acceptable form after duly checked and certified by concerned Engineer, under normal circumstances.

Disputed items

Note: The contractor shall submit a list of the disputed items within 30 days from the disallowance thereof and if he fails to do this, his claim shall be deemed to have been fully waived and absolutely extinguished.

Clause 9. Definition of Work :

- (a) The expression 'Work' or 'Works' where used in these conditions, shall unless there be something in the subject or context repugnant to such construction, be construed to mean the work or works contracted to be executed under or in virtue of the contract, whether temporary or permanent and whether original, altered, substituted or additional.

- (b) **Work to be executed in accordance with specifications, drawings, orders etc.**

The contractor shall execute the whole and every part of the work in the most sound and substantial and workmanlike manner, and in strict accordance with the specifications both as regards materials and workmanship. The contractor shall also conform exactly, fully and faithfully to the designs, drawings and instructions in writing relating to the work signed by the Project Engineer cum Estate officer or other competent authority and lodged in his office and to which the contractor shall be entitled to have access at such office, or on the site of the work for the purpose of inspection during office hours. The contractor shall also be responsible for the delivery of structure in sound conditions and the execution of the work strictly in accordance with the specifications of the work.

- (c) **Action where there is no specification**

In the case of any class of work for which there is no such specification, then in such a case of the work shall be carried out in all respects in accordance with the instructions and requirements of the Project Engineer cum Estate officer or other competent authority.

- (d) **Work as per Specifications and IS Codes.**

The detailed specification, which forms a part of contract, accompanies the tender document. In carrying out the various items of work as described in Schedule B of the tender documents and the additional, substituted, altered items of work these detailed specification shall be strictly adhered to, supplemented by relevant provisions of the Indian standard specifications, the code of practice; etc., The Indian standard specification, National Building

Code and the code of practice to be followed shall be the latest versions of those listed in the detailed technical specifications. Any class of work, not covered by the detailed technical specifications, shall be executed in accordance with the instructions and requirements of the Project Engineer cum Estate officer and the relevant provisions of the Indian standard specifications.

Clause 10. Alteration in quantity of work, specifications and designs, Additional work, deletion of work

- (i) The Project Engineer cum Estate officer shall have power to make any alternations in, omissions from additions to or substitutions for the original specification, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work. For that purpose or if for any other reason it shall in his opinion be desirable, he shall have power to order the Contractor to do and the contractor shall do any or all the following: -
 - (a) Increase or decrease the quantity of any work included in the contract.
 - (b) Omit any such work.
 - (c) Change the character or quality or kind of any such work,
 - (d) Change the levels, lines, positions and dimensions of any part of the work,
 - (e) Execute additional work of any kind necessary for the completion of the works and
 - (f) change in any specified sequence, methods or timing of construction of any part of the work.

Contractor bound by Project Engineer cum Estate officer's instructions

The Contractor shall be bound to carry out the work in accordance with any instructions in this connection which may be given to him in writing signed by the Project Engineer cum Estate officer or other competent authority and such alteration shall not in any way vitiate or invalidate the contract.

Standard Quantity Take-off (SQT)

Contractor within **14 days** of Issue of LOI to submit the Project Manager & seek approval for the Standard quantity Take-off sheets for all the items mentioned in the Tender BOQ, after due referencing the Tender/ GFC drawings and the Technical Specification. Upon approval, the SQT shall remain the base document for initiating any change orders/ variation in accordance to Clause 31, tracking the daily project progress, and for the measurement sheets.

Orders for variations to be in writing

- (ii) No such variations shall be made by the Contractor without an order in writing of the Project Engineer cum Estate officer; provided that no order in writing shall be required for increase or decrease in the quantity of any work where such increase or decrease is the result of the quantities exceeding or being less than those stated in the 'Schedule B' provided also that if for any reason the Project Engineer cum Estate officer shall consider it desirable to give any such order verbally, the Contractor shall comply with such order without any confirmation in writing of such verbal order given by the Project Engineer cum Estate officer, whether before or after the carrying out of the order, shall be deemed to be an order in writing within the meaning of the clause; provided further that if the Contractor shall within seven days confirm in writing to the Project Engineer cum Estate officer and if such confirmation is not contradicted in writing within fourteen days by the Project Engineer cum Estate officer, it shall be deemed to be an order in writing by the Project Engineer cum Estate officer.
- (iii)
 - a) Any additional work which the contractor may be directed to do in the manner above specified as part of the work shall be carried out by the Contractor on same conditions in all respects on which he agreed to do the main work and same rates as are specified in the tender for the main work. However, change in the Undertaking rates tendered and accepted shall be considered in respect of items under which the quantity of work performed exceeds tendered quantity by more than 25 percent and this actual change in rate will be restricted only to such excess quantity (i.e. beyond 125 percent of the tendered quantity).
- (b) **Rate for excess quantity beyond 125 percent of tendered quantity**

The Additional quantity which exceeds 125 percent of the tendered quantity shall be paid at the rates entered in or derived from Schedule of Rates prevalent at the time of executing additions and alterations plus or minus

the overall percentage of the original tendered rates over the current Schedule of Rates (KPWD) of the year in which the tender is accepted (as per the comparative Statement prepared at the time of acceptance of the tender).

(c) Rates for additional, substituted, altered items of work

If the additional, substituted or altered work includes any class of work for which no rate is specified in the contract, then such work shall be carried out at the rates specified for or derived from similar item of work in the agreement. In the absence of similar items in agreement, rate shall be as specified for or derived from similar items in the schedule of rates of KPWD prevalent at the time of execution of such additional substituted or altered items of works, plus or minus the overall percentage of original tendered rates over the current schedule of rates of (KPWD) the year in which tender is accepted as mentioned in sub clause (b) above. With regard to the question whether the additional, substituted or altered item/items of work/works is / are similar or not, to that/those in the agreement / in the Schedule of Rates of KPWD and the decision of the Center for campus management and Development shall be final and binding on the contractor.

(D) Determination of rates for items not found in Estimate or Schedule of Rates

If the rates for additional, substituted or altered work cannot be determined in the manner specified in sub clauses (b) and (c) above, then the contractor shall within 7 days of the date of receipt by him of the order to carry out the work, inform the Project Engineer cum Estate officer of the rates which it is his intention to charge for such class or work, supported by analysis of the rate or rates claimed. Thereupon the Project Engineer cum Estate officer shall determine the rate or rates on the basis of observed data and failing this, on the basis of prevailing market rates. Under no circumstances the contractor shall suspend the work on the plea of non-settlement of rates for items falling under this clause. In the event of any dispute regarding the rates for such items the decision of Project Engineer cum Estate Officer, Center for campus management and Development shall be final.

Working out the data rates for non SR/ non tendered items shall be based on the procedures laid down in the standard rate analysis format of KPWD Bangalore circle Bangalore. The data rates shall be approved by the Project Engineer cum Estate Officer, Center for campus management and Development and shall be binding on the contractor.

Clause 11. TIME LIMITS UNFORSEEN CLAIMS

Under no circumstances whatever shall the contractor be entitled to any compensation from Institute on any account unless the contractor shall have submitted claim in writing to the Project Engineer cum Estate officer or other competent authority within 30 days of the cause of such claim occurring.

Clause 12. NO CLAIM TO ANY PAYMENT OR COMPENSATION FOR DELETION OF WHOLE OR PART OF WORK

- (a)** If at any time after the execution of the contract documents, the Project Engineer cum Estate officer or other competent authority shall, for any reason whatsoever, require the whole or any part of the work as specified in the tender, to be stopped for any period or require the whole or part of the work (i) not to be carried out at all or (ii) not to be carried out by the tendered contractor, he shall give notice in writing of the fact to the contractor who will thereupon suspend or stop the work totally or partially as the case may be. In any such case, except as provided hereunder, the contractor shall have no claim to any payment of compensation whatsoever on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not so derive in consequence of the full amount of the work not having been carried out, or on account of any loss that he may be put on account of materials purchased or agreed to be purchased, or for unemployment of labour recruited by him. He shall not also have any claim for compensation by reason of any alterations having been made in the original specifications, drawings, designs and instructions, which may involve any curtailment of the work, as originally contemplated.

(b) Payment for materials already purchased or ordered by contractor.

Where, however, materials have already been purchased or agreed to be purchased by the contractor before receipt by him the said notice the contractor shall be paid for such materials, at the rates determined by the

Project Engineer cum Estate officer or other competent authority provided they are not in excess of requirements and are of approved quality, and/or shall be compensated for the loss, if any, that he may be put to, in respect of materials agreed to be purchased by him, the amount of such compensation to be determined by the Project Engineer cum Estate officer or other competent authority whose decision shall be final.

(c) Labour charges during stoppage of work

If the contractor suffers any loss on account of his having to pay labour charges during the period during which the stoppage of work has been ordered under this clause, the contractor shall on application, be entitled to such compensation on account of labour charges as the Project Engineer cum Estate officer or other competent authority, whose decision shall be final, may consider reasonable. Provided that the contractor shall not be entitled to any compensation on account of labour charges if in the opinion of the Project Engineer cum Estate officer or other competent authority, the labour could have been employed in the same locality by the contractor for the whole or part of the period during which the stoppage of the work has been ordered as aforesaid.

(d) Time limit for stoppage of work

The period of stoppage ordered by the Project Engineer cum Estate officer or other competent authority should not ordinarily exceed six months. Thereafter the portion of works stopped may be treated as deleted from this agreement if a notice in writing to that effect is given to the Project Engineer cum Estate officer or other competent authority by the contractor within seven days after the expiry of the above period.

Execution of work deleted

The portion of work thus deleted may be got executed from the same contractor on supplemental agreement on mutually agreed rates, which shall not exceed current Schedule of Rates plus or minus tender percentage,

Clause 13. ACTION AND PENALTY IN CASE OF BAD WORK

If at any time before the security deposit is refunded to the contractor, it shall appear to the Project Engineer cum Estate officer or other competent authority that any work has been executed with unsound, imperfect or unskillful workmanship or with materials of inferior quality, or that any materials or articles provided by him for the execution of the work are unsound or of a quality inferior to that contracted for, or are otherwise not in accordance with the contract, it shall be lawful for the Project Engineer cum Estate officer or other competent authority to intimate this fact in writing to the contractor and then notwithstanding the fact that the work, materials or articles complained of may have been paid for, the contractor shall be bound forthwith to rectify, or remove and reconstruct the work so specified on whole or in part as the case may require, or if, so required shall remove the materials or articles at his own charge and cost and in the event of his failing to do so within a period to be specified by the Project Engineer cum Estate officer or the competent authority in the written intimation aforesaid, the contractor shall be liable to pay a penalty not exceeding one percent on the amount of the estimate for every day not exceeding ten days during which the failure, so continues and in the case of any such failure the Project Engineer cum Estate officer or other competent authority may rectify or remove, and re-execute the work or remove and replace the materials or articles complained of, as the case may be at the risk and expense in all respects of the contractor should the Project Engineer cum Estate officer or other competent authority for any valid reasons consider that any such inferior work or materials as described above is to be accepted or made use of, it shall be within his discretion to accept the same at such reduced rates he may fix thereof.

Clause 14. WORK TO BE OPEN TO INSPECTION - CONTRACTOR OR RESPONSIBLE AGENT TO BE PRESENT

- (a)** All works under or in course of execution or executed in pursuance of the contract shall at all time be open to the inspection and supervision of the Project Engineer cum Estate officer or other competent authority and his Engineer-in-charge, and the contractor shall at all times during the usual working hours, and at all other times at which reasonable notice of the intention of the Project Engineer cum Estate officer or other competent authority Project Engineer to visit the work shall have been given to the contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing present for the purpose.

Orders given to the contractor duly authorized agent shall be considered to have the same force and effect as if they had been given to the contractor himself.

(b) Employment of Minimum technical staff

The Contractor shall employ the following technical staff during execution of this work:

- (i) One qualified Graduate Engineer & One qualified Diploma Engineer, when the cost of the work to be executed up to 1 Crore,
- (ii) Two qualified Graduate Engineer & Three qualified Diploma Engineer, when the cost of the work to be executed from 1 Crore to 10 crores;

Three qualified Graduate Engineer & Six qualified Diploma Engineer, when the cost of the work to be executed above 10 crores;
- (iii) In addition to (i) and (ii) above, the contractor shall employ different types of such technical personnel as may be required and sufficient for execution of work and directed by the Project Engineer cum Estate officer to ensure efficient execution of work.

The technical staff so employed, should be available at site whenever required by Engineer in-charge to take instructions.

- (c) If the contractor fails to employ the technical staff as aforesaid, he shall be liable to pay a sum of Rs. 25000 (Rupees Twenty thousand only) for each month of default in the case of Graduate Engineers and Rs. 15000 (Rupees Ten thousand only) for each month of default in case of Diploma Holders.
- (d) If the Contractor himself possesses the required qualification and is available at the site for receiving instructions from the Project Engineer cum Estate officer and other competent authority vide **sub-clause (a)** above it will not be necessary for the technical staff to be available at site for receiving instructions.

Clause 15. NOTICE TO BE GIVEN BEFORE WORK IS COVERED UP

The contractor shall give not less than five days' notice in writing to the Project Engineer cum Estate officer or his Project Engineer in charge of the work before covering up or otherwise placing beyond the reach of the measurement any work in order that the same may be measured; and correct dimensions thereof taken before the same is so covered up or placed beyond the reach of measurement, and shall not cover up or place beyond the reach of measurement, and work without the consent in writing of the Project Engineer cum Estate officer or other competent authority or his Project Engineer in charge of work; and if any work shall be covered up or placed beyond the reach of measurement, without such notice having been given or consent obtained, the same shall be uncovered at the contractor's expense, and in default thereof no payment or allowance shall be made for such work or for the materials with which the same was executed.

Clause 16. CONTRACTOR LIABLE FOR DAMAGE DONE, AND FOR IMPERFECTIONS FOR TWELVE MONTHS AFTER CERTIFICATE OF COMPLETION

If the Contractor or his workmen or servants shall break, deface, injure or destroy any part of a building in which they may be working, or any building, road fence, enclosure or grassland or cultivated ground contiguous to the premises on which the work or any part thereof is being executed, or if any damage shall be done to the work, while it is in progress from any cause whatever or if any imperfections become apparent in it within Twelve months of the grant of a certificate of completion, final or otherwise, by the Project Engineer cum Estate officer or other competent authority the contractor shall make good the same at his own expenses, or in default the Project Engineer cum Estate officer or other competent authority may cause the same to be made good by other workmen, and deduct the expenses (of which the certificate of the Project Engineer cum Estate officer or other competent authority shall be final) from any sums that may be due or may thereafter become due to the contractor, or from his Security Deposit or the proceeds of sale thereof, or of a sufficient portion thereof.

The Defects liability period shall be extended for as long as defects remain to be corrected. Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Institute.

Clause 17. CONTRACTOR TO SUPPLY PLANT, LADDERS, SCAFFOLDINGS, ETC., AND IS LIABLE FOR DAMAGES ARISING FROM NON-PROVISION OF LIGHT, FENCING ETC

The contractor shall supply at his own cost all materials, plant, tools, appliance, implements, ladders, scaffolding, and temporary works required for the proper execution of the work whether in the original, altered or substituted form and whether included in the specification, or other documents forming part of the contract or referred to in these conditions or not, and which may be necessary for the purpose of satisfying or complying with the requirements of the Project Engineer cum Estate officer or other competent authority as to any matter as to which under these conditions he is entitled to be satisfied, or which he is entitled to require together with carriage therefore, to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials necessary for the purpose of setting out works, and counting, weighing and assisting in the measurement or examination at any time and from time to time of the work or the materials. Failing this, the same may be provided by the Project Engineer cum Estate officer or other competent authority at the expense of the contractor and expense may be deducted from any money due to the contractor under the contract or from his security deposit or the proceeds of sale thereof, or of a sufficient portion thereof. The contractor shall provide necessary fencing and lights required to protect the public from accident, and shall also be bound to bear the expense of defense of every suit, action or other legal proceedings, that maybe brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any suit, action or proceedings to any person, or which may with the consent of the contractor be paid for compromising any claim by any such person.

Clause 18. Measures for prevention of fire

The contractor shall not set fire to any standing jungle, trees, brushwood or grass without a written permit from the Project Engineer cum Estate officer. When such permission is given, and also in all cases when destroying cut or dug up trees, brushwood grass, etc., by fire the contractor shall take necessary measures to prevent such fire spreading to or otherwise damaging surrounding property.

Clause 19. Liability of contractor for any damages done in or outside work Area.

Compensation for all damages done by contractor or his men whether in or beyond the limits of Institute property including any damage caused by spreading of fire mentioned in Clause 18 shall be estimated by the Project Engineer cum Estate officer and the estimate of the Project Engineer cum Estate officer, subject to the decision of the Center for campus mangement and Development on appeal shall be final and the contractor shall be bound to pay the amount of the assessed compensation on demand failing which the same will be recovered from the contractor as the damages in the manner prescribed in clause 1(c) or deducted by the Project Engineer cum Estate officer or other competent authority from any sums that may be due or become due from Institute to the contractor under this contract or otherwise.

The contractor shall bear the expenses of defending any action or other legal proceedings that may be brought by any person for injury sustained by him owing to neglect of precautions to prevent the spread of fire and shall pay any damages and cost that may be awarded by the court in consequence.

Clause 20. Work on Notified Holiday

No work shall be done on any notified holiday without the sanction in writing of the Project Engineer cum Estate officer or other competent authority

Clause 21. WORK NOT TO BE SUBLET

- (a) The contract shall not be assigned or sublet by the contractor,. However, any specific portion of the work which is of a specialized nature and normally not executable by a general contractor could be got done by the

specialized agencies which are executing such works, after obtaining the specific approval of the Project Engineer cum Estate officer in writing in each case. Such consent to sublet the work, if given, shall not relieve the contractor from any liability or obligation under the contract and he shall be responsible for the acts, defaults and neglects of any sub-contractor or his agents, servants or workmate as fully as if they were the acts, defaults or neglects of the contractor, his agents, servants or workmen.

Consequences of subletting work without approval, becoming insolvent, bribing etc., by contractor and action against the contractor.

If the contractor shall assign or sublet his contract or any portion thereof without the specific approval of the Project Engineer cum Estate officer or attempts to do so or become insolvent or commence any proceedings to get himself adjudicated as insolvent or make any composition with his creditors or attempts so to do or if any bribe, gratuity, or indirectly be given, promised or offered by the contractor or any of his servants or agents to any officer or person in the employ of Institute in any way relating to his office or employment or if any such officer or person in the employment or if any such officer or person shall become in any way directly or indirectly interested in the contract, the Project Engineer cum Estate officer or other competent authority may thereupon by notice in writing rescind the contract and the security deposit of the contractor shall thereupon stand forfeited and be absolutely at the disposal of Institute and the same consequences shall ensure as if the contract had been rescinded under Clause 3 here of and in addition, the contractor shall not be entitled to recover or be paid for any work actually performed under contract.

(b) Recovery of excess payments based on excess measurements and action against contractor.

Whenever it is noticed that excess payments have been made to the contractor based on excess measurements recorded by the Project Engineer in the measurement book and countersigned by the contractor or his duly authorized agent, action shall be taken to recover the excess payments together with interest immediately. Action may also be taken to remove the name of the contractor from the approved list of contractors and also to black-list him.

Change in classification of excavations accepted not permitted.

Once the measurements mentioning the classification of the excavations are recorded in the measurement book and the same is signed by the contractor or his authorized agent in token of acceptance, no request for reclassification by the contractors shall be entrained.

(c) Criminal proceedings against IISc Officer and Contractor for the lapses.

Institute also reserve the right to initiate criminal proceedings against the concerned Institute Officers who are directly responsible for the lapse and the contractors who have colluded with the officers of the Institute in the lapse and fraudulently received amounts not due to them legitimately.

Clause 22. SUM PAYABLE BY WAY OF COMPENSATION TO BE CONSIDERED AS REASONABLE COMPENSATION WITHOUT REFERENCE TO ACTUAL LOSS.

All sums payable by a contractor by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied for the use of Institute without reference to the actual loss or damage sustained and whether any damage has or has not been sustained.

Clause 23. SETTLEMENT OF DISPUTES -TIME LIMIT FOR DECISION

- (a)** If any dispute or difference of any kind whatsoever were to arise between the Project Engineer cum Estate officer and the contractor regarding the following matters namely,
- (i)** The meaning of the specification's designs, drawing and instructions herein before mentioned,
 - (ii)** The quality of workmanship or materials used on the work and
 - (iii)** Any other question, claim right, matter, thing whatsoever, in any way arising out of or relating to the contract, designs, drawings, specification, estimates, instructions, or orders, or those conditions, failure to execute the same whether arising during the progress of the work, or after the completion, termination or

abandonment thereof, the dispute shall, in the first place, be referred to the Center for campus management and Development who have jurisdiction over the work specified in the contract. The Center for campus management and Development shall within a period of fifteen days from the date of being requested by the Contractor to do so give written notice of its decision to the Contractor.

If the decision of the Center for campus management and Development is not acceptable to the contractor he may approach the **Director, IISc within** a period of 15 days for settlement.

(b) Director's decision final.

Subject to other form of settlement hereafter provided, the Director's decision in respect of every dispute or difference so referred shall be final binding upon the contractor. The said decision shall forthwith be given effect to and contractor shall proceed with the execution of the work with all due diligence.

(c) Remedy when Director's decision is not acceptable to contractor

In case the decision of the Director is not acceptable to the contractor, he may approach the Law Court at Bangalore for settlement of dispute after giving due written notice in this regard to the Director within a period of ninety days from the date of receipt of the written notice of the decision of the Director. Further, the Bangalore courts alone shall have the exclusive jurisdiction.

(d) Time limit for notice to approach Court of law by contractor

If the Director has given written notice of his decision to the contractor and no written notice to approach the law court has been communicated to him by the contractor within a period of ninety days from receipt of such notice, the said decision of Director shall be final and binding upon the contractor.

(e) Time limit for notice to approach law court by contractor when decision is not given by Director, IISc as at (b).

If the Director fails to give notice of his decision within a period of ninety days from the receipt of the contractor's request in writing for settlement of any dispute or difference as aforesaid, the Contractor may within ninety days after the expiry of the first named period of ninety days approach the Law Courts at Bangalore giving due notice to the Director.

(f) Contractor to execute and complete work pending settlement of dispute.

Whether the claim is referred to the Director or to the Law Courts, as the case may be, the contractor shall proceed to execute and complete the works with all due diligence pending settlement of the said dispute or differences.

(g) Obligations of the Project Engineer cum Estate officer and contractor shall remain unsettled during considerations of dispute.

The reference of any dispute or difference to the Director or the Law Court may proceed notwithstanding that the works shall then be or be alleged to be complete, provided always that the obligations of the Project Engineer cum Estate officer and the contractor shall not be altered by reason of the said dispute or difference being referred to the Director or the Law Court during the progress of the works.

Clause 24. CONTRACTOR TO PAY COMPENSATION UNDER WORKMEN'S COMPENSATION ACT.

(a) The contractor shall be responsible for and shall pay any compensation to his own workmen payable under the relevant Workmen's Compensation Act for injuries caused to the workmen. If Institute pays such compensation on behalf of the contractor it shall be recoverable by Institute from the contractor under as per relevant clauses.

(b) Contractor to pay expenses of providing medical aid to workmen.

The contractor shall be responsible for and shall pay the expenses of providing medical aid to any workman who may suffer a bodily injury as a result of an accident. If Institute incurs such expenses, the same shall be

recoverable from the contractor forthwith and be deducted without prejudice to any other remedy of Institute, from any amount due or that may become due to the contractor.

Clause 25. CONTRACTOR TO PROVIDE PERSONAL SAFETY EQUIPMENT FIRST AID APPARATUS, TREATMENT etc.

The contractor shall provide all necessary personal safety equipment and first aid apparatus for the use of the persons employed on the site and shall maintain the same in good condition suitable for immediate use, at any time and shall comply with the following regulations in connection therewith: -

- (i) The worker will be required to use the equipment so provided by the contractor and the contractor shall take adequate steps to ensure proper use of the equipment by those concerned.
- (ii) When work is carried on in proximity to any place where there is a risk of drowning; all necessary steps shall be taken for the prompt rescue of any person in danger.
- (iii) Adequate provision shall be made for prompt first - aid treatment of all injuries likely to be sustained during the course of the work.

Clause 26. Minimum age of persons employed by contractor

(a): No contractor shall employ

- (i) Any person who is under age of 15 years.
- (ii) Who does not produce a valid certificate of vaccination against epidemic diseases in respect of himself/ herself as well as all the members of his/her family.
- (b) The contractor shall provide potable water facilities to the workers. Similar amenities shall be provided to the workers engaged on large works in urban area.
- (c) Removal of persons not satisfying conditions (a) (i) & (ii)

The Project Engineer cum Estate officer or other authority is authorized to direct the removal or to remove through - his own agency, from the work any person referred to in sub-clauses (a) above not satisfying these conditions and no responsibility shall be accepted by the Institute for any delay caused in the completion of the work by such directions for removal.

(d) Payment of fair and reasonable wages by contractor.

The contractor shall pay fair and reasonable wages, which shall not be less than the minimum wages fixed by Govt. of Karnataka from time to time to the workmen employed by him in the contract undertaken by him. In the event of any dispute arising between the contractor, and his workmen on the ground that the wages paid are not fair and reasonable the dispute shall be referred without delay to the Project Engineer cum Estate officer or other competent authority, who shall decide the same. The decision shall not in any way affect the conditions in the contract regarding the payment to be made by Institute at the agreed tender rates.

Clause 27. CONTRACTOR NOT ENTITLED TO ANY CLAIM OR COMPENSATION FOR DELAY IN EXECUTION OF WORK IN BORROW PITS.

The contractor shall not be entitled to claim compensation if there is any delay in the execution of the work on account of water standing in borrow pits and Compartments. The rates are inclusive for hard or cracked soil, excavation in mud, sub-soil water or water standing in borrow pits and no claim for extra rate shall be entertained, unless otherwise specified.

Clause 28. METHOD OF PAYMENT OF BILLS

Payment to contractors shall be made by cheques drawn by the Institute

Clause 29. SET OFF AGAINST ANY CLAIM OF INSTITUTE

Any sum of money due and payable to the contractor (including the security deposit refundable to him) under this contract may be appropriated by the Institute and set off against any claim of Institute in respect of a payment of a sum of money arising out of or under any other contract made by the contract with the Institute.

Clause 30. RATES INCLUSIVE OF SALES TAX AND LABOUR CESS AND ROYALTY

- (a) The rates to be quoted by the contractor shall be inclusive of all taxes like GST , Labour cess, Royalty etc., No extra payment on this account will be made to the contractor. Any statutory levies imposed by the central Government/ state Government/ local body from time to time are to the contractors account only.
- (b) When there is a change in existing taxes from time to time i.e. upward or downward is admissible accordingly
- (c) All quarry fees, octroi dues levied by the state or any local body or authority and ground rent, if any, charged by the Project Engineer cum Estate officer for stacking materials should be paid by the contractor.

Clause 31. IMPORTANCE OF SAFETY

In addition to Contractor's Contractual Obligations on Safety as per the relevant clauses stated, The Contractor shall comply with all safety standards to the satisfaction of the Employer's Representative.

In respect of all labour, directly or indirectly employed on the project for the performance and execution of the Contractor's Work under the Contract, the Contractor shall at its own expense arrange for all the safety provisions as listed in (i) Safety codes of C.P.W.D. and Bureau of Indian Standards, (ii) The Electricity Act, (iii) The Mines Act, and Regulations, Rules and Orders made there under and such other acts as applicable. Precautions as stated in the safety clause are the minimum necessary and shall not preclude the Contractor taking additional safety precautions as may be warranted for the particular type of work or situations. Also mere observance of these precautions shall not absolve the Contractor of his liability in case of loss or damage to property or injury to any person including but not limited to the Contractor's labour, the Employer's, Architect's, Employer's Representative's and Project Manager's representatives or any member of the public or resulting in the death of any of these.

The Contractor shall institute and implement to the satisfaction of the Project Manager a construction safety programme, including:

- Preparing a Site-specific written safety programme consistent with the EHS Plan, Indian law and best practices. As a minimum, the programme shall require applicable safety equipment for all workers, use of barriers and barricades around potentially dangerous areas, protection of workers working under elevated conditions, accident reporting, first aid provisions etc.
- Weekly safety reviews and 'risk assessments' shall be carried out in conjunction with the Project Manager and the Employer in order to identify potential safety hazards and to mitigate against them.
- Attending weekly or as scheduled safety meetings at site conducted by the site safety representative of project manager
- The Contractor will be required to provide all personnel entering the Site an Identity and safety rules card and verbal explanation of the safety programme.
- Requiring all Sub-Contractors and other workers under the responsibility of the Contractor (including the Vendors or later phases of the construction of the Project) to adhere to the written safety programme as per approved format.

Experienced safety officers with adequate number of supporting personnel shall be appointed by the Contractor for full time on the site during the Contract period.

NON-COMPLIANCE OF REGULATIONS

If the Project Manager or the Employer's Representative notifies the Contractor of non- compliance with the foregoing regulations, the Contractor shall immediately, if so directed, or in any event not more than eighteen (18) hours after receipt of such notice, make all reasonable efforts to correct such non-compliance. If the Contractor fails to do so, the Employer may suspend all or any part of the Work. When the Contractor has undertaken satisfactory corrective action, Employer shall lift the suspension of the Work. The Contractor shall not claim any extension of time to complete the Work or additional fees due to any such work

suspension.

The Client reserves the right to levy penalty if the safety norms such as not wearing helmets, safety gloves/belts/shoes/jackets. etc., even after a written notice by the enforcing authority, a penalty of Rs. 10,000/- per day per event or till the safety norms are adhered to in addition to stopping of work till the safety norms are adhered

Clause 32 Refund of Security Deposit (EMD & FSD):

The Security Deposit lodged/paid by a Contractor shall be refunded to him after the final bill is paid or after the successful completion of defect liability period, during which period the work should be maintained by the Contractor in good order, whichever is later.

Clause 33. PENALTY FOR DELAY

(a) Written Order to Commence Work

After acceptance of the tender, The Project Engineer cum Estate Officer, CCMD shall issue a written order to the successful tenderer to commence the work. The Contractor shall enter upon or commence any portion of work only with the written authority and instructions of The Project Engineer cum Estate Officer, CCMD. Without such instructions the Contractor shall have no claim to demand for measurements of or payment for, work done by him.

(b) Programme of work

The time allowed for carrying out the work as entered in the tender shall be strictly observed by the contractor. It shall be reckoned from the date of handing over the site to the Contractor not less than 75 percent of work site area comprising a continuous block. The work shall throughout the stipulated period of the contract be proceeded with, all due diligence (time being deemed to be the essence of the contract on the part of the Contractor). To ensure good progress during the execution of the work, the contractor shall be bound (in all cases in which the time allowed for any work exceeds one month) to comply with the time schedule according to the programme of execution of the work as agreed upon and enclosed to the agreement.

(c) Review of progress and responsibility for delay etc.,

The Project Engineer cum Estate Officer, CCMD shall review the progress of all works with the contractor during the first fortnight of every month. Such a review shall take into account the programme fixed for the previous month, obligations on the part of the Contractor.

(d) Apportioning of responsibility for delay between Contractor and Institute.

In case the progress achieved falls short by more than 25 percent of the cumulative programme, the reasons for such shortfall shall be examined and a record made thereof apportioning the responsibilities for the delay between the contractor and the Institute. This record should be signed in full and dated both by The Project Engineer cum Estate Officer, CCMD and the Contractor.

Clause 34 BAR CHART / CPM CHART:

BAR chart /CPM chart shall be produced during agreement by the contractor. According to the bar chart work is to be executed otherwise penalty will be levied for the delay of work

REFERENCES OF CODE BOOK

<u>I.S SPECIFICATIONS</u>	
A general list of IS Specifications applicable to this contract is appended here with	
IS CODE NO	
SP 7-1970	National Building Code
1885	Symbols
4648	Guide for electrical layouts
5578	Marketing of insulated conductors
5216	Guide for safety in installations
374	Ceiling fans
5077	Decorative light fitting
1913	Safety requirement of fittings
1536 & 6616	Ballasts
3323	Bi-pin lamp holders
2215	Starters for fittings
2418	Flourescent lamps
1569	Discharge lamps
3324	Holders
5513	Boxes for enclosures for Ele Accessories
Sp-7-2675	Fuse distribution boards
371	Ceiling roses
2667 & 3387	Metal conduits – fittings and accessories
1653	Rigid metal conduits
3854	Switches for lighting circuit control
1293	Three pin plugs
2351	Danger Board
3106	Instalation and selection of fuses
3043	Earthing
2147	Degree of protection by switch and control gear
4237	Requirement for switch and control gear
40437	Heavy duty air break switch and Sf units
2208	HRG fuses
375	Switch gear bus bars
2607	Air break isolators
1951	PVC sleeveings
1255	Code of practice for laying cables.
1694	PVC insulated cables.
1554	PVC cables.
3961	Current rating of cables.

LIST OF APPROVED MAKES FOR CIVIL WORKS

	Item	Make
1	WINDOWS	UPVC, RG, Fenesta
2	ALUMINIUM	JINDAL/INDAL/HINDAL CO
3	STEEL	TATA/ SAIL
4	DOORS	SAL WOOD DOOR WITH FLUSH SHUTTER, GRP LAMINATED DOORS
5	GLAZING	JOHNSON, KAJARIA, NAVEEN, REGENT
6	GLAZED TILES	JOHNSON, KAJARIA, NAVEEN, REGENT
7	CERAMIC TILES	JOHNSON, KAJARIA, NAVEEN, REGENT
8	PAINTS AND DISTEMPER	ASIAN BRAND, BERGER
9	SYNTHETIC ENAMEL	ASIAN BRAND, BERGER
10	WATER PROOFING COMPOUND	FOSROC, DR.FIXIT
11	VITRIFIED FLOORING	JOHNSON, KAJARIA, REGENT
IF THE ABOVE BRAND IS NOT AVAILABLE THE EQUIVALENT MATERIAL TO BE APPROVED BY PROJECT ENGINEER-CUM-ESTATE OFFICER BEFORE FIXING		
ALL MATERIAL SHALL HAVE TO BE GOT APPROVED FROM THE PROJECT ENGINEER CUM ESTATE OFFICER BEFORE BEING PROCURED.		

10.0 ACCEPTED MAKE OF MATERIALS FOR WATER SUPPLY & SANITARY WORKS

CPVC PIPES	ASTRAL / ASHIRVAD /PRINCE
G.I.Pipes and G.I.Fittings	TATA /Jindal
Ball & Butterfly Valves, NRV, Foot Valve, PRV	AUDCO / NVR/ INTERVALVE
'Y' Strainer	AUDCO/ ZOLOTO/ LEADER/I TAP
HDPE pipe	GEBRIT /equivalent
U PVC pipes and Fittings	ASTRAL / ASHIRVAD/PRINCE /SUPREME
PVC external pipe	ASTRAL / SUPREME/ASHIRVAD
Pre cast Frame & cover	SOUTHERN CONCRETE INDUSTRIES
CI frame and cover	NECO
Insulation	VIDOFLEX / THERMAFLEX
Pumps	Grundfos/WILO/DP/KSB
GRP tanks	Binani / Devi Polymers
Level controller	Sridhan International / SRI VINAYAK
Water Meters	DESHMESH / CAPATAN / KENT
CI pipes	Neco / ELECTROSTEEL
Solar panel	EMVEE/Solariser/Equivalent
Heat Pumps	Emmerson/Tipco/AO smith/Unidyne
Oil and Grease trap	ACO/KESSEL

All material shall have to be got approved from the Project Engineer-cum-Estate Officer before being procured

FIRE ALARM WITH P.A. SYSTEM

1.	FIRE ALARM CONTROL PANEL	:	EDWARDS / NOTIFIER / HONEYWELL
2.	MANUAL CALL POINTS	:	EDWARDS / NOTIFIER / HONEYWELL
3.	ELECTRONIC HOOTERS	:	EDWARDS / NOTIFIER / HONEYWELL
4.	MONITOR MODULAE	:	EDWARDS / NOTIFIER / HONEYWELL
5.	FAULT ISOLATOR MODULAE	:	EDWARDS / NOTIFIER / HONEYWELL
6.	CONTROL MODULAE	:	EDWARDS / NOTIFIER / HONEYWELL
7.	CONTROL REALY MODULAE	:	EDWARDS / NOTIFIER / HONEYWELL
8.	BATTERY	:	HITACHI / RESTOLITE / JOHNSON
5.	COPPER CONDUCTOR CONTROL CABLE / WIRES	:	POLYCAB / VARSHA / FINOLEX
6.	COMMUNICATION WIRES	:	POLYCAB / VARSHA / SHAKTICAB/
7.	M S CONDUITS	:	BHARATH / GB / PRINCE
8.	PVC CONDUITS	:	VIP / PRECISION / NELCO
9.	P.A. SPEAKERS	:	AHUJA / AGNI SURAKSHA
10.	P.A. AMPLIFIERS	:	PHILIPS / AHUJA / BOSCH
11.	P.A.CONSOLE	:	ROYAL ELECTRONICS/ RAVEL/EQUIL.

<u>List of approved makes – Plumbing and sanitary Works</u>		
1	VITREOUS CHINA SANITARY WARE	PARRY WARE / TOTO / JAGAOR
2	C.P FITTINGS	JAQUAR CONTINENTAL
3	PVC PIPES (SWR QUALITY)	ORIPLAST / SUPREME / ASTRAL
4	G.I FITTINGS	R BRAND
5	G.I PIPES	TATA B CLASS A GRADE
6	BALL VALVE (15MM TO 150MM DIA)	ZOLOTO/AM
7	GUN METAL GATE VALVE	ZOLOTO/LEADER
8	STONE WARE PIPES AND GULLY	NECO/TSL/ANDHRA
9	MAN HOLE COVERS	NECO
10	EWG SEAT COVER TO LID	COMMANDER/PRINCE
11	FLOAT GLASS MERCURY COATED	MODI/KONICA
12	PVC CONNECTION PIPE	KOHINOOR
13	PVC SWR PIPE	SUPREME
14	FLUSHING CISTREN	SLIMLINE
15	CP BOTTLE TRAP	JAQUAR
16	MIRROR	ATUL/MODIGUARD
If the above brand not available the Equivalent Material to be approved by the Project Engineer-cum-Estate officer before fixing		
All materials shall have to be got approved from the Project Engineer-cum-Estate Officer before procured.		

List of Approved make - Electrical

The following makes of components are acceptable. Any other make if offered shall be subject to Institute/ Project engineer cum Estate officer's approval:

All materials shall have to be got approved from the Project Engineer-cum-Estate

Officer before being procured

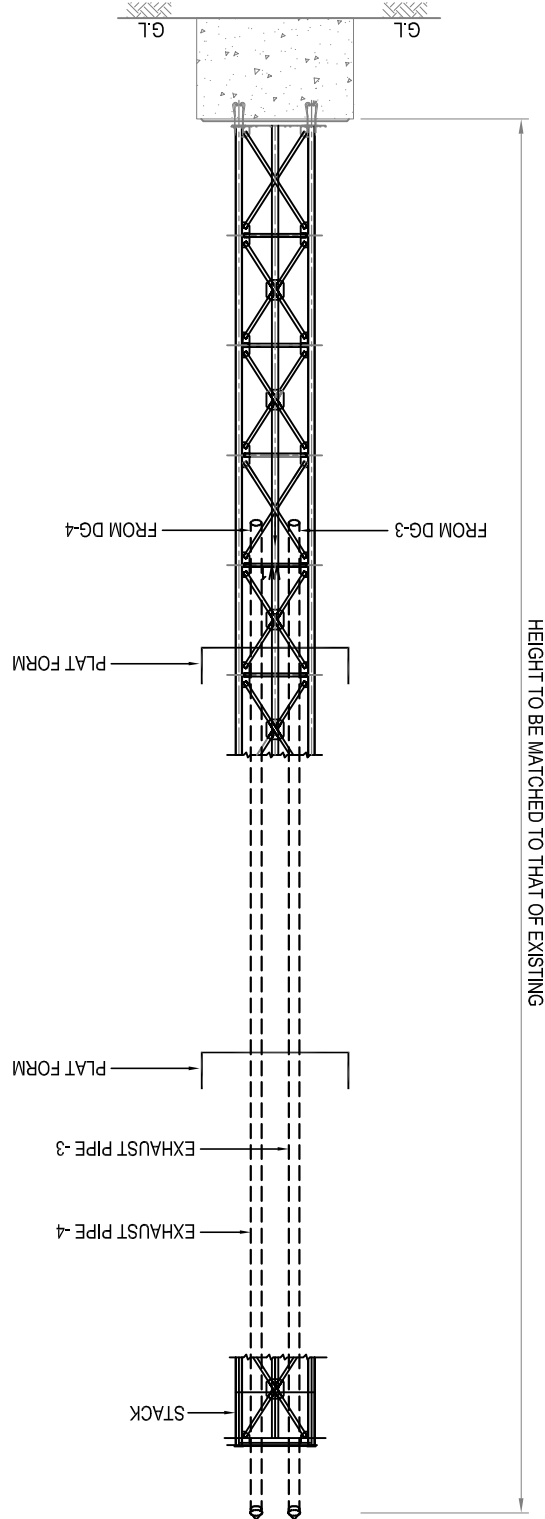
1.0	Diesel Engines	MTU / Caterpillar / Cummins / Perkins/
2.0	Generator	Cummins Generator technologies / Leroy Somers / TDPS / ABB
3.0	AV Mounts	GERB (Germany) / Resistoflex
4.0	Electronic Governor	Engine manufactures standard
5.0	Generator Synch and Load Share Controller	Woodward Easygen Only.
6.0	11kV Switchgear Panel	Schneider Electric (OEM/Channel Partner)
7.0	NIS+NGR Panel	Amp Controls (Pune)/ Ohmark Controls/ Vee Vee Controls / Amba Industries.
8.0	HT Isolator for NIS+NGR Panel	Pentagon/Essen/Crompton
9.0	Neutral Grounding Resistor	Amp Controls (Pune)/ Ohmark Controls
10.0	MCCB	Siemens / ABB / Schneider
11.0	HV Circuit Breakers	Schneider Electric make and model is preferred as per the existing so as to have interchangeability.
12.0	Air Circuit Breakers	Siemens / ABB / Schneider
13.0	MCCB/MCB/ ELCB	Siemens / ABB / Schneider
14.0	Power & Aux Contactors	Siemens / ABB / Schneider
15.0	Battery Bank	Amara Raja / Exide / HBL Power Sys / Rocket
16.0	Battery Charger	Amara Raja / HBL Power Sys / Caldyne
17.0	Instrument Transformers	Kappa / Pragathi / Kalpa
18.0	11kV Grade Cables	CCI / NICCO / Universal/ KEI / KEC-RPG
19.0	415V Power / Control / Instrumentation Control Cables	CCI / NICCO / Universal / RR kabel / LAPP / KEI / KEC-RPG

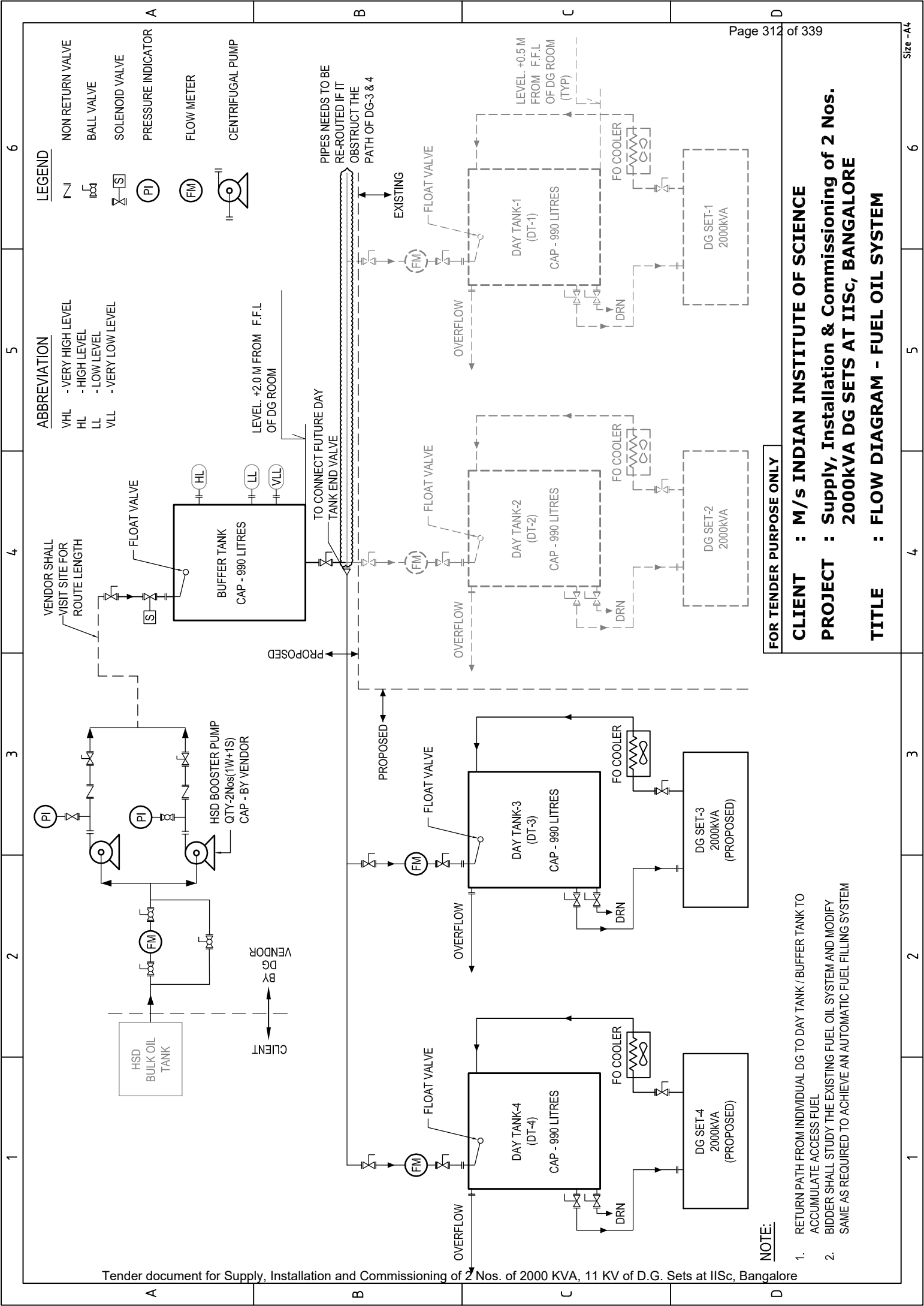
20.0	Wall mounted DBs	MDS Legrand/ Siemens/ Schneider/ ABB
21.0	Switches/ Sockets/ Boxes	ABB/ Siemens/ Legrand/ Schneider
22.0	Steel	SAIL/ TISCO/ ESSAR
23.0	Terminal connectors/ Glands	Wago/ Phoenix / Connectwell
24.0	Bushings/ Insulators	Modern/ BHEL/ WSI/ Jayashree/ IEC
25.0	Protective relays	ABB/ Siemens/ GE/Schneider/ Woodward
26.0	Trivector Meter	L&T/Secure Meters
27.0	Analog & Digital meters	Siemens/ Schneider(Digital)/ AE (Analog)
28.0	MS Conduits & Accessoires, Cable lugs	AMP/ Dowells
29.0	Temp. Scanner	Masibus
30.0	Insulation	Dupont/ 3M
31.0	Fasteners	TVS/ Internationally reputed
32.0	Glass wool:	Twaiga / Lloyd / eqt.
33.0	Fresh air / Exhaust fan	GEC / Almonard / Nadi
34.0	Indicating Lamps / Push Buttons	Siemens / ABB / Schneider / Teknic

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE
PROJECT : Supply, Installation & Commissioning of 2 Nos. 2000KVA DG SETS AT IISc, BANGALORE
TITLE : GENERAL ARRANGEMENT - D.G EXHAUST SYSTEM

FOR TENDER PURPOSE ONLY

INDIVIDUAL EXHAUST WITH COMMON STACK





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DG AUX. MCC FOR DG-1, 2, 3&4

FOR TENDER PURPOSE ONLY

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : Supply, Installation & Commissioning of 2 Nos. 2000kVA DG SETS AT IISc, BANGALORE

TITLE : SINGLE LINE DIAGRAM - DG AUXILIARY MCC

THE ARTICLES OF AGREEMENT

This Agreement is made at Bangalore, on this _____ day of _____ (month) in the year _____

BY AND BETWEEN

INDIAN INSTITUTE OF SCIENCE, a Trust registered under the Charitable Endowments Act, 1890, a deemed University and an autonomous Institution funded by the Ministry of Human Resource Development, Government of India having its office at **Sir C.V Raman Road, Malleswaram, BANGALORE 560 012**, (hereinafter referred to as the EMPLOYER which expression shall unless repugnant to the context or meaning thereof, mean and include its successors in interest, trustees and permitted assigns) of the ONE PART

AND

_____, hereinafter referred to as the "CONTRACTOR", (which expression shall unless repugnant to the context or meaning thereof, mean and include their partners, their respective heirs, executors, administrators and assigns) on the OTHER PART.

WHEREAS the Employer is desirous of getting the work of **"Supply, Installation and Commissioning of 2 Nos. of 2000 KVA, 11 KV of D.G. Sets at IISc, Bangalore"**

(hereinafter called the work) executed by the Contractor at the rates quoted by him amounting to **Rs. 540,00,000/- (Rupees Five hundred and forty Lakhs Only)** which is the estimated amount put to tender.

AND WHEREAS the Contractor has agreed to execute the aforesaid work on terms and conditions mentioned herein and subject to Tender Conditions of Contract and in accordance with the particular specifications, general notes and the schedule of quantities, schedule of rates, payment and penalty condition.

AND WHEREAS the contractor has deposited a sum of Rs 8,10,000/- (Rupees Eight Lakh and Ten Thousand Only) with Employer as security for the due performance of this Contract.

NOW it is hereby agreed and declared by and between the parties hereto as follows;

1. In consideration of the payment to be made to them as hereinafter provided, the contractor shall, subject to the terms, conditions, specifications, schedule of quantities, drawings, etc., more particularly stated in the Schedules aforesaid, execute and complete the work within **10 (Ten) Months** starting after 10 days of issuance of work order or from the date of handing over of site, whichever is later.
2. The Employer shall pay to the contractor such sums as shall become payable hereunder at the time and in the manner specified in the conditions contained in the schedule aforesaid.
3. The time allowed for carrying out the work as entered in the tender Agreement shall be strictly observed by the contractor and shall be deemed to be the essence of the contract on the part of the contractor and shall be reckoned from 10 days after the date on which the order to commence the work is issued to the Contractor or the date of handing over of site, whichever is later. The work shall throughout the stipulated period of the contract be proceeded with all due diligence and the Contractor shall pay as compensation an amount equal to one percent, or such smaller amount, as the Director, Indian Institute of Science (whose decision in writing shall be final) may decide on the amount of estimated cost of the whole work as shown in the tender for every day that the work remains un commenced or unfinished, after proper dates.
4. The contractor shall to ensure good progress during the execution of the work the contractor shall be bound

in all cases in which the time allowed for any work exceeds one month (save for special jobs) to complete one-eighth of the whole work before, one-fourth of the whole time allowed under the contract has elapsed, three-eighths, of the work before one-half of such time has elapsed, and three-fourths of the work before three-fourths of such time has elapsed.

However, for special jobs if a time schedule has been submitted by the contractor and the same has been accepted by the Architects/ Project Engineer-cum-Estate Officer, CCMD the contractor shall comply with the said schedule. In the event of the Contractor failing to comply with the conditions he shall be liable to pay as compensation an amount equal to one percent or such smallest amount, as the Director, Indian Institute of Science (Whose decision in writing shall be final), may decide on the said estimated cost of the whole work for every day that the due quantity of work remains incomplete; provided always that the entire amount of compensation to be paid under the provisions of this clause shall not exceed seven and a half (7 ½) percent of the estimated cost of the work as shown in the tender.

5 The Director of the Indian Institute of Science, without prejudice to his rights under the contract in any respect of any delay or inferior workmanship or otherwise, or to any claim for damages in respect of any breaches of the Contract and without prejudice to any rights of remedies under any of the provisions of this contract or otherwise and whether the date of completion has or has not elapsed, by notice in writing absolutely determine the contract in any of the following cases:-

- (i) If the contractor having been given by the Architects/Project Engineer-cum-Estate Officer, CCMD a notice in writing to rectify reconstruct or replace any defective work or that the work is being performed in any inefficient or otherwise improper or un workmanlike manner, shall omit to comply with the requirements of such notice for a period of seven days of such notice thereafter or if the contractor shall delay or suspend the execution of the work so that in the judgment of the Project Engineer-cum-Estate Officer, CCMD (which shall be final and binding) either he will be unable to secure completion of the work by the date for completion of the work or he has already failed to complete the work by that date.
 - (ii) If the Contractor being a company passes a resolution or if the Court passes an order to wind up the company or if a receiver or a manager is appointed on behalf of the creditors of the company or under circumstances which entitles the Court or the creditors to appoint a receiver or manager which would entitle the Court to make a winding up order.
 - (iii) If the Contractor commits breach of any of the terms or conditions of this contract;
 - (iv) If the contractor assigns or sublets without written approval of the Project Engineer-cum-Estate Officer, CCMD or becomes insolvent.
- When the Contractor has made himself liable for action under any of the cases aforesaid, the Project Engineer-cum-Estate Officer, CCMD on behalf of the Director of the Institute shall have powers:
- (a) To determine or rescind the Contract as aforesaid (in which termination or recession notice in writing to the Contractor under hand of the Project Engineer-cum-Estate Officer, CCMD shall be conclusive evidence) Upon such determination or recession the security deposit of the Contractor shall be liable to be forfeited and shall absolutely be at the disposal of Institute.
 - (b) To employ labor paid by the Institute and supply materials to carry out the work or any part of the debiting the Contractor with the cost of the labor and the price of the materials (of the amount of which cost and price certified by the Project Engineer-cum-Estate Officer, CCMD shall be final and conclusive against the Contractor) and crediting him with the value of the work done in all respect on the same manner and at the same rates as if it has been carried out by the contractor under the term of his contract. The certificate of the Project Engineer-cum-Estate Officer, CCMD as to the value of the work done shall be final and conclusive against the contractor, provided always that action under the sub-section shall only be taken after giving notice in writing to the contractor. Provided also that if the expenses incurred by the Institute are less than the amount payable to the contractor at his agreement rates, the difference shall not be paid to the Contractor.
 - (c) After giving notice to the contractor to measure up the work of the contractor and to take such part thereof as shall be un-executed out of his hands and to give it to another contractor to

complete in which case any expenses which may be incurred in excess a sum of which would have been paid to the original contractor if the whole work had been executed by him (of the amount of which excess the certificate in writing of the Project Engineer-cum-Estate Officer, CCMD shall be final and conclusive) shall be borne and paid by the original contractor and may be deducted from any monies due to him from the Institute under this contract or any other account whatsoever, of from his security deposit or the proceeds of sales thereof, or a sufficient part thereof as the case may be.

In the event of any one or more of the above courses being adopted by the Project Engineer-cum-Estate Officer, CCMD, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advances on account or with a view to the execution of the work or the performance of the contract. And in case action is taken under any of the provisions, aforesaid, this contractor shall not be entitled for recover or be paid any sum for work thereto/for actually performed under this contract unless the Architect/ Project Engineer-cum-Estate Officer, CCMD has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified.

6. The schedules above mentioned including the General Rules and Directions to Contractors and the following documents, viz.,

- i) Letter of Intent
- ii) Conditions of Contract – Volume I
- iii) Contractor's Bid – Bill of Quantities – Volume II
- iv) Technical Specifications – Volume III
- v) Drawings
- vi) The pre-Bid meeting proceedings and corrigendum
- vii) Any other document listed in the Contract Data as forming part of the contract

shall form an integral part of agreement and the decision of the Project Engineer-cum-Estate Officer, CCMD in reference to all matters of dispute as to material and workmanship shall be final and binding on both the parties.

7. The employer reserves to himself the right of altering the drawings of the works and of adding to or omitting any item of work from or of having portions of the same carried out departmentally or otherwise and such alterations or variations shall not vitiate this agreement.

8. This agreement comprises the work aforesaid and all subsidiary works connected therewith even though such works may not be shown on the schedule appended hereto.

9. Notwithstanding anything contained in the tender submitted by the contractor, all the clauses of this agreement shall be binding on both the parties.

10. Where counter terms and conditions, printed or copied, are offered by the contractor, the same shall not be deemed to have been accepted by the Employer, unless specific written acceptance thereof is furnished by the Employer. Notwithstanding the foregoing, no verbal agreement or inference from conversation with any office members/representatives/employees of the Employer before, during or after the execution of the agreement, shall in any way affect or modify any of the terms/obligations contained herein.

11. In the event the contract is terminated by the Employer due to any aforementioned act/omission on the part of the contractor, or for any reason whatsoever, the Employer shall be entitled to engage the services of any other person, agency or Contractor to meet its requirement, without prejudice to its rights including claim for damages against the Contractor.

12. The Employer shall be indemnified for all losses due to commissions and omissions of persons deployed

by the contractor. If any loss or damage is caused to the Employer on account of any negligence, carelessness, acts of omissions, commissions of contractors, his employees or staff, the same shall be made good by the contractor. The contractor shall defend, indemnify and hold the Institute harmless from any liability or damage, lawsuits, penalties imposed by any State or Central Government Department or statutory body or by a third party for reasons of violation of any of statutory provisions or requirements by the contractor. The Employer shall not be liable for any damage or compensation payable to any workmen or to any person as a consequence of this work and the Employer shall be completely indemnified accordingly.

13. In case of disputes including all questions relating to the performance of the obligations under this agreement and all the dispute and differences which shall arise either during or after the agreement period or other matters arising out of or relating to this agreement or payments to be made in pursuance thereof shall be decided by the Director of IISc whose decision shall be binding on the contractor. The Contractor hereby agrees to be bound by the decision of the Director.

IN WITNESS WHEREOF the parties hereto have set their respective hands the day and the year here in above written.

In the presence of:

Signed by for and on behalf of the said Contractor.

In the presence of:

Signed by for and on behalf of the said Employer.

REGISTRAR
INDIAN INSTITUTE OF SCIENCE
BANGALORE-12

INDIAN INSTITUTE OF SCIENCE, BANGALORE-12
ITEM RATE TENDER FOR WORK

I/We, hereby tender for the execution for the Indian Institute of Science, Bangalore-12 of the works specified in the under mentioned memorandum within the time specified in such memorandum at the rates specified therein and in accordance, in all respects, with the specifications, designs, drawings and instructions in writing which have been read by me/read and explained to me and with such materials as provided for by and in all other respects in accordance with such conditions as for as possible.

MEMORANDUM OF WORK

1.	GENERAL DESCRIPTION	Supply, Installation and Commissioning of 2 Nos. of 2000 KVA, 11 KV of D.G. Sets at IISc, Bangalore
2.	ESTIMATED COST	Rs 540,00,000/-
3.	EARNEST MONEY	Rs. 8,10,000/-
4.	FURTHER SECURITY DEPOSIT	6.0% on the running account bills and final bill in addition to Earnest Money Deposit. When the F.S.D. deducted from the RA bills of the Contractor @ 6.0% of the bill amount exceeds Rs.1.00 lakhs, the amount in excess of Rs.1.00 lakh may, at the request of the Contractor, be released to him against the production of a bank guarantee issued by a Nationalised /Scheduled Bank only for an equal amount in the prescribed form. The bank guarantee should be valid till the completion of the defect liability period.
5.	TIME ALLOWED FOR THE COMPLETION OF WORK IN ALL RESPECTS FROM THE DATE OF COMMENCEMENT OF WORK	10 (Ten) Months
6.	BILLS OF QUANTITIES.	Enclosed.
7.	SPECIFICATIONS.	The work shall be carried out strictly in accordance with the enclosed specifications and wherever items are not covered by those specifications in accordance with specifications/drawings/designs/requirements and directions of the Project Engineer-cum-Estate Officer, CCMD or his representatives.

I/We hereby agree to abide by and fulfill all the terms and provisions of the conditions contained in the articles of agreement, which have been read by me/us or in default thereof to forfeit and pay to the Registrar, Indian Institute of Science or his successors the sums of monies mentioned in the said conditions.

The sum of **Rs.8,10,000/- (Rupees Eight Lakhs and Ten Thousand Only)** has been deposited in cash/Bank draft as Earnest Money the full value which is to be absolutely forfeited to the Registrar or his successors in Office should I/We fail to commence the work specified in the above memorandum and complete the same.

Dated this

Signature of the Contractor/s

Witness to Contractor/s Signature:

NAME

ADDRESS

OCCUPATION

The above tender is hereby accepted by me on behalf of the Indian Institute of Science, Bangalore-12.

**REGISTRAR
INDIANINSTITUTE OF SICENCE
BANGALORE.**

Indian Institute of Science, Bangalore-12

APPENDIX

1.Name of the work	Supply, Installation and Commissioning of 2 Nos. of 2000 KVA, 11 KV of D.G. Sets at IISc, Bangalore
2.Date of commencement of work	Within Ten days from the date of issue of work order or the date of handing over the site whichever is later
3.Time of Completion	10 (Ten) Months
4.Frequency of interim Certificate and payment	Once every month.
5.Further Security deposit	6.0% on the running bills and final bill in addition to earnest money deposit. When the F.S.D. deducted from the R.A. Bills of the contractor @ 6.0% of the bill amount exceeds Rs.1.00 Lakhs, the amount in excess of Ra.1.00 Lakh may, at the request of the contractor, be released to him against the production of bank guarantee issued from a Nationalised /Scheduled Bank only for an equal amount in the prescribed form. The bank guarantee should be valid till the completion of the defect liability period.
6. Defects liability period / retention amount from the final bill/release of balance of deposit.	The security deposit lodged/paid by a contractor shall be refunded to him after the final bill is paid or after twelve months from the date of completion of the work, during which period the work so executed should be maintained by the contractor in good order, whichever is later.
7. Penalty for delay	In respect of the shortfall in progress, assessed as due to the delay on the part of contractor as per clause 2(b) and 2(c), the contractor shall be liable to pay as penalty an amount equal to one percent of the estimated cost of the balance work assessed according to the programme, for every day that the due quantity of work remains incomplete, provided always that the total amount of penalty to be paid under the provisions of this clause shall not exceed 7 ½ percent of the estimated cost of the entire work as shown in the tender, provided further that in the event of the contractor making up the shortfall in progress within the stipulated or extended time of completion, the penalty so recovered may be refunded on an application in writing by the contractor.
8. Period for payment of Running Bill.	Three weeks from the date of submission of each Running account bills by the Contractor.
9. Period for submitting the final Bill.	One month from the date of virtual completion of the work by the Contractor.

GENERAL RULES AND DIRECTIONS TO CONTRACTORS

1. A Schedule of Quantities (Bill of Quantities) is attached herewith. It should however, be clearly understood that these quantities are liable to alterations by omission, addition or variation, at the discretion of the Architects/Project Engineer Cum Estate Officer
2. The tenderer shall insert all rates and amounts and the totals in the schedule of quantities. Rate for alternative items, when asked for, shall be entered in red ink and shall not be included in the total.
3. The drawings together with specifications and conditions of contract are enclosed. These should be studied carefully by the intending tenderers. In the absence of specifications for any item of work, material or ingredient in the specifications, PWD specifications shall be followed and in the absence of specification for any item, materials are ingredient shall be fixed in all respects in accordance with the instructions and requirements of the Project Engineer Cum Estate Officer, the work will be the best of the kind.
4. The tenderer is expected to inspect the site and acquaint himself with the local conditions and will be deemed to have so done before submitting the tender.
5. The successful tenderer is required to sign an agreement for the due fulfillment of the contract and start the work immediately on of the acceptance of his tender. A draft of the Articles of the Agreement is enclosed. The Earnest Money referred to in item No.3 of Memorandum contained in the "Item Rate Tender for Works", will be forfeited and at the absolute disposal of the Employer if the Contractor defaults from signing the Agreement of in starting the work.
6. The rates quoted shall be for finished work and shall include for all necessary incidental work. Sales or any other tax on materials in respect of this contract will be payable by the Contractor. The Contractors cannot presume any details regarding the contract.
7. Water supply: The Contractor has to make his own arrangement for water supply. However, if water supply to the site at one convenient point is made available by the Institute, the charges for the consumption of water will be borne by the Contractor at 1.50% of the value of the work.
8. Supply of Electricity-electricity required for construction shall be arranged by the contractor itself. Electricity if supplied to the contractor by the institute will be metered and amounted will be recovered in the bills as per actual at rate fixed by the Institute. Supply of electricity from the institute is not mandatory. Non supply of electricity by the institute cannot be held as reason for short fall in progress.
9. The duration of the work is **10 (Ten) Months.**
10. Institute reserves the right to accept or reject any tender without assigning reasons thereof. He further reserves the right of deleting any item of work in this contract at his discretion.
11. The tenders are valid for a period of 6 (three) months from the date of opening.
12. This "General Rules and Directions to Contractors" shall also form part of the tender document.
- 12.1 Cement to be procured by contractor only, adhering to the following conditions.
 1. Only 43 grade OPC cement is to be used for the projects.
 2. The cement shall conform to IS 8119-1976.
 3. ACC, L&T, Coromandel, Birla brands only to be used.
 4. Test certificate is to be produced for every procurement made for.

13. This contract comprises:
 - a) General Builders work (Civil works).
 - b) Water supply and Sanitary installations.
 - c) Electrical Installations.
 - d) Sump and overhead tanks.
14. The General Builder should get the water supply and sanitary installations and the Electrical installations executed through licensed sub-contractor having good experience and qualified and competent tradesmen in the respective fields and approved by the Project Engineer Cum Estate Officer.
15. It is entirely the responsibility of the Contractor to arrange for and provide all materials required for successful completion of the work except such special materials that may be supplied if any.
16. The Brand, size and colour of vitrified/ceramic/glazed tiles shall be got approved from the Competent authority before procurement of materials. Brands recommended are Johnson, Naveen, Kazaria.
17. Water supply/Sanitary fixtures like Bibcocks, pillarcocks, Health-faucet, anglecock, bottle traps, EWC, IWC, urinal basins shall be as per approval from competent authority.
18. Tenders determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows
 - a) Where there is discrepancy between the rates in figures and in words, the lower of the two will be governed and
 - b) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will be governed.
 - c) Where there is a discrepancy in entries of unit rate between the Original and Duplicate, the lower will govern.
19. Tol tax, Royalty for collecting earth, gravel, sand stone etc., GST or any other tax payable on account of this contract will have to be met from contractors account.
20. The Contractor should make his own arrangements to cover the all-round construction area, by providing polyester net/polythene sheet/barricading to avoid inconvenience to other surrounding departments, as directed by the Project Engineer-cum-Estate Officer of the work.
21. The debris arise during the period of construction will have to be cleared then and there to keep the surroundings clean and tidy. Such debris shall, if not cleared, be cleared at his risk and cost.
22. Work done as a sub- contractor under a prime contractor will not be considered for qualification.
23. "Prime Contractor" means a firm that performs a construction work itself and that the work is directly entrusted to the firm by the owner/ government/ local body/ quasi government/ Government undertaking bodies.
24. The contractor shall vacate the campus premises with all his men/ materials immediately after completion of the project.

Supply portion : Basic engineering, Design, Drawing preparation / submission for approval, Manufacture, Testing (Factory Acceptance Testing), Packing, Supply, delivery upto site and Unloading at site. ET&C portion : Erection/Installation, Testing and Commissioning, Load Trials and As Built Documentation, Training of O&M Personnel and Handing over.

-Detailed scope is as per the Specification. The bidder shall quote rates for all the items.

-Bidder shall visit the site and make himself acquainted with site conditions and existing equipment before submitting the bids.

-The quantities of various items indicated are only approximate and payment will be made on the basis of actual quantity executed. The quantities of the individual items can vary to any extent and the purchaser is at liberty to delete any item.

-Drawings enclosed herewith are meant only for bidding purpose and are meant only to give the bidder general idea about the nature of work, various items of work involved etc. The actual execution of the work is to be done as per "Released for construction" (RFC) drawings. RFC drawings will be issued later to the contractor. RFC drawings may vary from the bid drawings to any extent. No claim is admissible in the quoted rate on this account.

- Bidder shall submit the Catalogues/GA Drawings and datasheets duly filled along with Bid. Bidder in the event of contract shall submit GA/Layout/SLD/Scheme/Bill Of Materials/ Supporting calculations etc before proceeding with manufacturing work.

SECTION-A					
1.0	DG Set				
a	<p>Diesel Engine Generator Set (DG-3 & 4),1500RPM sized to Prime power of 2000kVA, 0.8 Power factor, 1600kWe (electrical) ,11kV, 50Hz at alternator terminals along with</p> <p>a) Engine Driven Radiator</p> <p>b) Flywheel /Coupling/Coupling Guard.</p> <p>c) Common Skid/ Steel Base Frame</p> <p>d) Heavy duty Anti vibration Pads, mounitngs.</p> <p>e) Acoustic Enclosure complete internal illumination ,interior and exterior painting.</p> <p>f) Engine Local Control Panel complete with Engine monitoring, Governor Controls, AVR, Generator Excitation systems, etc.,</p> <p>complete as pe the enclosed Specification, Drawings, Datasheets, ISO, IEC, IS standards.</p> <p>Note :</p> <p>1) Supplied DG Set shall be able to operate Parallel among each other and also with <u>existing two Number DG Set 1 & 2(Perkins Engine-Leroy somer Generator with Woodward-easy gen-3200XT series synch and load sharing system)</u> . AMF Dead bus closing, Auto Synch, Parallel Operation/Load sharing of all the Sets (1,2,3 & 4) shall be demonstrated during commissioning. Necessary support, if required, from any other OEM / Vendor / service provider is to be inlcuded in the pricing. Purchaser shall be relieved from any such obligations.</p> <p>2) Resistance Temperature detector (RTD) and Temperature Scanner shall be provided for Bearing &</p>	No	2		
b	Unloading & Positioning	No	2		

c	Installation Materials (Foundation Bolts/Anchor Bolts/Any other items as required) excluding civil foundation.	No	2		
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d	Protection Relay/Meter/Generator Controller settings review, testing by secondary injection kits such as Doble/Omicron / other equivalent makes by third party testing agency including necessary Hardware and Software tools	No	2		
f	Testing and Commissioning Charges of all the items supplied by him under this tender work in this whole schedule whether explicitly mentioned or not. Note : Bidder to include the necessary man power and expert services for the existing DG-1&2 as well which may be required during integration of all the DG sets 1,2,3 & 4	No	2		
g	Load Testing charges with Load Bank for 2000kVA, 0.8Power factor, 1600kWe 2Hrs including Fuel and Coolant for both the sets (DG-3 & 4) during Factory acceptance Testing to be witnessed by Purchaser and thier representatives.	Job	1		
2.0	Fuel System & Building Ventilation relevant.				
a	Fuel Supply system comprising of 2 Nos 990 Ltr day tanks, 1 No Buffer Tank , Level Gauge, Level Monitoring, Isolation Valves, Flow Meters, Pressure Guages, Over flow controls, interconnecting pipes of 40mm dia 120 Meter length, Booster Pumps (1W +1Stand by)etc., as per the enclosed drawing /Specification/Data sheets. Vendor has to make analysis of Motor rating and Pipe sizing with respect to pressure loss and required pressure.	Set	2		
b	DG-1 & 2 Fuel Supply lines re routing if the same is obstructed by DG-3 & 4.. Bidder to carry out this work before taking up other installation work so as not obstruct/hamper the operation of DG set 1 & 2. Project engineer shall be consulted before taking up this work.	Mtrs	10		
c	Fuel required for load test shall be included. Post Load testing 990Lts of Diesel need to be filled prior to Handing over. All necessary consumables such as Diesel, Oil, Coolant, D.M.Water are in Vendors Scope.	Set	2		
d	Dismantling of existing Building Inlet Air Fan, Supply, Installation, Testing and commissioning of New Industrial Grade Inlet Air Fans, Direct Driven, Axial Ventilation, Double Flange, along with 3Phase Motor, Fixing Hardware, Safety Guard +Local Cable Isolation Box. Minimum Capacity of Fan shall be 75000 CFM, However same shall be sized to cater for the air consumption of all DG sets (existing 1 & 2 and New 3 & 4) and limit the termperature rise of air within persmissible limits of 5 Deg C Rise. Bidder to submit the sizing calculation for approval before proceeding.	No	4		

e	Modification of Existing Metal Door of DG Room so as to have 50% of Area with Chain Link/Louvers for free air circulation with all the hardware as required to complete work including Painting.	No	3		
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3.0	Exhaust System				
	a Supply & Installation of Exhaust pipe, galvanised steel of size 16" for each engine, with insulation of rock/mineral wool to a minimum. thickness of 75mm (wool density of 150kg/m3) with wire mesh binding and Aluminium sheet cladding. Vendor has to make analysis on account of exhaust flow, back pressure etc., and check the adequacy of the chimney.	Mtrs	120		
	b Supply & Installation of Star 'Y' Coupler along with Muffler / Exhaust Silencers (Residential Type) with Insulation.	No	2		
	c Supply & Installation of Bellows/Expansion joint for 16" Exhaust pipe (Qty as required per engine)	Set	2		
	d Supply & Installation of required Steel Supports like ISMC, 'L' Angles, Nuts, Bolts, Joining / Welding for Exhaust Piping/Chimney with Ladder and Maintenance Platform as per the approved drawing. All the outdoor support structure steel shall be Hot Dip Galvanised. Bidder to submit the detailed drawing mentioning sizes and weights for certification.	kGs	13000		
4.0	Electrical Switch gear and Control Gear				
	a Supply, Installation, Testing and Commissioning of Free standing, Floor Mounting Cubicle with IP52 Protection, matching the height and paint shade of existing Panel(CRM), Control Relay Metering Panel- Auto Mains Failure, Auto Synch and Load sharing for DG-3 & 4 complete with SCADA/BMS Compatibility as per SLD/Specification/Data Sheet. Note : Existing DG 1 & 2 Sets Control System is provided with Schneider make P343 Protection relay and Woodward Easy Gen-3200XT controllers . The proposed DG-3 & 4 system shall interface with these existing DG-1 & 2 controller so as to have Complete synchronization and load sharing of all 4 Sets satisfactorily. Same make and model of Relays and controllers are preferred for ease of integration. In case bidder offers other make/model necessary engineering and hardware, shall be	No	2		
	b Supply, Installation, Testing and Commissioning of Free standing, Floor Mounting 11kV Switch gear Panel complete with Adopter Panel for coupling to existing panel, Two Nos Incomer VCB(630A)+CT+PT+Surge Arrestor, 800A rated Copper Bus bar (80 x10mm size), Augmentation of existing outgoing feeder for 630A with 500/5A CT, as per SLD/Specification/Data Sheet. Preferred make and model of VCB is Schneider as that of existing.	Set	1		
	c Augmentation of Main Bus Bar for 800A with 80 X 10mm Size Cu Busbars in 11kV DG 1&2 Switch gear Panel in case required.	Set	1		

d	Providing, Testing and Commissioning of Surge Arrestor in Existing 11kV DG 1&2 Switch gear incomer Panel for all three phases in case required.	Set	2		
e	11kV Switch gear Panel @ 66kV MUSS-DG Incomer rating Augmentation. Bus jumper rating shall be augmented to 630A with necessary Busbars. CT shall be replaced with 500A rating. Existing Meters shall be either calibrated/replaced as per the new CT Ratio including Testing and Commissioning.	No	1		

f	Supply, Installation, Testing and Commissioning of Free standing, Floor Mounting Cubicle NGR+NIS Panel near the respective DG 3 & 4 : 11kV Neutral Grounding Resistor complete with Neutral isolating Vacuum contactor-Current Transformers complete as per SLD/Specification/Data Sheet.	No	2		
g	Supply, Installation, Testing and Commissioning of Free standing, Floor Mounting Cubicle, DG Auxiliaries Motor Control Center for DG Set 1,2,3 & 4 with Incomer : 400A MCCB+CT+Ammeter+Voltmeter+Multifunctional Meter+RYB Indicating Lamps, Bus Bar : Copper rated for 400A, Outgoing Feeder : Type-2 Co-ordinate Motor Starter Feeder with MPCB+Contactor+Thermal Overload Relay+ON/Off PB+Auto Manual Selector Switch) and other outgoing feeder as per SLD/Specification/Data Sheet. Note : 1) The Existing MCC shall be discarded after the New MCC is put into service. 2) Existing incoming and outgoing cable shall be relocated to New MCC. 3) New MCC shall be compact in dimension to match the available space. 4) DG essential fuel Pumps and ventilation Fans shall have Auto start/stop feature. Bidder to include necessary hardware and interface requirements for the same.	No	1		
h	110VDC, Dual Float cum Boost Charger Panel with minimum of 65Ah Capacity Battery, Battery Stand, Battery MCCB Junction Box, Interconnection DC Cabling work (Battery Ah Sizing shall be done by bidder to serve the loads of DG-3 & 4 Switchgear and Control gear Panels)	No	1		
5.0	Power and Control Cables				
a	Supplying and Laying of 11kV, 3C X 240Sqmm Stranded Aluminium conductor, XLPE insulated, Screened, Armoured Cable (Alternator Neutral Terminals to NIS/NGR Panel) over trays in existing trench as required.	Mtrs	30		
b	Supplying and Laying of 11kV, 3C X 240Sqmm Stranded Aluminium conductor, XLPE insulated, Screened, Armoured Cable (Alternator Line side to VCB Panel) over trays in existing trench as required.	Mtrs	120		
c	Supplying and Laying of 11kV, 3C X 300Sqmm Stranded Aluminium conductor, XLPE insulated, Screened, Armoured Cable (DG VCB Panel Outgoing to 11kV Switchgear Panel incomer in 66kV Substation are) direct in ground including excavation, sand cushioning, protective covering and	Mtrs	240		
d	Supplying and making indoor cable end termination with heat shrinkable jointing kit complete with all accessories including lugs suitable for above size of 3 core, XLPE aluminium conductor cable of 11 kV grade as required.	Set	10		

e	Supplying and Laying of 415V Power Cables, 4Core X 4,6,10,16Sqmm (As per Motor Size) Stranded Copper, XLPE insulated, Armoured, PVC outer sheathed cables over existing cable trays including double compression brass cable glands and termination lugs etc as required for DG Aux Motors interconnection cabling. Bidder shall assess the required quantity as per the feeders in DG Aux MCC SLD.	Lumpsum	1		
f	Supplying and Laying of Control Cables of below mentioned sizes, Stranded Copper,PVC insulated, Armoured, PVC outer sheathed cables over existing cable trays including double compression brass cable glands and termination lugs etc as required for interconnection of bidder supplied electrical panels and equipment. Bidder shall assess the required quantity as per their equipment and layout. 2C X 2.5Sqmm 4C X 2.5Sqmm 7C X 2.5Sqmm 12C X 2.5Sqmm	Lumpsum	1		
g	Supplying and Laying of Instrumentation Cables of below mentioned sizes, Stranded Copper,PVC insulated, Armoured, PVC outer sheathed cables over existing cable trays including double compression brass cable glands and termination lugs etc as required for interconnection of bidder supplied electrical panels and equipment. Bidder shall assess the required quantity as per their equipment and layout. 1T,2T,6T X 1.5Sqmm	Lumpsum	1		
6.0	Earthing Works				
a	Earthing with Centrifugally Cast Iron earth pipe 3 meter long, 150mm mm dia, wall thickness of 13mm including GI Clamps, Funnel, accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe treated with charcoal/ coke and salt as required for Equipment Body earthing complete in all respect.	No	6		
b	Earthing with Centrifugally Cast Iron Pipes. pipe 3 meter long, 150mm mm dia, wall thickness of 13mm including GI Clamps with Funnel, accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe treated with charcoal/ coke and salt as required for Generator Neutral earthing complete in all respect.	No	4		
c	Supplying and laying 50mm X 6 mm GI strip on surface or in recess for connections including mounting supports, PVC sleeves terminating with nut, bolt, spring, washer etc. as required.	Mtrs	200		

d	Supplying and laying 50 mm X 8 mm copper strip on surface or in recess for connections including mounting supports, PVC sleeves terminating with nut, bolt, spring, washer etc. as required. (Jointing shall be done by overlapping and with 2 sets of nut bolt & spring washer spaced at 50 mm)	Mtrs	100		
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7.0	Miscellaneous Works				
a	Providing and fixing of A1 size Drawing Display Board with Laminated drawing	No	2		
b	Providing and fixing of Shock Treatment Chart in English and Local Language	No	2		
c	Providing and fixing of Danger Board in English and Local Language	No	2		
d	Providing and fixing M.V. danger notice plate of 200 mm X 150 mm, made of mild steel, at least 2 mm thick, and vitreous enameled white on both sides, and with inscription in single red colour on front side as required.	No	2		
e	Providing and fixing H.T. danger notice plate of 250 mm X 200 mm, made of mild steel, at least 2 mm thick, and vitreous enameled white on both sides, and with inscription in single red colour on front side as required.	No	2		
f	One inch Height Bold Painted Text Labeling and marking of DG Sets / Fans / Pumps / Panels / Feeders / tanks / Pipes / Exhaust System and Stainless Steel Tag Plates for Valves/Motors/ Junction Boxes etc for all the supplied equipment.	Lumpsum	1		
8.0	Fire and Safety relevant				
a	Providing and fixing of 11kV Grade Safety Insulation Mats as per IS:15652, Anti Skid type for entire Switchgear Room	Sq Meter	60		
b	Providing and fixing of 4.5kG Class CO2 type Portable Fire Extinguisher on wall	No	2		
c	Providing and fixing of Set of Sand Buckets with Stand	No	2		
d	Providing and fixing of First Aid Box complete with all standard first aid materials	No	2		

e	Providing cable trench cover with lifting arrangements and any other openings with Mild Steel Plates of approved design and thickness wherever required as advised by Project Engineer. Drawing / Sketch shall be approved by project engineer.	kGs	250		
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9.0	Approvals/Liasoning				
	Preparation of necessary drawings for DG Set, getting approval from the Chief Electrical Inspectorate/Electrical Board/ Pollution Control Board before taking up work and to furnish completion report, arranging for inspection, giving trial run on load, obtaining approval for commissioning the sets by paying necessary fees for inspection etc., (Necessary statutory fees will be re-reimbursed after producing the receipts)	Lumpsum	1		
10.0	Civil Works- DG/Chimeny foundation relevant				
a	Removing/dismantling carefully RCC foundations and disposing off the debris to a place designated by Owner.	cum	63.2		
b	Excavation in loose and hard soil below the levels for foundation, back filling the sides of foundations, walls, trenches etc. consolidating backfill by watering and ramming in layers of 300 mm consolidated thickness and transporting excess excavated spoil to dumping yard out of the premises (back filling shall not be paid separately, bidder to include this rate), max 800mm width over & above the excavation as per drawing shall be measured & paid for. Extra excavation made by contractor for his convenience will not be paid for.	Cum	43.6		
c	Providing and laying reinforced cement concrete M25 grade with opc @340kgs with 20 mm and down grade coarse aggregate and river sand including superplasticisers form work, required compacting and curing complete for below and above ground works	Cum	74.1		
d	Supplying, fabricating, cutting bending, tying & placing in position reinforcement high strength deformed bars with $F_y=500$ N/sq m, including tying with 16g annealed binding wire as per drawings & keeping the same in position during concreting	ton	1.1		
11.0	Civil Works- Miscalaneous				
a	Cooling Tower relevant : Removing/dismantling carefully RCC walls,tanks & etc and disposing off the debris to a place designated by Owner.	cum	13.2		
b	Cutting and removing projected portion of RCC loft and RCC Chajja from the beam by using appropriate cutting equipment including disposing off the debris to designated spot by owner all as per specification	cum	2.4		
c	Removing existing brick wall including Door ,windows & exhausts if any & removal of plaster & water proof material over the same & dispose off debris to a place designated by Owner.	cum	7.7		

d	Removing & dismantling of existing exhaust structure cutting & dismantling of steel members & dispose off scrap to a place designated by Owner.	tonn	1.5		
e	Refilling of cable trench with plain cement concrete 1:4:8, Opc cement @180kgs & 600 mm thick with 40 mm and down grade aggregates and river sand, over soling, including any form work required, compacting and curing complete	cum	6		
f	Providing and laying as per drawings, 230 mm thick brick masonry in CM 1:5 using approved quality first class table-moulded bricks, including scaffolding, curing etc., complete, for walls, wall footings, partitions etc., as per specifications, at all levels and locations	Cum	1		
g	Providing and laying 13 mm thick internal plain faced cement plaster in CM 1:5 on RCC, brick, stone etc., including sides and under sides of slabs chajjas, lintels etc., including scaffolding, curing etc., complete	cun	1		
h	Providing and laying exterior cement plaster in 2 layers, first layer 13 mm thick, second layer 7 mm thick in CM 1:5 on RCC, brick, stone etc., including scaffolding, curing, drip mould etc., complete	cum	1		
i	Providing and applying 2 coats of oil bound distemper of approved make internal paint over 1 coat of primer & approved colour and required by Owner	Sqm	1		
j	Cutting main Doors size of 3000mm X 1000 mm in 2 places & closing the openings with approved wire mesh to allow constant movement inside the building including cutting frames,angles & cutting machine cost.	Sq.m	6		
k	Providing and laying plain cement concrete 1:4:8, 100 to 200 mm thick with 40 mm and down grade aggregates and river sand, over soling, including any form work required, compacting and curing complete other than mentioned above.	Cum	1		
l	Cleaning up the area including removal of debris, all unused material, and stack usable material at specified location, position etc. complete and handing over possession	Lumpsum	1		

12.0	Below mentioned items shall be operated as per the project engineer discretion				
	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray (galvanization thickness not less than 50 microns) in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders or supported with Angle iron in Trenches including G.I. bolts & nuts etc. as required				
	Ladder Type Cable Tray-600mm Wide	Mtrs	40		
	Ladder Type Cable Tray-300mm Wide	Mtrs	15		
	Supplying and installing following size of perforated Hot Dipped Galvanised Iron cable tray (galvanization thickness not less than 50 microns) with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with G.I. suspenders or supported with Angle iron in Trenches including G.I. bolts & nuts, etc. as required				
	300 mm width X 62.5 mm depth X 2.0 mm thickness	Mtrs	15		
	150 mm width X 50 mm depth X 1.6 mm thickness	Mtrs	14		
	75 mm width X 50 mm depth X 1.6 mm thickness	Mtrs	10		

SECTION-B					
1.0	Buying Back of following items as it is (as in wherein)basis at site.				
a	Diesel Engine Generator Set-3 & 4-Complete Engine and Alternator (Kirloskar) along with it's Chimeny and Day Tank and interconnection pipes	Set	2		
b	Outdoor Cooling Tower Motors and Pumps-Piping Materials	Set	1		
c	NIS+NGR Panel of DG-3 & 4, Kirloskar Make Control and Relays panels and PLC Panel (line up in the First Floor)	Set	1		
d	Un used Cables after identfication-Al Conductor	kGs	50		
e	Un used Cables after identfication-Copper Conductor	kGs	50		
f	Scrap Iron Materials after identification	kGs	50		
	TOTAL for Section-A and B				