

TABLE OF CONTENTS

| | | |
|-----|--|---------|
| 1 | Notice Inviting Tender | Page 3 |
| 2 | Check List | Page 8 |
| 3. | Formats for covering letter, eligibility criteria & BG etc | Page 9 |
| 4. | Copy of abridged NIT for Press Publication | Page 18 |
| 5. | General Terms & Conditions of Contract | Page 19 |
| 6. | Aims, Objectives & Meteorological Details of Site | Page 36 |
| 7. | Technical Specification for Civil & Architectural Works | Page 41 |
| 8. | Technical Specification for Electrical Works | Page 63 |
| 9. | Schedule of Items for Civil & Architectural Works | Page 73 |
| 10. | Schedule of Items for Sanitary and plumbing Works | Page 77 |
| 11. | Schedule of Electrical Items | Page 88 |
| 12. | Drawings- 4+4 Nos. | |

Jharkhand Renewable Energy Development Agency
 Plot No. 328/B, Road No. 4, Ashok Nagar, Ranchi 834002
 Phone No. 0651-2246970, FAX: 0651-2240665,
 Web-site: www.jreda.com, Email: info@jreda.com

NOTICE INVITING TENDER

Tender Notice No: JREDA / SLEP/02/ 2007-2008

Date: 24/07/2007

Sealed **TWO PART** tenders are invited by JREDA from resourceful, reputed and experienced contractors and having experience in setting up of at least two buildings valued at more than Rs.50.00 (fifty) lacs based on solar passive architecture in last three years.

Name of Work: Construction of Exhibition Hall based on solar passive architecture at the State Level Energy Park Complex at Siddu-Kanu Udyan, Ranchi, Jharkhand.

Time of completion 180 days.

The salient features of the Tender Document are as follows:

1.0 TENDER DOCUMENTS

The tender documents shall comprise of all the documents mentioned in Table of Contents of this document. In addition to these any other document(s) /amendment(s) or revisions/ instructions issued by JREDA from time to time to the bidders till the due date of opening of the offers, shall also be deemed to be integral part of the tender document. Failure to furnish all information as per bid document in every respect will be at bidder's risk.

2.0 COST OF TENDER DOCUMENT

- 2.1 The Tender Document can be purchased from the office of the JREDA against payment by Demand Draft drawn in favour of "The Director, Jharkhand Renewable Energy Development Agency" on any nationalized bank/ scheduled bank payable at Ranchi of requisite value and within the time and period as specified in the NIT.
- 2.2 The bidders may download the tender Document from the web site www.jreda.com and submit the cost of Tender Document as specified along with Part – I of the offer, in a separate envelope failing which the bid will be summarily rejected.

3.0 EARNEST MONEY

- 3.1 Tender must be accompanied with 2% of the tendered value as earnest money by a Demand Draft drawn in favour of "The Director, Jharkhand Renewable Energy Development Agency" on any nationalized bank/ scheduled bank payable at Ranchi. This shall be enclosed with Part -1, of the tender, i.e. The Techno-commercial bid
- 3.2 A Bank Guarantee drawn in favour of "The Director, Jharkhand Renewable Energy Development Agency" on any nationalized bank/ scheduled bank payable at Ranchi and valid for a period of 240 days may be submitted against earnest money in lieu of Demand Draft as per format enclosed as Annexure No.6.
- 3.3 The request for adjustment of earlier dues against earnest money shall not be entertained.

- 3.4 Earnest money shall be returned to the unsuccessful bidders within 60 (sixty) days from the date of issue of Letter of Intent/Firm order on the successful bidder.
- 3.5 In case the tender of any party is rejected during scrutiny of the 'Technical bid' the earnest money will be returned to such bidder(s).
- 3.6 The earnest money will be forfeited if any bidder withdraws his offer during the validity period and if the successful bidder fails to furnish his acceptance of order letter within specified time or fails to start the work and execute it within specified time frame.

4.0 SUBMISSION OF OFFER

- 4.1 After procurement of tender documents the bidders must go through carefully all the terms and conditions and technical specification, seek clarification wherever necessary, before submission of tender. The intending bidders should also visit the site before submission of the Tender.
- 4.2 The offer shall be prepared by typing or printing in English language with black ink on white paper or printed 'letter head' of the contractor in consecutively numbered pages duly signed by the authorized signatory of the contractor with seal of the firm affixed on each page.
- 4.3 Original copy of the Tender Document, amendments/ revisions to Tender Documents issued by JREDA, (if any) shall be signed and submitted along with the bid.
- 4.4 The Tender Document shall comprise of all documents/drawings/information as stated in the offer. The checklist shall be duly filled up and signed by the contractor to specify and confirm submission of documents with the offer.
- 4.5 The offer shall be free from overwriting but if any corrections are made, the same should be initialed by the person signing the offer

5.0 MODE OF TENDER SUBMISSION

- 5.1 The Part – I : The Techno-commercial Bid shall be submitted complete with the following: -
 - 5.1.1 Complete Tender Documents as purchased from JREDA or unloaded in full from www.jreda.com duly filled in and signed; except the price part of the tender.
 - 5.1.2 Cost of Tender Document (non-refundable), if unloaded from website:www.jreda.com by Demand Draft drawn in favour of Director, JREDA on a scheduled/nationalized bank of India.
 - 5.1.3 Earnest Money deposit in one of the acceptable forms as specified.
 - 5.1.4 Documentary evidence showing that the Bidder has completed at least two Nos. of buildings valued at more than Rs. 50.00 (fifty) lacs in last three years.
 - 5.1.5 Any other supplementary details required for the evaluation of the tenders such as drawings, technical literature/catalogues and data etc.
 - 5.1.6 A Bar Chart indicating completion schedule for various items involved in the work within the stipulated completion period.
 - 5.1.7 Deviations, if any from tender specifications and or tender conditions, with reasons therefore. It is open to JREDA whether or not to accept them.
 - 5.1.8 Duly filled up Check List shall be enclosed.

Each tender will have to be submitted either personally or by registered post in a sealed envelope addressed to The Director, Jharkhand Renewable Energy Development Agency,

Plot No. 328B, Road No. 4, Ashok Nagar, Ranchi – 834 002 duly marked on the envelope as “PART – 1, TECHNO-COMMERCIAL BID: Tender For Construction of Exhibition Hall based on Solar Passive Architecture at the State Level Energy Park Complex at Siddu-Kanu Udyan, Ranchi, Jharkhand. Due on 23 August 2007.

5.2 The Part – II : The Price Bid shall be submitted complete with the following: -

Part – II: PRICE BID. Tender For Construction of Exhibition Hall based on Solar Passive Architecture at the State Level Energy Park Complex at Siddu-Kanu Udyan, Ranchi, Jharkhand.”

5.2.1 The price schedule should be duly filled up both in figures and in words. Each page to be duly signed by authorized person with seal of the firm.

5.2.2 In case of any discrepancy between the price mentioned in figures and words, the price mentioned in words will be considered as final.

5.2.3 The price bid should not contain any technical matter or other matter except those related to price. The date of opening of price bid shall be notified after opening of techno-commercial bid.

5.3 The envelopes containing Technical Bid and the Price Bid shall be put inside a third envelope along with a forwarding letter. The Cover should be duly marked as “Tender For Construction of Exhibition Hall based on Solar Passive Architecture at the State Level Energy Park Complex at Siddu-Kanu Udyan, Ranchi, Jharkhand. Due on 23 August, 2007”.

6.0 ELIGIBILITY AND QUALIFICATION CRITERIA FOR BIDDERS

The bidder is required to submit the supporting documents for the following:

6.1 Confirmation of meeting Basic & Minimum Eligibility Criteria as per format enclosed in Annexure 2 & 3.

6.1.1 The bidder must have constructed at least two numbers of modern buildings based on Solar Passive Architecture in last three years. Bidder must have qualified Architect registered with Council of Architecture of India.

6.1.2 The bidder must have adequate experience of constructing public buildings based on modern environment friendly architecture and must have constructed two modern buildings worth more than Rs. 50.00 (fifty) lakhs each.

6.1.3 List of works completed in the last 3 (three) financial years giving description of work, name of client, value of contract, date of award, schedule of completion, actual date of starting and actual date of completion should also be given.

6.1.4 List of works on hand indicating description of work, contract value, approximate value of balance work yet to be done and the date of award of contract.

6.1.5 The average annual turnover during the last three years as per ITCC should be minimum of Rs.1.5 crores.

6.1.7. Registration certificate of the firm.

6.1.8 Certificate of conduct from main/lead Banker certifying status of operation of account.

6.1.9 Photocopy of Partnership Deed in case of Partnership firm.

6.1.10 Power of Attorney for Authorized Signatory in case of companies.

7.0 SCOPE OF WORK

- 7.1 The scope of works shall be as indicated in Technical Specification, General Conditions of Contract and Schedule of Items of Work
- 7.2 The Director, JREDA reserves the right amend the scope of work, accept or reject any or all offers, in full or in part or in full or cancel or withdraw the NIT for bids without assigning any reason whatsoever and in such case the bidder or intending bidder shall have no claim arising out of such action.
- 7.3 The tenderer shall carefully study the technical specification, general conditions of contract and the schedule of items of work and shall satisfy himself regarding technical and all other aspects of the work before submitting his offer.
- 7.4 The design shown in the document is indicative and the detailed construction drawings will be prepared and submitted by the contractor for approval to the JREDA/Consultant without changing the basic dimensions and shape of the building. The work will be carried out on the basis of approved detailed drawings. The contractor will be responsible for structural stability of the complex.

8.0 PRICE

- 8.1 The tenderer shall quote his price as per 'Schedule of Items of Work'. The price shall be firm and binding and shall not be subject to any variation except for statutory variation of taxes and duties during the contractual completion period.
- 8.2 The price shall be inclusive of all taxes, duties and levies etc. as on the date of opening of tender.

9.0 PAYMENT TERMS

Payments for execution shall be made as per terms and conditions of the contract subject to any deductions related to work, which the purchaser may be authorized to make as per terms and conditions of the contract and Income Tax or any other tax deductions as per prevailing rules and acts applicable at the time of payment.

10.0 AUTHORIZATION FOR SIGNING THE OFFER.

- 10.1 The person signing the offer shall have a Power Attorney duly solemnized before a Magistrate giving him authority to sign the offer on behalf of the firm/company on Non-judicial Stamp Paper of Rs.10.00 only.
- 10.2 In case the authorized signatory of the contract is not in a position to attend the bid opening, he may authorize another person to attend the bid opening on his behalf by issuing an authority letter on the printed letterhead of the firm as per proforma enclosed in Annexure – 5. This will be valid only for attending the bid opening.

11.0 NO CLAIM OR COMPENSATION FOR SUBMISSION OF TENDER

The tenderer, whose offer is not accepted shall not be entitled to claim any costs, charges, expenses of and incidental to or incurred by him through or in connection with his submission of Bid, even though JREDA may elect to withdraw the Invitation to Bid.

12.0 VALIDITY OF OFFER

Unless otherwise specified, the Tenderer shall keep his tender valid initially for a period of 120 days from the due date of submission of the offer.

13.0 OTHER TERMS & CONDITIONS

- 13.1 Insertion, post-script, addition and alteration shall not be recognized unless confirmed by tenderer's signature and stamp. Incomplete tender or tenders not submitted as per requirement of the NIT may be rejected.
- 13.2 In case of any deviation in design, the tenderer must submit a statement of deviation indicating technical and commercial implications. The decisions of the Director, JREDA shall be final and binding regarding acceptance or rejection of such items.
- 13.3 If at any time any of the documents/ information submitted by the bidder is found to be incorrect, false or untruthful, the bid and/ or the resultant order may be summarily rejected/ cancelled at the risk of the bidder.
- 13.4 Failure to furnish all information and documentary evidence as stipulated in the bid document or submission of an offer that is not substantially responsive to the bid document in all respects shall be summarily rejected.
- 13.5 All bids will be received in duly Sealed Cover within the due date and time. Bids received after the due date and time shall be rejected outright.
- 13.6 If the scheduled date of final submission and opening of the bid happens to be holiday on then the bids shall be submitted/ opened on next working day at the same time & at the same venue.
- 13.7 No request for extra time for delay in obtaining or submission of tender Documents shall be entertained.
- 13.8 Issuance of bid documents shall not construe that the bidders would be automatically considered qualified.
- 13.9 The Director, JREDA reserves the right to postpone the date of receipt and opening of the bids or cancel the bid without bearing any liability, whatsoever, consequent upon such decision.
- 13.10 The undersigned reserves the right not to accept the lowest tender and may reject any or all the tenders without assigning any reason whatsoever.

14. FORMATS

The Formats for various purpose related to submission of this tender are enclosed as Annexure 1 to Annexure 7.

**DIRECTOR,
JHARKHAND RENEWABLE ENERGY DEVELOPMENT AGENCY**

CHECK LIST OF DOCUMENTS TO BE ENCLOSED WITH OFFER DOCUMENT

- C.1 Envelope – I: Containing Part – 1 of the offer. Any offer submitted without the following mandatory documents will be liable for rejection:**
- C.1.1 Photocopy of receipt issued by JREDA for purchase of offer document or Demand Draft (non-refundable) for Rs.10,000.00 (Rupees ten thousand) only in favour of Director, JREDA on a nationalized/scheduled bank of India for those who have downloaded the offer document from JREDA website.
- C.1.2 Covering letter on Company's letterhead duly signed by authorized signatory giving details of name and designation of authorized signatory.
- C.1.3 Certificate in support of meeting Eligibility Criteria along with following supporting documents:
- a) The bidder must have completed at least two numbers of buildings based on Solar Passive Architecture in last three years valued at more than Rs. 50.00 (fifty) lacs each.
 - b) The bidder must have adequate experience of constructing public buildings based on modern environment friendly architecture.
 - c) List of works completed in the last 3 (three) financial years giving description of work, name of client, value of contract, date of award, schedule of completion, actual date of starting and actual date of completion should also be given.
 - d) List of works on hand indicating description of work, contract value, approximate value of balance work yet to be done and the date of award of contract.
 - e) The average annual turnover during the last three years as per ITCC should be minimum of Rs.1.5 crores.
 - f) Registration certificate of the firm.
 - g) Certificate of conduct from main/lead Banker certifying status of operation of account.
 - h) Photocopy of Partnership Deed in case of Partnership firm.
 - i) Power of Attorney for Authorized Signatory in case of companies.
- C.2 Envelope – II: Containing Part – II of the offer document.**
- C.2.1 Covering letter on Company's letterhead duly signed by authorized signatory giving details of name and designation of authorized signatory.
- C.2.2 Schedule of Items indicating rates quoted.

ANNEXURE –1

Format for Covering Letter

(To be submitted by the Tenderer in official letterhead of the Company)

No.....

Date.....

To
The Director
Jharkhand Renewable Energy Development Agency
Plot No. 328/B, Road No. 4, Ashok Nagar,
Ranchi 834002

Sub: Offer in response to Notice Inviting Tender No.....for

Sir,

We are hereby submitting our offer in compliance with the terms and conditions of the Notice Inviting Tender No.....As specified the offer has been submitted in two envelopes duly marked and sealed.

We further declare:

- a) That, we are submitting this offer under the abovementioned NIT after having fully read and understood the nature of work and having carefully noted all the specifications, terms and conditions laid down in the offer documents.
- b) That, we have never been debarred from executing similar type of work by any Central/ State/ Public Sector Undertakings/ Departments.
- c) That, we shall execute the work offered as per specification, terms and conditions of the offer on award of work.
- d) That our offer shall remain valid for placement of order for a period of 120 days from the date of opening of the tender.

(Authorised Signatory)

Name
Designation
Company seal

ANNEXURE – 2

Format for Confirmation of Basic Eligibility Criteria
(To be submitted by the Tenderer in official letterhead of the Company)

No.....

Date.....

To
The Director
Jharkhand Renewable Energy Development Agency
Plot No. 328/B, Road No. 4, Ashok Nagar,
Ranchi 834002

Sub: Confirmation of meeting the Basic Eligibility Criteria.

Tender No. Your NIT No...

Sir,

Having examined the tender documents No....., we hereby confirm the following towards minimum eligibility conditions to participate in the aforesaid tender:

1. We are manufacturers of sub-systems for Solar Photovoltaic Systems.
2. We have supplied & installed at least 2 (two) Nos. of modern buildings based on Solar passive Architecture worth more than Rs. 50.00 lakhs (Rs. Fifty lakhs) each during last three years.
3. We confirm that the building mentioned here conforms to best engineering practices and are appreciated by users.

(Authorized Signatory)

Name
Designation
Company seal

ANNEXURE – 3

INFORMATION IN SUPPORT OF MEETING MINIMUM ELIGIBILITY CRITERIA

(To be submitted by Bidders in official letterhead of the company)

We hereby confirm that we have supplied and installed the following SPV systems against orders placed by State Nodal Agencies/ other organizations during last three financial years.

| Year | Name of SNA/ Department/ Organization | Purchase Order No. & Date | Type of Power System | Quantity Supplied |
|----------------|---|------------------------------|-------------------------|----------------------|
| 2004-05 | | | | |
| | | | | |
| | | | | |
| 2005-06 | | | | |
| | | | | |
| | | | | |
| 2006-07 | | | | |
| | | | | |
| | | | | |

(Authorised Signatory)

Name
Designation
Company seal

Filling Instructions

1. Please give details of supplies made only in support of meeting eligibility criteria specified in the NIT.
2. Please submit legible photocopies of atleast 2 (two) purchase orders for systems mentioned above.
3. Please do not use this format for giving complete reference list of supplies made to SNAs.
4. Please submit legible photocopies of certificates of satisfactory performance issued by SNAs/ Purchasers.

ANNEXURE – 4

FORMAT FOR GENERAL PARTICULARS OF BIDDER

1. Name of the Firm
2. Postal Address
3. Telephone, Fax, Website & E-mail
4. Name & designation of the authorized signatory of the bidder to whom all references shall be made.
5. Nature of the Firm (Proprietary, Partnership, Private Limited, Public Ltd./ Public Sector) with attested copy of Registration & Partnership deed/ memorandum & Articles of Association.
6. Financial capacity of the contractor/ firm for carrying out the work. (Please attach certificate of conduct from lead Banker)
7. Name & address of Indian / Foreign collaborator, if any.
8. Income Tax Clearance Certificate (Please attach certified copy)
9. Has the bidder been ever debarred by any Government Department/ PSU for undertaking any work?
10. Reference to any other information attached by the Bidder (please mention page No. and drawing No.)

(Authorised Signatory)

Name
Designation
Company seal

ANNEXURE – 5

Format for authorization for attending Tender Opening Meeting
(To be submitted by the Tenderer in official letter head of the Company)

No.....

Date.....

To
The Director
Jharkhand Renewable Energy Development Agency
Plot No. 328/B, Road No. 4, Ashok Nagar,
Ranchi 834002

Sub: Offer in response to Notice Inviting Tender No.....for

Sir,

We are hereby authorize(Name & designation) to attend the Tender Opening meeting to be held onat JREDA Office, Ranchi on behalf of our company.

The specimen signature of the authorized person is given below:

(Specimen Signature)

(Authorised Signatory)

Name
Designation
Company seal

ANNEXURE - 6

PROFORMA FOR BANK GUARANTEE IN LIEU OF EARNEST MONEY DEPOSIT

(TO BE SUBMITTED IN Rs. 50/- NON-JUDICIAL STAMP PAPER TO BE PURCHASED IN THE NAME OF THE ISSUING BANK.

No. Date:

To,

WHEREAS (Supplier's name) (Hereinafter referred to as "Contractor"), a Company registered under the Companies Act. 1956 and having its registered office atis required to deposit with you, the Purchaser, by way of Earnest Money. Rs.(Rupees only) in connection with its Tender for the work was reference to Tender Enquiry No. datedas per specification and terms and conditions enclosed therein AND.

WHEREAS the Supplier as per Clause No. of Instructions to Bid has agreed to establish a Bank Guarantee in Your favour through us valid up to (date) instead of deposit of Earnest Money in cash AND.

WHEREAS you have agreed to accept a Bank Guarantee from us in instead of Earnest Money Deposit in cash from the Supplier.

1. We (Bank) hereby agree and undertake to pay you on demand the said amount of Rs. (Rupees only) without any protest or demur in the event the Supplier / Tenderer after submission of his Tender, resiles from or withdraws his offer or modifies the terms and conditions thereof in a manner not acceptable to you or expresses his unwillingness to accept the order placed and/ or letter of intent issued on you on the Supplier/Tenderer for the work under. Tender Enquiry No. date
2. Your decision as to whether the Supplier/tenderer has resiled from or has withdraw his offer or has modified the terms and conditions there of in a manner not acceptable to you or has expressed his unwillingness to accept the order placed and/or Letter of Intent issued by you on the Supplier/Tenderer for the work under Enquiry No.dated in this regard, shall be final and binding on us and we shall not be entitled to question the same.
3. Notwithstanding anything contained in the foregoing, our liability under this Guarantee shall be restricted to Rs. (Rupees only).
4. This Guarantee shall remain valid and in full force and effect upto and shall expire thereafter unless an intimation is given to the Bank by you earlier in writing discharging us from our obligation under this Guarantee.
5. We shall not revoke this Guarantee during its currency except by your consent in writing.

6. This Guarantee shall not be affected by any change in the Constitution of the Supplier/Tenderer or yourselves or ourselves but shall ensure to your benefit and be enforceable against our legal successors or assignees by you or your legal successors.
7. Notwithstanding anything contained herein above unless a demand or claim under this Guarantee is made on us in writing within six months from the date of expiry of this Guarantee we shall be discharged from all liabilities under this Guarantee thereafter.
8. We have power to issue this Guarantee under our Memorandum and Articles of Association and the undersigned who is executing this Guarantee has the necessary power to do so under a duly executed Power of Attorney granted to him by the Bank.

SIGNED AND DELIVERED
For and on behalf of above named Bank. For
and on behalf of (Banker's Name)

MANAGER

Address

**PROFORMA FOR BANK GUARANTEE TOWARDS PERFORMANCE GUARANTEE (SECURITY)
DEPOSIT**

(To be executed on non-judicial stamp paper of appropriate value)

Name of the Bank.....Bank Limited
 Address.....Guarantee No.....
 A/c Messrs.....
 Date of Expiry.....limit to liability Rs.....
 Contract No.....
 For (Name of Work).....

Subject : **Security Deposit**

Date.....2007

GUARANTEE BOND

1. In consideration of the JHARKHAND RENEWABLE ENERGY DEVELOPMENT AGENCY (JREDA)(hereinafter called the Company) having agreed to exempt _____ (hereinafter called the said contractor(s) from the demand under the terms and conditions of an Agreement dated _____ made between _____ and _____ for _____ (hereinafter called the said Agreement) of security deposit for the due fulfillment by the said contractor(s) of the terms and conditions contained in the said Agreement, on production of a bank guarantee for Rs. _____ (Rupees _____ only) we _____ (indicate Name of the Bank) (hereinafter referred to as the Bank) at the request of _____(Contractor(s)) do hereby undertake to pay to the Company an amount not exceeding Rs. _____ against any loss or damage caused to or suffered or would be caused to or suffered by the Company by reason of any breach by the said contractor(s) of any of the terms or conditions contained in the said Agreements.
2. We _____(indicate the name of the Bank) do hereby undertake to pay the amounts due and payable under this guarantee without any demur, merely on a demand from the Company stating that the amount claimed is due by way of loss or damage caused to or would be caused to or suffered by the Company by reason of breach by the said contractor(s) of any of the terms or conditions contained in the said Agreement or by reason of the contractor(s) failure to perform the said Agreement. Any such demand made on the bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____.
3. We undertake to pay to the Company any money so demanded notwithstanding any dispute or disputes raised by the contractor(s)/supplier(s) in any suit or proceeding pending before any court or Tribunal or arbitration relating thereto our liability under these presents being absolute and unequivocal.

The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the contractor(s)/supplier(s) shall have no claim against us for making such payment.

4. We, _____(indicate the name of the bank) further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Agreement and that it shall continue to be enforceable till all the dues of the Company under or by virtue of the said Agreement have been fully paid and its claims satisfied or discharged or till the Company _____certified that the terms and conditions of the said Agreement have been fully and properly carried out by the said Contractor(s) and accordingly discharges this guarantee. Unless a demand or claim under this guarantee is made on

us in writing on or before the _____(date) we shall be discharged from all liability under this guarantee thereafter.

- 5. We, _____(indicate the name of the Bank) further agree that the Company shall have the fullest liberty without or consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Agreement or to extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Company against the said Contractor(s) and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor(s) or for any forbearance, act or omission on the part of the Company or any indulgences by the company to the said Contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.
- 6. This guarantee will not be discharged due to the change in the constitution of the bank or the Contractor(s)/supplier(s).
- 7. We, _____(the name of the Bank) further undertake to extend the validity of this guarantee beyond the period stated in hereinabove or as extended from time to time, for such further period as may be required by the Company in writing before the expiry of this guarantee and upon such extension(s), all terms and conditions of this guarantee shall remain in full force till the expiry of the extended period(s).
- 8. We, _____(indicate the name of bank) lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing.
- 9. We have power to issue this guarantee under our Memorandum and Articles of Association and the undersigned has full powers to sign this guarantee on our behalf under power of Attorney dated granted to his and/or the resolution datedpassed by our Company of Directors in accordance with our constitution.

Dated the.....day of..... 2007.

For (indicate the name of Bank).
 Signature-----
 Name -----
 Designation -----
 Authorization No -----

In presence of
 1.-----
 2.-----

Validity of BGs shall be 90 days beyond date of receipt of last material at site

Date & Place -----
Bankers' Seal

NOTICE INVITING TENDER

NIT No: JREDA/SLEP/02/2007-08

Date 24/07/2007

Sealed tenders are invited from reputed and experienced Indian firms for the followings works:

| Sl. No. | Description | Details |
|---------|--|---|
| 1. | Tender No. | JREDA/SLEP/02/2007-08, Date 24/07/2007 |
| 2. | Name of Work | Construction of Exhibition Hall based on solar passive architecture at the State Level Energy Park Complex at Siddu-Kanu Udyan, Ranchi, Jharkhand. |
| 3. | Period of sale of Tender Documents | Date: 25 July 2007 to 22 August 2007. Time : 10.30 A.M. to 5.00 PM on all working days. |
| 4. | Last date & time of submission of tender. | 23 August 2007 upto 12.00 Noon. |
| 5. | Date of opening of Part -1, the Techno-commercial bid. | 23 August 2007 at 2.30 P.M. |
| 6. | Cost of Tender Document (Non-refundable) | Rs. 10,000.00 (Rupees ten thousand) only |
| 7. | Place of issue & submission of Tender Documents and address for communication. | Jharkhand Renewable Energy Development Agency Plot No. 328/B, Road No. 4, Ashok Nagar, Ranchi 834002 Phone No. 0651-2246970, FAX: 0651-2240665, Web-site: www.jreda.com , Email: info@jreda.com |

Interested parties may download the Tender Documents from our website:www.jreda.com

Director
JREDA, Ranchi

GENERAL TERMS & CONDITIONS OF CONTRACT

G1.0 DEFINITIONS OF TERMS

In the contract the following expression shall, unless the context otherwise requires have the meanings thereby respectively assigned to them.

- G1.1 The “**Government**” shall mean the Government of Jharkhand or the Government of India, as may be the case.
- G1.2 “**JREDA**” means Jharkhand Renewable Energy Development Agency with its head office located at present at 328/B, Road No.4, Ashok Nagar, Ranchi, PIN : 834 002.
- G1.3 “**Contract**” means the document forming the tender, acceptance thereof and the formal agreement executed between the JREDA and the Contractor, together with documents referred to therein otherwise it shall mean the Notice Inviting Tender, information and instructions to bidder. Accepted tender (including the warranty “schedule of quantities and prices” and other schedule attached thereto) general conditions of contract, special conditions, if any, specifications, designs, drawings and letter of award thereof will form the agreement.
- G1.4 “**Contract Price**” Means the price payable to the Contractor under the contract for full and proper performance of its contractual obligations.
- G1.5 The “**Contractor**” shall mean the person or corporation or firm who’s tender for the work has been accepted and his/its executors, administrations, or permitted assigns.
- G1.6 “**Works**” Means the materials to be supplied and the work to be executed as defined and set out in the specifications and includes all extra work, additions, deletions, substitutions and variations ordered by the Director, JREDA in accordance with the provisions of the contract.
- G1.7 “**Project-in-Charge**” Means the Director, JREDA to sign or cause to sign, the contract agreement on behalf of the JREDA and the Engineering officer duly authorized by the Director, JREDA to direct, supervise and be in-charge of the works for the purpose of the contract.
- The Consultant on behalf of the Director, JREDA, will supervise the work. The Consultant will scrutinize all drawings and technical proposals. Measurement of works, quality verification etc. will be carried out and certified by the Consultant for payment. However, final decision regarding all such matters rests with the Director, JREDA.
- G1.8.1 “**The Consultant**” means the firm or person as may be duly appointed by the Purchaser to act as Consulting Engineer for the purpose of work covered in the contract. Cross Informatics (P) Ltd., Kolkata has been appointed as Technical Consultant on behalf of JREDA for this work for overall supervision of the work.
- G1.8.2 Birla Institute of Technology, Mesra (B.I.T., Mesra) will also act as Consultant for testing of materials required for building construction. Sample materials to be supplied/ used in construction may be sent to BIT, Mesra for testing. Testing related to civil construction of the building will be carried out in the laboratories of BIT, Mesra.
- G1.9 “**Specifications**” Means collectively all the terms and stipulations contained in this document including the conditions of contract, technical provisions, drawings and attachments thereto and list of corrections and amendments.

- G1.10 **“Site”** Means the land on, under in or through which the works are to be executed or carried out and in this the work will be carried out in Siddu-Kanu Udyan, located near Kanke Road in the heart of Ranchi City.
- G1.11 **“Tests on Completion”** means all such tests as are prescribed by the specification of the and this also includes those tests not specifically mentioned in the specification but required under various BIS codes, relevant Acts and rules.
- G1.12 **“Commissioning”** means the satisfactory, continuous and uninterrupted operation of the equipment/ work as specified after all necessary initial tests, checks and adjustments required at site for a period of at least 30 days to the satisfaction of the Director, JREDA.
- G1.13 **“Commercial use”** means that use of the work, which the contract completes or which is commercially capable of.
- G1.14 **“Approval”** means the written approval of the Director, JREDA and of the statutory authorities, wherever such authorities are specified by any codes or otherwise.
- G1.15 **“Drawings”** means collectively all the accompanying general drawings as well as all detailed drawings, which may be used from time to time.
- G1.16 **“Tender drawings”** to be furnished by the Consultant/JREDA/Contractor for execution of the work and they will form part of the contract.
- G1.17 **“Detailed drawings”** to be furnished by Consultant/ JREDA/ Contractor for execution of the work and they will fill the part of the contract.
- G1.18 **“Labourer”** means all categories of labour engaged by the contractor, his sub-contractors and his piece workers for work in connection with the execution of the worked covered by the specifications. All these labourers will be deemed to be employed primarily by the contractor.
- G1.19 **“Fiscal year”** means year beginning on the first day of April and ending on 31st March in the succeeding year.
- G1.20 **“Day”** means a calendar day beginning and ending midnight.
- G1.21 **“Month or Calendar month”** means not only the period from the first of a particular month, but also any period between a date in a particular month, and the date previous to the corresponding date in subsequent month unless specifically stated otherwise.
- G1.22 **“Week”** means seven consecutive calendar days.
- G1.23 **“JREDA Stores”** means the stores owned by the JREDA.
- G1.24 **“Security Deposit”** means all deposits whether in Government Securities, Fixed deposit receipts or Bank Guarantee from a Nationalized Bank of India, amounts deducted from interim payments or in any other form pledged to JREDA for due performance of the contract and shall be adjusted in case of compensations, or penalties and which may stand either in part or whole as the situation demands.
- G1.25 **“Urgent Works”** means any urgent measures, which in opinion of the Director, JREDA, become necessary at the time of execution and/or during the progress of work to obviate any risk of damage to the structure, or required to accelerate the progress of work or which become necessary for security or for any other/reason the Director, JREDA may deem expedient.
- G1.26 **“Project”** refers to *Cconstruction of Exhibition Hall based on solar passive architecture at the State Level Energy Park.*

- G1.27 **“Manufacturer”** refers to the party proposing to Design and construct as specified complete or in part.
- G1.28 **“Plant, Equipment, Stores”** mean and include plant and materials to be provided under the contract.
- G1.29 **“Delivery of Plant/ Equipment”** shall be deemed to take place on delivery of the plant/ equipment in accordance with the terms of contract complete in all respects after approval by the Director, JREDA on report of the Project-in-charge.
- G1.30 **“Letter of intent” (LOI)** means the letter from the Director, JREDA conveying his acceptance of the tender subject to such reservations as may have been stated therein.
- G1.31 **“Sub-Contractors”** refers to a party or parties having direct contact with the contractor and to whom any part of the contract has been sublet by the contractor with the consent in writing of the Project-in-charge.
- G1.32 **“Tonne (M.T)”** Where used in these specifications shall mean metric tonne of 1000 Kg.
- G1.33 The terms and expressions not herein defined shall have the same meaning as assigned to them in the Indian Sale of Goods Act, 1977 or any such Act as the case may be.

G2.0 SCOPE OF WORK

The scope of work against the tender includes the Civil and Architectural works related to Construction of Exhibition Hall based on solar passive architecture at the State Level Energy Park Complex at Siddu-Kanu Udyan, Ranchi, Jharkhand.

G3.0 ELIGIBILITY AND QUALIFICATION CRITERIA FOR BIDDERS

The eligibility and qualification criterion for the bidder has been specified in Sec.6.0 of the Notice Inviting Tender. Information of meeting eligibility criteria to be furnished as per formats given in Annexure 2 & 3.

G4.0 TECHNICAL SPECIFICATION

The Technical Specification for the work has been furnished in detail in the ‘Technical Specification’ section.

G5.0 EARNEST MONEY DEPOSIT (EMD)

The tenderer shall submit the EMD in the form of a Demand Draft drawn in favour of “Director, JREDA” payable at Ranchi from any Indian Nationalized Bank/ Scheduled Bank or as a Bank Guarantee as per prescribed format given in Annexure - 6 along with Part –I, The Technical Bid.

G6.0 VALIDITY OF OFFER

The offer and the prices quoted therein shall remain valid for the period as 120 days from the scheduled date of opening of the Tender.

G7.0 OPENING AND EVALUATION OF OFFER

- G7.1 Part-I : The Technical Part will be opened on the date and time mentioned in NIT at the office of Director, JREDA at Plot No. 328/B, Road No. 4, Ashok Nagar, Ranchi in the presence of bidders, or their authorized representative. The authorized representative should produce letter of authorization to attend the bid opening meeting as given at Annexure - 5. The representative who does not produce such authorization will not be allowed to attend the bid opening.
- G7.2 The bidder's name, prices, discounts and the presence or absence of the requisite bid security and such other details as the Purchaser, at its discretion, may consider appropriate will be announced at the opening.
- G7.3 To assist in the examination, evaluation and comparison of the offers, the Purchaser may at its discretion, may ask the tenderer for clarification of his offer prior to price bid opening. The request for clarification and the response shall be in writing and no change in price or substance of the offer shall be sought, offered or permitted.
- G7.4 Any effort by a Bidder to influence the purchaser in the Purchaser's bid evaluation or contract award decisions may result in rejection of his bid.
- G7.5 The tender evaluation will take into account the bidder's technical, financial, past experience and capability. It will be based upon the examination of documentary evidence of Bidder's qualification submitted by the bidder in Techno-commercial Part (Part – 1) of the offer.
- G7.6 Part-II of the tender, i.e. the Price Bid only of those bidders, whose offers are technically and commercially found to be acceptable after evaluation of the Technical and Commercial Part, will be opened and evaluated. The date & time for opening of Part-II: The Price Bid will be intimated in JREDA web site. Bidders are requested to visit the web site www.jreda.com regularly and keep themselves informed. The Price Part will be opened at the office of Director, JREDA at 328/B, Road No. 4, Ashok Nagar, Ranchi 834002 as intimated, in the presence of eligible bidders or their authorized representative(s). The authorized representative will be allowed to attend the price bid opening on production of authorization letter from the Bidder.
- G7.7 The Director, JREDA, if required, may at his own discretion extend the scheduled date of opening of Price Bid.
- G7.8 The intending tenderers should have all relevant licenses and permits etc. from competent Government authorities as required for executing the contract.
- G7.9 The Director, JREDA, reserves the right to cancel any or all tenders without assigning any reasons thereof and not bound to accept the lowest tender.

G8.0 AWARD OF CONTRACT/ LETTER OF INTENT

- G8.1 The successful tenderer shall be required to enter into a contract agreement for execution of the work under the terms and conditions stipulated in the tender document and also any other special terms & conditions that may be mutually settled before awarding the contract.

G8.2 After the issue of the Letter of Intent, the Purchaser shall prepare the agreement based on accepted offer, rates, specification, terms and conditions and the same shall be executed by the contractor.

G9.0 TIME PERIOD FOR SIGNING THE AGREEMENT

The suppliers have to enter into an agreement within two weeks, in the office of the Director, JREDA in prescribed format before commencement of supply, construction and services

G10.0 PERFORMANCE GUARANTEE

G10.1 Within 30 days from the date of issue of Letter of Intent, the contractor shall furnish a Bank Guarantee from a Nationalized Bank /Scheduled Bank on the format given in enclosed as Annexure No. 7 for an amount equal to ten percent (10%) of the order value by way of Bank Guarantee for the due and faithful performance of the agreement and for the due and faithful performance of the Letter of Intent along with other terms and conditions.

G10.2 Such agreement shall be valid and binding, notwithstanding such variations, alterations or agreed under these general conditions during the entire warranty period as per Clause No.G.24 of the General Conditions of Contract. The contractor shall, at his own cost, get the validity period of the Bank Guarantee furnished by him, extended from time to time till completion of warranty period, as per provisions of the contract and shall furnish the extended Bank Guarantee to the Purchaser before expiry date of original Bank Guarantee or any extension thereof. In case the extended Bank Guarantee is not received by the Purchaser 15 days before the expiry date, the purchaser, entirely at his discretion shall be at liberty to encash the aforesaid Bank Guarantee.

G10.3 On due completion of work in all respects and on expiry of the Guarantee Period as per relevant clause the earnest Money and all payments due to him will be returned to the contractor without any interest on presentation of an absolute 'NO DEMAND CERTIFICATE' from JREDA and up on return, in good condition, of any specifications, drawings, technical literature, samples, tools and tackles or any property belonging to the purchaser which may have been issued to the contractor. Provided always that JREDA shall be entitled to retain, set off, deduct or adjust any claim against the contractor from the money deposited with or becoming payable to JREDA.

G11.0 EFFECTIVE DATE OF CONTRACT

The effective date of commencement of execution of the order by the Contractor shall be the date of issue of the Letter of Intent or Work Order whichever is earlier.

G.12 CONTRACT PRICE

G12.1 Contract Price and unit rates shall remain firm and binding and shall not be subject to any variation, whatsoever, on any account except for statutory variation on taxes & duties during contractual completion period.

G12.2 The Contract price & unit rates includes and covers the cost of all royalty & fees for all articles & processes, protected by letters, patent or otherwise incorporated in or used in

connection with the work, also all royalties, rents and other payments in connection with obtaining all the materials for the work and the supplier shall indemnify and keep indemnified the JREDA, which indemnity, the contractor hereby gives against all actions, proceedings, claims, damages, costs and expenses arising from the incorporation in or use of work of any such articles, processes or supplies.

G12.3 During the period of the contract, JREDA may order addition / deletion in quantities which supplier shall comply. The adjustment in Contract Price shall be made at the same unit rate as per Price Schedule.

G12.4 All applicable charges for taking statutory clearances, wherever necessary, are included in the contract price.

G13.0 MOBILIZATION ADVANCE

No Mobilization advance will be made.

G14.0 TERMS & CONDITIONS OF PAYMENT

Subject to any deduction which the Purchaser may be authorized to make under this contract, and or to any additions or deductions provided for in this contract, the contractor shall be entitled to payment as follows:

G14.1 All payments shall be made in Indian Rupees, unless otherwise specified in the contract.

G14.2 An amount equivalent to 90% (ninety percent) of contract value of the item will be paid after completion of work. Another 10% (ten percent) of contract value of the item will be released after three months from the date of commissioning provided the contractor has already provided a Performance Guarantee for 10% of the contract value.

G14.5 In the event of contractor not being able to carry out the work or a part of the work assigned to him in accordance with the terms of this contract, the Purchaser shall have the right to recover any sums advanced, from the contractor from his/its assets/amount due against Earnest Money/Security Deposit.

G15.0 INCOME TAX

Without prejudice to the obligations of the Supplier under law, any Income Tax, which JREDA may be required to deduct by law/statute, shall be deducted at source and shall be paid to the Income Tax authorities on account of the Supplier. JREDA shall provide the Supplier a certificate for such deduction of tax.

G16.0 STATUTORY VARIATION IN TAXES AND DUTIES

G16.1 The adjustment in the Contract Price towards imposition of new taxes or abrogation of existing taxes due to statutory variation shall be applicable only if the new tax is enacted or existing tax is abrogated within Contractual delivery/execution period.

G16.2 The Supplier shall bear and pay all liabilities in respect of statutory variations in taxes and duties and imposition of new taxes and duties that may be imposed after the execution of the particular item(s) of work though new tax may be imposed during the currency of the contract.

G17.0 INSURANCE

G17.1 Insurance for Workmen

The contractor should arrange for providing insurance cover to his workmen under Workmen's Compensation Act or similar Rules/Acts as applicable during the pendency of the contract for covering risk against any mishap to his workmen. JREDA will not be responsible for any such loss or mishap.

G18.0 WORKMAN'S PAYMENT & COMPLIANCE TO LABOUR LAWS

The contractor shall comply with all labour rules and regulations of the State & Central Government and these rules shall be strictly followed. All labour licenses and other formalities required for this purpose must be carried out in time. Payments to all workmen engaged for this work will be paid wages as Minimum Wages Act of Jharkhand State. Labour disputes, if any shall be solved entirely by the contractor himself and JREDA will not be responsible for any such dispute.

G19.0 COMPLETION SCHEDULE

The contractor shall submit a Completion Schedule of Work along with a **BAR CHART** as per the terms and conditions of the contract/order within 180 days as specified from the date of issue of the Letter of Intent or Work Order, whichever is earlier.

G.20. GUARANTEE PERIOD

G20.1 Guarantee Period

G20.1 The Contractor shall without prejudice to any other clauses of the order repair/replace the defects and restore the building to satisfactory condition within 10 days of intimation of fault without any additional cost to JREDA within the period of guarantee.

G21.0 ASSIGNMENT/ SUB-LETTING

G21.1 The contractor shall not without the prior consent in writing of the Purchaser, assign or sublet or transfer his contract, or a substantial part thereof other than raw materials, or for any part of the work of which makers are named in the contract, provided that any such consent shall not relieve the Contractor from any obligation, duty or responsibility under the contract.

G21.2 JREDA reserves the right to reject the equipment/Work sub-contracted and procure the same from elsewhere at Contractor's Risk and Cost. The Vendor shall be solely liable for any loss or damage which JREDA may sustain in consequence or arising out of such replacing of the contract work.

G22.0 TIME OF COMPLETION

The contractor shall provide full programme of the execution of work. Strict adherence to schedule mentioned in contract conditions shall be the essence of the contract and must be maintained. The work must be completed, within 6 (six) months from the date of acceptance of order or date of handing over of site, whichever is earlier.

G.23 DELAY IN EXECUTION OF WORK

G23.1 If the work is delayed on account of: -

- a) Increase in quantity of work.
- b) Suspension of work as ordered by the JREDA.
- c) Force Majeure conditions.
- d) Any other causes which, in absolute discretion of the Director, JREDA are beyond the contractor's control.

The contractor shall appeal to JREDA in the form of a written application before expiry of the contract period, bringing out the causes responsible for the delay, for granting suitable time extension.

G23.2 The Director, JREDA, if satisfied, that the delay is not attributable to the fault of the Contractor, may grant suitable time extension. However if the contractor is found responsible for any delay completion of the work, formal time extension shall also be granted by the JREDA but reserving its right to recover a sum towards liquidated damage, for late completion of this contract.

G23.3 However, if the contractor fails to execute the work or fails to start the work within specified time frame after the receipt of work order or leave the work site after partial execution of the work, JREDA may without prejudice to the right of the purchaser to recover damages for breach of trust of the contract may impose the following penalties:

G.24 LIQUIDATED DAMAGE

Scheduled date of completion shall be treated as the essence of the contract. Liquidated damage shall be imposed at the rate of 0.5% of the unexecuted value per week of delay up to a maximum of 5% at the sole discretion of the Director, JREDA. If there is any valid and acceptable reason for delayed execution supported with details of hindrances, the Director, JREDA may, at his discretion consider lowering down the penalty rate or even waiving off the penalty on having written application from the contractor.

G25.0 BREACH & CANCELLATION OF THE CONTRACT

G.25.1 In case of non-performance in any form or change of the covenants and conditions in this contract by the contractor, Director, JREDA shall have the power to annul, rescind, cancel or terminate the contract and upon its notifying in writing to the contractor that it has so done, this contract shall absolutely determine. The decision of Director, JREDA in this regard shall be final and binding.

G.25.2 JREDA may cancel the contract or a portion thereof and if so purchase or authorized purchase of the plant/ equipment not so delivered or order exhibit/ equipment of similar description (opinion of the Director, JREDA shall be final) at the risk and cost of the contractor. If the contractor had defaulted in the performance of the original contract, the purchaser shall have the right to ignore his tender for risk purchase even though lowest.

G.26 FORCE MAJEURE CONDITIONS

- G.26.1 In the event of either party being rendered unable by Force Majeure to perform any obligation required to be performed by them under this agreement, relative obligation of the party affected by such force majeure shall be treated as suspended during which the force majeure clause last.
- G.26.2 The term "Force Majeure" shall have herein mean riots (other than among the contractor's employee), Civil commotion, War (whether declared or not), invasion, act of foreign enemies hostilities, civil war, rebellion, revolution, insurrection, insurrection, military coup to usurp power, damage from aircraft, nuclear fission, acts of god such as earthquake (above 7.0 magnitude on Richter scales), lightning, unprecedented floods, fires not caused by contractors negligence and other causes which the contractor has no control and accepted as such by the Director, JREDA whose decision shall be final and binding.
- G26.3 Time for performance of the relative obligation suspended by the force majeure shall stand extended by the period for which such clause lasts.
- G.26.4 If works are suspended by force majeure conditions lasting for more than two months, the Purchaser shall have the option of canceling this contract in whole or part thereof, at its discretion.
- G26.5 The Contractor shall not claim or compensation for 'Force Majeure conditions' and shall take appropriate steps to insure men and materials utilized by him under the contract well in time.

G27.0 PROGRESS REPORT OF WORK

The Contractor shall submit weekly and monthly progress report on execution of works conforming to bar chart. In case of any slippage(s) or the contractor along with modified Bar Chart will submit reasons for delay in execution of work with details of hindrances.

G28.0 CONTRACTOR TO INFORM HIMSELF FULLY

- G28.1 The contractor shall be deemed to have carefully examined the general conditions, specifications and schedules and also to have satisfied himself as to the nature and character of the plant and equipment to be supplied and installed and the architectural aspects of the BIPV building under the contract, the site conditions and all relevant matters & details.
- G28.2 If he shall have any doubt as to the meaning of any portion of the contract/work order, he shall, before signing/accepting it, set forth the particulars thereof and submit them to the Director, JREDA/Engineer-in Charge in writing in order to remove such doubts.

G29.0 COMPLETENESS OF TENDER

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connection etc. and for civil works, all necessary fittings, assemblies, accessories, hardware items, shuttering utilities and safety devices as required shall be deemed to have been included in the tender, whether such items are specially mentioned in the BOQ or not.

G30.0 WORKS TO BE DONE BY THE CONTRACTOR

Unless otherwise mentioned in the tender document, the following works shall be deemed to be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost: -

- a) Construction of Exhibition hall block, which includes the exhibition hall, solar shop, toilets, plaza, septic tank. This civil work includes the foundation, superstructure, finishing, electrification and curing.
- b) Foundation for exhibits/equipments and components where required including foundation bolts.
- c) Cutting of walls and floors and making good all damages caused during installation and restoring the same to their original finish.
- d) Sealing of all floor openings provided for pipes and cables from fire safety and water leakage point of view, after installation of the same.
- e) Painting at site of all exposed metal surfaces of the installation other than pre-painted items, if any. Damages to the finished surfaces of pre-painted items while handling and erection shall, however be rectified to the satisfaction of Director, JREDA.
- f) Temporary shed, if required over the storage space and locking arrangements thereof, watch and ward of materials and installations till completion of work.
- g) Water and power as may be required for installation, curing and testing.

G31.0 TOOLS AND PLANTS REQUIRED FOR CONSTRUCTION.

All tools and plants required for the work shall be the responsibility of the contractor.

G.32 CONTRACT DRAWINGS

- G32.1 The drawings enclosed with the tender document shall form a part off the agreement. The bidder, in case his bid is accepted, will submit detailed construction drawings for approval before starting construction work. The construction/ installation work will be carried out as per approved drawings. The contractor may also submit drawings with the tender giving details about his equipment, layout, control circuit and diagrams etc. with reasons. These drawings will also form part of agreement, if accepted by JREDA.
- G32.2 In case, contractor wants some modifications or change in layout or drawings, the same should be clearly indicated in a drawing showing sufficient overall dimensions, clearances and space requirements of all apparatus to be furnished, to enable the consultant/JREDA to take a final decision in the matter.
- G32.3 No extension of time shall be allowed on account of the time consumed in submission and examination of defective drawings and resubmission of corrected drawings.
- G32.4 Any drawing suggesting modification or change in original drawings, technical data or correspondence which form the basis of an order or contract, as aforesaid, or which may be furnished by the contractor for JREDA's approval, or information, as provided under the said order or contract, shall be in English and if it is in any other language, a complete translation in English should be duly furnished.
- G32.5 The contractor shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors and omissions in the drawings or other particulars supplied by him whether such drawings or particulars have been approved by the purchaser or not, provided that such discrepancies, errors or omission are due to inaccurate information or

particulars furnished to the contractor by the Purchaser. The Purchaser shall pay for any alterations, in the work necessitated by reasons of such inaccurate information of particulars.

G.33 PATENT RIGHTS

In the event of any claim or demand being made or action being brought against the purchaser for infringement or alleged infringement of patent rights in respect of any exhibit, machine, work or things used or supplied by the contractor in respect of using or working by JREDA, such exhibit, machine, work or thing, the contractor shall indemnify JREDA from and against such claims whatsoever or demand and costs and expenses arising from or incurred by reasons of such claim or demand. JREDA shall notify the contractor immediately on receipt of any claim and that contractor shall be at liberty, if he desires with the assistance of JREDA, if required, but at the contractor's own expense to conduct all negotiations for the settlement of the same/or any litigation that may arise there from provided that no such machine, plant, work or things shall be used by JREDA for any purpose in any manner other than that for which have been supplied by the contractor and specified under the contract.

G.34 MATERIALS AND WORKMANSHIP

G.34.1 All materials shall be of the best quality and workmanship capable of satisfactory operation under the operating and climatic conditions as may be specified. Unless otherwise specified, they shall conform in all respect to the latest edition of the relevant BIS specification wherever Indian specifications apply.

G34.2 The Contractor at site shall supply all materials required for construction. The contractor shall also arrange for transportation, loading/unloading and safe storage of materials at site.

G34.3 If the contractor offers equipments manufactured in accordance with other international well recognized standards, he shall, in case, supply a copy in English of the Standard specification adopted and shall clearly mention in what respect such standard differs from Indian Standard Specification.

G35.0 PACKING AND MARKING

G35.1 The Contractor shall be responsible for security protecting and packing the plant and equipment as per prescribed standards in force to withstand the journey and ensuring safety of materials and also arrival of materials at destination in original conditions and good for contemplated use. Packing case size and weight shall take into consideration the remoteness of the goods final destination and absence of heavy material handling facilities at all points in transit.

Each bundle or the package shall have the following markings on it:

- a) The name and address of the consignee
- b) Destination
- c) Relevant marks, reference numbers etc. for identification

G35.2 Packing lists of materials shall be provided in each package to facilitate checking up of the contents at the destination.

G.36 POWER TO VARY/OMIT WORK

G36.1 No alterations, amendments, omissions, additions, subtractions or variations of the work (hereinafter referred to as 'variation') under the contract shall be made by the contractor except as directed by the Director, JREDA. The Director, JREDA shall have full power, subject to provisions hereinafter contained from time to time during execution of the contract by notice in writing to instruct the contractor to make such variations up to $\pm 10\%$

of the scheduled quantity and be bound by the same conditions though the said variations occurred in the contract.

- G36.2 If any suggested variations would, in the opinion of the contractor, if carried out, prevent him from fulfilling any of his obligations or guarantees, under the contract, he shall notify the Director, JREDA thereof in writing, and the Director, JREDA shall decide forthwith whether or not the same shall be carried out, and if Director, JREDA confirms his instruction, the contractor shall carryout the work as per instruction.
- G36.3 The differences in cost, if any, occasioned by such variations, shall be added to or deducted from the contract price, as the case may be.
- G36.4 In the event of Director, JREDA requiring any variations, reasonable and proper notice shall be given to the contractor as well to enable him to make arrangements accordingly, and in case where goods or materials are already prepared or procured, or any designs, drawings or patterns made or work done that required to be altered, a reasonable sum in respect thereof shall be allowed by the Director, JREDA.
- G36.5 In every cases in which the contractor shall receive instructions from the Director, JREDA for carrying out any work, which either then or later, will in the opinion of the contractor involve a claim for additional payment, the contractor shall as soon as reasonably possible after the receipt of such instructions, inform in writing the Director, JREDA of such claim for additional payment.

G.37 NEGLIGENCE

- G37.1 If the contractor shall neglect to carry out the work or shall refuse or neglect to comply with any reasonable order given to him in writing by the Director, JREDA or shall contravene any provisions of the contract, the purchaser may give seven days notice in writing to the contractor, to make good the failure, neglect or contravention complained of any if the contractor shall fail to comply with the notice within reasonable time from the date of serving thereof in the event of failure, neglect or contravention capable of being made good within that time, then is such case if the Purchaser shall think fit, it shall be lawful for him to take the work wholly or in part, out of the contractor's hand and give it to another person on contract at a reasonable price and the Purchaser shall be entitled to retain and supply any balance which may be otherwise due on the contract by him to the contractor or such part thereof as may be necessary, to the payment of the cost of manufacture or supply of such plant as aforesaid.
- G37.2 If the cost of executing the work as aforesaid shall exceed the balance due to the contractor and the contractor fails to make good such deficiency, the Purchaser shall take action in the manner it may consider deem fit in terms of the contract.

G38.0 COMPLIANCE WITH REGULATIONS

- G38.1 The Contractor shall comply with all applicable laws or ordinances, codes, approved standards, rules and regulations and shall procure all necessary Municipal, other statutory bodies and Government permits & licenses etc. at his own cost. The contract shall leave the Purchaser and the Director, JREDA harmless as a result of any infractions thereof.

G.39 DEATH, INSOLVENCY AND BREACH OF CONTRACT

The Purchaser may at anytime by notice in writing summarily determine the Contract without compensation to the contractor in any of the following events:

- G39.1 If the contractor being an individual or if a firm, any partner thereof shall at any time, be adjudged insolvent of shall have a receiving order or order from administration of his estate made against him or shall take any proceeding for composition under any Insolvency Act for the time being in force or make any conveyance or assignment with his creditors or suspend payment or if the firm be dissolved under Partnership Act, or

G39.2 If the contractor being a Company is wound up voluntarily or by the order of a court or a Receiver, Liquidator or manager on behalf of the Debenture holder is appointed or circumstances have arisen which entitle the Court or debenture holder to appoint a Receiver, Liquidator or Manager, or

G39.3 If the contractor commits any breach of the contract not herein specifically provided for provided always that such determination shall not prejudice any right of action or remedy which shall have accrued or shall accrue thereafter to the Purchaser and provided also that the contractor shall be liable to pay to the Purchaser. The contractor shall under no circumstances be entitled to pay again or repurchase.

G40.0 PROGRESS REPORT OF WORK

The Contractor shall submit weekly and monthly progress report on execution of works conforming to bar chart. In case of any slippage(s) or the contractor along with modified Bar Chart will submit delay in execution of work reasons for such delay along with details of hindrances.

G41.0 STATUTORY ACTS, RULES AND STANDARDS

The work shall be executed in conformity with the relevant standard of Bureau of Indian Specification (or equivalent International standards), National Building code of India, Indian Electricity rules 1956 (as amended up to date), Indian Electricity Act and relevant Rules in vogue at the time of execution.

G42.0 SAFETY MEASURES

The contractor shall have to provide necessary measures for providing adequate safety measures and precautions to avoid any accident, which may cause damage to any equipment/material or injury to workmen. JREDA shall not be responsible for any such accidents.

G43.0 STOPPAGE OF WORK

JREDA shall not be responsible for any damage or loss caused due to 'force majeure' conditions. The contractor should make provisions for adequate insurance cover against such loss or damages. JREDA shall not be responsible and not liable to pay any compensation due to stoppage of work as a reaction from local public due to any undue action on the part of the contractor causing annoyance to local people.

G44.0 HINDRANCE REGISTER

The contractor may also maintain a Hindrance Register where reasons for delay may be recorded from time to time and at the time of occurrence of the hindrance and get it duly certified by the Director, JREDA or his authorized representative.

G45.0 RESPONSIBILITY OF THE CONTRACTOR

The contractor shall guarantee and be entirely responsible for the execution of the contract in accordance with the specification, schedules and appendices. He shall further guarantee and be responsible for the quality and workmanship of all materials and completed works, correct designs and drawings, correct delivery of material, civil construction, plant erection, testing and commissioning: within the guaranteed completion and warranty period of 60(sixty) months from the date of commissioning.

G46.0 RIGHT OF JREDA TO MAKE CHANGE (S) IN DESIGN

JREDA shall have the right to require the contractor to make any change in the design, which may be necessary in the opinion of the Director, JREDA to make the plant and materials conform to the provisions and contents of the specification without extra cost to the purchaser.

G47.0 DRAWINGS AND MANUALS

The contractor shall supply all necessary erection/ construction, drawings, erection, testing and commissioning of manuals etc. as and when required. Six sets of drawings; manuals etc. shall be submitted by the contractor on commissioning of 20 kWp Solar PV power plant.

G48.0 INSPECTION AND TESTING

G48.1 The Director, JREDA and his duly authorized representative shall have, at all reasonable time access to the Contractor's premises, and shall have the power, at all reasonable times, to inspect and examine the materials and workmanship during execution of the work during its manufacture, shop assembly and test and if part of the plant is being manufactured in another premises, the contractor shall obtain for the Director, JREDA or his duly authorized representative, necessary permission to inspect it as if the plant was manufactured at Contractor's own premises.

G48.2 The Director, JREDA shall, on giving seven days' notice in writing to the Contractor, setting out any grounds of objections which he may have in respect of the work, be at liberty to reject all or in part or workmanship connected with such work, which, in his opinion defective for any reason whatsoever; provided that, if such notice be not sent to the Contractor within reasonable time after the grounds on which notice is based have come to reject the said plant or workmanship on such grounds. Unless specifically provided otherwise, all tests shall be made at the Contractor's works before shipment.

G48.3 The contractor shall, if required, give the Director, JREDA notice of any equipment being ready for testing, and the Director, JREDA or his authorized representative, if so desired, shall on giving twenty four hour's previous notice in writing to the contractor attend at Contractor's premises within 15 days of the date on which the material is notified as being ready failing which or alternatively if JREDA at its own discretion waives the inspection and testing, the contractor may proceed with the tests which shall be deemed to have been made in the presence of Director, JREDA and he shall forthwith forward six sets of duly certified copies of test results and certificated to the Director, JREDA for the approval of JREDA. The contractor shall dispatch the equipment only after receiving the test certificates in writing by JREDA.

G48.4 In all cases where the contract provides for tests whether the premises of the Contractor or any sub-contractor, the contractor except where otherwise specified, shall provide free of charge such labour, materials, electricity, fuel, water, stores, apparatus and instruments as may reasonably be demanded to carry out efficiently such tests in accordance with the contract, and shall give facilities to the Director, JREDA or his authorized representative, to accomplish such testing.

G48.5 If the inspection is done through an independent authority, at the option of JREDA, the purchaser shall pay the inspection fee, if any.

G48.6 When the inspection and tests have been satisfactorily completed at the contractor's work, the Director, JREDA or his authorized representative shall issue a certificate to that effect.

G48.7 Neither the waiving inspection nor acceptance after inspection by JREDA shall, in any way, relieve the contractor of responsibility of supplying the plant and equipment strictly in accordance with specification and drawings etc.

G49.0 DELIVERY OF EQUIPMENTS

- G49.1 The Contractor shall deliver the materials in accordance with the terms and conditions of the contract at the time/times at the place/places and in the manner specified in the contract. The contractor shall comply with instructions that may be given by the purchaser from time to time regarding the transit of the plant and material.
- G49.2 Notification of delivery or dispatch in regard to each and every consignment shall be made to JREDA immediately after dispatch or delivery. The supplier shall supply the consignee Invoice in triplicate and packing account of all stores delivered or dispatched by him.
- G49.3 In case of any occurrence of loss or damage in transit up to destination, it shall be liability of the contractor to initiate or pursue the claim with insurance company. He should take immediate steps to repair the damaged apparatus or replacement thereto. JREDA on merit will consider any time limit extension in such contingency.

G50.0 DIRECTOR'S DECISION

In respect of all matters which are left to the decision of the Director, JREDA, including the granting or withholding certificates, the Director, JREDA shall if required to do so by the contractor, give in writing a decision there on. If the decision is not accepted by the contractor the matter will, at the request of the contractor be referred to arbitration under the provision for arbitration hereinafter contained but, subject to the right of reference to arbitration; such decision shall be final and binding on the contractor.

G51.0 LIABILITIES FOR ACCIDENTS AND DAMAGES DURING TRANSIT

The Contractor shall be responsible for loss, damages or depreciation to goods or of plant/equipment up to delivery at site.

G52.0 DEDUCTION FROM CONTRACT PRICE

- G52.1 All costs, claims, damages or expenses which the JREDA. may have paid for, which under the contract the contractor is liable, may be deducted by the JREDA. from the running bill or earnest Money /or from any money due or which become due by him to the contractor under this contract.
- G52.2 Any sum of money due and payable to the contractor under this contract may be appropriated by the JREDA. and set off against any claim of the JREDA, for the payment of a sum of money arising out of or under any other contract made by the Contractor with JREDA.
- G52.3 It is an agreed term of the contract that the sum of money withheld or obtained under this clause by JREDA. will be kept withhold or retained as such by JREDA. or till this claim arising out of in the same contract is either mutually settled or determined by the arbitrator, or by competent court, as the case may be, and that the contractor shall have no claim for interest or damages whatsoever on this account or any other account in respect of any sum of money withheld or retained under this clause and duly notified as such to the contractor.

G53.0 TEST ON COMPLETION

For 20 kWp Solar PV power plant, all shop tests shall be carried out before shipment. It will be necessary for the final tests as to performance and guarantees to be held over until the plant is erected at site: the test shall be carried out in the presence of contractor's representatives within reasonable time of completion of erection. If the results of these tests are not within the margin specified, the tests shall, if required be repeated after re-tests, and the contractor shall bear all reasonable expenses to which he may be put by such tests.

G54.0 REJECTION OF DEFECTIVE WORK

G54.1 If the completed work or any portion thereof, before it is taken over, be found to be defective, or fail to fulfill the requirements of the contract, the Director, JREDA shall give to the contractor notice stating the particulars of such defects or failure and the contractor shall forthwith make the defect good, or alter the same to make it comply with the requirements of the contract. If the contractor fails to do so within a reasonable time, the Purchaser may reject and replace, at the cost of the contractor, the whole or any portion of the wall, as the requirement of the contract. Such replacement shall be carried out by the Purchaser within a reasonable time and a reasonable price and where possible to the same specifications under competitive conditions. In cases of such replacement by JREDA, the contractor shall be liable to pay to the Purchaser the extra cost, if any of such replacement, be delivered and /or erected as provided for in the contract agreement. The extra cost may be ascertained as the difference between the prices paid by the Purchaser for such replacement and the contract price of the plant/equipment so replaced as also any sum paid by JREDA to the contractor in respect of defective plant. If JREDA does not so replace the defective plant within a reasonable time, the contractor shall be liable only to repay to JREDA all money paid by JREDA to him in respect of such plant.

G55.0 GUARANTEE

G55.1 The contractor must ensure that the goods supplied are new, unused and have most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in contract.

G55.2 The guarantee period of the 20 kWp Solar PV power plant will be 60 (sixty) calendar months from the date of commissioning. The contractor shall remain liable to replace any defective parts that may develop in his own manufacture or that of his sub-contractors under the conditions provided by the contract under proper use, and arising solely from faulty design, materials or workmanship, provided always that such defective parts are not, repairable at site and are not essential in the meantime to the maintenance in commercial use of the park are promptly returned to the contractor's works at the expense of the contractor unless otherwise arranged.

G55.2 If it becomes necessary for the contractor to replace or renew any defective parts of the power plant or other equipment under this clause, the provisions of the first paragraph of this clause shall apply to the parts of the power plant and other equipment supplied by the contractor. So he will replace or renew the defective parts until the expiration of six months from the date of such replacement or renewal or until the end of the above-mentioned period of 60 months whichever is later.

G55.3 If any defects not remedied within a reasonable time, JREDA may proceed to do work at the contractor's risk and expense, but without prejudice to other rights, which JREDA may have against the contractor in respect of such defects.

G55.4 At the end of guarantee period, the contractor's liability shall cease. In respect of goods not covered by the first paragraph of this clause, JREDA shall be entitled to the benefit of such guarantee given to the contractor by the original supplier or manufacturer of such goods.

G56.0 OPERATION AND MAINTENANCE OF THE 20 kWp SOLAR PHOTOVOLTAIC POWER PLANT

The contractor will be responsible for operation and maintenance of the 20 kWp Solar PV power plant, other equipments supplied by him and repair and maintenance of Exhibition Hall as per details furnished in relevant clauses of Technical Specification.

G57.0 ARBITRATION

G57.1 Except where otherwise provided, if at any time, any question, dispute or difference, whatever shall arise between the contractor and JREDA upon or in the relation to or in connection with this contract with either of the parties may give to other notice in writing of the existence of such a question on rejection of the matter, the dispute or difference shall be referred to the sole arbitrator appointed by JREDA at the time of dispute after ascertaining the terms of reference mutually.

G57.2 The arbitrator will preferably be a member of Arbitration Council and arbitration proceedings will take place as per provisions of Arbitration Act, 1940 or any statutory modifications or re-enactment thereof, and the rules made there under and for the time being in force shall apply.

G57.3 The contractor will ensure that the work under this contract shall continue during arbitration proceedings and dispute and no payments due from or payment by the purchaser shall be withhold on account of such proceedings except to the extent which may be in dispute.

G58.0 COURT OF COMPETENT JURISDICTION

Only the Judicial Courts of Ranchi have jurisdiction in case of dispute between JREDA and the contractor.

G59.0 CONSTRUCTION OF CONTRACT

The contract shall in all respect be construed and operated as a contract as defined in the Indian Contracts Act, 1972, and all the payments hereunder shall be made in Indian Rupees unless otherwise specified.

G60.0 ADDRESS OF THE CONTRACTOR AND NOTICES AND COMMUNICATIONS ON BEHALF OF THE PURCHASER

G60.1 For all purpose of the contract, including arbitration hereunder, the address of the contractor mentioned in the tender shall be the address to which all communications addressed to the contractor shall be sent, unless the contractor has notified a change by a separate letter containing no other communication and sent by registered post acknowledged by JREDA. The contractor shall be solely responsible for the consequence of an omission to notify a change of address in the manner aforesaid.

G60.2 Any communication or notice on behalf of the Purchaser in relation to the contract may be issued to the contractor by engineer and all such communication and notice may be served on the contractor either by registered post or under certificate of posting or by ordinary post or by hand delivery at the option of the officer.

G61.0 CONTRACT DOCUMENTS & MATTERS TO BE TREATED AS CONFIDENTIAL

All documents, correspondence, the contractor shall consider decision and other matters concerning the contract as confidential and restricted nature and he shall not divulge or allow access thereto un-authorized person of any kind.

G62.0 FINAL BILL

The final bill relating to the contract shall be prepared only when the equipment have been installed and tested for final acceptance and it will include the adjustments of all claims against the contractor by Director, JREDA and awarded in his favour by the arbitrator up to the date of preparation of the final bill.

AIMS, OBJECTIVES & METEOROLOGICAL DETAILS OF SITE

1.0 INTRODUCTION

A large part of the energy consumed in a building is related to protection from external climate and operation of the systems needed to create a comfortable indoor environment. Normally, envelopes are designed to isolate the building from the surrounding environment through thermal insulation, rain and wind proofing etc. The building envelope and structural elements are normally designed and optimized without considering optimum working condition of service systems like heating, cooling, ventilation, lighting, water and electrical illumination system. These systems are often added on after finalizing the building design.

There are many scopes for exploring the energy available in the exterior climate and reduce the requirement of purchased grid power. The new energy and building construction technologies can be utilized in buildings; e.g. solar thermal energy, solar PV electricity, day lighting and natural ventilation systems etc. For efficient energy and environment management, these new technologies must be combined with conventional systems to create energy-producing and energy-saving climate-adapted envelopes. The integration between building envelope and the climate control service systems opened new avenues for exploiting natural energy and reduce demand for grid power.

1.2 DEFINITIONS

The building integrated energy systems can be defined as “Building integrated energy systems are systems in the building envelope or fabric that utilizes the available on site energy resources in a way that minimizes the need for purchased energy and maintains a satisfactory indoor environment.”

These systems can be further classified as “passive’ and “active” systems. Passive systems are characterized by their direct interaction between building fabric and environment. They do not produce power and do not need any mechanical device or significant mechanical energy to operate.

1.3 OBJECTIVES OF THE PROJECT

The main project is to build the scientific background necessary for creating public awareness about the utility of smart intelligent solar passive buildings, which reduces requirement of purchased energy from the grid at the same time enhancing comfort level inside the building.

1.4 SOLAR PASSIVE SYSTEMS

There are many possibilities for direct interaction between the building fabric and the environment in order to reduce the need for grid power to achieve the desired comfort level and cover the residual demand.

Passive solar systems are designed to capture and process solar radiation passively, where eventual storage is bound to the interior elements and the building fabric and these systems consist of various elements.

1.5 CONSTRUCTION DRAWINGS

The contractor will be solely responsible for all aspects of design, structural stability, quality of material and execution as per best available practices. The contractor will submit detail construction drawings based on drawings supplied by JREDA for approval before starting work to the Consultant /JREDA. Samples of construction materials should be submitted before use for approval.

2.0 SITE ENVIRONMENT

2.1 LOCATION

The Jharkhand Forest Corporation Ltd. has agreed to hand over existing Siddu-Kanu Udyan situated at Kanke area of Ranchi for setting up of the State Level Energy Park by modifying the existing park.

| | |
|--|---|
| ❖ City | Ranchi |
| ❖ District | Ranchi |
| ❖ Location | Siddu-Kanu Udyan, Kanke Road, Ranchi |
| ❖ Access | Situated at the heart of the city and well connected by a network of roads. |
| ❖ Geographical coordinates | Latitude : 23°18'N Longitude : 85°18'N |
| ❖ Average Annual rainfall | 1544 mm. |
| ❖ No. of rainy days in a year | 75 days |
| ❖ Average Monsoon seasonal (June to September) | 1295 mm. (this may vary from 978 to 1769 mm.) |
| ❖ Day time temperature | Varies from 21.5°C (1 st week of Jan) to 37.0°C (3 rd week of May) |
| ❖ Night time temperature | Varies from 6.4°C (1 st week of Jan) to 24.0°C (3 rd week of May) |
| ❖ Total area | 9 Acres |

2.2 MONTHLY AVERAGE WIND SPEED AT 10M. ABOVE THE SURFACE OF THE EARTH FOR TERRAIN SIMILAR TO AIRPORTS (Meter/Second)

| | | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|------|
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 1.77 | 2.06 | 2.22 | 2.65 | 2.84 | 2.77 | 2.44 | 2.16 | 1.95 | 1.60 | 1.64 | 1.67 |

Average: 2.14 m/s (not suitable for Wind Turbine operation)

2.3 MONTHLY AVERAGE RELATIVE HUMIDITY (%)

| | | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|------|
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 51.4 | 46.6 | 41.2 | 48.6 | 65.5 | 79.2 | 85.7 | 86.7 | 86.5 | 82.9 | 69.8 | 60.9 |

2.4 SOLAR INSOLATION LEVEL

The solar insolation data for the site are collected from NASA Surface Meteorology and Solar Energy tables. The average annual solar insolation is about 1794.74 kWh/m². The month wise 10 year-average solar insolation data for project site are furnished hereunder.

2.4.1 Monthly Solar Insolation Data of Ranchi

| Month | 10 Year Average daily solar Radiation* kWh/ m ² | 10 Year Average Monthly Solar Radiation kWh/ m ² | Equivalent Number of NO-SUN days |
|-----------|--|---|----------------------------------|
| January | 4.34 | 134.54 | 3.42 |
| February | 5.03 | 140.84 | 1.83 |
| March | 5.85 | 181.35 | 3.02 |
| April | 6.47 | 194.10 | 1.66 |
| May | 6.41 | 198.71 | 1.74 |
| June | 5.20 | 156.00 | 7.09 |
| July | 4.18 | 129.58 | 5.11 |
| August | 4.04 | 125.24 | 4.45 |
| September | 4.38 | 131.40 | 3.55 |
| October | 4.96 | 153.76 | 3.68 |
| November | 4.49 | 134.70 | 3.80 |
| December | 4.09 | 126.79 | 4.09 |
| Average | 4.95 | { 1807.01/12 =150.58} | |

Source:: NASA Surface Meteorology & Solar Energy Tables.

2.5 DAYLIGHT HOURS

Monthly averaged daylight (hours)

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|------|------|------|------|------|------|------|------|------|------|------|------|
| 10.8 | 11.4 | 12.0 | 12.6 | 13.2 | 13.5 | 13.3 | 12.9 | 12.3 | 11.6 | 11.0 | 10.7 |

2.6 MINIMUM & MAXIMUM DIFFERENCE FROM MONTHLY AVERAGE INSOLATION (%)

| Diff. | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Min. | -11 | -7 | -10 | -6 | -6 | -24 | -17 | -14 | -12 | -12 | -13 | -13 |
| Max. | 8 | 9 | 6 | 10 | 6 | 13 | 10 | 11 | 19 | 7 | 7 | 8 |

2.7 HEIGHT ABOVE SEA LEVEL

654 m above MSL (approx).

2.8 SOIL CONDITION

Normal dry soil mixed with small rock pieces.

3.0 DESIGN CONSIDERATIONS

3.1 Design Concept

Solar design in architecture involves the use of appropriate solar technologies to maintain a building's environment at a comfortable temperature through the sun's daily and annual cycles. It may do this by storing solar energy as heat in the walls of a building, which then acts to heat the building at night. Another approach is to keep the interior cool during a hot day by designing in natural convection through the building's interior. The design concept of Passive Solar System consists of various elements and some of the elements are mentioned below:

3.1.1 Elements for Direct Solar Gain

The direct solar gain involves using the position of windows, skylights and shutters to control the amount of direct solar radiation reaching the interior spaces to warm the air and surfaces within the building. It has been estimated that a correctly dimensioned and oriented window openings can save 5 to 15% of reduction in heating energy consumption. Conscious and intelligent planning is necessary to take full advantage of this potential.

3.1.2 Indirect Solar Gain

The indirect gain, in which solar radiation is captured by a part of the building envelope designed with an appropriate thermal mass. The heat is then transmitted indirectly to the building through conduction and convection. Examples of this are Trombe walls, water walls and roof ponds.

3.1.3 Isolated Solar Gains

Isolated gain involves passively capturing solar heat and then moving it passively in or out of building using a liquid or air, either directly or using a thermal store. Sunspaces and green houses are alternative ways of capturing isolated heat gain from which warmed air can be taken.

3.1.4 Other Solar Passive design Techniques

a) Building Position

Based on local climatic condition and sun's positions, the entire building can be positioned and angled to be oriented towards or away from the sun according to heating or cooling need. Overshadowing from other structures or natural features can be avoided or used depending on requirement.

b) Building Properties

The shape and surface area of the building can be controlled to reduce heating or cooling requirement. Use of material properties to reflect, absorb or transmit energy can be gainfully used.

c) External Environment

Energy efficient landscaping materials including use of selected trees and plants can be used to reflect or absorb heat, create summer shading (particularly in case of deciduous plants) or shelter from wind.

d) Thermal Insulation

Thermal insulation materials are used to reduce heat loss or unwanted heat gain.

3.2 Design Concept & Development

the main objective of this project is to promote renewable energy utilization, as this Exhibition Hall will house a number renewable energy exhibits. A monitoring and experimental programme will be implemented to evaluate the efficiency of the building at two levels as mentioned below:

- a) Ecological level
- b) Reduction in energy consumption compared with main auxiliary heating and cooling methods in Jharkhand.

3.3 Design Process & Methodology

The design process consisted of two design levels as mentioned hereunder:

- i) The first one is to formulate the geometry of the design based on concepts of traditional architecture.
- ii) The second is to employ the renewable energy technologies for operating the building to ensure clean energy production, reduction in use of energy from grid supply and costs.

TECHNICAL SPECIFICATIONS FOR CIVIL & ARCHITECTURAL WORKS

TC.1.0 GENERAL SPECIFICATIONS:

TC.1.1 Materials shall be of the best-approved quality available in Eastern part of India. Materials of approved brand(s) and manufacturers(s) are to be used. Testing of materials of approved brand(s) may have to be done at the discretion of Consultant. The costs of such tests are to be borne by the contractor.

In case, for some reason or other materials are required to be obtained from any other manufacturer, then prior approval from Consultant/JREDA will be necessary, and supported by a relevant test certificates qualifying the material to the required standard. Further tests if directed by the Consultant shall also be carried out by the contractor at his own cost.

TC.1.2 Samples of all materials including the sources shall be got approved before placing order and the approved sample shall be carefully preserved in an appropriate manner at the site office for verification from time to time.

TC.1.3 For standard bought out items, the sizes manufactured by the firms listed, shall prevail when there is discrepancy in the sizes mentioned in the schedule without any financial adjustment.

TC.1.4 Any materials supplied by the Purchaser/ any other specialist firms shall be properly stored and the contractor shall be responsible for its safe custody until they are required on the works and till the completion of work.

TC.1.5 The contractor, without any extra cost shall provide all equipment and facilities for carrying out field tests on materials.

TC.1.6 Unless otherwise shown on the drawings or mentioned in the Schedule of quantities or special specifications, the quality of materials, workmanship, dimensions etc. shall be followed hereunder.

TC.2. EARTH FILLING

Shall be selected earth suitable for filling as approved by the Consultant and free from building rubbish or organic decomposed materials. It shall be obtained either from excavation or brought from outside as specified in the schedule of items. Black cotton soil shall not be used for filling.

TC.3 CEMENT

Cement of grade 33 & 43 or higher grade shall be used and as specified by the consultants for all construction. Cement shall comply in every respect with the requirements of the latest publication of IS : 269/IS: 455. The cement shall be ordinary Portland cement of approved brand.

The weight of cement shall be taken as 1440 kg. Per cum (90 lbs per cft), Cement shall be measured by weight and in whole bags, and each undisturbed and sealed 50 kg. bag being considered equivalent to 1.25 cft in volume. Care should be taken to see that each bag contains full quantity of cement. When part bag is required cement shall be taken by weight or measured in measuring boxes.

No other make of cement but that approved by the Consultant once, will be allowed on works and the source of supply shall not be changed without approval of the

Consultant/JREDA in writing. Test certificates to show that the cement is fully complying the specifications shall be submitted by the contractors to the Consultant/JREDA.

Cement shall be stored in order 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. first received being first used. Cement deteriorated and or coloured shall not be used on work but shall be removed at once from the site. However, the Consultant/JREDA whose decision in this regard shall be final and binding shall determine allowing use of warehouse set cement.

TC.4 FINE AGGREGATE

Sand shall be from natural source or crushed stone screenings, if allowed, chemically inert, clean, sharp, hard, durable and well graded and free from excessive foreign materials. The silt content should not be more than 5%. If it is excess, washing shall be done in an approved manner to bring it within allowable limit.

The fine aggregate for concrete shall be graded and the fineness modulus may range between 2.60 to 3.20. The fineness modulus of fine aggregate may range between 1.80 to 2.60 for plasterwork and all other works.

TC.5. COARSE AGGREGATE

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 crushing Granite, Quartzite, Trap, basalt or similar approved stones. Coarse aggregate shall be chemically inert when mixed with cement and shall be roughly cubical in shape and free from soft friable, thin laminated or flaky pieces.

TC.6. STEEL REINFORCEMENT MILD STEEL BARS

Mild steel reinforcement bars shall conform to IS 226- 1962 "Standard quality" or IS 432-1966 - Grade-II. Other qualities of steel shall not be acceptable.

TC.6.1 HIGH STRENGTH DEFORMED BARS

Where deformed high strength reinforcement bars are specified, the contractors shall use the following:

"Torsteel" as manufactured by SAIL or other manufacturers confirming to IS 1786 - 1979.

TC.7 BRICKS

The bricks shall be first class kiln burnt bricks of regular and uniform size, shape and colour, uniformly well burnt throughout but not over burnt. They shall be free from cracks or other flaws.

They shall show a fine grained uniform homogeneous and dense texture on fracture and be free from lumps of lime laminations, cracks, air holes, soluble salts causing efflorescence or other defects which may in any way impair the purpose intended. They shall not break even when thrown on the ground on their flat face in a saturated condition from a height of 60.00 cm (About 2")

After immersion in water, absorption by weight shall not exceed 20 percent of the dry weight of the brick when tested according to I.S.S. No. 1077-1970. The brick shall have a minimum average compressive strength of 35 to 50kg/ per cm² as specified on the nomenclature of the item. The bricks to be used for the work shall be approved by the Consultants before hand.

TC.8. WATER

Water for mixing Cement mortar or concrete shall not be salty or brackish and shall be clean, reasonably clean and free from objectionable quantities of silt and traces of oil, acid and injurious alkali, salts, organic matter and other deleterious materials which will either weaken the mortar or concrete or cause effloresce or attack the steel in reinforced cement concrete. Water shall be obtained from sources approved by the Consultant. Potable water is generally considered satisfactory for mixing and curing concrete, mortar for masonry etc. Where water other than municipal source is used this shall be tested in an approved testing laboratory to establish its suitability. All charges connected therewith shall be borne by the contractor.

TC.9 CEMENT MORTAR

Cement mortar shall be of proportions specified for each type of work in the schedule. It shall be composed of Portland cement and sand.

The ingredients shall be accurately gauged by measure and must be well & evenly mixed together in a mechanical pan mixer only. Care being taken not to add more water than is required. No mortar that has begun to set shall be used.

If hand mixing is done, then it shall be done on pucca waterproof platform. The gauged materials shall be put on the platform and mixed dry. Water will then be added and the whole mixed again until it is homogeneous and of uniform colour.

TC.10 EARTHWORK

TC.10.1 **Site Clearance:** shall be done 4 meters around the proposed construction. The contractor shall provide all labour and materials for site clearance at his own cost, and the earth shall be leveled and rammed properly.

TC.10.2 **Bench mark and levels:** The contractor shall layout one or more permanent bench marks in some central place before start of the work, from which all important levels, exact bed levels for the excavation will be set. The contractor shall provide all labour and material for setting, levels and profiles at his own cost.

TC.10.3 **Excavation:** The foundation trenches shall be excavated to the exact width of the lowest step of the foundation or footing as shown on drawing. . The excavated earth shall be deposited at least three meter or 1/3rd of depth away from the edge of excavation whichever is more. Working space on the outer periphery, if required, shall be provided by the Contractor as per IS code.

The bed of the trenches shall be made level and compact by watering and ramming, any soft and defective spots detected shall be filled with concrete of the mix as specified for foundations or as directed by the Engineer at site.

The contractor shall at his own expense without extra charges, make provision for all shoring, strutting, close or open timbering, pumping, dredging or bailing out water and the trenches shall be kept free from water until the work in foundations is completed and trenches refilled. The trenches shall be inspected and passed before concrete is placed.

TC.10.4 **Earth Filling:** Filling can be general in the sides of foundation trenches, under floors and for site formation. The earth to be used for filling shall be free from saltpeter organic or other foreign matter. The space around the foundations in trenches and under floors shall be cleared of all debris, brick piece, or any other rubbish, surplus mortar falls etc. Filling shall be done in layers not exceeding 150 mm thickness. Each layer shall be well watered and rammed to the satisfaction of the Engineer. Final surface shall be neatly dressed.

TC.10.5 **Sand-Filling:** The sand shall be clean and free from any foreign matter. Sand filling shall be done, in the same manner as earth filling as described in the foregoing Para.

TC.11 PLAIN AND REINFORCED CONCRETE WORK

TC.11.1 **Cement Concrete:** For foundations shall be mixed in proportion and with ingredients as specified and shown in the drawings. Concrete shall be mixed in a mechanical mixer. No more concrete shall be mixed than can be consumed within half an hour. It shall be deposited gently in the trenches in horizontal layers not more than 30 cm. thick and rammed and consolidated with steel rammers of 5 to 6 kg. Weight. After laying and consolidation is completed watering twice a day for a week from the next day shall be done.

TC.12 REINFORCED CEMENT CONCRETE WORK

TC.12.1 **General:** It is intent of these specifications to ensure that all concrete placed at various locations in the job should be durable, strong enough to carry the design loads; it should wear well and be practically impervious to water. It should be free from such defect as shrinkage, cracking, and honey combing and soiling of the surface. Unless otherwise called for in these specifications, as plain and reinforced concrete shall conform in all respects to IS 456:1978.

TC.12.2 **Proportions:** The proportion by volume of the concrete in the various parts of the work will be specified on the drawings and shall by weight be accurately measured. The quantity of water used shall be the minimum consistent with practical workability and shall be varied as required to suit the moisture content of the aggregate and to produce concrete having the specified slumps.

TC.12.3 **Mixing:** The aggregate and sand shall be free from all silt and earthy matter washed if required by the Engineer before using. The materials shall be accurately measured in standardized boxes or by weight as specified, and mixed in a machine. Water being added in required quantity only. The mixture shall be semi-liquid mass with cement uniformly distributed.

TC.12.4 **Strength:** Concrete mixed in the proportions desired should have compressive strength at 7 and 28 days after placing not less than the following:

| | Nominal Mix in terms of Weight of Cement: fine aggregate; Coarse aggregate (Design Mix) | Cube Crushing strength (N/mm ²) After 7 DAYS | Cube Crushing strength (N/mm ²) After 28 DAYS |
|---|---|--|---|
| 1 | 1:2:4 (M-15) | 10 | 15 |
| 2 | 1:1 ½: 3 (M-20) | 13.5 | 20 |
| 3 | 1:1:2 (M-25) | 17 | 25 |

The contractor shall as and when directed by the Architects cast 6 cubes of the concrete being used in the work and after maturing shall get them tested. The cost of all testing shall be borne by the Contractor.

TC.12.5 **Mixing:** All concrete whether plain or reinforced, ordinary or controlled shall be mixed in a full bag mechanical mixer, having a minimum drum speed of 60 revolutions per minute. The cement and aggregate shall be first mixed dry until all particles of aggregate are coated with cement. Water shall be added and mixing continued for one and a half to two minute time resulting in a concrete of a uniform colour and consistency.

If there is segregation after unloading from the mixture the concrete shall be remixed.

TC.12.6 **Water Cement Ratio:** The water cement ratio shall be carefully controlled throughout the work (limited to 0.55); this calls for regular check on the equipment used for measuring water. Only graded liter-cans shall be used for this purpose.

TC.12.7 Concrete should not be dropped from height greater than 2 M. properly constructed chutes shall be used in such cases where it is necessary to exceed this height. Concrete must be thoroughly worked in the forms so that they are entirely filled; reinforcing bars adequately and tightly surrounded and entrapped air released from the mass of concrete.

Placing shall be carried out by hand punning as well as vibrators. Concrete should not be moved any considerable distance in the moulds, being consolidated as nearly as possible to the place where it is dumped. In casting beams or other deep sections concrete shall not be placed in layers.

TC.13 Transportation:

Concrete should be placed in its final position within 30 minute of mixing. The contractor shall arrange the mixer position and adopt a method of transportation so as to ensure that this period is not exceeded under any circumstances. Transportation shall be smooth and free from jolting.

TC.14 CONSOLIDATION:

All plain and reinforced concrete shall be consolidated by means of mechanical vibration. Adequate number of vibrators shall be used to ensure full compaction of concrete in about 10 minutes of placing. If needle vibrators are used, these shall be inserted at place not exceeding 0.5 M. apart until it is immersed to the full depth of concrete. Care shall be taken to ensure that concrete is not over vibrated so as to cause segregation. In addition to mechanical vibration, sufficient hand tools must be used to ensure full consolidation against reinforcement and at edges and corners.

TC.15 Testing:

Consistency: Only sufficient water shall be added to the cement and aggregate during mixing to produce a consistency so that the concrete shall be sufficiently workable to enable it to be well consolidated to be worked into the corners of the shuttering and around the reinforcement and to give the specified strength. Slump tests shall be carried out from time to time as directed by the Architects on concrete actually being placed in the works at the commencement of each period of concrete placing in accordance with the procedure laid down in IS: 456 (latest revision).

The slump shall not exceed in limits specified for different items of works as given below or as directed.

- | | | |
|--------------------|---|-----------------|
| a. Pre cast work | - | 1" (25mm) slump |
| b. Footing & roads | - | 3" (75mm) slump |
| c. Columns | | 3" (75mm) slump |
| d. Walls | - | 3" (75mm) slump |
| e. Floor slabs | | 3" (75mm) slump |

TC.15.1 **Preliminary Test:** The Contractor will be called upon to submit representative samples of materials to be used for concrete so that preliminary tests in accordance with I.S. 456-1978 may be carried out in a recognized laboratory to establish the suitability of the materials and proportion of mix by weight proposed by the Contractor. The contractor shall have to bear all costs in connection with this test.

TC.15.2 **Curing of Concrete:** All exposed faces of concrete shall be covered with Hessian, sand or similar material which shall be kept continuously wet for a period of at least 10 days

after casting. After removal of Hessian or sand all concrete surfaces shall be well wetted at intervals for a period of at least three weeks.

TC.15.3 **Protections of completed Works:** The contractor shall take suitable precautionary measures to prevent breaking and chipping of corners and edges of completed work.

TC.15.4 **Surface Finish of Concrete:** All form work, centering and shuttering used for concreting shall be rigid and straight so as to produce all concrete members true to line and level with a tolerance of 1/8" (3mm). This shall be cast against an approved pattern made up of new material such as timber/steel/ply to give neat and exposed finish. No old shuttering material is allowed at the work site.

TC.16 FORM WORK

TC.16.1 Formwork shall be erected true to line and to the shapes required in the work and shall carry without deformation the full weight of wet concrete, and other live loads. It should also withstand the effect of vibration without deflection, bulging distortion or loosening of its component parts. The contractor shall be responsible for the sufficiency of the formwork, centering and moulds. Formwork shall be oiled thoroughly before concreting.

Wire or similar ties shall not be left in concrete having face exposed to weather. Bolts shall be permitted if they are greased to allow for easy withdrawal and the holes subsequently made good.

The formwork shall be designed so that sufficient slabs area and the side of beams may be removed first then the under side of the slab and lastly the under side of the beam. Wedges shall be provided to allow accurate adjustment of formwork and its easy removal.

All joints shall be tongued and grooved and sufficiently tight to prevent leakage of grout. Chamfer fillets shall be provided at all corners wherever called for on the drawings. The boards shall be plain and straightened in order that the surface against the corner shall not be coated with approved oil before it is fixed in position.

Clean out holes shall be provided at the bottom of all columns and pier form work and care shall be taken to remove any rubbish, wood shaving or any other foreign material before concreting Temporary supports shall be provided as required and/or ordered by Engineer. The contractor shall provide steel/plywood formwork in place of timber boarding wherever called for by the Engineer.

TC.16.2 Removal of Form work: All formwork shall be kept in position until the expiry of a minimum period after concreting as specified below: -

| | | |
|----|--|---------|
| a. | Forms supporting sides of beams, walls and columns. | 2 days |
| b. | Bottoms of slabs up to 15ft. (4.50 M) span. | 7 days |
| c. | Bottoms of slabs above 15 ft. (4.50 M) span to 20 ft. (6 M) span | 14 days |
| d. | Bottoms of beams up to 20 ft. (6.00) | 21 days |
| e. | Bottoms of beams over 30 ft. (10.00) span | 28 days |

After removal of form adequate props shall be provided to support beams/slabs until 28 days after concreting.

TC.17 AGGREGATES

TC.17.1 **Fine Aggregate:** Colour being an important consideration, for exposed concrete, colour of sand used shall also be uniform throughout the entire construction. Preferably total quantity required for the work shall be collected and well mixed together to uniform shade.

TC.17.2 **Coarse Aggregate**: The colour of the aggregate shall be maintained the same throughout. Unless otherwise specified, exposed concrete in walls parapets and facials, which are no-load bearing and are less than 120 mm in thickness, the maximum size of the coarse aggregate shall be limited to 12mm. for which nothing extra shall be admissible. Flat or flaky pieces shall not be allowed.

TC.17.3 **Reinforcement & Cover of Concrete**: Correct placing of the reinforcement with proper cover is important in all exposed concrete work to avoid discoloration by rusting. The minimum cover specified under specification for R.C.C. work shall be maintained throughout. Concrete blocks or spacers shall be sparingly used at exposed surface. .

TC.18 **STEEL SHUTTERING**

Steel shuttering for exposed concrete work shall be made of shuttering plates of standard sizes and to suit the pattern of exposed concrete indicated in Architects drawings. The shuttering plates used will be made of steel sheets strengthened at the edges and in middle to prevent sagging or any deflection when concrete is laid. These plates will be free from any deformity or dents and should fit with each properly without any space or grooves being left between adjacent plates to avoid any leakage of concrete slurry. If any concrete projects out between plates this will be neatly cut away.

TC.18.1 **Coating for Shuttering**: Burma shell shuttering oil, colourless and emulsifiable in water shall be used for oiling the wood work, when only thin film shall be neatly applied avoiding collection at one place. Any mark left by the shuttering oil shall be washed clean.

TC.18.2 **Mechanical Vibration**: All concrete for exposed concrete work shall be vibrated; using needle vibrators 30/32 mm. Surface vibrators may be permitted to be used for thin slabs. External vibrators for walls may be allowed but this shall be done carefully to safeguard the displacement of the shuttering. Vibrators shall only be operated by skilled labour. Over or under vibration shall not be permitted. Any spillage or leakage, which is unavoidable and which flows down the exposed concrete surfaces shall be immediately washed away with clean water and brushed before setting. All finishing to the top surface of exposed concrete member shall be finished to desired surface while the concrete is still green.

TC.18.3 **Finishing**: Exposed concrete surface shall on no account be permitted to any sort of repairs or patching after striking the formwork. In the event of any portion not coming up to standard, the Contractor at no extra cost shall take this down. Decision of the Consultant/JREDA as to the rejection of such work shall be final and binding on the Contractor.

TC.19 **REINFORCEMENT**

TC.19.1 **Steel reinforcement** shall be either mild steel of tested quality to IS 432-1960 or square or round twisted steel conforming to IS 1786-61 or conforming to IS 1139-1966 as called for on the drawings. Bars shall be free from mill scale, excessive rust, oil or paint.

All joints in mild steel reinforcement up to and including 16 mm dia shall be over-lapped. The length of overlap for tension and compression joints shall be in accordance with IS: 456. Joints in mild steel reinforcement above 16 mm diameter may be welded if permitted by the Consultant in writing. All joints in to steel reinforcement shall be over-lapped strictly in accordance with typical drawing. The laps shall be as agreed in such a way that at one particular section not more than 25% of the bars are lapped.

TC.19.2 **Cover to Reinforcement**: Care shall be taken to maintain the correct cover to reinforcement. Unless otherwise specified on the drawing the following minimum covers (exclusive of rendering or other decorative finish) shall be provided in all reinforced concrete work.

For Foundation Concrete (Concrete in contact with earth/water): 50 mm

For Columns (bigger than 200 mm): 40 mm

For Slabs (less than 20 mm): 15 mm

For Beams soffit/ sides: 25 mm

For Walls (up to 300 mm thickness): 15 mm

For Walls (above 300 mm): 25 mm

TC.19.3 All the reinforced cement concrete works shall be M20 (1:1.5:3)

MASONRY WORK

TC.20 BRICK WORK

TC.20.1. GENERAL

All brickwork should be carried out as shown on the drawings with set backs, projections, curvatures, cuttings, footings etc. No additional cost for use of cut bricks shall be allowed. Wherever the proportion of cement mortar has not been specifically mentioned, cement mortar in the proportion of 1:6 shall be used. Flat brick shall be provided wherever required without any extra cost Brick work shall be kept wet while in progress, till mortar has properly set. On holidays or when work is stopped, top of all unfinished masonries shall be kept covered. Should the mortar become dry or powdery, for want of curing, work shall be pulled down and rebuilt at the contractor's expenses.

TC.20.2 BRICK MASONRY

Bricks shall be of class designation 75, sub class 'A' as per parameters given in IS: 1077:1976, regarding edges, dimensions etc. Bricks shall be free from cracks, flaws, and modules of free lime. Under or over burnt bricks or warped bricks shall be totally rejected. Water absorption after 24 hours immersion in cold water shall not be more than 20%.

TC.20.3 SOAKING

All bricks shall be immersed in water for twenty-four hours before being put into work so that they will be saturated and will not absorb water from the mortar.

TC.20.4 BATS

No bats or cut bricks shall be used in the work unless absolutely necessary around irregular openings or for adjusting the dimensions of different course and for closures, in which case, full bricks shall be laid at corners, the bats being placed on the middle of the courses.

TC.20.5 LAYING

The brick shall be laid in mortar to line, level & shapes shown on the plan, slightly pressed and thoroughly bedded in mortar and all joints shall be properly flushed and packed with mortar and no hollows left anywhere. Brick shall be handled carefully so as not to damage their edges.

They should not also be thrown from any height to the ground, but should be put down gently. All courses shall be laid truly horizontal and all vertical joints made truly vertical. Vertical joints on one course and the next below should not come over one another & shall not normally be nearer than quarter of a brick length. For battered faces beading shall be at right angles to the face.

Fixtures, frames etc. if any, shall be built in at place shown in the plans while laying the courses only and not later by removal of bricks already laid. Care shall be taken during construction to see that edges of bricks at sills, heads etc. are not damaged.

The verticality of the walls and horizontally of the courses shall be checked at regular intervals with plumb bob and spirit level respectively.

TC.20.6 Joints shall not exceed 10 mm (about 3/8") in thickness & this thickness shall be uniform throughout. The joints shall be raked out not less than 10 mm (about 3/8") deep when the mortar is green where pointing is to be done. When the brick surface is to be plastered, the joints shall be raked to a depth of 5mm when the mortar is green so as to provide good key to plaster.

TC.20.7 **UNIFORM RISING**

Brick work shall be carried up regularly in all cases where the nature of work will permit, not leaving any part 60.00 cm. lower than another. The rate of laying masonry may be up to a height of 80.00 cm (about 32") per day if cement mortar is used.

TC.21 **SCAFFOLDING**

The scaffolding must be strong and rigid stiffened with necessary cross bearers and always decked and bewared on the sills with closed board ceilings and swings to prevent injury to persons or materials. The contractor shall have to allow other trades to make reasonable use of his scaffolding as directed by the Site Engineer. If for the interest of work the contractor has to erect scaffolding in other areas also, the arrangement for the same including the cost shall to be borne by the contractor and the Purchaser should be kept free from any liability on this account.

Put-log holes shall be made good by bricks to match the face work when put logs are removed after ensuring that the holes behind are solidly filled in 1:4:8 cement concrete.

All brickwork shall be kept well watered for 7 days after lying. If white pozzolana cement is used for mortar, the curing shall be extended by one week at contractor's expenses.

STRUCTURAL STEEL WORK

TC.22 **FABRICATION**

TC.22.1 **STRAIGHTENING**

All materials shall be straight and if necessary, before being worked shall be straightened and/or flattened by pressure, unless required to be curvilinear form and shall be free from twists.

TC.22.2 **CLEARANCE**

The erection clearance for cleaned ends of members connecting steel to steel should be preferred not greater than 2mm at each end, the erection clearance at ends of beams without web cleats should be not more than 3mm at each end and where for practical reasons, greater clearance is necessary suitable designed seating should be provided.

Where black bolts are used, the holes may be made not more than 2mm greater than the diameter of the bolts unless otherwise specified by the Engineer-in-Charge.

TC.22.3 **CUTTING**

Cutting may be affected by shearing, crapping or sawing; gas cutting by mechanically controlled torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be

removed by machining so that all metal that has been hardened by flame is removed. Hand flame cutting may be permitted subject to approval of the Engineer. Except where the material is subsequently jointed by welding no load shall be transmitted into metal through a gas cut surface.

Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion and should the Engineer find it necessary the edges shall be ground afterwards.

The edges of plates that have been cut, when the plate is to be subjected to dynamic or fatigue loading, shall be machined over the full thickness.

TC.22.4 HOLES

Holes through more than one thickness of materials or members such as compound stanchion and girder flanges shall, where possible be drilled after the members are assembled. Holes can be drilled, provided the hole are punched 3mm less in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall not be greater than 16mm.

When holes are drilled in one operation through two or more separable parts, those parts when so specified by the Engineer shall be separated after drilling and the burrs removed.

Holes in connecting angles and plates other than splices, also in R.C. roof members and light framing, may be punched full size through material not over 13mm thick except where required for close tolerance of barrel bolts.

Matching holes for rivets and black bolts shall register with each other so that a gauge of 1.5mm or 2.00mm (as the case may be depending on whether the diameter of the rivet or bolt is less than or more than 25mm in diameter than the diameter of the holes, will pass freely through the assembled members in the direction at right angle to such members. Finished holes shall not be more than 1.5mm or 2mm (as the case may be in diameter larger than the diameter of the rivet or black bolt passing through them unless otherwise specified by Engineer.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the normal diameter of shank of barrel subject to HB tolerance specified in IS-919-1963 (Recommendations for limits and fits for Engineering). Preferably, parts to be connected with close tolerance or barrel bolts shall be firmly held together by tacking bolts or clamps and the holes drilled through all the thickness at one per operation and subsequently reamed to size. All holes not drilled through all thickness at one operation shall be drilled to a smaller size and reamed out after assembly where this is not practicable the parts shall be drilled and reamed separately through hard brushed steel jobs. Holes for bolts shall not be formed by a gas cutting process.

TC.22.5 ASSEMBLY

The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified cambers, if any, are provided. No drifting shall be allowed except for bringing together several parts forming a member but the drifts must not be driven with such a force as to disturb the metal around the holes.

All members must be so formed that they may be accurately assembled without being unduly packed strained or forced into position and when built shall be true and free from any twist, link buckle or open joints between component pieces. Failure in this respect involves the rejection of the defective members.

TC.22.6 BOLTING

Where necessary washers shall be tapered or otherwise suitably shaped to give the heads and nuts of bolts a satisfactory bearing. In all cases where the full bearing area of the bolt is to be developed the bolt shall be provided with a washer of sufficient thickness under the bolt to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. Threaded portion of bolt shall be projected one thread beyond nut.

TC.22.7 WELDING

Welding shall be in accordance with any of the following standard as appropriate: -

IS 816, 819 and 823 (latest). All electrodes used shall conform to IS: 814 & 815 (latest). For welding of any particular type of joint, welders shall give evidence acceptable to the Purchaser of having satisfactorily completed appropriate tests as described in any of the following standards as relevant: -

IS: 817 - 1957

IS: 1181 - 1957

TC.22.8 MATCHING OF BUTTS, CAPS AND BASES

Column splices and butt joints of struts and compression members depending on contact for stress transmission shall be accurately machined and close butted over the whole section with a clearance not exceeding 0.1mm locally at any place of column caps, attached gussets, angles, channels etc, after bolting together should be accurately machined so that the parts connected butt over the entire surfaces of contacts. Care should be taken that these connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 1.0mm

Where sufficient gussets are provided to transmit the entire loading the column ends need not be machined. Ends of all bearing stiffeners shall be machined or ground to fit tightly at both top and bottom.

TC.22.9 SLAB BASES AND CAPS

Slab bases and slab caps, except when cut from material with true surfaces shall be accurately machined over the bearing surfaces and shall be in effective contact with the end of the stanchion. The bearing face, which is to be grouted direct to a foundation, need not be machined if it is true and paralleled to the upper face.

To facilitate grouting holes shall be provided where necessary in stanchion bases for the escape of air.

TC.23 PAINTING**TC.23.1 GENERAL**

All steel work shall be painted with one coat of red oxide zinc chromate primer or other similar approved paint as base coat at fabrication shop before erection.

TC.23.2 SHOP PAINTING

All surfaces, which are to be painted, shall be dry and thoroughly cleaned to remove all grease loose scales and rust.

Shop contact surface need not be painted unless so specified. If specified, they shall be brought together with the paint still wet.

Surface not in contact but inaccessible after shop assembly shall receive the full specified protective treatment before assembly. This does not apply to the interior of sealed hollow sections.

Welds and adjacent parent metals shall not be painted prior to de-slugging inspection and approval.

Parts to be encased in concrete shall be painted.

TC.23.3 MARKING

Each piece of steel work shall be distinctly marked before delivery in accordance with a marking diagram and shall bear such other marks as will facilitate erection viz. the relevant drawing number, its orientation where erected, its weight when this exceeds 5 tons etc.

TC.23.4 SHOP ERECTION

The steel work shall be temporarily shop erected or as arranged with the Engineer so that accuracy of fit may be checked before erection. The parts shall be shop assembled with a sufficient number of paralleled drifts to bring and keep the parts in place.

TC.23.5 ERECTION

TC.23.5.1 PLANT AND EQUIPMENT

The contractor shall supply all plant and equipment necessary for the efficient erection of steel work.

The suitability and capacity of all plant, equipment need for erection shall be to the satisfaction of the Engineer.

TC.23.5.2 STORING AND HANDLING

All structural steel should be so stored and handled at the site so that the members are not subject to excessive stresses and damage. The mode of storing and handling operation must satisfy the Engineer.

TC.23.5.3 SETTING OUT

The positioning and leveling of all steel work, the plumbing of stanchions and the placing of every part of the structure with accuracy shall be in accordance with the approved drawing and to the satisfaction of the Engineer. The maximum tolerance for line and level of the steel work shall be plus or minus 3mm on any part of the structure. The final positioning of the structure including level should require the approval of the Engineer.

TC.24 SECURITY DURING ERECTION

During erection, the steel work shall be bolted or otherwise fastened as shown and temporarily braced to provide for all loads to be carried by the structure during erection including those due to the erection equipment and its operation.

No permanent bolting or welding should be done until proper alignment has been obtained.

TC.25 FIELD CONNECTIONS

All field assembly and welding shall be executed in accordance with the requirements of shop fabrication excepting such as manifestly apply to shop conditions only. Where the

steel has been delivered, painted, the paint shall be removed before field welding for a distance of at least 50mm on either side of the joints.

TC.26 FLOOR FINISHING

TC.26.0. CEMENT CONCRETE FLOORING WITH EPOXY HARDENER TOPPING

TC.26.1 GENERAL

TC.26.1.1 SUB GRADE.

Flooring shall be laid on concrete sub-grade where so provided. The sub-grade shall be provided with the slopes required for the flooring. Plinth masonry offset shall be depressed so as to allow the sub-grade concrete to rest on it.

TC.26.1.2 UNDER LAYER

Cement Concrete flooring of specified thickness and mix shall be laid as under layer. The top surface shall be roughened with brushes while the concrete is still green and the forms shall be kept projecting up 12 mm over concrete surface, to receive the epoxy hardening compound topping.

TC.26.1.3 CEMENT CONCRETE FLOORING WITH EPOXY HARDENER

EPOXY HARDENER: The compound shall be of approved quality of FOSROC and approved by the Consultant/ Site Engineer.

SUB GRADE: If the cement concrete is to be laid directly on the RCC slab, the surface of RCC slab shall be cleaned and a coat of cement slurry at 2 kg of cement per sqm shall be applied, so as to get a good bond between RCC slab and concrete floor.

THICKNESS: The thickness of floor shall be as specified in the description of the item.

UNDER LAYER: Cement concrete flooring of specified mix should be laid as under layer.

TOPPING: Top layer shall be laid as per the manufacture's specification.

TC.26.2 MARBLE FLOORING

TC.26.2.1 MARBLE SLABS

The Marble shall be of approved shades and sources as mentioned in the schedule of quantities and their size and thickness shall be as shown on the drawings and as approved by the Engineer/Architects. They shall be of selected quality, dense, uniform and homogeneous in texture and free from cracks or their structural defects. It shall have even and crystalline grains. The surface shall be machine polished to an even and perfectly plain surface and edges machined out true and square. The near face shall be rough enough to provide a key for mortar. No slab will be thinner than specified thickness at its thinnest part. The dimension of the slabs be as specified. A few approved samples of finished slabs to be used shall be deposited by the contractor to the E/I.

TC.26.2.2 CONCRETE BASE & MORTAR BEDDING

The base of cement concrete shall be laid and compacted to a reasonably true plain surface and to the required slopes and below the level of finished floor to the extent of the thickness of the slabs and mortar bedding. Cement concrete base shall be laid under a separate item. Cement mortar for bedding may be mixed manually or by a mechanical mixer as directed. Cement mortar may be the minimum necessary to give just sufficient

plasticity for laying and satisfactory bedding. Care should be taken in preparation of the mortar to ensure that there are no hard lumps that would interfere with the even bedding of the stone. Before spreading the mortar, sub-floor or base should be cleaned of all dirt, scum or laitance and of loose materials and then well wetted without forming any pools of water on the surface.

TC.26.2.3 LAYING MARBLE SLABS

Before laying, Marble shall be thoroughly wetted with clean water. Neat cement grout of honey-like consistency shall be spread on the mortar bed over as much area as could be covered with the slabs within 30 minutes. The specified type of marble slabs shall be laid to pattern as directed on the neat cement float and shall be evenly and firmly bedded to the required level and slope in the mortar bed. Each slab shall be gently tapped with a wooden mallet till it is firmly and properly bedded. There shall be no hollows left. If there be a hollow sound on gently tapping on the slab, such slab shall be removed and rest properly. The edges of the adjoining slabs shall be in one plane.

The flooring shall be kept undisturbed at least seven days and wet for 14 days. Marble flooring shall be given a wax polish of approved make.

TC.26.3 SANDSTONE FLOORING

TC.26.3.1 PREPARATION OF SUBGRADE

The surface of the structural slab shall be struck of reasonably true and at a level of 40 mm. below the level of the finished floor. All water, laitance or dirt on the surface of the structural slab shall be removed before the base course is laid. The slope required should be provided in the concrete sub-base. The sub-base will be provided with slopes towards predetermined position. The sandstone blocks would be placed keeping a tolerable gap in between them as per detailed drawings and drainage of the flooring would be done by the sub-base surface only.

TC.26.3.2 BASE COURSE

The mix for the base for sand stone flooring shall be 1 part of Portland cement, 2 parts of fine aggregate and 4 parts of coarse aggregate by volume. The stone chips for the base course should be 6 mm. and down and should be properly screened and washed before use. The concrete shall be of driest consistency possible work with a sewing motion of the strike off board or straight edge.

Changes in consistency shall be obtained by adjusting the proportion of aggregate and cement. The base course shall be laid as per IS 2571/1970.

DOORS WINDOWS AND VENTILATORS

TC.27 STEEL WORKS

TC.27.1 STEEL DOORS, WINDOWS AND VENTILATORS

All steel doors, window etc. shall be procured from A Class manufacturer subject to approval of the Site Engineer. Steel sections for fabricating framework for doors, windows etc. shall be of 16 gauge steel tubes conforming to I.S. 806 of 1968 latest edition or as approved equivalent.

The Site Engineer shall approve all section before fabrication is taken up. . All works for doors, windows frames etc. shall be made to hairlines and then welded or braced. Glazing beads shall be of sizes to accommodate up to 5mm thick glazing. All works shall be adequately braced and reinforced as necessary for strength and rigidity. The members

of the framework shall be of one piece, unless the same has prior approval of the Engineer –in-Charge.

TC.27.2 GLAZING

Unless otherwise mentioned the whole of the glass shall be 5mm thick clear float glass.

TC.27.3 HANDLING AND STORAGE OF FABRICATED MATERIALS

All doors, windows etc. shall be packed & created properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons/truck shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

All the fabricated materials at site shall be stored under cover in such a way to prevent damage or distortion. Special care shall be taken to apply two coats of approved steel primer of an approved manufacture

TC.27.4 ACCEPTANCE CRITERIA

TC.27.4.1 FOR FABRICATED ITEMS

- a) Overall dimensions shall be within +1.5mm of the size shown on drawings.
- b) Mullions, transoms etc. shall be of one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.
- c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5mm. For double leaf doors, the gap at the meeting stiles shall not be more than 1.5mm.
- d) Door leaves shall be under cut where shown on drawings.
- e) Doors, windows, frames etc. shall be on a true plane free from warp or buckle.
- f) All welds shall be dressed flush on exposed and contact surfaces.
- g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures.
- h) Provision for hardware and fixtures to be installed at site.
- i) Glazing beads shall be cut with mitered corners.
- j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.
- k) Shop coats shall be properly applied.
- l) Exposed surfaces shall be free from scratches, stains and discolouration. Surfaces shall present a uniform and pleasing look.

TC.27.4.2 FOR INSTALLED ITEMS

- a) Installation shall be at correct location, elevation and in general in a true vertical plane.
- b) Fixing details shall be strictly as shown on drawings.
- c) All open able sections shall operate smoothly without jamming.

- d) Locks, fasteners, floor spring etc. shall be fitted in position properly. Keys shall be non-interchangeable.
- e) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.

TC.27.5 SCAFFOLDING

Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

TC.27.6 PREPARATION OF SURFACE

All putlog holes in brickwork and junction between concrete & brickwork shall be properly filled in advance. Joints in brickwork shall be raked about 10 mm and concrete surface hacked to provide the grip to the plaster. Projecting burns of mortar formed due to gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brush/coir brush to remove dirt; dust etc. and the surface thoroughly washed with clean water to remove efflorescence grease and oil etc. and shall be kept wet for a minimum of six hours before application of plaster.

TC.27.7 ORDINARY CEMENT PLASTER

The preparation of surface shall be as stated above. The thickness and preparation of plaster shall be as specified in the schedule of items.

The mortar shall be applied evenly with force on the surface to be plastered. The mortar surface shall be finished at once by rubbing over with a trowel till the cement appears on the surface. All corners, angles and junctions shall be truly vertical & horizontal as the case may be and neatly finished. Rounding of corners and junctions where required shall be done without extra charge. The mortar shall adhere to the surface intimately when set and there should not be hollow sound when struck.

TC.28 PAINTING WORKS

TC.28.1 CEMENT PAINT

TC.28.1.1 PREPARATION OF SURFACE

For new work, the surface shall be thoroughly cleaned of all mortar dropping, dirt, dust, algae, grease and the foreign matter by brushing & washing. The surface shall be thoroughly wetted with clean water before the cement paint is applied.

In the case of old work, all loose pieces and scales shall be cleaned of all dirt, dust, algae, oil etc. by brushing & washing. Pitting in plaster shall be made good and a coat of waterproof cement paint shall be applied over patches after wetting them thoroughly.

TC.28.1.2 PREPARATION OF MIX

Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set & thicken, affecting flow & finish.

Cement paint shall be mixed with water in two stages. The first stage comprises of 2 parts of cement paint and one part of water stirred thoroughly & allowed to stand for five minutes. Care shall be taken to add the cement paint gradually to the water and not vice-versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously.

The lids of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hygroscopic qualities.

TC.28.1.3. APPLICATION

The solution shall be applied on the clean and wetted surface above 1 coat of gray cement wash with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface, which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work.

The second coat shall be applied after the first coat has been set for at least 24 hours before application of the second or subsequent coats, the surface of the previous coat shall not be wetted. For new work, the surface shall be treated with three or more coats of waterproof cement paint as found necessary to get a uniform shade.

TC.29 TREATMENT TO STRUCTURAL STEEL WORK

TC.29.1 Preparation of Surface - All rust and scales shall be removed by scarping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which become loose by rusting, shall be removed. All dust and dirt shall be thoroughly wiped away from the surface. If the surface is wet, it shall be dried before treatment.

TC.29.2 Application of moisture cured Polyurethane as primer coat and topcoat over the steel surfaces all in one. The application shall start right from fabrication stage and final touching shall be done after complete erection to ensure proper protection to all surfaces / areas of the steel work.

TC.30 PLASTERED SURFACE

The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall then be taken in hand. Before primer is applied, holes and undulations, shall be filled up with plaster of Paris and rubbed

TC.31 APPLICATION

The primer shall be applied with brushes, worked well in to the surface and spread even and smooth. The painting shall be done by brushing and laying off as described in cement paint above.

TS. SANITARY INSTALLATION

TS.1.0 Indian type W. C. Pan

TS.1.1 The W.C. pan shall be of white vitreous China of specified size and pattern wash down type unless otherwise specified. It shall be back flush inlet. The pan shall be of approved quality and shall bear the mark of the firm manufacturing it and shall be of best quality. The pan shall be provided with a 100 mm. P or S trap as specified in the item with approximately 75 mm. seal.

TS.1.2 The W.C. pan shall be raised from the general floor as specified but its surrounding floor should be sloped towards the pan. Care should be taken so as not to damage the pan in the process of fixing. If damaged anyway, it shall be replaced immediately. It shall be placed in a proper cement concrete base of 1:3:6 (with a wire netting where required) proportion taking care that cushion is uniform and even without having any hollows

between the concrete base and pan. The joint between the pan and the trap shall be made with cement sand mortar 1:1 and jute Hessian gasket and shall be leak proof.

TS.2.0 European type W.C.

These shall be readily flushed or wash down type, shall bear the mark of an approved firm and shall be of best quality. The close shall be of vitreous chinaware having integrated trap P or S type with or without vent holing right or left as directed. Cost of such any colour fittings including the contractor's cost.

The seat with lid shall be of heavy *Bestolite* or approved colour or as specified with rubber buffers and shall fix in position by using chromium plated brass hinges and screws.

TS.2.1 Flushing Cistern

Unless otherwise specified, pull and let go type GI flushing cisterns of approved make of best quality cast iron mosquito proof of 12.5 liters capacity shall be provided together with cover, lever, shall overflow GI fancy chain and pulley of specified quality, brass ball valve with polythene float and necessary unions etc. for connection with inlet, outlet and overflow pipes. The flushing of the WC pan shall be done through suitable flush pipe.

Unless otherwise specified, low level type flushing cistern shall be of glazed earthen ware or white vitreous chinaware of approved make, 12.5 liters capacity, with internal fittings, brackets and C.P. flush pipe 40 mm. dia as specified, brass C.P. handle etc. The low-level type-flushing cistern shall be connected with the W.C. pan by means of 40mm. dia C.P. flush bend and rubber adopted. The inlet pipes shall be connected with either white PVC connector or brass C.P. connector as specified.

The cistern shall be fixed on cast iron or rolled steel brackets painted to match surrounding walls which shall be firmly embedded in the wall fixed by using lugs and screws, Phil plug, rawl plug to the satisfaction of Site-in-charge.

The cistern shall be provided with 15 mm. polythene or GI overflow pipe with fittings, which shall terminate into mosquito proof coupling of the approved municipal design with 0.05 mm. dia perforations.

The outlet or flush pipe from the cistern shall be 32 mm. dia GI medium quality pipe or polythene pipe or as specified. The flush pipe shall be 2m. high approximately, which shall be connected to the W.C. pan by means of approved type of joint. The flush pipe shall be fixed to wall by using holder bat clamps or embedded as required. If the connection between the cistern and the W.C. pan is made with G.I. pipe, the bend and offsets shall be made cold.

TS.3.0 Toilet Basin

The basins shall be of white vitreous china of approved design. The size of the basin will be of as specified. The basin shall be of approved quality and make. This will be fitted with modern faucets, which operate with sensors.

Each basin shall be provided with pillar tap as specified having a centered tap hole with CP protruded nose pillar cock heavy type. This must be included with 32mm. dia CP brass chain, Cp waste 32-mm. dia Rubber plug etc.

The basin shall be supported on a pair of CI concealed type brackets embedded or fixed in position by means of wooden cleats and screws as required. Alternatively, this should be supported in pedestal type brackets required as specified. These brackets shall be painted to the required shade as specified under flushing cistern for the WC pan.

The waste pipe shall discharge into the floor trap inlet or as specified.

TS.3.1 Toilet Requisites**TS.3.2 Mirror:**

The mirror shall be of approved make glass with beveled edged, porcelain framed or as specified. The size and shape of the mirror shall be as specified. It shall be mounted on the asbestos sheet and shall be fixed in position by means of CP brass domicile screws and washers over rubber washers and rawl plug firmly embedded in wall, CP brass clamps with CP brass screws may be an alternative method for fixing.

TS.4 Water Connection

Water connection to flushing cistern, basins shall be by means of heavy type white PVC connector or CP connector with stopcocks. The size of the CP connectors and stopcocks shall depend upon the size of water connection as specified.

TS.5.0 Shelf

Unless otherwise specified, the shelf shall be of porcelain/ glass of approved quality with edges rounded off. The size of the shelf shall be as specified. The shelf shall have CP brass or the shelf be fixed to the wall with CP brass screws to wooden plug firmly embedded in the wall.

TS.6.0 Towel Rail

The towel rail shall be of square or round brass CP with brackets or as specified. The size of the rail shall be as specified. The brackets shall be fixed by means of CP brass screws to Rawl plug firmly embedded in wall. This should be projected approximately 75 mm. from the wall

TS.6.0 HCI Soil, Waste and Vent Pipes and Fittings**TS.6.1 HCI Pipes and fittings:**

The heavy-duty cast iron pipe and fittings should be of IS marked pipes and fittings conforming to IS 3989/1970 and IS 1729/1964 of approved quality. The pipes shall be free from cracks and other flaws. The interior pipes and fittings shall be clean, smooth and painted inside and outside with approved anticorrosive paint.

TS.6.2 Fixing:

The pipes and fittings shall be fixed to walls by using proper clamps. The pipes shall be fixed perfectly vertical or in a line as directed. All soil pipes shall be carried above roofs and have HCI cowl.

Where pipes are laid along walls, the iron pipes shall be fixed about 25 mm. away from the wall surface. Cast iron bobbins, nails and clamps etc. shall to be used for this purpose.

TS.6.3 Jointing

The annular space between the sockets and spigots shall be first well packed in with span yarn leaving half depth of the socket from the lip of the socket for lead. The joint may be leaded by using proper leading rings, or if they are not available, by wrapping a ring of lamp rope, covered with clay round the pipe at the end of the socket leaving a hole through which lead shall be poured in for pipes with sockets facing upwards 15 mm. high clay round the socket edge may be used as guide for leading.

TS.6.4 Lead for Joints

It shall be bluish gray in colour, very soft and malleable, readily melted, free from mixture of zinc or tin conforming to IS 782/1978. Same joint to be done by lead wool.

TS.6.5 Spun Yarn for joints:

This shall be of best quality, preferably white. It shall be free from dust etc. it shall be socked into hot coat tar on bitumen and dried before use.

TS.6.6 Jointing:

The spigot shall be carefully centered in the socket by two or three laps of treated spun yarn, twisted into ropes of uniform thickness, well caulked, into the back of the socket leaving the requisite depth of the lead. No making up of the pieces shall be allowed.

The leading of the pipes etc. shall be done by means of ropes covered with clay or by using special leading rings. The lead shall be rendered thoroughly fluid and each joint shall be filled in one pouring.

TS.6.7 Caulking:

After the joints have been run, they must be thoroughly caulked until they are perfectly watertight. Caulking of joints will be done after convenient length of pipe has been laid and leader. The leading ring shall first be removed with a flat chisel but leaving enough so that the joint can be finished 3mm. behind the socket face and then joint caulked round three times with caulking tools of increasing thickness and hammer of 4 to 6 lbs. weights. Lead joints shall not be covered till the pipe has been tested under pressure but the rest of the pipeline may be covered up to prevent expansion and contraction due to variation in temperature and any lead outside the socket shall be removed.

TS.6.8 Testing:

All HCI pipes and fittings including joints will be tested by smoke test and left in working order after completion. The smoke test will be carried as under:

Smoke shall be pumped into the drains at the lowest and from the smoke machine, which consists of blower and burner. The materials usually burnt are greasy cotton waste, which form clear pungent smoke, easily detectable by sight and smell, if leaking occurs at any point of the drain. The contractor will have to rectify all defects traced in such tests at his own expenses to the complete satisfaction of the Engineer-in-charge. The traps and soil fittings should be of heavy cast iron and should have water seal at least 50 mm. deep.

TS.7.0 Galvanized Iron Pipes & Fittings**TS.7.1 GI Pipes and fittings:**

The pipes shall be of galvanized steel, welded and seamless screwed and socketed and shall conform to ISS 1239 (Part I) 1963 & ISS 1239-1969 for heavy quality. These shall be of Indian tube Co. Ltd. Jamshedpur or equivalent approved make. The fittings shall be of 'R' brand. Unless otherwise specified, threaded shall be screws taper thread and sockets parallel thread and each tube shall be laid beveled sufficiently to prevent damage to the leading thread.

TS.7.2 Laying and Fixing

Where pipes have to be cut or re-threaded, and shall be carefully filled out so that no obstruction to bore is offered.

In jointing the pipes, the inside of the socket and screws and of the pipes shall be rubbed cover while lead and few turn of hemp yarn wrapped around the screwed and of the pipe which shall be then screwed home to the socket with a pipe wrench. Care must be taken that all pipes and fittings are kept at all times free from dust and dirt during fixing. Any threads exposed after jointing shall be painted.

TS.7.3 Painting

All internal GI pipes and fittings shall be painted with 2 coats of oil paint of approved quality manufacture, colour and shade. The cost of such paintings shall be included in the Contractor's rate. All pipes and fittings in external work shall be painted with 3 coats of anticorrosive paint.

TS.7.4 Testing

All GI pipes and fittings shall be tested by hydraulic pressure machine to a pressure of 7 Kg. per sq.cm. or more as instructed by Engineer-in-charge. All leaky joints must be made lead proof by tightening or re-doing at contractor's expenses.

TS.7.5 Brass CP and Brass fittings

All water fittings shall be of standard manufacture and shall in all respect comply with the Indian Standard Specifications. The brass CP fittings shall be fixed in pipeline in a workman like manner. Care should be taken to see that joints between fittings are made leak proof. The fitting and joints shall be tested to a pressure of 7 Kg. per sq. cm. unless otherwise specified. The defective fittings and the joints shall be repaired, redone or replaced at the contractor's expense.

TS.7.7 Bib Cock

The Bibcock shall be specified make, model and quality, opening fully way, of screw down pattern of the size as specified.

TS.7.8 Stop Cock;

The stopcock shall be specified make, model and quality, opening fully way, of screw down pattern of the size as specified.

TS.8.0 VALVES**TS.8.1 Ball Valves:**

It shall be of approved quality and manufacture in brass cock and rod with copper ball float or polythene ball float and shall operate freely and efficiently in water.

TS.8.2 Gun Metal Gate, Globe and Check Valves:

These shall conform to IS 778/1971 and shall have ISI marks on it. The type, class, nature of ends (screwed or flanged male or female) and nominal size of the valve shall be as specified.

The valves shall be tested to 21 Kg/sq. cm. pressure.

The component materials specifications shall be as under:

- Body and Bonnet per IS 318/ 1962 Grade 2.
- Gland, Gland nut, Disc spindle nut, disc retaining nut etc. of non-ferrous alloy having ultimate tensile stress not less than 20% on a 50 mm. gauge length.
- Spindles of non-ferrous materials with minimum ultimate tensile stress for class II valves: 40 kgf/mm. minimum elongations on 50 mm. gauge length, 20% minimum hardness numbers for materials specified shall be 80, when tested with 10 mm. dia ball and a load of 1000 Kg. applied for 15 seconds.

- Trim that includes body slats, discs, gates balls, piston hinge pins and swing discs. Trim of check valves may be made of material similar to body or bonnet or other materials as specified for the required service conditions.
- Hand wheel of ferrous or non-ferrous material. Its bolt shall have an ultimate tensile stress of not less than 20% on a 50-mm.-gauge length when tested per IS 1608/1960.
- Flange jointing materials used between flanges of valve components shall be compressed fiberboard or rubber as per IS 638/1965 of thickness between 1.5 mm. to 3 mm. the fiberboard shall be impregnated with chemically neutral mineral oil and shall have a smooth and hard surface. Its weight per sq.m. shall not be less than 112 gms./mm thickness. Jointing material between connecting flanges and adapters shall conform to IS 638/1965.

TS.9.0 SENSORS

Sensors would be used in bibcocks and urinals. Item no 51011 and 51077 of Jaquar brand will be used respectively in bibcocks and urinals. Technical specification of the aforesaid brand has to be followed.

TS.10.0 SEPTIC TANKS

The construction of septic tank shall be done as per specification, drawings and instructions. After completion of the tank, it shall be filled up with clear water after removing any foreign materials from inside of the tank, if any. The septic tank shall then be seeded with activated sludge. No separate payment shall be made on this account.

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS

The supply and installation work shall be executed in conformity with IS: 732-1989 and Indian electricity Rules, 1956 (as amended up to date) and as stipulated in this specification. All equipment and accessories shall be suitable for 230 ± 10% volts in case of single phase and 400 ± 10% volts in case of three phase supply. Specification of lighting fixtures shall be detailed in the Schedule of Items.

TE.1 THE POWER CONTROL PANEL

The main power control panel (MPCP) will be located just below the staircase at the main exhibition hall. The MPCP will receive power from the main panel of Seminar Hall.

TE.3.1 Specification of Power Control Panel

- i) The cubicle of the panel shall be floor mounted (on a base frame) totally enclosed and extensible type. The general construction shall conform to IS : 8623/93. The IP degree of protection shall be IP-42.
- ii) It shall be fabricated out of CRCA not less than 2.0 mm thick for load bearing members and 1.6 mm for doors of LT panels. The framework may be MS angle iron, channel/bolted type construction.
- iii) The cable entries shall be made from rear. Removable gland plate to be provided for each cable entry.
- iv) The bus bar system may comprise of a system of main/ auxiliary bus bars run in bus bar alleys. The size of bus bar shall be 40 mm x 5 mm per phase including neutral.
- v) 2 Nos. of 20 mm x 3 mm copper strip shall be fixed all around the panel connected to 2 Nos. earth bus copper strip connected to incoming earth conductors.
- vi) The bus bar clearances for enclosed indoor air insulated bus bars for medium voltage are as follows

Between Phase to Earth – Minimum clearance – 26 mm

Between Phase to Phase – Minimum clearance – 32 mm

TE.4.1 EARTHING

The earthing shall be carried out as per IS Code of Practice of earthing No. IS : 3043 - 1987 unless otherwise specified.

TE.4.1.2 Application

- a) Every sub-main will have earth continuity conductor to run along with sub-main wiring. In case of 3-phase sub-main two earth continuity conductors shall be provided.
- b) Looping of earth is allowed only in case of point wiring.
- c) When 2/3 power outlets are looped to one circuit, earth looping of these outlets is permissible.

TE.4.2 Earth Electrode & Conductor

- a) Only copper plate of size 600 mm x 600 mm x 3 mm thick shall be used as earth Electrode.
- b) The size of earthing conductor shall be 8 SWG (4 mm) for equipment earthing and 20 mm x 3 mm copper strip for connecting lightning conductor and for earth bus etc. as specified.
- c) Size of Earth continuity wire shall be of same material as phase conductor.
- d) Earth electrode shall not be located closer than 1.5 m from any building.

TE4.3 Protection of Building Against Lightning

The work for protection of building against lightning shall be carried out in conformity with IS : 2309 -1989. The annual average of thunderstorms in Ranchi is 34.

TE.4.3.1 Principal Components of Lightning Protections System

The principal components of the system are:-

- a) Air Terminations – the lightning Conductor finial made of 25 mm dia. 300 mm long copper tube, having single prong at top with 85 mm dia. 3 mm thick copper base plate.
- b) Down Conductors shall be of size 20 mm x 3 mm thick copper strip.
- c) Joints shall be made by soldering copper strips as mentioned above.
- d) Testing Joints shall made of 20 mm x 3 mm thick copper strip, 125 mm long with 4 Nos. of tinned brass bolts, nuts, check nuts and spring washers etc. complete.

TE.5 Allied Services

The Exhibition Hall being a modern building shall have the provision of following services besides electrical wiring:

- i) Telephone wiring

- ii) Computer Cabling, networking and dedicated earthing.
- iii) Audiovisual Systems.
- iv) CCTV based Security System
- v) Public Address System for the whole Energy Park.
- vi) Stage Lighting for the Seminar Hall
- vii) Solar energy based External lighting
- viii) Photovoltaic Power System
- ix) Building Management System.

NOTE: Wiring for some of the systems like audio-visual, telephone, CCTV and PA system etc. will be taken up at the time of installation of the equipment.

TE.5.1 Lux Level

Proper lighting level is to be maintained as per BIS specified levels.

TE.6 Out Door Lighting & Garden Lighting

All outdoor lights shall be either Solar PV Street light system or Solar garden Lights fitted with bright white LED lamps as per specification for these items mentioned separately.

TE.7 Electric Power Distribution & Wiring

The electric power will be received and distributed in the building through the following means:

Main Power Control Panel to receive power through copper cables from different sources as mentioned below:

- 1) 3½ C & 70.00 sq.mm PVC insulated armoured copper conductor cable for power supply from main control panel of Seminar Hall

TE.8 System of Distribution and Wiring

- i) The wiring shall be done from a distribution system through main and/or branch distribution boards,
- ii) The DBs shall be separate for light and power.
- iii) Only MCCB/MCB/RCCB/HRC fuse type DBs shall be used. Re-wirable type fuses shall not be used.
- iv) 'Power' wiring shall be kept separate and distinct from 'light' wiring from the level of circuits i.e. beyond branch distribution boards. Conduits for light and power wiring shall be separate.
- v) All switchboards except MPCP will not have more than one source of incoming power supply.
- vi) All MDB/DB/Switchboard shall have reasonable spare outgoing ways for future extension.

- vii) Load balancing of three phase circuits shall be done.

TE.9 Wiring

The definitions of terms shall be in accordance with Indian Standard Code of Practice for electrical Wiring Installation, IS: 732-1963 except for the definition of a 'point'.

TE.9.1 Definition of Sub-main Wiring

Submain wiring shall mean the wiring from the one main/ distribution switchboard to another.

TE.9.2 Definition of Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board to the 1st tapping point inside the switch box, from where the point wiring starts.

A conduit carrying sub main wiring will not carry circuit or point wiring.

TE.10 Scope:

The point (other than socket outlet point) wiring shall be inclusive of circuit wiring and shall include cost of all labour and materials necessary in complete wiring of switch circuit of any length from tapping point on the distribution board to the following via the switch:-

- a) Ceiling rose or connector in case of ceiling fan/exhaust fan/stiff pendant and similar fittings.
- b) Wall bracket type lamps fitted with CFL lamps.
- c) Socket outlets.
- d) Call bell/buzzer

The cost of following shall be deemed to be included in the rate for the point wiring, starting from distribution board (hereinafter to be mentioned as DB) to fitting via switch/push button.

- a) Required switch, specified socket outlet and plug top.
- b) Ceiling rose or connector as required.
- c) Any special and suitable block for neatly housing the connector and covering the fan hook in case of fan point.
- d) Rigid PVC conduit as required.
- e) Metal box, bushed PVC conduit or porcelain tubing where cables pass through wall/floor.

- f) All fixing accessories, such as nuts-bolts, check-nuts, bushes, clips, nails, screws, rawl plug, phil plug and wooden plug etc. as required.
- g) Looping, interconnections and end-terminations with socket/ferrules etc. wherever required.
- h) Earth wire from light/fan points to common earth including connections.
- i) Earth wire from three-pin socket outlet point/fan regulator to the common earth including connections.
- j) Fish wire in case of conduit wiring.
- k) Painting /varnishing as required.
- l) Reasonable spare lengths of cables at termination points.

TE.11 Scope of Main & Sub-main Wiring

Main and Sub-main wiring shall include the cost of material and installation charges for complete wiring length as detailed below:

- a) Rigid PVC conduit as required.
- b) Cables as specified.
- c) Earth wire.
- d) All fixing accessories, such as clips, nails, screws etc.
- e) All joints, elbows, bends, joint boxes, inspection covers etc. as required

TE.12 Distribution Boards

- a) The Distribution Board (DB) may be of single pole and neutral 240 V or triple pole 400 V rating. This shall consist of MCBs.
- b) DB shall be provided with MCB on the phase conductor of each circuit and the neutral conductor shall be connected to a common link and be capable of being disconnected individually for testing purposes.

TE.13 MEASUREMENT

a) Point Wiring other than Socket Outlet Points.

Unless otherwise specified there shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting.

b) Classification of Point Wiring

All wiring points of this building will be considered in 'Group "C" category as defined in General Specification for Electrical Works, Part – 1, Internal, 2005 of CPWD.

c) Wiring for Socket Outlet Points

- ❖ The light (6 Amp) point and power (16 Amp) point wiring shall be measured on linear basis, from respective tapping point of live cable, namely switch box, another socket outlet point, or the sub-distribution board as the case may be, up to the socket outlet.
- ❖ The metal /PVC box with cover; switch/ MCB, socket outlet and other accessories shall be measured and paid as a separate item.
- ❖ The power point outlet shall be 16A/6A six-pin socket outlet.
- ❖ There shall be no "on board" light plug point.

TE.14 WIRING SYSTEM

- ❖ Wiring shall be done only by looping system. Phase/live conductors shall be looped at the switch box. For point wiring, neutral wire/ earth wire looping for the 1st point shall be done in the switch box; neutral/ earth looping of subsequent points will be made from point outlets.
- ❖ In the wiring, no joints in wiring will be permitted anywhere, except in switch box.
- ❖ The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgear.

TE15 COLOUR CODING

The following colour coding shall be followed in the wiring:-

| | |
|----------------------------|-----------------------------------|
| Phase | Red (R)/ Yellow (Y) and Blue (B) |
| Live wire in single phase: | Red |
| Neutral: | Black |
| Earth: | Green |

TE.16 RUN OF WIRING

- a) The type of wiring shall be recessed PVC conduit in walls of main hall and rooms as far as practicable.
- b) In the central portion of the exhibition hall, the power conductors will be laid under the floor and taken to columns, where these will be connected to suitable DBs/MCBs/or points as the case may be. The cables under the floor shall be taken through suitable

GI steel pipe or porcelain tube such that they pass through in a straight line without twist or cross in them on either end of such holes. The end of the metallic pipe shall be neatly bushed with porcelain, PVC or other approved material.

- c) No joints shall be permitted in phase or neutral conductor of the wiring.

TE.17 Socket Outlets

The socket outlets shall be 16Amp/6Aamp 6 pin 2 or 5 pin socket outlets shall not be permitted. The third pin shall be connected to earth through protective (loop earthing) conductor.

TE.18 INDOOR LIGHTING SYSTEM

As the ceiling height of the building is high, lighting illumination fixtures will be 'wall bracket' type except some fixtures to be fitted below ceiling at (+) 1000 and (+) 2250 level. All the lighting fixtures will be of white colour bright LED lamps. The main source of power LED lamps will be 230 volt 50 Hz AC supply. The lighting fixtures will be fitted with suitable in-built attachments for supplying suitable low voltage power required for LED lamps.

The standard rating for CFL lamps will be 11 watt and 18 watt and that for LED will be 5.5 watt.

TE.19 SOLAR OUTDOOR LIGHTING SYSTEM WITH LED LAMPS (street light type)

The broad performance specifications of a white Light Emitting Diode light source based Solar Street Light system are given below:

TE.19.1 Broad Performance Parameters

- | | | |
|----|-------------------------------|---|
| a) | Light Source | White Light Emitting Diode (W-LED) |
| b) | Light Output | White colour, minimum 6 lux when measured from a height of about 3.66 m and illuminated over an area equal to atleast 2.5 m. Higher light output will be preferred. |
| c) | Mounting Height | 4.6 m high pole with extended arm to hold luminaire. |
| d) | PV Module | 37 Wp under STC, measured at 16.4 V as Vload Module Voc minimum 21 V. |
| e) | Battery | Flooded lead acid tubular plate, 12 V – 40 Ah @ C/10, Max. DOD 75% |
| f) | Electronic Circuit Efficiency | Minimum 72% |
| g) | Average Duty Cycle | Dusk to Dawn |
| h) | Autonomy | Minimum 3 days. |

TE.19.2 Duty Cycle

The LED street lighting system shall be designed to operate from dusk to dawn under average daily insolation of 4.9 kWh/sq.m on horizontal surface.

TE.19.3 Light Source

- a) The light source shall be of white LED type. Single or multiple lamps can be used. Wider view angles preferred. The luminous performance of LEDs used should not be less than 30 lumen/watt. Use of LEDs, which emit ultraviolet light, shall be avoided.
- b) The light source shall remain constant with variation of battery voltage.
- c) The lamps shall be housed in an assembly suitable for outdoor use. While fixing the assembly, the lamp should be held in a base up configuration.
- d) The test report on the technical characteristics of LEDs conducted in a Test laboratory approved by MNRE should be furnished.

TE.19.4 PV Module

- a) The PV Module shall contain crystalline silicon solar cells.
- b) The Operating voltage corresponding to the power output mentioned above shall be 16.4 Volt.
- c) The open circuit voltage of the PV modules under STC shall be atleast 21.0 Volts.
- d) The terminal box on the module shall have provision for opening for replacing the cable, if required.
- e) A strip containing the following details shall be laminated inside the module so as to be clearly visible from the front side:
 - i) Name of manufacturer or distinctive logo.
 - ii) Model or Type No.
 - iii) Serial No.
 - iv) Year of make.

TE.19.5 Battery

- a) Flooded lead acid battery maintenance free battery. It shall conform to latest BIS standards or equivalent international standards
- b) 75% of the rated capacity of the battery shall be between fully charged & load cut off conditions.

TE.19.6 Electronics

- a) The total electronic efficiency should be at least 72%.
- b) The electronic system shall operate at 12 volt and shall have temperature compensation for proper charging of the battery through out the year.
- c) The light output shall remain constant with variations in the battery voltages.
- d) Necessary lengths of wire/cables, switches suitable for DC use and fuses shall be provided.
- e) The PV Module will be used to sense the ambient light level for switching ON and OFF the lamp.

TE. 19.7 Electronic Protections

- i) Adequate protection is to be incorporated under no load conditions e.g. when the lamp is removed and the system are switched ON.
- ii) The system should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut-off limits must be specified.
- iii) A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the PV module(s), in case such a diode is not provided with the solar module(s).
- iv) Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

TE.19.8 Mechanical Hardware

- i) A metallic frame structure (with corrosion resistance paint) to be fixed on the top of the pole to hold the SPV module. The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that the module(s) can be oriented at the specified tilt angle.
- ii) The design of Structure is enclosed herewith. The pole should be made of mild steel pipe with a height of 4 meters above the ground level, after grouting and final installation. The pole should have the provision to hold the weatherproof lamp housing with a metallic arm of 1.25 m length.
- iii) A vented, acid proof and corrosion resistant painted metallic box for outdoor use should be provided for housing the battery.

TE.19.9 Other Features

The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged. There will be a Name Plate on the system which will give :(a) Name of the Manufacturer or Distinctive Logo. (b) Serial Number. Components and parts used in the solar street lighting systems should conform to BIS specifications, wherever such specifications are available and applicable

TE.19.10 Charging Indication

One green and another red LED indicators will be provided. The green light will indicate charging in progress and the red LED will indicate deep discharge condition of the battery. The green light will glow only when the battery will be actually charged.

TE.19.11 Quality & Warranty

The components of the lighting system should conform to latest BIS or International specifications of an advanced country.

The warranty period for Solar PV Module will be 10 (ten) years from the date of supply and the warranty for the balance of system will be for at least 5 (five) years from the date of supply.

TE.20 GARDEN LIGHTS

The garden Light body shall fabricated out of stainless steel for long term all weather durability. Ten numbers of super bright white LED with 50,000 hours life expectancy shall be fitted to give a lovely ambient lighting effect. It will have premium quality crystalline solar module of at least 1.5 Wp capacity and fitted with suitable high capacity Ni-Cd/Ni-Mh battery. The garden Light will automatically switch on at dusk and switch off at dawn with option for manual switch ON/OFF.

The Garden Light shall be stand-alone and weatherproof type. The crystalline solar module shall be discreetly position on the top of the lamp body, which will collect energy during day from sunlight. The light should be suitable for installation anywhere.

TE.21 SAFETY MEASURES**TE.21.1 Dry Chemical Fire Extinguishers**

Ten numbers of Dry Chemical type Fire extinguishers conforming to relevant BIS standard shall be provided in the power plant. These shall be suitable for fighting of fire due to oil, solvents, gases, paints, electrical fire, paints and varnishes etc.

TE.21.2 Danger Plate

Danger Notice plates of size 200 mm x 150 mm, made of MS sheet, at least 2 mm thick and vitreous enameled on both sides with the inscription in signal red colour on front size for LT voltage. The inscriptions shall be in Hindi and English.

TE.21.3 Sand Buckets

12 Nos. of sand buckets shall be mounted on an angle iron structure made with MS angles and kept very near the power plant.

