

**PAITHAN MEGA FOOD PARK PVT. LTD.
AT PAITHAN (MH)**

**TENDER FOR LOW- VOLTAGE TELEPHONE AND
LAN CONNECTION LINES & STREET LIGHTING
SYSTEM**

BID NO.: PMFPPL – PTBS – 01 - 2016



Paithan Mega Food Park Pvt. Ltd.

Nath House, Nath Road, Aurangabad-431005, Maharashtra

Project Management Consultants (PMC)



Abhyuday Techno Economic Consultants Pvt. Ltd.

211-212, Patel Avenue, Near Gurudwara

S.G. Highway, Thaltej, Ahmedabad – 380054, Gujarat

A/E Consultants



SEM MAC Consultants Private Limited

'Conjeevaram House' , 2nd Floor, 6-1-276,

Padmarao Nagar, Secunderabad – 500 025.

PAITHAN MEGA FOOD PARK PVT. LTD.

AT PAITHAN (MH)

BOOK NO. 1

Bid Information, General Conditions, Special Conditions, Appendix

BID NO. PMFPPL – PTBS – 01 - 2016

Section 1	: Bid Information
Section 2	: Bidders Qualification Criteria
Section 3	: General Conditional of Contracts
Section 4	: Special Conditions of Contracts
Section 5	: Appendix



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Section 1: Instruction to Bidders

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A. General

1. Scope of Bid

- a) Paithan Mega Food Park Private Limited, Aurangabad (referred to as Employer in these documents) invite bids for Low - Voltage Telephone and LAN connection lines & Street Lighting System (As defined in these documents and referred to as "the Works") detailed in Preface.
- b) The successful bidder will be expected to complete the works within a period of 4 months including rainy season.

2. Source of Funds: It is a Central Government aided project

3. Eligible Bidders

- a) Eligible Bidder's Qualification criteria
 - i. **The bidder should have satisfactorily completed at least one similar work (Installation for Low - Voltage Telephone and LAN connection lines & Street Lighting System) with a contract value of at least Rs. 1.20 Crs or two similar works of Rs. 0.75 Crs in any one of 12 month continuous period within last 5 financial years.**

The average annual turnover of the bidder should be more than Rs. 1.20 Crs for last three financial years.

The Bidders should have sound financial status, in support of which, the annual turnover statement of the preceding 3 years, Certified Balance sheet of the three proceeding 3 years for the previous year and Solvency Certificate from a Nationalised Bank shall be submitted.

- ii. The Solvency certificate shall be for a minimum amount equalling 20 percent of the quoted tender.
- iii. The bidder having successfully completed similar type of Industrial project of similar under reputed Consultants in last Five years. The bidder shall submit an attested copy of completion certificates of these projects.

The bidder shall also furnish details of work in hand on other contracts.

4. Forms of Bid and Qualification Information

- a) All bidders shall fill in Section 2, Forms of Bid and Qualification Information".

5. One Bid per Bidder

- a) Each bidder shall submit only one bid for one contract. A bidder who submits or participates in more than one Bid (other than as a Sub-contractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the Bidder's participation to be disqualified.
- b) Tender documents are not transferable

6. Cost of bidding

- a) The bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will in no case be responsible and liable for those costs

7. Site visit

- a) The Bidder should visit the site and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

B. Bidding Documents

8. Contents of Bidding Documents

- a) The set of bidding documents comprises the documents listed in the table below and addenda issued in accordance with Clause 10:

Book 1	: Invitation for Bids containing Sections as below
Section 1	: Instructions to Bidders
Section 2	: Forms of Bid and Qualification Information
Section 3	: General Conditions of Contract
Section 4	: Special Conditions of Contract
Section 5	: Appendix
Book 2	: Bills of Quantity
Book 3	: Technical Specifications

- b) Only one set of original bidding document will be provided. The original documents prepared for submission have to be photocopied by the Bidder, for submission together with the Original.
- c) Each Bidder should submit one original documents & one duplicate document in all respect.
- d) Each Bidder should submit one copy of BOQ in Excel sheet in CD with financial bid.

9. Clarification of Bidding Document

- a) A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or by fax at the Employer's address indicated in the invitation to bid. The Employer will respond to any request for clarification which he received earlier than 7 days prior to the deadline for submission of bids. Copies of the Employer's response will be forwarded to all purchasers of the bidding documents, including a description of the enquiry but without identifying its source.
- b) Pre-bid meeting
- i. The bidder or his official representative having authorization to attend, will be invited to attend a pre-bid meeting which will be arranged by the Employer. The purpose of meeting will be to clarify issues if any. The Bidder may send for points of clarifications with respect to tender if any by e-mail to Employer/ Consultants before Pre- bid meeting. Date, time and venue will be conveyed to the Bidder. **Pre bid meeting of this tender will be on 02nd April 2016 at Nath House, Aurangabad at 11.00 Am.** The notice of Pre Bid Meeting shall be displayed on the employer's website. Bidders are advised to check the website routinely.

10. Amendment of Bidding Documents

- a) Before the deadline for submission of bids, the Employer may modify the bidding documents by issuing tender addends.
- b) Any addendum thus issued shall be part of the bidding documents and shall be communicated in writing through email or by fax to all the purchasers of the bidding documents. Prospective bidders shall acknowledge receipt of each

addendum by fax to the Employer. Addenda shall be incorporated in the bids submitted by the Bidder.

C. Preparation of Bids

11. Language of the Bid

- a) All documents relating to the bid shall be in the English language

12. Documents comprising the Bid

- a) The bid submitted by the bidder shall comprise the following:
 - i. The Bid (in the format indicated in Section 2) and the Bill of Quantities wherein the Bidder shall fill in the rates; original plus one photocopy
 - ii. EMD and Qualification Information Form and Documents; original plus one photocopy
 - iii. Originals only of Specifications and Drawing Volumes duly stamped on all pages by the Bidder
 - iv. Any other materials required to be completed and submitted by bidders in accordance with these instructions

All documents shall be filled in without exception. Supporting documents related to qualifying criteria shall be duly attested / notarised true copies.

13. Bid Prices

- a) The unit rate so quoted in the Bill of Quantity (BOQ) shall be applicable irrespective of any future change in quantities. Contractor has to quote for all items, if rate for any item/ items not quoted then Bid will be liable to reject.
- b) The quoted item rate shall include for all duties, taxes and other levies payable by the Contractor under the contract, and no claim whatsoever, in this respect shall be entertained by the Employer.
- c) The item rate quoted by the bidder shall be fixed during the tenure of the Contract.

14. Currencies of Bid and Payment

- a) The rates and the prices given are in Indian Rupees.

15. Bid Validity

- a) Bids shall remain valid for a period not less than 90 (Ninety) days from the last date for bid submission. A bid corrected by the Bidder as valid for a shorter period shall be rejected by the Employer as non-responsive.
- b) In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the bidders may extend the period of validity for a specified additional period. The request and the bidders' responses shall be made

in writing or by fax. A bidder may refuse the request without forfeiting his bid security. A bidder agreeing to the request will not be required or permitted to modify his bid except as provided in 15(a) hereinafter, but will be required to extend the validity of his bid security for a period of the extension.

- c) The rates in BOQ shall remain fixed during the extended period of validity/extended period of contract.

16. Earnest Money Deposit:

- a) The Bidder shall furnish, as part of his Bid, an EMD of **Rs. 75,000/-** in favour of Paithan Mega Food Park Private Limited, Aurangabad ; and may be in one of the following forms:
 - i. A bank guarantee issued by a Nationalized / Scheduled Commercial banks notified by RBI (excluding co-operative / Rural banks)
 - ii. Demand draft or Bankers Cheque or Pay order drawn on Nationalized / Scheduled Commercial banks notified by RBI (excluding co-operative / rural banks) in favour of Paithan Mega Food Parks Private Limited.
- b) Bank guarantees issued as surety for the bid should be valid for 45 days beyond the validity of bid.
- c) Any bid not accompanied by an acceptable Bid Security and not secured as indicated in Sub-Clauses 16 (a) and 16(b) above shall be rejected by the Employer as non-responsive.
- d) The EMD of unsuccessful bidders will be returned within 30 days from the end of the bid validity period specified.
- e) The EMD of the successful bidder will be returned/ discharged when the bidder has signed the Agreement and furnished the required Performance Bank guaranty.
- f) The EMD may be forfeited
 - i. If the Bidder withdraws the Bid after Bid opening during the period of Bid validity.
 - ii. If the Bidder does not accept the correction of the Bid Price, pursuant to Clause 28.
 - iii. In the case of a successful Bidder, if the Bidder fails within the specified time limit to
 - a) Sign the Agreement or Furnish the required Performance Bank Guarantee.
- g) No interest shall be paid on any EMD/ Performance Bank Guarantee in lieu thereof.

17. Alternative Proposals by Bidders

- a) Alternative bids shall not be considered for any part of the Works.

18. Format and Signing of Bid

- a) The Bidder shall prepare the Bid as specified in clause 12 and following the instruction in clause 19.
- b) The original and copy of the Bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the Bidder. All pages of the bid where entries or amendments have been made shall be initialled by the person or persons signing the bid.

- c) The Bid shall contain no alterations or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the bidder, in which case such corrections shall be initialled by the person or persons signing the bid.

D. Submission of Bids

19. Sealing and Marking of bids

- a) There shall be two parts for the bids, part 'A' and part 'B'. The part 'A' shall contain Technical part of the bid and Part 'B' shall contain financial part of the bid. The Bidder shall enclose the original and one photocopy of Part A in one envelope marking it as, Envelope-A, TECHNICAL BID-ORIGINAL and COPY. He will then enclose the original and one photocopy of Part-B in another envelope marking it as Envelope B, FINANCIAL BID ORIGINAL and COPY. These envelopes shall then be put inside one outer envelope.

Part 'A', Technical BID of the bid shall contain

- i. EMD as per tender requirement. If the EMD is not deposited the tender shall be declared as non-responsive and rejected
- ii. The Technical Qualification Information indicated in Section 2 duly filled in original and photocopy
- iii. Conditional Tender will be rejected outright.
- iv. Originals only of Book – 1 Conditions of Contract and Book – 3 Drawing volume duly stamped and initialled on each page by the bidder as proof of their having scrutinized the documents.

Part 'B', Financial bid shall contain

- i. Form of Bid duly filled in original plus photocopy
 - ii. Book – 2 Bill of Quantities wherein the Bidder shall fill in the unit rates in digits and words and each page duly signed and sealed
- b) The inner and outer envelopes shall
Be addressed to the Employer at the following address:

Paithan Mega Food Park Pvt Ltd
Nath House , Nath Road ,
Aurangabad – 431005
Maharashtra State , India

20. PMC Address : Abhyuday Techno Economic Consultants Pvt. Ltd., 211-212, Patel Avenue, Near Gurudwara, S.G. Highway, Ahmedabad-380054.
E-mail : pmc@abhyuday.in

- a) Bear the following identification
- i. Bid for **Low - Voltage Telephone and LAN connection lines & Street Lighting System**
 - ii. Bid Reference No.: PMFPPL – TLSL – 01 – 2016.
- b) In addition to the identification required in Sub-Clause 19(b), the inner envelopes shall indicate the name and address of bidder.

- c) If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the bid.

21. Deadline for Submission of the Bids

- a) Bids must be received by the Employer at the address specified above no later than **17.30 Hours on 08st April 2016**. In the event of the specified date for the submission of bids declared a holiday for the Employer, the Bids will be received up to the appointment time on the next working day.
- b) The Employer may extend the deadline for submission of bids by issuing an amendment in accordance with Clause 10, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will then be subject to the new deadline.

22. Late Bids

- a) Any Bid received by the Employer after the deadline prescribed in Clause 21 will be liable to rejection.

23. Modification and withdrawal of bid: No modification or withdrawals shall be permitted after submission. EMD shall not be refunded.

E. Bid Opening and Evaluation

24. Bid Opening: The received bids will be opened after closing hours of the Bid on same day or next day. Any changes in the date will be notified on the website.

25. Process to Be Confidential

- a) Information relating to the examination, clarification, evaluation and comparison of Bids and recommendations for the award of a contract shall not be disclosed to the Bidders or any other persons not officially concerned with such process until the award to the successful Bidder had been announced. Any effort by a Bidder to influence the Employer's processing of Bids or award decisions may result in the rejection of his Bid

26. Clarification of Bids

- a) To assist in the examination, evaluations and comparison of Bids, the Employer may, at his discretion, ask any Bidder for clarification of his Bid, including of the unit rates.
- b) Subject to sub clause 25 (a), no bidder shall contact the employer on any matter relating to its bid from the time of the bid opening to the time the contract is awarded. If the bidder wishes to bring additional information to the notice of employer, he should do so in writing.
- c) Any effort by the Bidder to influence the Employer in the Employer's bid evaluation, bid comparison or contract award decision may result in the rejection of the Bidders' bid.

27. Examination of Bids and Determination of Responsiveness

- a) Prior to the detailed evaluation of Bids, the Employer will determine whether each Bid (a) meets the eligibility criteria defined in Clause 3; (b) has been properly signed; (c) is accompanied by the required securities and; (d) is substantially responsive to the requirements of the Bidding documents.
- b) A substantially responsive Bid is one which conforms to all the terms, conditions and specifications of the Bidding documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality or performance of the Works; (b) which limits in any substantial way, inconsistent with the Bidding documents, the Employer's right or the Bidder's obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other Bidders presenting substantially responsive Bids.
- c) If a Bid is not substantially responsive, it will be rejected by the Employer and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

28. Correction of Errors

- a) Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows:
 - i. Where there is a discrepancy between rates in figures and in words, the rate in words will govern; and
 - ii. Where there is a discrepancy between the unit and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.
- b) The amount stated in the Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and, with the concurrence of the Bidder, shall be considered as binding upon the Bidder, if the Bidder does not accept the corrected amount the Bid will be rejected and the Bid security may be forfeited in accordance with Sub-Clause 16.(f)

29. Short listing of Eligible Bids: The bids shall be evaluated for technical capability first. An empowered Committee shall evaluate the qualification criteria based on internally decided scoring pattern and shall shortlist contractors based on the information and supporting evidence provided.

30. Evaluation of Bids.

- a) **The contractor shall be shortlisted on the basis of their technical bid.**
- b) The Employer will open, evaluate and compare the financial Bids only for shortlisted proposals (based on their technical evaluation) and take his decision for award of work. The process of Evaluation shall not be disclosed to any Bidder or others.
- c) Shortlisted contractor shall be invited for negotiations by the employer.
- d) The Employer reserves the right to accept or reject any variation, deviation from the bid document, or any alternative offer. Variations, deviations and alternative offers and other factors which are in excess of the requirements of the Bidding documents or otherwise result in unsolicited benefits for the Employer shall not be taken into account in Bid evaluation

F. Award of Contract

31. Award Criteria

As per clause 30, the bids will be evaluated on technical and financial basis and the bidder will be selected on the basis of capability and price offer.

32. Employer's Right to Accept any Bid and to Reject any or all Bids

- a) Notwithstanding Clause 30, the Employer reserves the right to accept or reject any Bid or part of the Bid, and to cancel the Bidding process and reject all Bids, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder of Bidders of the grounds for the Employer's action.

33. Notification of Award and Signing of Agreement

- a) The Bidder whose Bid has been accepted will be notified of the award by the Employer prior to expiration of the Bid validity period by fax confirmed by registered letter. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") will state the sum that the Employer will pay the Contractor in consideration of the execution, completion and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").
- b) The notification of award will constitute the formation of the Contract, subject only to the furnishing of a performance Bank Guarantee in accordance with the provisions of Clause 33 (a) of Contract Price.
- c) The Agreement will incorporate all agreements between the Employer and the successful Bidder. It will be kept ready for signature of the successful bidder in the office of employer within 15 days of receipt of Letter of Acceptance; the successful Bidder will sign the Agreement and deliver it to the Employer.
- d) Upon accepting the Performance Bank Guarantee for the Successful Bidder and signing of the agreement, the employer shall issue a LOI / Notice to Proceed' to the Contractor, in which the date of commencement of the Contract shall be indicated.
- e) Upon furnishing of the Performance Bank Guarantee by the successful Bidder, the Employer will promptly notify the other Bidders that their Bids have been unsuccessful.

34. Performance Bank Guarantee (PBG)

- a) Within 15 days of receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a Performance Bank Guarantee (PBG) in any of the forms given below for an amount equivalent to 5% of the Contract price.

- b) A Performance bank guarantee, Validity shall be **13 months** from the date of Mobilisation or up to completion of work, whichever is later in the form given in Section 2.
 - i. Bank draft, in favour of Paithan Mega Food Park Private Limited, Aurangabad, payable at Aurangabad.
 - ii. If the Performance security is provided by the successful Bidder in the form of a Bank Guarantee, it should be issued by a Nationalized Bank or a Scheduled Commercial Bank in the format attached herewith.
- c) Failure of the successful bidder to comply with the requirements of sub-clause 33(b) shall constitute a breach of contract, cause for annulment of the award, forfeiture of the EMD, and any such other remedy the Employer may take under the contract and the Employer may resort to awarding the contract to the next ranked bidder.

35. Mobilisation Advances and Security

- a) The Employer will provide a Mobilisation Advance Payment, @ **10 % of the Contract Price** as stipulated in the Conditions of Contract against submission of Bank Guarantee from Nationalised Bank or a Scheduled Bank only. Validity of this BG should be **13 months** or up to complete recovery of Mobilisation advances or decided by the SPV & party during negotiations.

36. Corrupt or Fraudulent Practices

- a) The Employer expects the Bidders, Suppliers, Contractors and Consultants; observe the highest standard of ethics during the procurement and execution of such contracts. Therefore, the Employer
 - i. Defines, for the purpose of this provision, the terms set forth below as follows:
 - a) "corrupt practice" means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence the action of the Employer in the procurement process or in contract execution;
 - b) "fraudulent practice" means a misrepresentation or omission of facts in order to influence a procurement process or the execution of a contract;
 - c) "collusive practice" means a scheme of arrangement between two or more Bidders, with or without the knowledge of the Employer, designed to establish bid prices at artificial, non-competitive levels; and
 - d) "Coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the procurement process or affect the execution of a contract.
 - ii. Will reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive or coercive practices in competing for the Contract in question;

SECTION - 2: FORMS OF BID, QUALIFICATION INFORMATION AND LETTER OF ACCEPTANCE, SECURITIES

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<i>Form 2: Qualification Information *</i>	15
FORMATS	
- <i>Format for Credit Facility</i>	18
- <i>Letter of Acceptance</i>	19
- <i>Notice to Proceed with the Work</i>	20
- <i>Agreement Form</i>	21
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NOTE:-

*BOTH THESE FORMS ARE TO BE FILLED IN BY THE TENDERER AND SUBMITTED AS PART OF HIS BID.

Form 1: Contractor's Bid

This will be submitted with Financial Bid. In this book Bidder are requested to submit this letter without mentioning contract price.

Description of the Works : Tender for Low - Voltage Telephone and LAN connection lines & Street Lighting System.

BID No. : PMFPPL - TLSL - 01 - 2016

To : Paithan Mega Food Park Private Limited.

Address : Nath House, Nath Road, Aurangabad - 431005, Maharashtra

GENTLEMEN,

Having examined the bidding documents including addendum, we offer to execute the Works described above in accordance with the Conditions of Contract, Specifications, Drawings and Bill of Quantities accompanying this Bid, for a contract price as submitted in Financial Bid.

This bid shall be valid for a period of 90 (Ninety) days from the day the bid is opened.

This Bid and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any Bid you receive.

We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf will engage in bribery.

We also undertake that, in competing for (and, if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in India namely "Prevention of Corruption Act 1988"

We hereby confirm that this Bid complies with the Eligibility, Bid Validity and Bid Security required by the Bidding documents.

Yours faithfully,

Authorized Signature:

Name & Title of Signatory : _____

Name of Bidder : _____

Address : _____

Contractor No. : _____

Email ID : _____

Company Seal/ Stamp

Form 2: Qualification Information

The information to be filled in by the Bidder in the following pages will be used for purposes of Evaluation of Technical Submission as provided for in Clause 29 of the Instructions of Bidders.

The Contractor shall use this format and prepare the submission in as many pages as he wishes.

Particular care shall be taken to submit certification from the previous clients in support of the Bidder's claims. *(The supporting documents should be duly attested or notarized)*

1.1 Constitution or legal status of Bidder *[Attach copy]*

Place of registration:

Principal Place of business:

Power of attorney of signatory of Bid *[Attach]*

1.2 Total value of Civil Engineering construction work
Executed and payments received in the last three year
(In Rs. Crores)

2012-2013 _____ #

2013-2014 _____ #

2014-2015 _____ #

1.3 Work performed as prime contractor (in the same name) on works of a similar nature over the last three years.

<u>Project Name</u>	<u>Name of the Employer*</u>	<u>Description of work</u>	<u>Contract no.</u>	<u>Value of contract (Rs. Millions)</u>	<u>Date of issue of work order</u>	<u>Stipulated period of completion</u>	<u>Actual date of completion*</u>	<u>Remark explaining reasons for delays and work completed</u>

1.4 Information on Bid Capacity (works for which bids have been submitted and works which are yet to be completed) as on the date of this bid.

(A) Existing commitments and on-going works:

<u>Description of work</u>	<u>Place & State</u>	<u>Contract No. & Date</u>	<u>Name and Address of Employer</u>	<u>Value of Contract (Rs. Millions)</u>	<u>Stipulated period of completion</u>	<u>Value of works* remaining to be completed (Rs. Millions)</u>	<u>Anticipated date of completion</u>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

- 1.5 Contractor's Plant, tool and Equipment essential for carrying out the Works shall be listed below

Contractor should have basic & necessary tools and tackles required for the said work and to execute all items mentioned in the BOQ. These set of tools should always remain on site. If contractor fails the work due to lack of tools and tackles then will be fined with penalty, hence every pre-requisite tools required by contractor to execute the work shall remain present on site till the contract is active.

- 1.6 Construction management and QC Organisation, Qualifications and experience of key personnel proposed for administration and execution of the Contract. Attach biographical data.

<u>Position</u>	<u>Name</u>	<u>Minimum Qualification</u>	<u>Years of experience (Years) (general)</u>	<u>Years of experience in the proposed position (Years)</u>
Project Manager -1 Nos.		Mechanical Engineering Graduate	15	8
Site Engineers- 2 Nos.		Engineering Graduate/Diploma	4-7	5
Site Supervisors- 2 Nos.		Engineering Diploma/ITI	4-7	3

- 1.7 A statement regarding the number of skilled and unskilled workers, the company has on its rolls at the time of tender submission. The statement also should indicate the number of skilled and unskilled workers proposed to be deployed on this project.

- 1.8 evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit, etc. List them below and attach copies of support documents *[sample format attached]*

- 1.9 Name, address and telephone, telex and fax numbers of the Bidders' bankers who may provide reference if contracted by the Employer.

- 1.10 Information on litigation history in which the Bidder is involved.

<u>Other party(ies)</u>	<u>Employer</u>	<u>Cause of dispute</u>	<u>Amount involved</u>	<u>Remarks showing Present status</u>

- 1.11 Statement of compliance under the requirements of Sub Clause 3.(a) of the instructions to Bidders.

- 1.12 Proposed work method and schedule of work demonstrating monthly targets so that the work is completed within the desired time frame. The Bidder should attach descriptions, drawings and charts as necessary to comply with the requirements of the Bidding documents.

SAMPLE FORMAT FOR EVIDENCE OF ACCESS TO OR AVAILABILITY OF CREDIT FACILITIES (ON THE LETTER HEAD OF BANK)**BANK CERTIFICATE**

This is to certify that M/s.is a reputed company with a good financial standing.

If the contract for the work, namely..... is awarded to the above firm, we shall be able to provide overdraft/ credit facilities to the extent of Rs. to meet their working capital requirements for executing the above contract.

__Sd.__

Name of Bank

Senior Bank Manager

Address of the Bank

Letter of Acceptance
(Letterhead paper of the Employer)

To: _____ [name and address of the Contractor] _____-____-2015

Dear Sirs,

This is to notify you that your Bid dated _____ for execution of..... (Bid No.: PMFPPL - TLSL - 01 - 2016) for the Contract Price of Rs. _____ (Rupees _____) as corrected and modified in accordance with the Instructions to Bidders' is hereby accepted by our Agency.

We note that as per bid, you do not intend to subcontract any component of work.

[OR]

We note that as per bid, you propose to employ M/s. as subcontractor for executing

[Delete whichever is not applicable]

You are hereby requested to furnish Performance bank Guarantee for an amount of Rs. ----- within 15 days of the receipt of this letter of acceptance valid up to 28 day from the Defects Liability Period i.e. up to and sign the contract, failing which action as stated in Para 33 c of Section 1, clause 33c may be taken.

Yours faithfully,

Managing Director
Paithan Mega Food Park Private Limited

Issue of Notice to proceed with the work
(Letterhead of the Employer)

___-___-2015

To

----- (name and address of the Contractor)

Dear Sirs:

Pursuant to your furnishing the requisite Bank Guarantee as stipulated in clause 33(a) Section 1 and signing of the contract agreement for.....@ a Bid Price of Rs. _____ (Rupees _____) you are hereby instructed to proceed with the execution of the said works in accordance with contract documents. The date of commencement will be _____.

Yours faithfully,

Managing Director
Paithan Mega Food Park Private Limited

Agreement Form**Agreement**

This agreement, made the _____-2015, between Paithan Mega Food Park Private Limited (hereinafter called "the Employer") of the one part and _____ [name and address of Contractor] (hereinafter called "the Contractor") of the other part.

Whereas the Employer is desirous that the Contractor executes the said work (Bid No: PMFPPL - TLSL - 01 - 2016) (Hereinafter called "the Works") and the Employer has accepted the Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein, at a contract price of Rs. _____ (Rupees _____)

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expression shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all aspects with the provisions of the Contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
4. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz.:
 - i. Letter of Acceptance;
 - ii. Contractor's Bid;
 - iii. Book 1 containing Invitation to bid, General Conditions of Contract, Special Conditions of Contract, Appendix
 - iv. Book 2: Duly filled Bill of Quantities & Rates
 - v. Tender Drawings-Book 3 including Technical Specifications

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of _____

Was hereunto affixed in the presence of:

Signed, Sealed and Delivered by the said _____

In the Presence of:

Binding Signature of Employer

Binding Signature of Contractor

Forms of Securities

Approved forms of Securities are attached here with. The performance and Mobilisation Advance are to be given by the successful bidder after the Employer issues the Letter of acceptance.

- Bank Guarantee in lieu of EMD with the Bid Submission
- Performance Bank Guarantee with letter of acceptance
- Bank Guarantee for Mobilisation Advance Payment (before receiving mobilization Advance)

BANK GUARANTEE IN LIEU OF EARNEST MONEY DEPOSIT

BANK GUARANTEE (To be executed on Stamp Paper of Rs.100/- or such higher value as per this Stamp Act of the State in which the Guarantee is issued. Stamp Paper should be in the name of the Nationalized Bank Issuing the Guarantee.)

To,
Paithan Mega Food Park Private Limited
Nath House, Nath Road,
Aurangabad – 431005, Maharashtra

1. In consideration of M/s. Paithan Mega Food Park Pvt Ltd. (herein called “the Employer”) having agreed to extend M/s _____ Contractor incorporated under the provision of the Companies Act, _____ demand, under the terms and conditions contained in the Tender No. _____ Dated _____ 2016 (hereinafter called “the said Tender”) of Earnest Money Deposit for the due fulfilment by the said Parties of the terms and conditions contained in the said Tender, on the production of a Bank Guarantee for Rs. _____ (Rupees _____ Only) we, name of _____ Bank, address _____ (hereinafter referred to as “the Bank”) do hereby undertake to pay to Employer an amount not exceeding Rs. _____ (Rupees _____ Only) against any loss of any breach by the said Party of any of the terms and conditions contained in the said tender.
2. We _____ (Name of Bank) do hereby undertake to pay the amounts due and payable under this guarantee without any demur, merely on a demand from the Employer stating that the amount claimed is due by way of damage caused, to or would be caused to or suffered by the Company by reason of any breach by the said Party of any of the terms of conditions contained in the said Tender or by reason of the party’s failure to perform the said Tender. Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee.
3. We _____ (name of Bank), further agree to 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 Tender and that it shall continue to be enforceable till all the dues of the Company under or by virtue of the said Tender have been fully paid and its claims satisfied or discharged or till the Managing Director, Paithan Mega Food Park Private Limited, Certifies that the terms and conditions of the said tender have been fully and properly carried out by the said Party and accordingly discharge the 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.
4. We _____ (name of Bank), further agree with the Company that the Company shall have the fullest liberty without our consents and without affecting in any manner

our obligation hereby to vary any of the terms and conditions of the said Tender or extend time of performance by the said Party 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 Party and to forbear or enforce any of the terms and conditions relating to the said Tender and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said party or for any forbearance, act of omission on the part of the Company or any indulgence by the Company to the said party or by any such matter of thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

5. We, _____ name of Bank, lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing.

Notwithstanding anything contained hereinabove:

- a) The liability of the Guarantor under this guarantee is restricted to Rs _____ (Rupees _____ Only).
- b) This guarantee shall remain enforce until its expiry on _____.
- c) Unless a suit or action to enforce a claim under this guarantee is made against the rights within _____ months from the aforesaid date of expiry, i.e. _____ all the rights of the beneficiary under the said guarantee shall be forfeited and the guarantee shall be released and discharged and discharged from all liabilities thereof.

Witness

For _____

Signature _____

Seal

PERFORMANCE BANK GUARANTEE

PERFORMANCE BANK GUARANTEE (To be executed on Stamp Paper of Rs.100/- or such higher value as per this Stamp Act of the State in which the Guarantee is issued. Stamp Paper should be in the name of the Nationalized Bank Issuing the Guarantee.)

In consideration of the Paithan Mega Food Park Pvt. Ltd. (hereinafter called "the PMFPPL") having agreed to exempt M/s. _____ (hereinafter called "the said Contractor(s)") from the demand under the terms and conditions of an agreement dated _____ made between Paithan Mega Food Park Pvt. Ltd. and M/s. _____ for _____ work at Paithan Mega Food Park Pvt. Ltd, Aurangabad, (hereinafter called "the said Agreement") of security deposit for the due fulfilment 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, _____ bank (hereinafter referred to as "the Bank") at the request of M/s. _____ (Contractors) do hereby undertake to pay to the PMFPPL an amount not exceeding Rs. _____ (Rupees _____ only) against any loss or damage caused to or suffered by the PMFPPL by reason of any breach by the said Contractor(s) of any of the terms or conditions contained in the said Agreement.

We, _____ Bank do hereby undertake to pay the amounts due and payable under this guarantee without any demur, merely on a demand from PMFPPL stating that the amount claimed is due by way of loss or damage caused to or is likely to be caused to or suffered by the PMFPPL 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. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____ (Rupees _____ only.)

We, _____ Bank undertake to pay to the PMFPPL any money so demanded not withstanding any dispute or disputes raised by the Contractor(s) in whether any suit or proceedings before any Court or Tribunal or otherwise, relating thereto our liability under this present being absolute and unequivocal.

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

We, _____ Bank further agree that the Guarantee herein contained shall remain in full force and effect during the period that would be taken for the existence of the said Agreement and that it shall continue to be enforceable till all the dues of PMFPPL under or by virtue of the said Agreement have been fully paid and its claims satisfied or discharged or till _____ whichever is late, or Paithan Mega Food Park Pvt. Ltd. has 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 _____ we shall be discharged from all liability under this Guarantee thereafter.

We, _____ Bank agree with the Paithan Mega Food Park Pvt Ltd shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Agreement or to extend time of performance of the said terms and conditions 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 PMFPPL against the said Contractor(s) and/or 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 PMFPPL or any indulgence by the PMFPPL to the said Contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision have effect of so relieving us.

The Guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

We, _____ Bank lastly undertake not to revoke this Guarantee during its currency except with the previous consent of the PMFPPL in writing.

Dated this _____ day of _____.

PERFORMANCE BOND FOR UNBALANCED ITEMS

Performance Bond will not be accepted.

BANK GUARANTEE FOR MOBILISATION ADVANCE PAYMENT

BANK GUARANTEE (ADVANCE) (To be executed on Stamp Paper of Rs.100/- or such higher value as per this Stamp Act of the State in which the Guarantee is issued. Stamp Paper should be in the name of the Nationalized Bank Issuing the Guarantee.)

To,
Paithan Mega Food Park Pvt. Ltd.
Nath House, Nath Road,
Aurangabad-431005, Maharashtra

With reference to your Letter, Order No.....Dated.....Concluded between Paithan Mega Food Park Pvt. Ltd. hereinafter referred to as "Employer" and M/s.....hereinafter referred to as "The Contractor" for Civil Construction of Paithan Mega Food Park Pvt Ltd. as detailed in the above contract, herein after referred to as "The said contract" and in consideration of the Employer having agreed to make an advance payment, in accordance with the terms of the said contract to the said Contractor. We "The Bank" hereby irrevocably undertake and guarantee to you that if the said Contractor would fail to complete Civil Construction work in conformity with the terms of the said contract for any reason whatsoever or fail to perform the said contract in any respect or should the whole or part of the said on account payment at any time become repayable to you for any reason whatsoever, we shall, on demand and without demur pay to you all and any sum up to a maximum of Rs.....

We further agree that the Employer shall be the sole judge as to whether the Contractor has failed to abide by the terms of said contract or has failed to perform the said contract in any respect or the whole part of the on account payment made by the Employer has become repayable.

- d) We further hereby unconditionally undertake to pay the amount due and payable under this guarantee without any demur merely on a demand from the Employer stating the amount claimed. Any such demand made on the bank shall be conclusive and binding upon us. The liability of the Guarantor under this guarantee is restricted to Rs_____ (Rupees_____ Only).

We further agree that this Guarantee shall remain in full force for a period ofMonths unless it is released by you, on an application by Contractor made after the Bank Guarantee period has expired or such extended period of Guarantee, whichever is later, provided the Contractor has:

- (a) Completed Civil Construction work its obligations for Civil Construction work under the said Contract and adjusted the advance amount covered under this Guarantee.
- (b) Produced a Certificate of due completion of the aforesaid Civil Construction work under the said Contract.
- (c) Submitted a "No Demand Certificate" signed by your Managing Director.

Should it be necessary to extend this Guarantee beyond the said date we undertake to extend the period of this Guarantee without reference to the Contractor. Immediately after its lodging period or extended lodging period has expired, this document is to be returned

to us. No matter whether this document has been returned or not, no claim after the expiry of lodging period/ extended lodging will be accepted.

This Guarantee shall not be affected by any change in the Constitution of the Contractor or us nor shall it be affected by any change in your constitution or by any amalgamation or absorbable by the Absorbing/amalgamated Company or concern.

We further agree that the Employer shall have the fullest liberty without affecting in any way our obligations hereby guaranteed us, as aforesaid, and we hereby expressly waive all our rights of surety ship and other rights if any which are in any way inconsistent with the above or any other provision of the guarantee.

We further agree that the Employer shall be the fullest without affecting in any way our obligation hereunder, with or without our consent or knowledge to vary any of the terms and conditions of the said contract or to extend the time of completion period from time to time or postpone for any time or from time to time any of the powers exercisable by the Employer against the Contractor and either of forbear or enforce any of the terms and conditions relating to the said contract and we shall not be relieved from our liability by reason of any such variation or any indulge or forbearance shown or any act or omission on the part of the Employer or by any such matter or thing whatsoever under the law relating to sureties would but for this provision have the effect of so relieving us.

It shall not be necessary for you to proceed against the Contractor before proceeding against us and the Guarantee herein contained shall be enforceable against us, notwithstanding any security which you may have obtained or obtain from the Contractor at any time or when proceeding taken against us, hereunder, be outstanding or realized.

We further agree that this Guarantee shall come into force simultaneously with your making the said advance payment to the Contractor and shall not be revoked by us whether before its coming into force or any time during its currency without your previous consent in writing signed by your Managing Director.

Notwithstanding anything contained herein before, our liability under this guarantee is restricted to Rs.....(Rupees.....) and it will remain in force up tounless a suit to enforce any claim under this Guarantee is filed against us on or before (The claim lodging period should be 60 days beyond the date of expiry of Guarantee, Thus if the Guarantee is valid up to date_____ the claim lodging period should be _____, all your rights under this Guarantee shall be forfeited and we shall be relived and discharged from all liabilities there under.

Dated this.....day of2015.

COUNTERSIGNED

WITNESS:

SIGNATURE: (BANK)

NAME:

SECTION 3 - GENERAL CONDITION OF CONTRACT

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1. Interpretations

In construing these conditions, the specifications, schedule of quantities and the Contract Agreement, the following words shall have the meanings herein assigned to them except, where the subject or context otherwise requires.

- a) 'EMPLOYER/ OWNER 'shall mean Paithan Mega Food Park Pvt Ltd. having its registered office at Paithan and shall include their legal representatives, Assigns, successors or managing Committee or anyone authorized by them on their behalf
- b) 'CONTRACTOR' shall mean the tenderer and shall include his/ their legal representative/s, assigns/or successors
- c) 'PMC' shall mean M/s. Abhyuday Techno Economic Consultants Private Limited, 211-212, Patel Avenue, Near Gurudwara, S. G. Highway, Thaltej, Ahmedabad - 380054, Gujarat their nominees and also the Engineer-in-Charge or Engineer appointed by the Employer
- d) 'SITE' shall mean the site of the Contract works including any building and erections thereon and any other land (inclusively) as aforesaid allotted by the Employer for the Contractor' use
- e) 'THIS CONTRACT' shall mean the Articles of Agreement, the General Conditions, the Special Conditions, the Appendix, the Schedule of Quantities, Specifications, drawings, and other letters attached hereto and duly signed
- f) 'NOTICE IN WRITING' or 'WRITTEN NOTICE' shall mean a Notice in writing, typed or printed characters sent (unless delivered personally or otherwise Proved to have been received) by registered post to the last known private or business address or registered office of the addressee and shall be deemed to have been received when in the ordinary course of post it would have been delivered
- g) 'ACT OF INSOLVENCY' shall mean any act of insolvency as defined by the Presidency Towns Insolvency Act, or the Provincial Act or any Act amending such original

Words importing the persons include firms and corporations

Words importing the singular only also include the plural and vice versa where the context requires

2. Scope of Contract

The Contractor shall carry out and complete the said work in every respect in accordance with this Contract and with the directions of and to the satisfaction of the Employer / PMC/Architect / Engineer-in-charge. The Architect and Engineer-in-Charge on their own may from time to time issue further drawings and/or written instructions, details, directions and explanations which are hereafter collectively referred to as "Works Instructions" in regard to:

- a) The variation or modification of the design, quality or quantity of works or the addition or omission or substitution of any work

- b) Any discrepancy in the Drawings or between the Schedule of Quantities and/or Drawings and / or Specifications
- c) The removal from the site of any material brought thereon by the Contractor and the substitution of any other material therefore
- d) The removal and / or, re-execution of any works executed by the Contractor
- e) The dismissal from the works of any persons employed thereupon
- f) The opening up for inspection of any work covered up
- g) The amending and making good of any defects under clause

The Contractor shall forthwith comply with and duly execute any work comprised in such works Instructions provided always that verbal instructions, directions and explanations given to the Contractor or his representative upon the works by the Architect and Engineer-in-charge shall, be confirmed in writing by the Contractor within seven days, and if not dissented from in writing within a further period of seven days, such shall be deemed to be "Works Instructions" within the Scope of the Contract

3. Inspection of Site

The Employer shall have made available to the Contractor such as data on sub-surface conditions as shall have been obtained by or on behalf of the Employer from investigations undertaken relevant to the Works, but the Contractor shall be responsible for his -own interpretation thereof and deemed to have visited the site and done own analysis.

4. Sufficiency of Tender

The Contractor shall also be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his Tender for the works and of the rates and prices stated in the priced Bill of Quantities and the Schedule of Rates and Prices, which Tender rates and prices shall, except in so far as it is otherwise provided in the Contract, cover all his obligations under the Contract and all matters and things necessary for the proper execution and maintenance of the Works.

5. Program To Be Furnished

- a) Within the time stated of these Conditions, the Contractor shall, after the acceptance of his Tender, submit to the Engineer for his approval a program showing the order in which he proposes to carry out the works. The Contractor shall whenever required by the Engineer or Engineers' Representative, also provide in writing for his information a general description of the arrangements and methods which the Contractor proposes to adopt for the execution of the works
- b) If at any time it should appear to the Engineer that the actual progress of the works does not conform to the approved program referred to in sub-clause of this Clause, the Contractor shall produce, at the request of the Engineer, a revised

program showing the modifications to the approved program necessary to ensure completion of the works within the time for completion as decided and reworked to the satisfaction of the Employer

6. Drawings and Schedule of Quantities

The Copy of the Contract shall remain in the custody of the Employer. The Contractor on the signing thereof shall be furnished by the Architect with a copy of the priced Schedule of Quantities, one copy of each of the said drawings and the specifications and three copies of all further drawings issued during the progress of the work. The Contractor shall keep' one copy of all the Drawings on the works and Employer, Engineer-in-Charge or the Architect or his representative shall, at all reasonable-times, have access to the same. Before the issue of the Final Certificate to the Contractor, he shall forthwith return to the Architect all drawings and specifications, All the drawings supplied by the Architect will be in the form of Hardcopy.

7. Contractor To Provide Everything Necessary

The Contractor shall provide everything necessary for the proper execution of the works according to the intent and meaning of the Drawings, Schedule of Quantities and Specifications taken together whether the same may or may not be particularly shown or described therein provided that the same can reasonably be inferred there from and if the Contractor finds any discrepancy in the Drawings or between the Drawings, Schedule of Quantities and Specifications, he shall immediately and in writing refer the same to the Architect who shall decide which is to be followed

8. Authorities, Notices and Patents

The Contractor shall conform to the provision of any act of the Legislature relating to the works and to the Regulations and Bye-Laws of any Authority, and of any Water, Lighting and other Companies and/or Authorities with whose system the structure is proposed to be connected and shall, before making any variations from the Drawings or Specifications that may be necessitated by so conforming, give to the Architect written notice specifying the variation proposed to be made and the reason for making it, and apply for instructions thereon. In case, the Contractor shall not within twenty days receive such instructions, he shall proceed with the work, conforming to the Provisions, Regulations or Bye-Laws in question, and any variation so necessitated shall be dealt with under clause no.13

The Contractor shall bring to the attention of the Architect all notices required by the said Acts, Regulations or Bye-Laws to be given to any Authority and pay to such Authority or to any Public office all fees that may be properly chargeable in respect of the works, and lodge the receipts with the Architect

The Contractor shall indemnify the Employer and Architect against all claims in respect of patent rights, and shall defend all actions arising from such claims and shall himself pay all royalties, license fees, damages, costs and charges of all and every sort that may be legally incurred thereof.

9. Setting Out Works

The Contractor shall set out the works and shall be responsible for the true and perfect setting out of the same and for the correctness of the positions, levels, dimensions and alignment of all parts thereof. If at any time any error in this respect shall appear during the progress of the works, the Contractor shall at his own expense rectify such error if so required to the satisfaction of the Architect and the Engineer-in-Charge. The checking of any setting-out or of any line or level by the Engineer-in-charge or the Engineers representative shall not in any way relieve the contractor of his responsibility for the correctness thereof

10. Materials and Workmanship To Conform To Description

All materials and workmanship shall so far as procurable be of the respective kinds described in the Schedule of Quantities and/or Specification and in accordance with the "Works Instructions" and the Contractor shall, upon the request of the Employer/Architect, furnish him with all invoices, accounts receipts and other vouchers to prove that the materials comply therewith. The Contractor shall at his own cost arrange for and/or carry out any test of any materials which the Architect/ the Engineer-in-Charge may require

11. Contractors Superintendence And Representative On The Works

The Contractor shall give all necessary personal superintendence during the execution of the works, and so long thereafter as the Architect or Engineer-in-Charge may consider necessary until the expiration of the "Defects Liability Period" stated in the Appendix thereto. The Contractor shall also, during the whole time the works are in progress, employ a competent representative whose name is informed to the Employer/Architect who shall be constantly in attendance at the building while the men are at work. Any directions, explanations, instructions or notices given by the Architect or Engineer-in-Charge or Employer to such representative shall be held to be given to the Contractor. Such a person shall be a qualified engineer whose qualification and experience must be made known to the Architect / Engineer-in-charge and must have the approval

12. Dismissal of Workmen

The Contractor shall, on the request of the Architect or the Engineer-in-Charge or Employer, immediately dismiss from the works any person employed thereon by him who may, in the opinion of the Architect or the Engineer-In-Charge or the Employer, be incompetent or misconduct himself, and -such person shall not be again employed on the works without the permission of the Architect or Engineer-in-charge

13. Access To Works

The Architect and his representative or the Engineer-In-Charge or the Employer shall at all reasonable times have free access to the works and/or to the workshops, factories, or other places where materials are lying or from which they are being obtained and the Contractor shall give every facility to the Architect and his representative, the Engineer-In-Charge or the Employer necessary for inspections and examination and test of the materials and workmanship. Only persons authorized by the Architect, the Engineer-in-

Charge or the Employer, except the Representatives of Public Authorities, shall be allowed on the works at any time.

14. Engineer-In-Charge/ The Engineer

The term 'Engineer-in-Charge' shall mean the person nominated by the employer and acting under the orders of the Employer/ to inspect the works. The Contractor shall offer the Engineer-in-Charge every facilities and assistance for the inspection of the works and materials and for checking and measuring the works carried out by the Contractor. The Engineer-In-Charge or any representative of the Employer shall have power to give notice to the Contractor or his representative of non-approval of any work or materials and such work shall be suspended or the use of such material be discontinued. The work will from time to time be examined by the Architect ' the Engineer-in-Charge or the Employer but such examination shall not in any way exonerate the Contractor from the obligation to remedy any defect which may be found to exist at any stage of the work or after the same is completed. In case of Contractor not removing the rejected material nor rectifying the defective work pointed out by the Engineer-in-Charge, the Contractor will be liable to the consequences as per the Agreement. The Contractor shall honor all letters, notices issued by the Engineer-In-Charge as if they are issued by the Architect. The Engineer-In-Charge may be empowered by the Architect to issue certificates for payment and the Employer shall honor such certificates provided the Architect has obtained a written consent from the Employer or has informed the Employer in writing.

15. Care of Works

- a) From the Commencement of the Works until the date stated in the Certificate of Completion for the whole of the works pursuant to Clause 48 (d) hereof the Contractor shall take full responsibility for the care thereof. Provided that if the Employer/Architect issues a Certificate of Completion in respect of any part of the Permanent Works the Contractor shall cease to be liable for the care of that part of the Permanent Works from the date stated in the Certificate of Completion in respect of that part and the responsibility for the care of that part shall pass to the Employer. Provided further that the Contractor shall take full responsibility for the care of any outstanding work, which he shall have undertaken to finish during the Period of Maintenance until such outstanding work is completed. In case any damage, loss or injury shall happen to the Works or to any part thereof, from any cause whatsoever, save and except the excepted risks as defined in sub-clause (b) of this Clause, while the Contractor shall be responsible for the care thereof the Contractor shall, at his own cost, repair and make good the same, so that at completion the permanent works shall be in good order and condition and in conformity in every respect with the requirements of the Contract and the Engineers instructions. In the event of any such damage, loss or injury happening from any of the excepted risks, the Contractor shall, if and to the extent required by the Engineer-in-charge and subject always to the provisions of the contract, repair and make good the same as aforesaid at the cost of the Employer. The Contractor shall also be liable for any damage to the Works occasioned by him in the course of any operations carried out by him for the purpose of completing any outstanding work or complying with his obligations under clause 48 hereof.

b) Excepted Risks

The "excepted risks" are war, hostilities (whether war be declared or not), invasion, and act of foreign enemies, rebellion, and revolution. insurrection or military or usurped power, civil war, employees of the Contractor or of his sub-contractors and arising from the conduct of Works, riot, commotion or disorder, or a cause solely due to the design of the Works or ionizing radiations or contamination by radio-activity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel, radioactive, toxic explosive or other hazardous properties of any explosive, nuclear assembly or nuclear component thereof, pressure waves caused by aircraft or other aerial devices traveling at sonic or supersonic speeds, or any such operation of the forces of nature are collectively referred to as "the excepted risks".

16. Assignment and Sub-Letting

The whole of the works included in the Contract shall be executed by the Contractor and the Contractor shall not directly or indirectly transfer, assign or underlet the Contract or any part share thereof or interest therein without the written consent of the Employer/Architect and no undertaking shall relieve the Contractor from the full and entire responsibility of the Contract or from active superintendence of the works during their progress

17. Variation Not To Vitate Contract

No alteration, omission or variation shall vitiate this contract but in case the Architect and the Engineer-in-Charge in consultation with the Employer thinks proper at any time during the progress of the works to make any alterations in or additions to or omissions from the works or any alteration in the kind or quality of the materials to be used therein and shall give notice thereof in writing under his hand to the Contractor, the Contractor shall alter, add to or omit from as the case may require, in accordance with such notice, but the Contractor shall not do any work extra to or make any alterations or additions to or omissions from the works or any deviation from any of the provisions of the Contract, Stipulation, Specification or Contract Drawings without the previous consent in writing of the Engineer-in-Charge and the Employer jointly.

18. Schedule of Quantities

The schedule of Quantities, unless otherwise stated, shall be deemed to have been prepared as per mode of measurement specified in Technical Specification and Bill of Quantity attached with the Tender, Any error in description or in quantity or in omission of items from the Schedule of quantities shall not vitiate this Contract but shall be rectified and the value thereof as ascertained under Clause hereof shall be added to or deducted from the Contract Amount (as the case may be) provided that there shall be no rectification of errors in the Contractor's Schedule of Rates.

19. Sufficiency Of Schedule Of Quantities

The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his Tender for the works and of the prices stated in the Schedule of Quantities and / or the Schedule of Rates and Prices which rates and prices

shall cover all his obligations under the Contract, and all matters and things necessary for the proper completion of the works.

20. Measurement Of Works

The measurement and valuation in respect of the Contract shall be completed within "Period of final measurement" stated in the Appendix or if not so stated then within three months of the completion of the contract works as defined in Clause hereof.

21. Non Tender Items

The Contractor shall, when ordered in writing by the Architect and with the concurrence of the Employer, perform work not covered by the specifications or included in the Bills of Quantities but forming part of the work contracted for, on the same conditions in all respect in which he agrees to do the main work. Extra work and supply of such material shall be carried out at a rate settled by written agreement between the Contractor and the / the Engineer-in-Charge with the concurrence of the Employer.

22. Status of Workmen

None of the employees of the contractor shall be construed or deemed to be the employees of PMFFPL at any time and the Contractor shall indemnify and keep indemnified PMFFPL against any claim, loss or whatsoever in this connection.

There shall never exist any employer and employee relationship between PMFFPL and the manpower engaged by Contractor. PMFFPL shall not have any responsibility to nor shall be held directly or indirectly responsible or liable for the person so employed by the contractor for performing/providing services in terms of this agreement to PMFFPL in terms of its contractual obligations hereunder.

23. Quality of Materials & Workmanship and Tests

- a) All materials and workmanship shall be of the respective kinds described in the Contract and in accordance with the Engineer's instructions and shall be subjected to tests from time to time to such other place or places as may be specified in the Contract, or at all or any of such places. The Contractor shall provide assistance instruments, machines, labor and materials as are formally required for examining, measuring and testing any work and the quality, weight or quantity of any material used and shall supply samples of materials before incorporation in the work for testing as may be selected and required by the Engineer.
- b) Cost of Samples / Shop Drawings: All samples / shop drawings / fabrication drawings shall be supplied by the Contractor at his own cost.
- c) Cost of Tests: The Cost of making any Tests shall be borne by the Contractor.

24. Inspection of Operation

The Engineer and any person authorized by him shall at all times have access to the works and to all workshops on or off the site and places where work is being prepared

or from where materials, manufactured articles or machinery are being obtained for the works and the Contractor shall afford every facility for and every assistance in or in obtaining the right to such access. All works carried out off the site shall be duly brought to the notice of the Engineer.

25. Examination of work

- a) No work shall be covered up or put out of view without the approval of the Engineer or the Engineer's Representative and the Contractor shall afford full opportunity for the Engineer or the Engineer's Representative to examine and measure any work which is in view and to examine foundations about to be covered up or put out of before permanent work is placed thereon. The Contractor shall give due notice to the Engineer's Representative whenever any such work or foundation is or are ready or about to be ready for examination and the Engineer's Representative shall, without unreasonable delay, unless he considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such works of examining such foundations.
- b) Uncovering & Making Openings: The Contractor shall uncover any part or parts of the works or make openings in or throughout the same part or parts to the satisfaction of the Engineer-in-Charge. If any such part or parts have been covered up or put off view after compliance with the requirements of sub-clause (a) of this Clause and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating and making good the same shall be borne by the Employer, but in any other case all costs shall be borne by the Contractor.

26. Removal of improper Works and Material

- a) The Engineer-in-Charge shall during the progress of the works have power to order in writing from time to time
 - i. The removal from the Site, within such time or times as may be specified in the order, of any materials, which in the opinion of the Employer, are not in accordance with the Contract
 - ii. The substitution of proper and suitable materials and
 - iii. The removal and proper re-execution, notwithstanding any previous test thereof or interim payment thereof, any work which in respect of materials or workmanship is not, in the opinion of the Engineer, in accordance with the Contract

27. Default of Contract in compliance: In case of default on the part of the Contractor in carrying out such order, the Employer shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be recoverable from the Contractor after giving due notice in writing by the Employer, or may be deducted by the Employer from any money due or which may become due to the Contractor

28. Suspension of Work

- a) The Contractor shall, on the written order of the Engineer, suspend the progress of the Works or any part thereof for such time or times and in such manner as the

Engineer may consider necessary and shall during such suspension properly protect and secure the work, so far as is necessary in the opinion of the Engineer. The extra cost incurred by the Contractor in giving effect to the Engineer's instructions under this clause shall be borne and paid by the Employer unless such suspension is

- i. Otherwise provided for in the Contract, or
- ii. Necessary by reason of some default on the part of the Contractor, or
- iii. Necessary by reason of climatic conditions on the site, or
- iv. necessary for the proper execution of the works or for the safety of the works or any part thereof in so far as such necessity does not arise from any act or default by the Engineer or the Employer or from any of the excepted risks defined in the clause hereof

Provided that the Contractor shall not be entitled to recover any such extra cost unless he gives written notice of his intention to claim to the Engineer within fifteen (15) days of the Engineer-in-Charge's Order. The Engineer shall settle and determine such extra payment and / or extension of time under clause hereof to be made to the Contractor in respect of such claim as shall, in the opinion of the Engineer-in-Charge, be fair and reasonable.

b) Suspension lasting more than 90 days

If the progress of the works or, any part thereof is suspended on the written order of the Engineer and if permission to resume work is not given by the Engineer within a period of ninety days from the date of suspension then, unless such suspension is within paragraph (i), (ii), (iii) or (iv) of sub-clause (a) of this clause the contractor may serve a written notice on the Engineer requiring permission within twenty-eight days from the receipt thereof to proceed with the works, or that part thereof in regard to which progress is suspended and, if such permission is not granted within that time, the Contractor by a further written notice so served may, but is not bound to, elect or treat the suspension where it affects part only of the works as an omission of such part under clause hereof, or, where it affects the whole works, as an abandonment of the Contract by the Employer.

29. Defects during execution and after completion of works

Any defect, shrinkage, settlement or other faults which may appear during execution or within the "Defects Liability Period" stated in the Appendix hereto, or if none stated then within 12 months after the virtual completion of the works, arising in the opinion of the Employer from materials or workmanship not in accordance with the contract, shall upon the directions in writing of the Employer, and within such reasonable time as shall be specified herein, be amended and made good by the Contractor, at his own cost unless the Architect & Engineer-in-Charge in concurrence with the Employer shall decide that he ought to be paid for such amending and making good, and in case of default the Employer may employ and pay other persons to amend and make good such defects, shrinkage, settlements or other faults, and all damages, loss and expenses consequent thereon or incidental thereto shall be made good and borne by the Contractor and such damage, loss and expenses shall be recoverable from him by the

Employer or may be deducted by the Employer upon the Architect's & Engineer-in-Charge's Certificate in writing from any moneys due or that may become due to the contractor, or the Employer may in lieu of such amending and making good by the Contractor deduct from any moneys due to the Contractor a sum to be determined by the Architect and the Engineer-in-Charge in concurrence with the Employer equivalent to the cost of amending such work and in the event of the amount retained by employer being insufficient recover the balance from the Contractor, together with any expenses the Employer may have incurred in connection therewith.

Should any defective work have been done or material supplied by any sub-contractor employed on the works, who has been nominated or approved by the Architect / the Engineer-in-Charge and the Employer jointly as provided in the clause, the Contractor shall be liable to make good in the same manner as if such work or material had been done or supplied by the contractor and been subject to the provisions of this clause and the clause thereof. The Contractor shall remain liable under the provisions of this clause notwithstanding the signing by the Architect or the Engineer-in-Charge or the Employer of any Certificate or the passing of any accounts

30. Insurance

Without limiting his obligations and responsibilities, the contractor shall insure in the name of the Employer against all loss or damage for all works under (a) below and in the joint name of the Employer and the Contractor against any loss or damage for all items under (b) below from whatever, cause arising, including riot and excepted risks and for which he is responsible under the terms of the Contract and in such manner that the Employer is covered for the period stipulated hereof and are also covered during the period of Maintenance for loss or damage arising from a cause, occurring prior to the commencement of the Period of Maintenance, and for any loss or damage occasioned by the Contractor in the course of any operations carried out by him for the Purpose of complying with his obligation under clause hereof:

- a) The Works for the time being executed to the estimated current contract value thereof, or such additional such as may be specified together with the materials for incorporation in the works at their replacement value.
- b) The Constructional Plant and other things brought on to the site by the contractor to the replacement value of such constructional plant and other things.
- c) Such insurance shall be affected with an insurer and in terms approved by the Employer and the Contractor shall, deposit with the Engineer or the Engineer's Representative the policy or policies of insurance and the receipts for payment of the current premiums. All money payable by insurers shall be received by the Employer and disbursed to the Contractor in instalments.

31. Damage to Persons & Property

The Contractor shall indemnify the Employer, PMC and the Architect against all claims in respect of injuries or damage to any person or material or physical damage to any property whatsoever which may arise out of or in consequences of the execution and maintenance of the works and against claims, proceedings, damages, costs, charges and expenses whatsoever in respect of but not limited to, to include payment of Wages Act

1936 (Latest), Minimum Wages Act 1948 (Latest), Employers Liability Act 1938 (Latest), Workmen's Compensation Act 1947 (Latest), Industrial Disputes Act 1947 (Latest), Maternity Benefit Act 1961 (Latest) The Contract Labour (Regulation and Abolition Act, 1970 and any modifications thereof or of any law relating thereof in relation thereto including any compensation or damages for or with respect to

- a) The permanent use of occupation of Land by the works or any-part thereof.
- b) The right of the Employer to execute-the works or any part thereof on, over, under, in or through any land.
- c) In case of any expenses arising from any such injury or damage to persons of employer and architects on site, the compensation shall be made by the contractor of the actual expenses without any delays which may arise out of claim filed and settled by the Insurance Company.

32. Third Party Insurance

- a) Before commencing the execution of the works the Contractor, but without limiting his obligations and responsibilities under clause hereof, shall insure against his liability for any material or physical damage, Loss or injury which may occur to any property, including that of the Employer, or to any person, including any employee of the Employer, by or arising out of the execution of the Works or in the work being carried out by the Employer, by or arising out of the referred to in provision hereof.
- b) Minimum amount of Third Party Insurance

Such insurance shall be affected with an insurer and in terms approved by the Employer, and for at least the amount stated in the Appendix to the Tender. The Contractor shall deposit with the Engineer or the Engineer's Representative the policy or policies of insurance and the receipts for payment of the current premiums.

- c) Provision to indemnify Employer

The terms shall include a provision whereby, in the event of any claim in respect of which the Employer would be entitled to receive indemnity under the policy being brought or made against the Contractor, the insurer will indemnify the Employer against such claims and any costs, charges and expenses in respect thereof.

33. Accident / or Injury to Workmen

- a) The Employer shall not be Liable for or in respect of any damages or compensations payable at Law in respect or in consequence of any accident or injury to any workman or other person in the employment of the Contractor or any sub-contractor.

The Contractor shall indemnify and keeps indemnified the Employer against all such damages and compensation and against all claims, proceedings, costs, and charges, whatsoever in respect thereof or relation thereto.

b) Insurance against Accident etc. to Workmen

The Contractor shall insure against such liability with an insurer approved by the Employer and shall continue such insurance during the whole of the time that any persons are employed by him on the works and shall, deposit with the Engineer or the Engineer's Representative such policy of insurance and the receipt of payment of the current premium.

Provided always that, in respect of any persons employed by any sub-Contractor, the Contractor's obligation to insure as aforesaid under this sub clause shall be satisfied if the sub-contractor shall have insured against the liability in respect of such persons in such manner that the Employer is indemnified under the policy, but the Contractor shall require such sub-contractor to deposit with the Engineer of the Engineer's Representative, such policy of insurance and the receipt for the payment of the current premium.

34. Remedy on Contractors Failure to Insure

If the Contractor fails to effect and keep in force the insurance referred to in clauses hereof, or any other insurance which he may be required to effect under the terms of the contract, then and in any such case the Employer may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and from time to time deduct the amount so paid by the Employer as aforesaid from any monies due or which may become due to the Contractor, or recover the same as a debt due from the contractor.

35. Commencement of Works

The Contractor shall commence the works on site within the period named in the Appendix to the Tender after the receipt by him a written order to this effect from the Engineer and shall proceed with the same with due expedition and without delay, except as may be expressly sanctioned or ordered by the Engineer. The time for commencement and completion of work shall be of the essence of the contract.

36. Possession of Site

- a) Save in so far as the Contract may prescribe, the extent of portions of the Site of which the Contractor is to be given possession from time to time and the order in which such portion shall be made available to him and, subject to any requirement in the Contract as to the order in which the Works shall be executed, the Employer will, with the Engineer's written order to commence the works, give to the Contractor possession of so much of the Site as may be required to enable the Contractor to commence and proceed with the execution of the works in accordance with the program referred to in Clause hereof, if any, and otherwise in accordance with such reasonable proposals of the Contractor as he shall, by written notice to the Engineer, make and will, from time to time as the works proceed, give to the Contractor possession of such further portions of the

site as may be required to enable the Contractor to proceed with the execution of the Works with due dispatch in accordance with said program or proposals, as the case may be. If the Contractor suffers delay or incurs cost from failure on the part of the Employer to give possession in accordance with the term& of this Clause, the Engineer shall grant an extension of time for the completion of the works. In case of dispute the Employer may ask the contractor to leave the site and hand over the possession of the site. The contractor shall do so immediately.

37. Time for Completion

Subject to the requirement in the Contract as to completion of any sections of the works before completion of the whole, the whole of the works shall be completed, in accordance with the provisions of clause hereof, within the time stated in the Contract calculated from the last day of the period named in the Appendix to the Tender as that within which the Works are to be commenced, or such extended time as may be allowed under clause hereof.

38. Rate of Progress

If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the works or any section is at any time, in the opinion of the Engineer, too slow to ensure completion by the prescribed time or extended time for completion, the Engineer shall so notify the Contractor in writing and the Contractor shall thereupon take such steps as are necessary and the Engineer may approve to expedite progress so as to complete the Works or such section by the prescribed time or extended time. The Contractor shall not be entitled to any additional payment for taking such steps. If, as a result of any notice given by the Engineer under this Clause, the contractor shall seek the Engineer's permission to do any work at night or on Sundays, if locally recognized as days of rest, or their locally recognized equivalent, such permission shall not be unreasonably refused.

39. Liquidated Damages for Delay

If the Contractor fails to achieve completion of the works either in whole or part within the time prescribed, then the Contractor shall pay to the Employer the sum stated in the Appendix as liquidated damages for such default for everyday or part of a day which shall elapse between the time prescribed by clause hereof and the date of certified completion of the works. The Employer may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies in his hands, due or which may become due to the Contractor. The payment or deduction of such damages shall not relieve the contractor from his obligation to complete the works or from any other of his obligations and Liabilities under the contract.

40. Certification of Completion of Works

- a) When the whole of the Works have been substantially completed and have satisfactorily passed any final test that may be prescribed by the Contract, the Contractor may give a notice to that effect to the Engineer or to the Engineers Representative accompanied by an undertaking to finish any outstanding work during the period of Maintenance. Such notice and undertaking shall be in writing and shall be deemed to be a request by the Contractor for the Engineer to

issue a Certificate of completion in respect of the works. The Engineer shall, within thirty days of the date of delivery of such notice either issue to the Contractor, a Certificate of Completion stating the date on which, in his opinion, the works were substantially completed in accordance with the Contract or give instructions in writing to the Contractor specifying all the work which, in the Engineer's opinion, requires to be done by the Contractor before the issue of such Certificate. The Engineer shall also notify the Contractor of any defects in the Works affecting substantial completion that may appear after such instructions and before completion of the works specified therein. The Contractor shall be entitled to receive such Certificate of Completion within twenty-one days of completion to the satisfaction of the Engineer of the works so specified and making good any defects so notified.

b) **Certification of completion by Stage**

Similarly, in accordance with the procedures set out in Sub-clause (a) of this clause, the Contractor may request and the Engineer shall issue a Certificate of Completion in respect of

- i. Any section of the permanent works in respect of which a separate time for completion is provided in the Contract and
- ii. Any substantial part of the Permanent Works, which has been both, completed to the satisfaction of the Engineer and occupied or used by the Employer.

- c) If any part of the Permanent Works shall have been substantially completed and shall have satisfactorily passed any final test that may be prescribed in the Contract, the Engineer may issue a Certificate of Completion in respect of that part of the Permanent Works before completion of the whole of the works and upon the issue of such Certificate, the Contractor shall be deemed to have undertaken to complete any outstanding work in that part of the works during the Period of Maintenance.
- d) Provided always that a Certificate of Completion given in respect of any section of part of the Permanent Works before completion of the whole shall not be deemed to certify completion of any ground or surfaces requiring reinstatements, unless Certificate shall expressly so state.

41. Period of Maintenance/ Defect Liability

a) **Period of Maintenance**

The expression "Period of Maintenance" shall mean the period of maintenance named in the Appendix to the Tender, calculated from the date of completion of the Works, certified by the Engineer in accordance with Clause hereof, or, in the event of more than one certificate having been issued by the Engineer under the said Clause, from the respective dates so certified and in relation to the period of Maintenance the expression "the Works" shall be constructed accordingly.

b) **Execution of Work of repair, etc.**

To the intent that the works shall at or as soon as practicable after the expiration of the Period of Maintenance be delivered to the Employer in the condition required by the Contract, fair wear and tear excepted, to the satisfaction of the Engineer, the Contractor shall finish the work, if any, outstanding at the date of completion, as certified under Clause 40 hereof, after such date and shall execute all such work of repair, amendment, reconstruction, rectification and making good defects, imperfections, shrinkages or other faults as may be required of the Contractor in writing by the Engineer during the Period of Maintenance, or within fourteen days after its expiration, as a result of an inspection made by or on behalf of the Engineer prior to its expiration.

c) Cost of execution of work of repair etc.

All such work shall be carried out by the Contractor at his own expense if the necessity thereof shall, in the opinion of the Engineer, be due to the use of materials or workmanship not in accordance with the Contract, or due to neglect or failure on the part of the Contractor to comply with any, obligations, expressed or implied, on the Contractor's part under the Contract. If, in the opinion of the Engineer, such necessity shall be due to any other cause, the value of such work shall be ascertained and paid for as if it were additional work.

d) Remedy on Contractor's Failure to carry out work required:

If the Contractor fails to do any such work as aforesaid required by the Engineer, the Employer shall be entitled to employ and pay persons to carry out the same and if such work is work which, in the opinion of the Engineer, the Contractor was liable to do at his own expense under the Contract, then all expenses consequent thereon or incidental thereto shall be recoverable from the Contractor by the Employer, or may be deducted by the Employer from any monies due or which may become due to the Contractor.

e) Contractor to search

The Contractor shall, if required by the Engineer in writing, search under the directions of the Engineer for the cause of any defect, imperfection or fault appearing during the progress of the works or in the period of Maintenance. Unless such defect, imperfection or fault shall be one for which the Contractor is liable under the Contract, the cost of the work carried out by the Contractor in searching as aforesaid shall be borne by the Employer. If such defect, imperfection or fault shall be one for which the Contractor is liable as aforesaid, the Cost of the work carried out in searching as aforesaid shall be borne by the Contractor and / he shall in such case repair, rectify and make good such defect, imperfection or fault at his expense in accordance with the provisions of clause hereof.

42. Payment Withheld

The Engineer may withhold or on account of subsequently discovered evidence nullify the whole or a part of any certificate to such extent as may be necessary in the opinion to protect the Employer from loss on account of

- a) Defective work not remedied.
- b) Failure of the Contractor to make payments properly to sub-contractor for materials or labour or to Contractor's employees / workmen or failure to discharge any other obligations under applicable laws.
- c) A reasonable doubt that the Contract cannot be completed in the balance time.
- d) Damage to another Contractor's or sub-contractor's work.
- e) Claims filed or reasonable evidence indicating probable filing of claims.

43. Delay and Extension of Time

If, in the opinion of the Employer, the works be delayed

- a) By force majeure or
- b) By reason of any exceptionally inclement weather or
- c) By reason of proceedings taken or threatened by or dispute with adjoining or neighboring owners or public authorities arising otherwise than through the Contractor's own default or
- d) By the works or delays of other Contractors or Tradesmen engaged or nominated by the Employer or the Architect / the Engineer-in-Charge and not referred to in the Schedule of Quantities and / or specification or
- e) By reason of "Works Instructions" as per Clause or
- f) By reason of civil commotion, local combination of workmen or strike or lockout affecting any of the building traders or
- g) in consequence of the Contractor not having received in due time necessary instructions from the Architect / the Engineer-in-Charge or the Employer for which he shall have specifically applied in writing, the Employer in consultation with the Architect / the Engineer-in-Charge shall make a fair and reasonable extension of time for completion of the Contract Works; in case of such strike or lock-out the Contractor shall, as soon as may be, give written notice thereof to the Architect, the Engineer-in-Charge and the Employer; but, the Contractor shall nevertheless constantly use his endeavors to prevent delay and shall do all that may reasonably be required to the satisfaction of the Architect / the Engineer-in-Charge and the Employer to proceed with the work.

44. Termination of Contract by the Employer

The Employer may terminate this contract by giving one month notice.

The Employer may terminate this contract, if the Contractor being an individual or a firm commit any "act of insolvency" or shall be adjudged an insolvent or being an Incorporated Company having an order for compulsory winding up made against it or pass an effective resolution forwarding up voluntarily or subject to the supervision of the Court and of the official Assignee of the Liquidator in such acts of insolvency or

winding up shall be unable within seven days after notice to him requiring him to do so, to show to the reasonable satisfaction of the Architect / Owner with the concurrence of the Employer that he is able to carry out and fulfill the Contract, and to give security therefore, if so required by the Employer.

Or if the Contractor (whether an individual, firm or Incorporated Company) shall suffer execution to be issued.

Or shall suffer any payment under this Contract to be attached by or on behalf of any of the creditors of the Contractors,

Or shall assign or sub-let this Contract without the consent in writing of the Architect / the Engineer-in-Charge and the Employer first obtain,

Or shall change or encumber this Contract or any payments due or which may become due to the Contract thereunder;

Or if the Architect and the Engineer-in-Charge shall certify in writing the Employer that the Contractor

- a) Has abandoned the Contract, or
- b) has failed to commence the works, or has without any lawful excuse under these Conditions suspended the progress of the Works for 14 days after receiving from the Architect / the Engineer-in-Charge written notice to proceed, or
- c) Has failed to proceed with the works with such due diligence and failed to make such due progress as would enable the works to be completed within the time agreed upon, or
- d) has failed to remove materials from the site or to pull down and replace work for seven days after receiving from the Architect and the Engineer-in-Charge, written notice that the said materials or work were condemned and rejected by the Architect and the Engineer-in-Charge under these conditions, or
- e) has neglected or failed persistently to observe and perform all or any of the acts matters or things by this Contract to be observed and performed by the Contractor for seven days after written notice shall have been given to the Contractor requiring the Contractor to observe or perform the same, or
- f) has to the detriment of good workmanship or in defiance of the PMC/ Architect's/ Engineer-in-Charge's and Employer's instructions to the contrary sub-let any part of the Contract, then and in any of the said cases, the Employer in consultation with the Architect / the Engineer-in-Charge may not withstanding any previous waiver after giving seven days' notice in writing to the Contractor, determine the Contract, but without hereby affecting the powers of the Architect / the Engineer-in-Charge or the obligations and liabilities of the contract, the whole of which shall continue in force-as fully as if contract had not been so determined and-as if the works subsequently executed had been executed by or on behalf of the contractor.

- g) The Employer under advice of the Engineer-in-Charge / Architect may enter upon and take possession of the works and all plant, tools, scaffoldings, sheds, machinery, steam and other power generation unit and materials lying upon the premises or the adjoining lands or roads, and use the same as his own property or may employ the same by means of his own persons and workmen in carrying on and completing the works or by employing any other Contractors or other person or persons to complete the works.
- h) The Contractor shall not in any way interrupt or do any act, matter or things to prevent or hinder such other contractor or other person or persons employed for completing and finishing or using the materials and plant for the works. When the works shall be completed or as soon thereafter as convenient the Architect and the Engineer-in-Charge shall give a notice in writing to the Contractor to remove his surplus materials and plant, and should the Contractor fail to do so within a period of fourteen days after receipt thereof by him, the Employer shall sell the same by public auction, and shall give credit to the Contractor for the amount realized. The Architect and the Engineer-in-Charge shall, thereafter, ascertain and certify in writing under their hands (if anything) shall be due or payable to or by the Employer for the value of the said plant and materials so taken possession of by the Employer and the expense or loss which the Employer shall have been put to in procuring the works to be completed, and the amount if owing to the Contractor and the amount which shall be so certified shall thereupon be paid by the Employer, as the case may be, and the certificate of the Architect and the Engineer-in-Charge shall be final and conclusive between the parties.

45. Termination of Contract by the Contractor

The Contractor may terminate this contract if the payment of the amount payable by the Employer under CERTIFICATE of the Architect and the Engineer-in-Charge with interest as provided for hereinafter shall be in arrears and unpaid for forty five days after notice in writing requiring payment of the amount with interest as aforesaid shall have been given by the Contractor to the Employer, or if the Employer interferes with or obstructs the issue of such Certificate or the Employer commits any "act of insolvency", or (being and Incorporated Company) shall have an order made against him or pass an effective resolution for winding up, either compulsorily or subject to the supervision of the Court or Voluntary, or if the official Assignee or the Employer shall repudiate the Contracts or if the official Assignee or the Liquidator, in any such winding up, shall be unable within fifteen days after notice to him requiring him so to do, to show to the reasonable satisfaction of the Contractor that he is able to carry out and fulfill the Contract and to make Contractor, to give security for the same, or if the works be stopped for all payments due, and to become due thereunder and, if required by the three months under the order of the Employer or by any injunction or other order of any Court of Law, then and in any of the said cases the Contractor shall be at liberty to determine the Contract by notice in writing to the Employer and he shall be entitled to recover from the Employer payment for all works executed.

In arriving at the amount of such payment, the net rates contained in the Tender Agreement shall be followed.

46. Certificates and Payments

- a) Unless otherwise provided, payments shall be made at monthly intervals in accordance with the conditions set out

- b) Advances on Constructional Plant and Materials

No advances are to be made by the Employer to the Contractor in respect of Constructional Plant and Materials, the conditions of payment and repayment shall be as set out.

- c) Approval only by Maintenance Certificate

No certificate other than the Maintenance Certificate referred to in clause D hereof shall be deemed to constitute approval of the works.

- d) Maintenance Certificate

The Contract shall not be considered completed until a Maintenance Certificate has been signed by the Engineer-in-Charge and delivered to the Contractor stating that the Works have been completed and maintained to his satisfaction. The Maintenance Certificate shall be given by the Engineer within twenty-eight days after the expiration of the Period of Maintenance, or, if different periods of maintenance shall become applicable to different sections or parts of the works, the expiration of the latest such period, or as soon thereafter as any works ordered during such period, pursuant to clause hereof, shall have been completed to the satisfaction of the Engineer and full effect shall be given to the clause, notwithstanding any previous entry on the works or the taking possession, working or using thereof or any part thereof by' the Employer. Provided always that the issue of the Maintenance Certificate shall be a precondition to payment to the Contractor of the second portion of retention money in accordance with the Appendix.

Cessation of Employer's Liability:

The Employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the Contract or the execution of the works, unless the Contractor has made a claim in writing in respect thereof before the giving of the Maintenance Certificate under this Clause

47. Valuation at Date of Forfeiture

The Engineer-in-Charge shall, as soon as practicable after any such entry and expulsion by the Employer, fix and determine ex parte, or by or after reference to the parties, or after such investigation or enquiries as he may think fit to make or institute, and shall certify what amount, if any, had at the time of such entry and expulsion been reasonably earned by or would reasonably accrue to the Contractor in respect of work when actually done by him under the Contract and the value of any of the said unused or partially used materials and any Temporary Works

a) **Payment after Forfeiture**

If the Employer enters and expels the Contractor under this clause, he shall not be liable to pay to the Contractor any money on account of the Contract until the expiration of the Period of Maintenance and thereafter until the costs of execution and Maintenance, damages for delay in completion, if any, and all other expenses incurred by the Employer have been ascertained and the amount thereof certified by the Engineer-in-Charge. The Contractor shall then be entitled to receive only such sum or sums, if any, as the Engineer-in-Charge may certify as payable to him upon due completion by him after deducting the said amount. If such amount shall exceed the sum which would have been payable to the Contractor on due completion by him, then the Contractor shall, upon demand, pay to the Employer the amount of such excess and it shall be deemed a debt due by the Contractor to the Employer and shall be recoverable accordingly.

48. Urgent Repairs

If by reason of any accident, or failure, or other event occurring to in connection with the Works, or any part thereof, either during the execution of the works, or during the Period of Maintenance, any remedial or other work or repair shall, in the opinion of the Employer or the Engineer's Representative, be urgently necessary for the safety of the Works and the Contractor is unable or unwilling at once to do such work or repair, the Employer may employ and pay other persons to carry out such work or repair as the Engineer or the Engineer's Representative may consider necessary. If the work or repair so done by the Employer is work which, in the opinion of the Engineer, the Contractor was liable to do so at his own expense under the Contract, all expenses properly incurred by the Employer in so doing shall be recoverable from the Contractor by the Employer from any monies due or which may become due to the Contractor. Provided always that the Engineer or the Engineer's Representative, as the case may be, shall, as soon after the occurrence of any emergency as may be reasonably practicable, notify the Contractor in writing

49. Special Risks

The Employer shall repay to the Contractor any increased cost of or incidental to the execution of the Works, other than such as may be attributable to the cost of construction work condemned under the provision of clause hereof, prior to the occurrence of any special risk, which is however attributable to or consequent on or the result of or in any way whatsoever connected with the said special risks, subject however to the provisions in this clause hereinafter contained in regard to outbreak of war, but the Contractor shall as soon as any such increase of cost comes to his knowledge forthwith notify the Engineer thereof in writing.

a) **Special Risks**

The Special risks are war, hostilities, (whether war be declared or not), invasion, act of foreign enemies, the nuclear and pressure waves risk described in clause hereof, or insofar as it relates to the country in which the works are being or are to be executed or maintained, rebellion, revolution, insurrection, military or usurped power, civil war, or unless solely restricted to the employees of the

contractor or of his sub-contractors and arising from the conduct of the works, riot, commotion or disorders.

b) Outbreak of War

If, during the currency of the Contract, there shall be an outbreak of war, whether war is declared or not, in any part of the world which, whether financially or otherwise, materially affects the execution of the works, the Contractor shall, unless and until the Contract is terminated under the provision of this clause, continue to use his best endeavors to complete the execution of the works. Provided always that the Employer shall be entitled at any time after such outbreak of war to terminate the Contract by giving written notice to the Contractor and, upon such notice being given, this contract shall, except as to the rights of the parties under this clause and to the operation of clause hereof, terminate, but without prejudice to the rights of either party in respect of any antecedent breach thereof.

c) Removal of Plant on Termination

If the Contract is determined under the provisions of the last preceding sub-clause, the Contractor shall, with all reasonable dispatch, remove from the site all Constructional Plant, staff, workers; identify those of Sub-Contractors to do so.

50. Payment if Contract is terminated

- a) The amounts payable in respect of any items, so far as the work or service comprised therein has been carried out or performed, and a proper proportion as certified by the Engineer in Charge in Writing of any such items, the work or service which has been partially carried out or performed.
- b) The cost of materials or goods reasonably ordered for the works which shall have been delivered to the Contractor at site or of which the Contractor is legally liable to accept delivery for works being fabricated off site, or propriety goods ordered in both cases where due prior notice has been given to the Engineer, in writing, such materials or goods becoming the property of the Employer upon such payments being made by him.
- c) A sum to be certified by the Architect & Engineer-in-Charge in writing being the amount of any expenditure reasonably incurred by the Contractor towards, site office, site stores, fabrication yard, fencing in the expectation of completing the whole of the works insofar as such expenditure shall not have been covered by the payments in this sub-clause before mentioned.
- d) On any account, if the Contract is terminated by Employer, no liquidated damages shall be payable to the Contractor on account of profit on remaining portion of the contract or loss on account of premature termination. In such a case, the Contractor will be entitled to remove his material/equipment only after settling the account in full and final with Employer.
- e) Provided always that against any payments due from the Employer under this sub-clause, the Employer shall be entitled to be credited with any outstanding balances due from the Contractor for advances in respect of Constructional Plant

and Materials and any other sums recoverable by the Employer from the Contractor under the terms of the Contract.

51. Frustration

a) Payment in the event of Frustration

If a war, or other circumstances outside the control of both parties, arises after the contract is made so that either party is prevented from fulfilling his contractual obligations, or under the law governing the Contract, the parties are released further performance, then the sum payable by the Employer to the Contractor in respect of the work executed shall be the same as that which would have been payable under clause 50 / 52 as the case may be hereof if the Contract had been terminated under the provisions of clause 50 hereof.

52. Procedure for Disputes

In case of Dispute or Difference arising between Employer and the Contractor relating to any matter arising out of this contract, such disputes or differences shall be settled in accordance with the Arbitration and Conciliation Act 1996, The Arbitral tribunal shall consist of 3 Arbitrators one each to be appointed by the Employer and the Contractor. The third arbitrator shall be jointly nominated by the two Arbitrators and he shall be the presiding arbitrator. If there is no agreement about nomination of the third Arbitrator, then the third and presiding Arbitrator shall be appointed by the Indian Council of Arbitrations/ president of Institute of Engineers.

The Arbitration proceedings shall be at Aurangabad and the operative language shall be English.

The decision of the Majority of Arbitrators shall be binding upon both parties. The Cost of Arbitration proceedings shall be shared equally by the parties. The expenses towards preparation and fees of Arbitrator by each party shall be borne by the parties themselves.

If the contract value is Rs 500 Lacs or less, the dispute shall be referred to a sole Arbitrator to be appointed jointly by the parties. If there is no agreement on this, the Sole Arbitrator shall be appointed by the Indian Council of Arbitration/ president, Institute of engineers. Decision of the sole Arbitrator shall be binding on the parties.

Performance of the Contract shall continue during the Arbitration proceedings.

53. Safety Code

a) General

Contractor shall submit a Safety organization structure along with the Safety plan for approval before commencing the job.

Contractor shall adhere to safe construction practice and guard against hazardous and unsafe working conditions and shall comply with Owner safety rules as set forth herein prior to start of construction, Contractor shall be

furnished copies of Owner's Safety Code' for information and guidance. The contractor shall erect, display and maintain signage at different locations of the site, to show safety requirements during work, regulations regarding protective equipment, clothing and the like.

b) Safety Regulations

- i. In respect of all labour, directly or indirectly employed in the work for the performance of Contractor's part of this agreement, the Contractor shall at his own expense arrange for all the safety provisions as per (i) Safety codes of C.P.W.D. & Indian Standards Institution (ii) The Electricity Act, (iii) The Mines Act, and (iv) Regulations, Rules and orders made there under and such other act as applicable
- ii. The Contractor shall observe and abide by all Fire and Safety Regulations of the Owner. Before starting construction work, Contractor shall consult Owner's safety engineer or Engineer-in-charge and provide all required precautionary measures to this effect. The Contractor must make good to the satisfaction of the Owner any loss or damage due to fire to any portion of the work done under this contract or to any of the Owner's existing property.
- iii. The contractor shall obtain necessary licenses and approvals from appropriate authority under labour enactment as required to carry out obligations under this contract including license required under The Contract Labour (Regulation and Abolition Act, 1970)

c) First Aid and Industrial Injuries

- i. Contractor shall maintain first aid facilities for his employees and those of his Sub-contractors. He shall arrange Medical Treatment without any loss of time in the event of an accident or injury.
- ii. All critical injuries shall be reported promptly to Owner. All such injuries shall be thoroughly investigated and a copy of Contractor's report covering - cause, remedy and preventive measures (for each personal injury requiring the attention of a physician) shall be furnished to the Engineer-in-Charge in an approved format.
- iii. The contractor shall have a trained person at the site for administering first aid.
- iv. The Contractor shall have a Safety Inspector for the works

54. Setting Up Of Field Laboratory

The Contractor shall set up a field laboratory at the site at his own expense to carry out the tests as per requirements

All required equipment as per relevant IS test procedure shall be available along with applicable IS codes. In addition to the above, the Contractor shall provide all other necessary equipments to carry out any other field tests required by the Engineer-in-charge.

All the equipments should be calibrated by a third party periodically and certificates should be kept in the laboratory.

The Contractor shall carry out the various mandatory tests as per BIS Specifications and the technical documents that shall be furnished to him during the performance of the work. All the tests, either on the field or outside laboratories concerning the execution of the work and supply of materials for the same shall be carried out by the Contractor at his own cost. Price quoted by the Contractor shall be deemed to include the cost of such tests and inspections.

55. Taxes

- a) The Rates in Bills of Quantities shall be inclusive of transporting, loading, unloading, storage, security & all other charges such as toll, Octroi, local taxes, excise duty, other payments and compensations, if any in connection with the procurement and handling of materials, fabrication and execution of works or any method or process connected with the works or Temporary works. However Service Tax & VAT shall be paid as per actual.
- b) Notwithstanding anything contained elsewhere in the contract, the Owner shall deduct at source, from the payments due to the Contractor, any taxes required to be deducted at source by law. The amounts so deducted shall be deposited by the Owner with the concerned authorities as per law. It is for the Contractor to deal with the concerned authorities directly in respect of any claim or refund relating to the above deductions and the Owner shall not be liable or responsible for any claims or payments or reimbursement in this regard.

56. Contractors Subordinate Staff and Their Conduct

- a) The Contractor on award of the work shall nominate and depute a qualified graduate engineer having sufficient experience in carrying out works of similar nature, as full time resident project manager of the Contractor for the work, to whom instructions for works may be given. The Contractor shall also provide to the satisfaction of the Owner/ Engineer-in-charge, sufficient and qualified staff to supervise the execution of the works, competent sub agents, foremen and leading hands including those specially qualified by previous experience to supervise the types of works comprised in the contract in such manner as shall ensure the best quality and expeditious working. At any time in the opinion of the Engineer-in-charge, any additional, qualified and experienced staff is considered necessary; they shall be employed by the Contractor without additional charge. The Contractor shall ensure to the satisfaction of the Engineer-in-charge that his Sub-contractor's if any, shall provide competent and efficient supervision over the work entrusted to them.
 - i. If any of the Contractor's agents, sub agents, assistants, foremen or any employee in the opinion of Engineer-in-charge be guilty of any misconduct or be incompetent or insufficiently qualified or negligent in the performance of their duties or that in the opinion of the Owner or the Engineer-in-charge, undesirable for administrative or any other reasons,

for such person (s) to be employed on the works, then at the directions of Engineer-in-charge, the Contractor shall at once remove such persons(s) from employment at the works. The person(s) so removed from the works shall not again be employed in connection with the works without the written permission of the Engineer-in-charge. Vacancy so created shall be immediately filled at the expense of the Contractor by a qualified and competent substitute. Shall the Contractor be requested to repatriate any person removed from the works he shall do so and shall bear all costs in connection therewith?

- ii. The Contractor shall be responsible for the proper behavior of all the staff, foremen, workmen and others, and shall exercise proper degree of control over them and in particular without prejudice to the said generality the Contractor shall be bound to prohibit / prevent any employees from trespassing in anyway detrimental or prejudicial to the interest of the community or the properties or occupiers of land or properties in the neighborhood. In the event of such trespassing, the Contractor shall be responsible for all consequent claims or action for damages or injury or any other grounds whatsoever. The decision of the Engineer-in-charge upon any matter arising under this clause shall be final.
- iii. All employees of the Contractor shall be properly identified by badges of a type acceptable to the Owner, and must be worn at all times on the site.
- iv. Along with the tender, the bidder shall submit his schematic organization chart of staff to be employed at the works, along with their qualifications and experience.

b) Sub Letting Of Work

- i. No part of the contract be transferred, assigned or sublet by the Contractor directly or indirectly to any person, firm or corporation whatsoever except as provided for in the succeeding sub clauses without the consent of the Owner.

c) Sub-Contracting Of Works

- i. The Engineer-in-charge may give written consent to the Contractor for the execution of any part of the works/ specialized part of the works at the site, provided the Contractor submits credentials of each individual agency to the Engineer-in-charge for approval. Sub-contracting the work as a whole by the Contractor shall not be permitted. Furthermore, if it is noticed by the Owner that the Contractor has not made payments to one or any agencies working under him, without prejudice to the other conditions herein, the Owner reserves the right to make such payments directly to the concerned agency after due verification.

d) Contractor's Liability Not Limited By Agencies To Contractors

- i. Notwithstanding any subletting with such approval as aforesaid and notwithstanding that the Engineer-in-charge shall have received copies of

any sub contracts, the Contractor shall be and shall remain solely responsible for the quality and proper expeditious execution of the works and the performance of all the conditions of the contract in all respects as if such sub contract or subletting by the Contractor had not taken place, and as if such work had been done directly by the Contractor.

e) Owner May Terminate Sub Contracts Of Contractor

- i. If any Agency of contractor engaged upon the works at the site executes any work which in the opinion of the Engineer-in-charge is not in accordance with the contract, the Owner may by written notice to the contractor, request him to terminate such Agencies. The contractor upon the receipt of such notice shall terminate and dismiss the Agency. The Owner shall have the right to remove such Agency from the site if the Contractor fails to get the Agency immediately vacated.

f) No Relief For Action Under This Clause

- i. Action taken by Owner under the above clauses shall not relieve the Contractor of any of his liabilities under the contract or give rise to any right or compensation, extension of time or otherwise.

g) Contractor's Responsibility With Other Agencies

- i. Without repugnance to any other condition, it shall be the responsibility of the Contractor executing the work of civil construction to work in close cooperation and to co-ordinate in the works with the Piling, mechanical, electrical, air-conditioning, equipment, production machinery and intercommunication with other Contractors and other agencies or their authorized representatives, in providing the necessary grooves, recesses, cuts and openings etc. in wall, slabs, beams, and columns etc. and making good the same to the desired finish as per specification, for the placement of cables, conduits, air-conditioning inlets and outlets, grills and other equipment in the false ceiling and other partitions. The Contractor, before starting up the work shall in consultation, with the electrical, mechanical, equipment, inter communication, air-conditioning contractors and other agencies, prepare and put up a joint scheme, showing the necessary openings, grooves, recesses, cuts, the methods of fixing required for the works of the aforesaid, and the finishes therein, to the Engineer-in-charge and get the approval. The Contractor before finally submitting the scheme to the Engineer-in-charge shall have the written agreement of the other agencies. The Engineer-in-charge, before communicating his approval to the scheme, with any required modification shall get the final agreement of all the agencies, which shall be binding. No claim shall be entertained on account of the above.
- ii. The Contractor shall conform in all respects with the provisions of any statutory regulations, ordinance or bye laws of any local or duly constituted authorities or public bodies which may be applicable from time to time to the works or any temporary works. The Contractor shall keep the Owner indemnified against all penalties and liabilities of every

kind, arising out of non-adherence to such status, ordinances, laws, rules, regulations etc.

h) Other Agencies At Site

The Contractor shall have to execute the work in such place and condition where other agencies shall also be engaged for other works such as electrical and mechanical engineering works or other works etc. No claim shall be entertained due to work being executed in the above circumstances.

i) Serving Of Notices

i. To The Contractor

Any notice may be served on the Contractor or his duly authorized representative at the site or by registered mail directly to the postal address furnished by the Contractor at the time of tender. Proof of issue of such notice shall be conclusive of the Contractor having been duly informed of the contents therein.

ii. To The Owner

Any notice to be given to the Owner under the terms of the contract shall be served by sending the same by Registered mail to or delivering the same at the respective site office of the Owner addressed to the Engineer-in-charge.

57. Patents, Royalties, Liens

a) The Contractor shall indemnify the Owner from and against all claims and proceedings for or on account of infringement upon any patent, design, trade mark or name or other protected rights in respect of constructional plants, machines or materials used for or in connection with the works, temporary works therefore or any part thereof, and from and against all claims demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

b) Liens

i. If at any time there shall be evidence or any lien, claim for which the Owner might have become liable, which is chargeable to the Contractor, and then the Owner may pay and discharge the same and deduct the amount so paid by him, from any amount which may be or become due to the Contractor.

SECTION - 4: SPECIAL CONDITIONS OF CONTRACT

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1. General

The Contractor may please note that Special conditions hereinafter are part of the Contract Documents, which he shall fulfil in all respects. The cost towards these shall be included in BOQ rates. In case of variation the contents in Special conditions of contract shall take precedence over General Conditions of Contract.

2. Drawings

- (a) Tender Drawings issued with the Bid documents give details necessary to understand the work. Good for Construction Drawings shall be released as per project requirements to match the approved construction schedule
- (b) For structural steel fabrication work the Architect/Engineer shall issue the Design Drawings. Based on these the Contractor shall prepare fabrication Drawings as per BIS conventions and get the same approved from The Engineer. His approval shall however not relieve the Contractor of accuracy in details and dimensions. The Fabrication work shall start after such approval.
- (c) The fabrication drawings shall be in AutoCAD format. Contractor shall submit 3 hard copies and Digital files.

3. Addition/ reduction in scope of work

- (a) Any additional work within the site, instructed by The Engineer during the contract period shall be carried out by the Contractor as per BOQ rates. The Employer reserves right to reduce the scope of work in the contract

4. Water

- (a) Water shall be given by PMFFPL at one point at free of cost & all internal distribution arrangement shall be done by the Contractor at his own cost.. Contractor shall arrange to install the piping work and storage tanks, pumping as per requirement at his own cost. **Water for Labour colony shall be arranged by Contractor at his own cost.**

5. Electric power

- (a) Electric power for construction machinery, equipment, lighting at site shall be facilitated by PMFFPL at one point & all internal distribution shall be done by contractor at his own cost. The wiring/cablings/ earthing shall be safe and as per PWD Electrical Inspector's requirements. The installation shall be erected, operated, maintained and monitored on day to day basis by competent electrical supervisor. The contractor shall get a sub-meter installed and make the payments as per the readings.
- (b) DG sets of adequate capacity shall be installed, run and maintained so as to meet work quantum and schedule requirement by the contractor.
- (c) Necessary safety gear, gloves shall be available at site for the operating staff as provided by contractor.

6. Material testing lab at site

- (a) The Contractor shall provide at site and maintain and operate throughout the tenure of contract, Testing equipments for testing in situ, Hydro Pipe pressure test, gauges for thickness measurements etc. However certain percentage of tests as determined by the Engineer shall be carried out in approved Third party laboratory. Test apparatus shall be calibrated in approved laboratory periodically.
- (b) The Testing shall be manned and operated by qualified and experienced technicians.
- (c) All the tests as mentioned in the specifications and BOQ are mandatory & to be carried out as per standard practice, as per intimation or guidance of Engineer In Charge & to be submitted with R.A. Bills. R.A. Bill shall not be accepted without Test reports some of the test are given below.
 - 1. Hydrostatic Pipe Pressure Test.
 - 2. Flow Tests.
 - 3. Booster connection and pump tests.

Other standard tests whatever require for other types of material & workmanship like thickness of painting, Galvanized sections, Ply wood / Particle boards, Welding Etc.

7. Progress reports and photographs

- (a) Contractor shall prepare and submit following to The Engineer.

Daily Progress Report (DPR) giving details of man power, staff, plant and equipment, cement consumption.

Weekly report giving details of major items of work executed, cement and steel consumed.

Monthly progress report giving details of work executed in the month, month wise billing statement, value of work done in the month cement and steel consumed, stock position, review of construction schedule (M S Project), summary of action taken for Quality, planning of work in the next month and 8 photographs of work executed in the month.

The monthly report of the last month shall be submitted in the first week of current month.

8. Environment protection

- (a) Contractor shall take adequate measures to reduce dust, mud, and smoke and noise nuisance to people working at site and in the neighbourhood. Such measures shall inter alia include sheet barricade of adequate height, sprinkling water on aggregate storage, application of modern construction machinery and equipment meeting statutory provisions.

- (b) All the trees at site shall be thoroughly protected by guards as per requirement.

9. Site facilities

- (a) The Contractor shall establish his office, laboratory, stores, steel storage and fabrication yard, cement storage shed in watertight construction and of adequate capacity, drinking water facilities, sanitization facilities, rest room, crèche for his staff and workers. Proper access and internal roads for vehicular traffic in all-weather shall be provided by the contractor. As required lock and key arrangements shall be provided for all valuables.
- (b) Statutory approvals, licenses for above mentioned facilities shall be obtained and maintained by the contractor at his own cost.

10. Royalty

- (a) Royalty applicable on supply of building and quarried materials to site as also on excavation work at site shall be paid by the contractor and the Original copies of documents showing evidence of having paid the same shall be lodged with the Employer

11. Service tax and VAT

- (a) **The Service Tax and VAT, on the contract bills paid by the Employer-** Contractor have to submit the copy of challans. If copy of these Challans are not submitted for continuous two months or previous two consecutive R. A. Bills, then the amount shall be recovered from next R.A. Bill payment including any applicable penalty.

12. Measurement book

- (a) Measurements of work done shall be written jointly by The Engineer or his representative and contractor's Engineer and signed. The Book shall remain in the custody of The Engineer.
- (b) Measurements of work done in a particular month shall be completed before 7th day of the next month.
- (c) Contractor's Bill shall be accompanied by Xerox copies of duly signed measurements.

13. Monthly Running Bill:

Contractor shall prepare and submit monthly running bill covering work done in that particular month. The Engineer shall check, certify and forward to the Employer for further necessary action.

14. Terms of payment :

The payment terms for payment will be as below or as decided by the SPV & party during negotiations

14.1 Mobilization advance

Mobilization advance of 10% of the contract value will be paid to the contractor against the Bank Guarantee of any Nationalized /Scheduled Commercial Banks notified by RBI (except co-operative/Rural Banks) valid for 15 months from the date of LOI / notice to proceed or up to the total recovery of Mobilization advance whichever is earlier.

10% mobilization advance will be deducted from second Running Bill till completion or in equal instalments.

After recovery of the total mobilization advance, the Bank guarantee received against the mobilization advance will be returned to the contractor.

14.2 Monthly R.A. Bill:

Monthly consolidated single bill should be presented for settlement. The R.A. Bills will be checked by EIC within a period of 15 days & certified by the Consultant within a period of 20 days and payment shall be made within 10 working days from the date of certification by Consultants and necessary deductions like 10 % Mobilisation advance, 5 % Retention money & any other payment made, Income tax as per Terms. All bills shall be submitted in soft copy as well as hard copy. The reconciliation of Cement & Steel to be submitted along with R.A. bill, **as applicable**. All Test reports, J.M.R., Progress report with Photographs also to be submitted along with R.A. Bills , **as applicable**. **Original Royalty Slips also needs to be submitted along with the bills, as applicable. In failure of doing so, the employer will deduct the applicable royalty payment from the RA Bill amount, as applicable.**

The Consultants shall be within his right to adjust and deduct the advances such that full recovery will be made at appropriate stage.

14.3 Retention Money:

5% contract value will be deducted as retention money from each RA bill (it shall be in addition to the Performance Bank Guarantee of 5% of the contract value).

On submission of final bill/Completion of the contract, the retention money will be released against the Bank guarantee of equivalent amount of any Nationalized/Scheduled Commercial Banks notified by RBI (except co-operative/Rural Banks) valid for 12 months defect liability period from the date of final completion of work/handing over of site.

Bank Guarantee will be returned after the expiring of the defect liability period i.e., 12 months from the date of completion of work/handing over of site.

14.4 Final Bill

Only on obtaining final completion certification from the Consultants & Employer, the Contractor shall submit the FINAL BILL which will be settled within a period of two months provided there is no dispute. The completion certificate will be issued only after all the defects pointed out are rectified completely to the satisfaction of the Consultants and the Employer. The reconciliation of all materials to be submitted along with the bill.

15. Quality assurance and Quality control

The Construction Quality Management is necessary to ensure that the Construction Quality meets or exceeds the intents of the technical specifications and drawings set forth in the Contract Documents. This is a system in which The Construction Manager (contractor) and The Engineer in Charge (employer/consultant) perform defined tasks independently to achieve the Objective cited above.

- (a) Quality Control (QC) is regulatory process to be performed by the Construction manager and which includes following:
 - (i) Specific standards are set for Construction performance, deduced or derived from the Technical Specifications/Drawings/Contract Conditions.
 - (ii) Construction methodology and planning and detailed time schedule.
 - (iii) Planning and deployment of appropriate resources like plant/ machinery/ manpower
 - (iv) Systems for workmanship in process supervision, checks and corrections.
 - (v) Testing of Construction Materials and site facilities.
 - (vi) Quantification of work done.
 - (vii) Meetings/workshops for safety and improvement in quality Plan
- (b) The Construction Manager prepares Quality Plan particular to the Project and same is finalized in conjunction with Engineer in Charge. The Quality Plan shall comprise of
 - (i) QC Organization defines qualifications, hierarchy, authority and responsibility.
 - (ii) Construction method statement.
 - (iii) Procedure for material sample approvals.
 - (iv) workmanship checks for work in progress
 - (v) Material tests-standard/frequency/tolerances
 - (vi) Forms
 - (vii) procedure for interaction with Engineer in Charge
 - (viii) Bar Chart
 - (ix) safety manual
- (c) Quality Assurance (QA) includes defining criteria, applying procedures to ensure that QC system is effective .Thus the main functions of the Engineer in Charge are (1) to verify, vet contractor's Quality Plan and the QC system. (2) To monitor the

working of QC systems. (3) Taking remedial measures in case of failures and strengthening the system

The Engineer in Charge makes his Quality Plan which comprises of

- (i) QA Policy and goal.
- (ii) QA standards and procedure, procedure for QA/QC interface.
- (iii) Development of QC norms specific to the project.
- (iv) Organization
- (v) Acceptance criteria
- (vi) Site surveillance and checks to control and prevent non conformities.
- (vii) Audit of completed work
- (viii) Maintaining QA records.
- (ix) Periodic internal QA/QC audits and remedial measures as per requirement.
- (x) Periodic joint site visits and meetings with the Construction Manager to sort out quality related matter.

16. Supply of Required Materials Like Pipes, Pumps, Pressure Gauge, Reels, Valves & Etc. for contract work

- (a) The Contractor shall supply above materials at his own cost for contract work.
- (b) Weighing, unloading at site, handling, storage, security and testing of samples in approved laboratory shall be done by the contractor and same shall be included in relevant item rates.

The Contractor shall maintain at all times proper records of material received, consumed and stock of all materials for use by the Contractor in the construction of civil works at the site.

- 17.** The Material reconciliation statement shall be provided to the employer on demand only if needed.

18. Variations in Quantity and Non tender items

- (a) Even if the final quantity of work done differs from the BOQ quantity for the particular single item to any extent and this change causes variation in the Total Contract Price, there will not be any variation in the approved rates given in the attached BOQ.

- (b) Wherever applicable, the rates of non-tender items shall be deduced from similar items of work in BOQ and if this cannot be done then from DSR of Maharashtra State PWD for the nearest District HQ.

- (c) If above cannot be applied, then the Engineer shall arrive at the rate on the basis of actual cost incurred add 15% towards overheads, profits, transportation, handling, storage etc.

$L + M + 15\%$

L= Cost of Labour

M= Cost of Materials

- (d) For working out (18(c)above) the Contractor shall submit detailed analysis and supporting documents deemed necessary by the Engineer in advance and get the approval from the Engineer/ Employer before executing the work.

19. Completion period, completion certificate and taking over.

- (a) The Contractor shall complete the contract works in all respects within the Completion period as per Appendix.
- (b) On completion of contract work, the contractor shall give a written Intimation to the Engineer to this effect. Joint Inspection by Employer, The Engineer, and contractor shall be done within 10 days of intimation and the punch list or defect list shall be prepared and signed. The defects shall be rectified within 14 days, again the rectifications work will be verified jointly. After all the defects are rectified to the satisfaction of Employer/the Engineer, Acceptance report will be signed jointly and the Employer shall take over the work within 7 days of signing the Acceptance report.

20. Defect liability

- (a) The Defect liability period shall be as per Appendix. The contractor shall be responsible to make good at his own expenses every defect which may develop during this period and which in the opinion of The Engineer is due to defective materials / defective workmanship/erroneous construction method.
- (b) The Employer shall intimate the defects in writing to the contractor and the contractor shall rectify the same within 7 days of such intimation. Failing this, the Employer shall be within his right to get such defects rectified from other sources and recover the cost from the retention amount.

21. Liquidated damages

- (a) The liquidated damages to be recovered from the contractor for delay in completing the work shall be as per Appendix.
- (b) This clause shall be applicable delay in Mile Stones if so stated in the Appendix.

22. Performance Bank Guarantee

- (a) Performance Security shall be provided by the contractor of an 5 % of Contract Value plus additional security for unbalanced Bids in accordance with Clause No. 21 of Appendix (section 5) to the Employer not later than the date given in the Letter of Acceptance. The amount, time period of keeping in force and banker shall be as specified in the Appendix. The performance security shall be by way of Bank Guarantee.
- (b) The format for the Bank guarantee shall be as per Tender Documents.

23. Labour and compliances with labour regulations

- (a) The contractor shall deploy adequate force of skilled and unskilled workers, foremen, supervisors of requisite skills to ensure quality construction as per schedule.
- (b) During the currency of contract, the contractor, his sub-contractors shall abide all existing or deemed statutory Labour Enactments, Rules, and Regulations as applicable.
- (c) The Contractor shall keep the Employer, The Engineer indemnified in case any action is taken by competent authority due to contravention of any Act/rules/regulations including amendments if any.

24. Spaces for quarters

- (a) The Employer shall provide Open Space at site for contractor's workers residential quarters. Contractor shall barricade such area, maintain sanitation and hygiene and completely vacate and hand over to the Employer within 15 days of termination of contract.
- (b) All Statutory permits shall be arranged by the Contractor at his cost. He shall keep the Employer indemnified from any penalties, legal sanctions that may be imposed by the Authorities in this matter.

25 Safety at site.

- (a) The Contractor shall maintain high quality safety standards to control and arrest accidents, injuries, occurrences of fire and resultant damages. The compliances in this regards have been listed and discussed herein after. The Contractor may make his assessment and add more items as may become necessary and prepare Contractor's Safety Plan for site operations. Such Plan shall be reviewed in conjunctions with the Engineer and modified to achieve higher standards
- (b) Contractor's Construction Manager shall set up Vigilance cum Safety Committee to implement and monitor the Safety Plan. The constitution of the committee shall be as follows :

Chairman	Construction Manager.
Coordinator	Safety officer/Engineer
Members-minimum 6.	Site engineers/supervisor/Foreman Two from each

Associate Work group.
 The Engineer/ his representative.

The members shall be different work groups such as Machinery & Mechanical, Electrical Supervisor, Fabrication, carpentry, concreting, and earthwork etc. The members shall reach the employees in the group and make them aware of the safety measures and rules etc.

The first Workshop and briefing shall be held at the commencement of work. Subsequently the members shall continue periodic briefings to each group.

The Committee meetings may be held bi monthly to review and take suitable action

- (c) For creating greater awareness, appropriate safety posters and signages shall be put up neatly at prominent places. These should be visible.
- (d) The internal circulation roads, storages, site office, fabrication yards, material stacking, construction water lines, cable routes shall be made as per proper plan for smooth movements.
- (e) Following protective equipment/items shall be provided :
 - Safety shoes, helmets for all employees/workers at site.
 - Safety belts, canvass shoes while working on roofing.
 - Safety goggles, leather gloves, face screen by welders, fitters, gas cutters, and khalasis.
 - Shock resistant shoes, hand gloves, for wiremen, electricians.
 - Asbestos fibre gloves/rubber gloves while handling chemicals.
 - Protective heavy quality nylon net to be provided on the underside where work is on at an elevation.
 - Fire extinguishers and sand buckets.
 - 3m high sheet metal barricade to protect the neighbourhood from dust and noise.
- (f) Preliminary requirement of staff and Machinery/plant/equipment:
 - Vehicle drivers, crane drivers/operators, Electricians/wiremen, shall have well Experience, expertise and valid license from RTO/Electrical Inspector
 - Welders/fitters, mechanics should have good work knowledge and ITI licenses
 - Winches, cranes, pulley blocks, wire ropes shall have a valid test report and worthiness certificate of a chartered engineer
 - Approved capacity for load shall be clearly exhibited on cranes
 - transit mixers, trucks, vehicles shall have valid permits
 - At any time minimum 2 trained First Aid workers shall be available. They must be trained for artificial respiration, dressing the wounds, handling the causality in correct way
- (g) Standing instructions for safety :
 - Alcohol and tobacco is prohibited
 - Children/minors not allowed entering site
 - Earth work, fabrication areas to be barricaded
 - Movement of vehicles/Poclain/jcb etc to be controlled by a foreman

- Transportation of heavy articles at site to be closely controlled to protect workers / nearby objects
 - The main switch boards shall have double earthing. All earth moving equipment to have effective earthing
 - Circuit breakers shall be used
 - Only armoured cable/ heavy rubber insulated cables of minimum 660 V grade shall be used
 - Adequate lighting arrangements to be made
 - All electrical installation shall be protected from rains/leaking water etc.
 - Cranes/earth moving equipment shall have audio-visual signalling during operation
 - Sturdy staging, platforms with railing shall be provided for work at elevation
 - First Aid boxes and one stretcher to be available throughout the day and night
 - Telephone and address of the nearest Hospital to be displayed in site office
 - Vehicle to be available for evacuating causality
- (h) In case of accident arrangements shall be done very fast for evacuation, first aid, and admittance to a Hospital
- (i) Proper records shall be maintained as required by the Factory Inspector

SECTION - 5: APPENDIX**Contents**

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			<p>Consultants and necessary deductions like 10 % Mobilization advance, 5 % Retention money & any other payment made, TDS as per Terms. All bills shall be submitted in soft copy as well as hard copy. The reconciliation of Cement & Steel to be submitted along with R.A. bill. All Test reports, J.M.R., Progress report with Photographs to be submitted along with R.A. Bills. R. A. Bill is not accepted without Test Reports.</p> <p>The Consultants shall be within his right to adjust and deduct the advances such that full recovery will be made at appropriate stage.</p>
5.	Final Bill-Clause 14.4 of Special Conditions of Contract	:	Final Bill shall be complete in all respects including duly signed final measurements, material reconciliation statements, authentication of non tender items by quantity and by rates agreed upon. Payment against final bill will be made as set out in Special Conditions of Contract-Clause14, after deducting full mobilization advance, 5% retention, other dues/TDS and recoveries.
6.	Time for Completion & Mile Stone : Clause19 of Special Conditions of contract	:	4 Months from date of LOA.
7.	Liquidated Damage-Clause 21 of Special conditions of contract	:	In the event of delay in completion of work, the contractor shall pay liquidated damages at the rate of 0.5% of contract price per week of delay subject to a maximum of 5% of contract price.
8.	Penalty	:	Rs.1,000/- per incident of unsafe act / non compliance of Legal / Statutory requirements as may be pointed out by the Consultants / Employer. Such fault shall also include acts that are specifically prohibited under various provisions / clauses provided as part of this tender document.
9.	Reconciliation of Material	:	The Contractor shall maintain at all times proper records of material received, consumed and stock of all materials for use in the construction of civil works at the site.

			The Contractor shall also provide a proper reconciliation of the material consumed, duly verified by the Consultants / Employer, and along with the RA bills submitted from time to time and also Final reconciliation Statement with final Bill.
10.	Contract Rates.	:	The Contract rates as per BOQ shall remain firm throughout the currency of the contract. No escalation or price adjustment shall be done due to any reason.
11.	Certified Payments-Clause 14 of Special Conditions of Contract	:	All payments made against the certificate issued by the Architect and Employer shall be deemed as advance payments. Payments made will not be construed as the items are complete and without any defects. Only on receiving completion certificate & settlement of final bill, the work shall be considered as complete and payment made against the final bill be considered as full payment against the work.
12.	Mobilization Time - Clause 14 of Special conditions.	:	The Contractor shall mobilize to the satisfaction of the Engineer and start construction work at site within a period of Ten Days from the date of LOI.
13.	Labour - Clause 23 Special Conditions	:	The Contractor shall comply with the provision of all relevant Acts of Central or State Govt. including Payment of Wages Act 1936, Minimum Wages Act 1948, Employer's Liability Act 1938, Workmen's Compensation Act 1923, Industrial Dispute Act 1947, Maternity Benefit Act 1961, Mines Act 1952, Employees State Insurance Act 1948, Contract Labour (Regulations & Abolishment) Act 1970 or PF Act 1952 any modification thereof or any other law relating thereto and rules made there under from time to time. No child labour should be employed at site.
14.	Insurance	:	<p>The Insurance Policies to be taken and kept in force by the contractor throughout the construction and defect liability period: These policies will be in joint names of contractor and Employer</p> <p>Theft/pilferage insurance for steel, cement at site and in contractor's custody.</p> <p>Contractor's Plant and equipment at site.</p> <p>Personal injury or death insurance-third party</p>

			<p>liability up to Rs. 10.00 lacs (Rupees Ten Lacs) per occurrence and covering 10 occurrences during the Contract.</p> <p>Personal injury or death Insurance for Contractor's staff, employees.</p> <p>Motor vehicle insurance including third party.</p>
15.	Notice to Local Bodies	:	The Contractor shall comply with and give notices required by any Government authority, instrument, rule or order made under any Act of Parliament, State laws or any regulation or bye-laws of any local authority relating to the works.
16.	Indemnification	:	<p>The contractor shall indemnify and keep the Employer indemnified against any liability in respect of :</p> <p>(i) Any fee or charges payable under any Act of Parliament, State Laws or any Govt. instrument, rule or order and any regulation or bye-laws of any local authority in respect of the works.</p> <p>(ii) Any loss or damage caused to any building road or fence of the company or any other party in the working area due to negligence of the contractor.</p>
17.	Licenses and local approvals	:	The contractor shall obtain at his cost Govt/Quasi Govt/Municipal licenses/permits required for labour, site facilities, construction work
18.	Mobilization advance Clause 14 of Special conditions of contract		<p>Mobilization advance of 10% of the contract value will be paid to the contractor against the Bank Guarantee of any Nationalized /Scheduled Commercial Banks notified by RBI (except co-operative/Rural Banks) valid for 12 months from the date of LOA / notice to proceed or up to the total recovery of Mobilization advance whichever is earlier.</p> <p>Equal amount of mobilization advance will be deducted from each Running Bill. After recovery of the total mobilization advance, the Bank guarantee received against the mobilization advance will be returned to the contractor.</p>

19.	Supply of Materials and reconciliation.Clause no 16 of special conditions of contract Basic rates :	<p>The Contractor shall supply Required Pipes, Pumps, Pressure Gauges, Valves, Clamps, Hose reel and Box, Hooters & Alarms, hydrants, poles& necessary materials pertaining to work as per design, drawings and Complying with the Technical Specs. Along with the final measurements and Bill, reconciliation statement shall be prepared by the contractor which shall be checked by the engineer. Standard unit weight per rmt shall be considered for measurement wherever required.</p> <p>Should Be finalized At the Time Of Contract.</p> <p>All Materials to be procured should be approved by FSAI, BIS, UL Listed, FM Approved and should be Confirming to NBC (Latest Revision) India. Contractor has to submit quotations & submit to PMFPPL / PMC in 15 days advance for their approval. Procurement shall be start after approval only.</p>
20.	Site office & conference facilities-Clause 9 Special Conditions.	Contractor to provide lockable and properly ventilated site office of about appropriate size with toilet facility, pantry, electric supply for lighting and computers, fans etc... with conference facility, at his own cost.
21	Additional Performance Security for unbalanced Bids	If the Bid of the Successful Bidder is seriously unbalanced in relation to the Consultants 's estimate of the cost of work to be performed under the contract, the Employer may require the Bidder to produce detailed price analysis of any of all items of the Bill of Quantities to demonstrate the internal consistency of those prices with the construction. The employer may decide to seek additional performance bank guarantees for the bids.
22	Co-ordination with PEB Vendor & other Vendor	Coordination may be required with other vendors.

**PAITHAN MEGA FOOD PARK PVT. LTD.
AT PAITHAN (MH)**

BOOK NO. 2

BILL OF QUANTITIES

BID NO. PMFPPL – PTBS – 01 - 2016



Paithan Mega Food Park Pvt. Ltd.

Nath House, Nath Road, Aurangabad-431005, Maharashtra

Project Management Consultants (PMC)



Abhyuday Techno Economic Consultants Pvt. Ltd.

211-212, Patel Avenue, Near Gurudwara

S.G. Highway, Thaltej, Ahmedabad – 380054, Gujarat

A/E Consultants



SEM MAC Consultants Private Limited

'Conjeevaram House' , 2nd Floor, 6-1-276,

Padmarao Nagar, Secunderabad – 500 025.

CLIENT : M/s MEGA FOOD PARK PVT LTD													<div>Paithan Mega Food Park Pvt. Ltd.</div>		
Project : PROPOSED FOOD PARK DEVELOPMENT AT WAHEGAON VILLAGE , PAITHAN TALUKA , AURANGABAD															
Subject : TENDER BOQ FOR LAN&TP NET WORKS OF THE PROPOSED MEGA FOOD PARK PVT LTD															
	DESCRIPTION OF WORK	UNIT	QTY	SUPPLY							ERECTION				
SL.No				BASIC RATE	ED	CST	VAT		Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT	
	Percentage of taxes and Duties =>											12.36%			
	PART- E : DATA & TELE PHONE DISTRIBUTION WORKS														
1	OFC WORKS														
1.01	Supply, laying, testing and commissioning of 12 core SM Outdoor OFC Cable [MAKE : Molex] 12-core, Single Mode, Corrugated Steel tape Armour, Loose-tube, Fully water blocked core ,E glass Yarns, Out door fiber cable fully conforming to ITU-T G.652.D And/OR IEC 60793-2-50	RMT	4500												
1.02	Supply, laying, testing and commissioning of Pig Tail (1 m long) as per Tec Specification No. G/OFJ- 01 / 03 Jun'99 with latest amendment. [MAKE : Molex]	No	240												
1.03	Supply, laying, testing and commissioning of Molex 6 Pak SC Duplex Adaptor Plate SM Loaded [MAKE : Molex]	No	44												
1.04	Supply, laying, testing and commissioning of Molex Blank plate [MAKE : Molex]	No	6												
1.05	Supply, laying, testing and commissioning of Molex 48 Port Standard Grade fiber Enclosure, 2U - Unloaded [MAKE : Molex]	No	4												
1.06	Supply, laying, testing and commissioning of Molex 24 Port Standard Grade fiber Enclosure, 1U - Unloaded [MAKE : Molex]	No	4												
1.07	Supply, laying, testing and commissioning of Molex SC-LC / SC-SC Duplex Ptach cord SM 2 Mtr length [MAKE : Molex]	No	110												
2	RACKS:														
2.01	Supply, laying, testing and commissioning of 42 U 19" 800 X 800 Network Rack with necessary accessories	No	1												
2.02	Supply, laying, testing and commissioning of Outdoor Metal Enclosure H36"x W36"x D 12" Network Rack with necessary accessories	No	6												
3	Project Management Charges														
3.01	Project Management Charges for entire DATA works	LSM	1												
4	VOICE WORKS -TELEPHONE CABLES / JELLY FILLED CABLES :														


SL.No	DESCRIPTION OF WORK	UNIT	QTY	SUPPLY						ERECTION			
				BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties =>										12.36%		
	Supply and laying, Testing of telephone cables armoured annealed tinned copper conductor and petroleum jelly filled with polythene outer jackets conforming to P&T specification. The method of Telephone cables shall be run in a separate trench at least 600 mm away from other power cables. The civil works for excavation will be included under heading "Civil Works for Outdoor Cable Laying" This rate shall include cable end terminations also using kits cable glands cable lugs etc as required complete.												
	NOTE:- The cable sizes & lengths for Telephone cables, conduits & wires / LAN conduits are only tentative. However they may vary as per the site conditions & actual requirements												
4.01	10 Pair Armoured annealed tinned copper conductor cable and petroleum jelly filled	RMT	100										
4.02	50 Pair Armoured annealed tinned copper conductor cable and petroleum jelly filled	RMT	300										
4.03	100 Pair Armoured annealed tinned copper conductor cable and petroleum jelly filled	RMT	2000										
4.04	150 Pair Armoured annealed tinned copper conductor cable and petroleum jelly filled	RMT	1500										
5	TELEPHONE JUNCTION BOXES :												
	Supply and installation of outdoor type krone connectors terminal box with including krone connectors ,locking arrangements full set complete with All fixing hardwares .												
5.01	10 Pair Telephone junction MDF box with krone connectors	No	4										
5.02	50 Pair Telephone junction MDF with krone connectors	No	2										
5.03	100 Pair Telephone junction MDF with krone connectors	No	6										
5.04	150 Pair Telephone junction MDF with krone connectors	No	2										
6	Project Management Charges												
6.01	Project Management Charges for entire Tele phone system	LSM	1										
7	CIVIL WORKS FOR OUTDOOR CABLE LAYING :												

SL.No	DESCRIPTION OF WORK	UNIT	QTY	SUPPLY						ERECTION			
				BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties =>										12.36%		
	supply , Excavation of outdoor cable trenches at a depth specified below From Ground Level with including excavation at any type of soil as per site condition requirements and providing sand layer bed cushioning for cable, providing HALF CUT HEAVY DUTY HUME PIPE for entire length covering and refilling the trench and making good surface as required. quoted cost inclusive of Providing HT / LT cable route marker at every 15 Mtrs distance.												
7.01	Trench of width 600mm & depth 750 mm.	Rmt	750										
7.02	Trench of width 450mm & depth 750 mm.	Rmt	3000										
7.03	Trench of width 300mm & depth 750mm.	Rmt	100										
8	EARTHING												
8.01	Supply and Providing Copper Plate Earth station, with 600 X 600 X 3.15mm thick copper plate terminated with 2 runs of 25 x 6 mm copper strips of 3 M length with 100 mm internal dia 13mm thick C.I pipe 3 meter long CI pipe with including construction of 230mm thick brick trough (450 x 450 x 450 inner clearance), providing meshed funnel, CI heavy duty cover , rib and other civil Engineering works, spreading a homogenous mixture of Pentonite around the plate, copper bolt nut etc, completely as per IS 3043, 1987 or latest revision. (for 500 KVA Transformer Neutral earthing)] C.I pipe make : Kapilansh Dhatu Udyog Pvt Ltd, model no : type D1	No.	5										
9	ETP Grade EARTHING TAPES (Electrolyte Grade)												
	Supply and laying of following size earth strips including excavation and refilling of earth when laid in ground if required with all fixing accessories when laid on the wall/ Cable tray with necessary interconnections with earth station and equipments. Including copper hardware items. strips joints should be copper welded or brazed.												
9.01	25x 3 mm Copper Tape	Rmt	130										
	TOTAL COST												
	GRAND TOTAL OF SUPPLY AND ERECTIONS ==>												
	TOTAL VALUE OF E.D												
	TOTAL VALUE OF CST												
	TOTAL VALUE OF VAT												
	TOTAL VALUE OF SER. TAX												
	GRAND TOTAL INCLUSIVE OF ALL DUTIES & TAXES												
	Note :												

SL.No	DESCRIPTION OF WORK	UNIT	QTY	SUPPLY						ERECTION			
				BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties =>										12.36%		
	A) if any change in ROAD layout will affect the OFC and TP cable length												
	B) quoted cost should inclusive of all taxes , duty , octroi, transport etc												
	EXCLUSION OF ITEMS												
	MASONARY CABLE TRENCH												
	from EXTERNAL SERVICE PROVIDERS INCOMING OFC CABLE WITH ALL ACCESSORIES												
	civil works required Exchange room and 6 nos of mini exchange rooms												
	Each individual leasable plots OFC and TP cables												

SIGNATURE OF CLIENTS WITH SEAL

SIGNATURE OF BIDDER WITH SEAL

CLIENT : M/s MEGA FOOD PARK PVT LTD										<div> Paithan Mega Food Park Pvt. Ltd.</div>			
Project : PROPOSED FOOD PARK DEVELOPMENT AT WAHEGAON VILLAGE , PAITHAN TALUKA , AURANGABAD													
Subject : TENDER BOQ FOR EXTERNAL LIGHTING WORKS OF THE PROPOSED MEGA FOOD PARK PVT LTD													
SL.No	DESCRIPTION OF WORK	UNIT	QTY	SUPPLY						ERECTION			
				BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
Percentage of taxes and Duties =>											12.36%		
	PART- C : STREET / ROAD LIGHTING												
1	STREET LIGHTING @ 30 MTRS INTERVAL												
	MAKE : BAJAJ / CG												
1.01	Supply and erection testing and commissioning of Hot Dip Galvanized internally and externally 70 micron DFL GI Single Section Octagonal pole 9 mtrs Long with Bottom 175mm A/F, top 70 mm A/F made up of 3 or 4 mm thick HT sheet along with 275 x 275 x 16 mm thick base plate whole item suitable to with stand for wind speed 169 km /hrs with Earthing studs, with in build TP+N+E loop-in & loop-out smart pack junction box with 3 core heavy duty 2.5 sqmm copper wire from smart box to lamps , 6A SP MCB and 20A 8 Nos terminals should be inside the base compartment of pole and Suitable to Terminate the loop in loop out cables. with 3mm thick heavy duty 60mm /100 mm dia PVC Long Bend pipe, Spiral coil earthing by 8 SWG GI wire with 25 mm dia B glass GI pipe of 600 mm length for Spiral coil earthing . [BAJAJ Cat No: BOP-BOP-9030]	No	100										
1.02	Excavation of outdoor pole Foundation pit at a depth of 2000 mm below the Ground Level which includes excavation of any type of soil as per site condition and supply and providing reinforced 600 x 600 x 2000 mm deep RCC M20/M25 Civil foundation with necessary "U" Bolts & Nuts suitable for wind speed 169 km /hrs as per detail of civil foundation drawings approved by consultants . [Actual deep should be as per structural designer consultant]	No	100										
1.03	Supply and erection testing and commissioning of Hot Dip Galvanized internally and externally 65 to 70 micron DFL GI 1.0 / 0.5 meters long single cross Arm bracket suitable to the above pole ,pole cap bolt nut etc	No	4										
1.04	Supply and erection testing and commissioning of Hot Dip Galvanized internally and externally 65 to 70 micron DFL GI 1.5 meters long single cross Arm bracket suitable to the above pole ,pole cap bolt nut etc	No	35										
1.05	Supply and erection testing and commissioning of Hot Dip Galvanized internally and externally 65 to 70 micron DFL GI 1.0 / 0.5 meters long Double cross Arm bracket suitable to the above pole ,pole cap bolt nut etc	No	4										
1.06	Supply and erection testing and commissioning of Hot Dip Galvanized internally and externally 65 to 70 micron DFL GI 1.5 meters long Double cross Arm bracket suitable to the above pole ,pole cap bolt nut etc	No	57										
2	LIGHT FIXTURES WITH LAMPS												
2	Supply, installation, testing & Commissioning of the following types fittings shall be with energy efficient complete with low loss Electronic ballast , igniter,starters,controlgear, connecting wire with Lamps, pf improvement capacitors for Lamps, all prewired up to the terminal block ,the rates quoted shall include all other accessories complete as required for suspending the lights, fans to the required level [Make : Wipro / PHILIPS]												

SL.No		DESCRIPTION OF WORK		SUPPLY							ERECTION			
		UNIT	QTY	BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT	
		Percentage of taxes and Duties =>												
2.01	Supply, installation, testing and commissioning of 132 W LED light fixture fitting along with all accessories Such as Gear Box , lamps etc as required with all fixing accessories (Wipro CAT No: LR10-132-XXX-57 -XX)			No	165							12.36%		
2.02	Supply, installation, testing and commissioning of 250W MH light fixture fitting along with all accessories Such as Gear Box , lamps etc as required with all fixing accessories (Wipro CAT No:- WSH 50250)			No	1									
2.03	Supply, installation, testing and commissioning of 250W MH light fixture fitting along with all accessories Such as Gear Box , lamps etc as required with all fixing accessories (Wipro CAT No:- WSH 42250)			No	10									
2.04	Supply, installation, testing and commissioning of 250W MH Flood light fixture fitting along with all accessories Such as Gear Box , lamps etc as required with all fixing accessories (philips CAT No:- MWF 331 1 X HPITP 250W A)			No	20									
2.05	Supply, installation, testing and commissioning of 0.3 MTRS height suitable dia 50 mm dia B class GI pipe to be embedded in gate wall with 25 mm dia PVC bent Pipes for incoming and outgoing cables, with painting of two coats of Zinc chromate primer and two coats of Aluminum paint externally for length above the wall with weather proof Junction box consisting of 6A SP MCB, 20A 4 way Terminal box. The Junction box shall be of weather proof phase and neutral loop-in and loop-out box as per specifications/drawings The wiring from Junction box to Light fixture shall be carried out with 3core 2.5sq.mm flexible copper cable.			SET	4									
2.06	Supply, installation, testing and commissioning of 85 W CFL GATE light fitting along with all accessories such as Gear box, lamps etc as required with all fixing accessories (BAJAJ CAT NO: BNCL 85 RF CFL CLEAR ACRYLIC COVER)			No	8									
2.07	Supply and erection testing and commissioning of DECORATIVE wall mounted type Name board light fitting along with all accessories such as Gear box, lamps etc as required with all fixing accessories (BAJAJ CAT NO: PALU BASE 169243 ; BM GN 300WH 169223) or As per Architects / clients Selection and approved make.			No	1									
2.08	Supply, installation, testing and commissioning of weather proof [IP-66] junction box with full set complete with all fixing Hard wares (Hensel CAT.NO KF 9105) or equivalent of approved make.			No	4									
3	EARTHING :													

SL.No	DESCRIPTION OF WORK	UNIT	QTY	SUPPLY						ERECTION			
				BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties =>										12.36%		
3.1	SUPPLY & Providing C.I PIPE Earth station, with 100 mm internal dia 13mm thick C.I pipe 3 mtr long CI pipe with 2 runs of 50 x 6 mm Hot Dip Galvanized GI strips of each 3 Meter long with including Excavation of earth pit in any type of soil and construction of 230mm thick brick trough (450 mm length x 450mm wide x 450 inner trough clearance), providing meshed funnel, CI heavy duty ISI approved Square type cover , C.I heavy duty rib and other civil Engineering works, spreading a homogenous mixture of Pentonite around the plate, copper /bimetallic/ GI bolt nut washer etc, completely as per IS 3043, 1987 or latest revision. [C.I pipe make : Kapilansh Dhatu Udyog Pvt Ltd, model no : type D]	No	4										
3.2	Supply and Providing Copper Plate Earth station, with 600 X 600 X 3.15mm thick copper plate terminated with 2 runs of 25 x 3 mm copper strips of 3 M length with 100 mm internal dia 13mm thick C.I pipe 3 meter long CI pipe with including construction of 230mm thick brick trough (450 x 450 x 450 inner clearance), providing meshed funnel, CI heavy duty cover , rib and other civil Engineering works, spreading a homogenous mixture of Pentonite around the plate, copper bolt nut etc, completely as per IS 3043, 1987 or latest revision.][C.I pipe make : Kapilansh Dhatu Udyog Pvt Ltd, model no : type D]	No	2										
3.21	Supply and Providing Substation earth-mat Design, engineering, supply inclusive of corrosion protection measures if any,laying of earth-mat conductors of Hot dip galvanized flats of size 75X10 mm to the approval of Project Manager, excavation, welding/jointing ,application of two coats of bituminous Paint,wrapping of HT Tape etc of ground conductors along with risers (of size 50X6 mm GI flats) etc back filling and good compaction,grounding driven rods(40 mm MS solid rod),perforated GI pipes for treated earth pits(with details of treatment as per IS). The spacing between the earth conductor not more than 5 mtrs(both way) and to be buried at depth of 750mm from the finished ground level.For provision of treated earth-pit and untreated earth pit, refer the specification for designing. Provision of water taps inside the switch yard areas and peripheral treated and un-treated earth pit are required to be provided for watering the treated earth pits. The no. of treated and un treated earth pits are to be done as per the practice and as indicated in the drawing for different equipments. This is as per approved drawing and specification. spreading a homogenous mixture of Pentonite around the plate, copper bolt nut etc, completely as per IS 3043, 1987 or latest revision.												
a	75 x 10 mm Hot Dip Galvanized GI strip	Rmt	100										
b	50 x 6 mm Hot Dip Galvanized GI strip	Rmt	100										
c	25 x 6 mm Hot Dip Galvanized GI strip	Rmt	50										
d	50MM GI PIPE FOR TREATED EARTH PIT ELECTRODE WITH CHAMBER AND COVER	Rmt	35										
4	EARTHING TAPES/ WIRES:												

SL.No	DESCRIPTION OF WORK	SUPPLY								ERECTION			
		UNIT	QTY	BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties =>										12.36%		
	Supply and laying of following size Electrolyte grade Copper / Hot dip GI strip including all fixing accessories for laid inside the building with all necessary interconnections with earth station and equipments. end terminated with suitable copper lugs ,copper fixing hardware's. Below ground with civil excavation works , Below ground joints should be welded / Brazed only.												
4.1	Hot dip galvanized 40 x 6 mm GI tape with GI fixing hardware's.	Rmt	100										
4.2	Hot dip galvanized 25 x 6 mm GI tape with GI fixing hardware's.	Rmt	100										
4.2	8 SWG Copper wire ETP Grade material (as per IS:191) with copper fixing hardware's.	Rmt	40										
5	AREA LIGHTING PANEL (WEATHER Proof TYPE out door PEDESTAL MOUNTED)												
	(MAKE : SIEMENS / SCHNEIDER /LEGRAND)												
	INCOMER												
	125A, TPN, 415V, 25 KA Molded Case Circuit Breakers with Thermal Magnetic based releases with 125 A 3P contactors-1 no ,24 hours day timer-1 no, including ON/ OFF indication lamps-6 Nos. And Sensor or light Dependent resistors (LDR) to automatic ON & Off based on Sun light level												
	Area Light Circuit Should be connected with one timer switches to control all lights between 6 PM to 6 AM.												
	METERING												
	Load Manager with measuring parameters of Voltage, Current, Frequency (Conzerv Cat Log No: EM 6400 with Rs485).												
	125 /5A, CL - 1.0, 10VA Resin Cast Current Transformers - 3 No												
	2A, TPN MCB -1No.												
	Auto manual Selector switch-2												
	24 hours day timer-2 no												
	LED Type Indication Lamps for R, Y, B Phase Indication and Breakers ON / OFF / TRIP Indication												
	BUS BAR :												
	125 A,Electrolyte Grade TPN+E Aluminum Bus bars with 0.8A/Sq.mm Current density.												
	OUTGOINGS :												
	10-32A, DP, MCB(10 KA) - 12 Nos												
	63A, TP, MCB(10KA) - 4 Nos												
	10-32A, TP, MCB(10KA) - 12 Nos	No	2										
6	POWER AND Control CABLES :												

SL.No	DESCRIPTION OF WORK	UNIT	QTY	SUPPLY						ERECTION			
				BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties =>										12.36%		
	Supply, laying, testing and commissioning of following size 1.1KV Grade Aluminum XLPE / Copper Conductor XLPE insulated PVC extruded Sheathed Armored under ground cable and shall be laid in built up cable trench/ already laid RCC Hume pipe or on cable tray (indoor/outdoor). with all installation materials as required. The cable shall conform to IS 1554/ Part I. For buried cables, the excavation work will be included under the heading "Civil works for outdoor cable laying."												
	(MAKES: UNIVERSAL / CCI Tropodur / KEI /RR /RPG)												
6.01	3.5 Core x 95 Sqmm XLPE ALAR Cable	Rmt	50										
6.02	3.5 Core x 70 Sqmm XLPE ALAR Cable	Rmt	550										
6.03	3.5 Core x 50 Sqmm XLPE ALAR Cable	Rmt	550										
6.04	3.5 Core x 35 Sqmm XLPE ALAR Cable	Rmt	50										
6.05	4 Core x 25 Sqmm XLPE ALAR Cable	Rmt	1100										
6.06	4 Core x 16 Sqmm XLPE ALAR Cable	Rmt	2200										
6.07	4 Core x 10 Sqmm XLPE ALAR Cable	Rmt	3800										
6.08	4 Core x 6 Sqmm XLPE ALAR Cable	Rmt	1200										
6.09	4 Core x 2.5 Sqmm PVC CU.AR.Cable	Rmt	200										
7	CABLE END TERMINATIONS :												
7	Supply and Providing cable end terminations with Double compression type SS Gland, Bi-metallic Heavy duty lugs , insulation tape, identification Aluminum Engraved tags etc.With including Gland Earthing, Drilling for Gland complete as required.												
	.(Make-HMI/ COMET , Lugs: DOWELLS/HEX).												
7.01	3.5 Core x 95 Sqmm XLPE ALAR Cable	No	2										
7.02	3.5 Core x 70 Sqmm XLPE ALAR Cable	No	2										
7.03	3.5 Core x 50 Sqmm XLPE ALAR Cable	No	2										
7.03	3.5 Core x 35 Sqmm XLPE ALAR Cable	No	2										

SL.No	DESCRIPTION OF WORK	UNIT	QTY	SUPPLY						ERECTION			
				BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties =>										12.36%		
7.04	4 Core x 25 Sqmm XLPE ALAR Cable	No	20										
7.05	4 Core x 16 Sqmm XLPE ALAR Cable	No	20										
7.06	4 Core x 10 Sqmm XLPE ALAR Cable	No	200										
7.07	4 Core x 6 Sqmm XLPE ALAR Cable	No	100										
7.08	4 Core x 2.5 Sqmm PVC CU.AR.Cable	No	20										
8	CIVIL WORKS FOR OUTDOOR CABLE LAYING :												
	supply , Excavation of outdoor cable trenches at a depth specified below From Ground Level with including excavation at any type of soil as per site condition requirements and providing sand layer bed cushioning for cable, providing HALF CUT HEAVY DUTY HUME PIPE for entire length covering and refilling the trench and making good surface as required. quoted cost inclusive of Providing HT / LT cable route marker at every 15 Mtrs distance.												
8.01	Trench of width 600mm & depth 600 mm.	Rmt	400										
8.02	Trench of width 450mm & depth 600 mm.	Rmt	4050										
8.03	Trench of width 300mm & depth 600mm.	Rmt	150										
	TOTAL COST												
	GRAND TOTAL OF SUPPLY AND ERECTIONS ==>												
	TOTAL VALUE OF E.D												
	TOTAL VALUE OF CST												
	TOTAL VALUE OF VAT												
	TOTAL VALUE OF SER. TAX												
	GRAND TOTAL INCLUSIVE OF ALL DUTIES & TAXES												
	Note :												

SL.No	DESCRIPTION OF WORK	SUPPLY								ERECTION			
		UNIT	QTY	BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX 12.36%	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties =>												
	a) based on Road layout this BOQ prepared , If any changes in road layout will affect the Drawings as well qty												
	b) quoted cost should inclusive of pole identification number												
	c) quoted cost should inclusive of all taxes , duty ,octroi, transport etc												
	EXCLUSION OF ITEMS												
	MASONARY CABLE TRENCH												
	Feeder pillar panels - pedestal / FOUNDATION works ,												

SIGNATURE OF CLIENTS WITH SEAL

SIGNATURE OF BIDDER WITH SEAL

CLIENT : M/s MEGA FOOD PARK PVT LTD													
Project : PROPOSED FOOD PARK DEVELOPMENT AT WAHEGAON VILLAGE , PAITHAN TALUKA , AURANGABAD													
Subject : TENDER BOQ FOR SOLAR LIGHTING WORKS OF THE PROPOSED MEGA FOOD PARK PVT LTD													
<div>Paithan Mega Food Park Pvt. Ltd.</div>													
SL.No	DESCRIPTION OF WORK	UNIT	QTY	BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties =>										12.36%		
	PART- F : [SOLAR LIGHTING SYSTEM]												
1	SOLAR STREET LIGHTING - - as per MNRE												
1.01	Supply and erection testing and commissioning of Hot Dip Galvanized internally and externally 70 micron DFL GI Single Section Octagonal poles of 7 mtrs Long . with Bottom 130 mm A/F, top 70 mm A/F made up of 3mm thick HT plate along with 200X200X12mm thick base plate suitable for wind speed 169 km /hrs with Earthing studs, in build TP+N+E loop-in and loop-out smart pack junction box with 6A SP MCB and 20A 8 Nos terminals should be inside the base compartment of pole and Suitable to Terminate the 4C X 4 Sqmm CU AR cable. loop in loop out 3mm thick heavy duty 60mm dia PVC pipe cost should inclusive of Spiral coil earthing by 8 SWG GI wire with 32 mm B glass GI pipe of 750 mm length for Spiral coil pole earthing . (MAKE BAJA Cat No: BOP-7 030)	No	52										
1.02	Excavation of outdoor pole Foundation pit at a depth of minimum 1000mm below the Ground Level which includes excavation of any type of soil as per site condition and supply and providing reinforced 500 x 500 x 1200 mm deep RCC Civil foundation with necessary "U" Bolts & Nuts suitable for wind speed 169 km /hrs as per detail of civil foundation drawings approved by consultants . (actual deep should be as per structural design /baja drawins it will vary)	No	52										
1.03	Supply and erection testing and commissioning of Hot Dip Galvanized internally and externally 65 to 70 micron DFL GI 1.0 mtrs long single cross Arm bracket suitable to the above pole ,pole cap bolt nut etc	No	5										
1.04	Supply and erection testing and commissioning of Hot Dip Galvanized internally and externally 65 to 70 micron DFL GI 1.5 mtrs long single cross Arm bracket suitable to the above pole ,pole cap bolt nut etc	No	47										
2	HYBRID SOLAR STREET LIGHTING -												
	Supply, installation, testing & Commissioning of MPPT BASED CHARGE with Hybrid system solar street lighting system with High efficiency Mono Multi Crystalline Confirming to IEC standards , Low maintenance positive tubular plate lead Acid battery Rate of discharge Suitable for 3 days system , MPPT BASED Charge controller 12V, the entire lighting system is weather proof IP 66 /67 ,Charge Controller - MPPT (microprocessor based) , AUTONOMY 2 DAYS ; Enclosure -IP65 ; Solar cells- Multi crystalline silicon, Lead-acid tubular battery of low maintenance, Standards :EN50530 for MPPT performance ,Solar Panel:IEC 61215,Electronics, EN50530 : MPPT Performance evaluation , IEC62124 : Solar standalone system performance ,IEC61347-2-13 : LED driver safety ,IEC 62384 : LED driver performance, CISPR 15 : Radio disturbance characteristics, IEC61547 : EMC Immunity requirements ,IEC60598 : [MAKE : BAJAJ / CG / PHILIPS]												

		SUPPLY								ERECTION			
SL.No	DESCRIPTION OF WORK	UNIT	QTY	BASIC RATE	ED	CST	VAT	Net Supply RATE	Net Supply AMOUNT	BASIC RATE	SER. TAX	Net Erection RATE	Net Erection AMOUNT
	Percentage of taxes and Duties ==>										12.36%		
2.01	HYBRID 60W Solar LED street Light Luminaire comprises of die cast Aluminium housing powder coated in graphite grey and toughened glass with IP 65 Protection. fitted with gasket & accessories- IP65-Single luminary. Lumens minimum output-130 W .In- built dusk to dawn 2DAYS , automatic operation, Solar Panel PV Module: 12V/140Wp Poly Crystalline Type - 2nos , Battery: 135Ah-12V Tubular Battery - 2 Nos Battery Box Enclosure made by SS-304 , Charge Controller: MPPT type charge controller full set complete with all fixing hard wares [MAKE : BAJAJ / CG /PHILIPS]	No	52										
2.02	HYBRID 90W Solar LED street Light Luminaire comprises of die cast Aluminium housing powder coated in graphite grey and toughened glass with IP 65 Protection. fitted with gasket & accessories- IP65-Single luminary. Lumens minimum output-130 W .In- built dusk to dawn 2DAYS , automatic operation, Solar Panel PV Module: 12V/140Wp Poly Crystalline Type - 2nos , Battery: 150Ah-12V Tubular Battery - 4 Nos Battery Box Enclosure made by SS-304 , Charge Controller: MPPT type charge controller full set complete with all fixing hard wares [MAKE : BAJAJ / CG /PHILIPS]	No	2										
2.03	set of user's tool & tackles kit and operation &Maintenance manual as per - as per MNRE specs. Nodal Agencies [MAKE : BAJAJ / CG /PHILIPS]	SET	5										
	TOTAL COST												
	GRAND TOTAL OF SUPPLY AND ERECTIONS =====>												
	TOTAL VALUE OF E.D												
	TOTAL VALUE OF CST												
	TOTAL VALUE OF VAT												
	TOTAL VALUE OF SER. TAX												
	GRAND TOTAL INCLUSIVE OF ALL DUTIES & TAXES												
	Note :												
	A) based on Road layout this BOQ prepared , if any changes in road layout will affect the Drawings as well qty												
	b) quoted cost should inclusive of all taxes , duty ,octroi, transport etc												
	C) quoted cost should inclusive of all taxes , duty ,octroi, transport etc												
	EXCLUSION OF ITEMS												
	MASONARY CABLE TRENCH												
	LT cable for any Hybrid options												

SIGNATURE OF CLIENTS WITH SEAL

SIGNATURE OF BIDDER WITH SEAL

PAITHAN MEGA FOOD PARK PVT. LTD. AT PAITHAN (MH)

BOOK NO. 3

TECHNICAL SPECIFICATION

BID NO. PMFPPL – PTBS – 01 - 2016



Paithan Mega Food Park Pvt. Ltd.

Nath House, Nath Road, Aurangabad-431005, Maharashtra

Project Management Consultants (PMC)



Abhyuday Techno Economic Consultants Pvt. Ltd.

211-212, Patel Avenue, Near Gurudwara

S.G. Highway, Thaltej, Ahmedabad – 380054, Gujarat

A/E Consultants



SEM MAC Consultants Private Limited

'Conjeevaram House' , 2nd Floor, 6-1-276,

Padmarao Nagar, Secunderabad – 500 025.

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1. GENERAL SCOPE OF WORK & REQUIREMENT

The general character and the scope of work to be carried out under this contract is Illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The Contractor shall furnish all labor, materials and equipment (except those to be supplied by the owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The scope of work shall generally comprise, but not limited to the following:

- A) HT/LT Power and Control Cables.
- b) 433 V MCC/ PCC's, Automatic Capacitor Control Panels, Lighting Panels, Bus Ducts, etc.
- c) Raising Mains, Cable trays, earthing station/materials, lightning protection system.
- d) Transformers.
- e) HT Switchgear and accessories
- g) Any other items specified in Schedule of Quantities.

1.1 Comply in full with all requirements described in or implied by this specification and with the Conditions of Contract as well as Schedule and Drawings issued as part of the contract documents.

1.2 Request clarification and make all necessary enquiries prior to submitting the tender Regarding any obscurities or contradictions on or omissions from the specification, related Documents and Drawings. No consideration will be given to cost claims for work arising from the failure to obtain such clarification.

1.3 Minor civil works like drilling and punching holes and openings in concrete floors, slabs, chasing of brick walls, fabrication of supporting structures, drainage of water from cable trenches, cleaning and clearing of all debris due to electrical installation.

1.4 Excavation, scaffolding, back filling for direct burial of cables and earthing conductors as applicable.

1.5 Preparation of execution drawings and as built-in- drawings.

1.6 Coordination with other contractors with regard to installation of items in Electrical Contractors scope.

1.7 The extent of work services under the contract include all items shown on the drawings, indicated in companion with specifications, notwithstanding the fact that such items have been omitted from the price schedule. All equipments and services which are required to complete the intent of the contract shall also be deemed to be within the scope of the contract.

1.8 All required Liaison work in relation to subject scope, including STATE ELECTRICITY BOARD & CEIG liaisoning and follow-up, securing permission to commission the equipment and all related co-ordination with Municipal, BSNL & such other agencies

1.9 Training of Owner's Staff.

2. COMPLIANCE WITH STANDARDS.

2.1 STANDARDS:

Comply with the requirements of all relevant Indian Standards (IS) or equivalent British Standards (BS) regarding equipment manufacture, design and installation whether or not these are specifically mentioned in the Specification.

2.2 ALTERNATIVE STANDARDS:

International Standards (ISO) or (IEC) which are equivalent to the appropriate Indian Standard (IS) may be used. Other standards may be offered as an alternative only if submitted for approval along with the equipment manufacturer's written assurance that they are equal to BS, ISO or IEC Standards.

2.3 DISCREPANCIES:

In the event of a discrepancy between the Specification and any IS or BS or other approved standard request clarification in writing from the Engineer before tender opening / before execution.

2.4 CODE, REGULATIONS AND STANDARDS:

The installation shall conform in all respects to Indian Standard Code of Practice for Electrical Wiring Installation I.S.732-1982. It shall also be in conformity with the current Indian Electricity Rules Safety Codes and the Regulations and requirements of the Local Electrical Supply Authority. Wherever this specification calls for a higher standard of materials and/or workmanship then those

required by any of the above regulations, this specification shall take precedence over the said regulations and standards. In general, the materials, equipments and workmanship not covered by the above shall conform to the following Indian Standards (latest), unless otherwise called for. Nothing in the enclosed specification shall be construed to relieve the contractor of this responsibility.

Classification of degrees of protection provided by enclosures of electrical equipment	12063:1987 06
Electro technical vocabulary : Part 9 Electrical relays (Second revision of IS:1885)	1885(Part 9):1992 07
Electro technical vocabulary : Part 10 Power system protection (first revision of IS 1885)	1885 (Part 10):1993 03
Electro technical vocabulary : Part 11 Electrical measurements	1885 (Part 11):1966 09
Electro technical vocabulary : Part 17 Switchgear and control gear (first revision)	1885 (Part 17):1979 08
Electro technical vocabulary : Part 28 Instrument transformers (first revision of IS 1885)	1885 (Part 28):1992 04
Electro technical Vocabulary : Part 32 Electric cables (first revision of IS 1885)	1885 (Part 32): 1992 05
Electro technical vocabulary : Part 38 Transformers (first edition)	1885 (Part 38):1977 05
Electro technical vocabulary : Part 42 Power Capacitors (second revision of IS 1885)	1885 (Part 42):1992 04
Electro technical vocabulary : Part 54 Insulators (First revision of IS 1885)	1885 (Part 54):1993 03

Electro technical vocabulary : Part 69 Generation, transmission and distribution of electricity - Generation	1885 (Part 69):1993 04
Electro technical vocabulary : Part 71 Generation, transmission and distribution of electricity Substation	1885 (Part 71):1993 06
Graphical symbols for diagrams in the field of electro technology : Part 3 Conductors and connecting devices	12032 (Part 3):1987 05
Graphical symbols for diagrams in the field of electro technology: Part 7 Switchgear, control gear and protective devices.	12032(Part 7):1987 12
Graphical symbols for diagrams in the field of electro technology: Part 8 Measuring instruments, lamps and signaling devices.	12032(Part 8):1987 07
Guide for color coding of electrical mimic diagrams	11954:1987 02
Guide for limits of temperature rise of the windings of electrical equipment when tested by different methods.	9677:1980 02
Guide for preparation of diagrams, charts and tables for electro technology: Part 1 Definitions and classification.	8207(Part I):1976 02
Code of practice for earthing	3043:1987
Code of practice for the protection of buildings and allied structures against lightning (second revision)	2309:1989 15
Danger notice plates (first revision)	2551:1982 05
Guide for improvement of power factor in consumer installation Part I, Low and medium supply voltages	7752 (Part I):1982 06
Guide for safety procedures and practices in electrical work:	

Part 2, Life saving techniques (first revision)	5216(Part 2):1982 06
Guide for short-circuit current calculations in three-phase AC system, (Superseding of IS5728:1970)	13234:1992/IEC 909 (1986)
Special publication - National Electrical Code	30:1984
Special publication Chart on treatment for electric shock	31:1986
Warning symbol for dangerous voltages	8923:1978 01
Boxes for enclosure of the electrical accessories: Part 1, Steel and cast iron box (with amendment No.2)	5133(Part 1):1969 03
Boxes for the enclosure of electrical accessories: Part 2, Boxes made of insulating material	5133(Part 2):1969 03
AC electricity meters: Part 2, Single-phase whole-current watt hour meters, Class II (first revision)(with amendment No.4)	722(Part 2):1977 02
AC electricity meters: Part 3, Three-phase whole current and transformer operated and single-phase transformer operated watt-hour meters, class 2(Second revision)(with amendment No.2)	722(Part 3):1977 03
AC electricity meters: Part 5, Volt-ampere hour meters for restricted power factor range, class 3.5 (first revision) (with amendment No.2)	722(Part 5):1980 05
Guide for testing, calibration and maintenance of AC electricity meters: Part 1, Single phase whole current watt hour meters, Class 2.0 (first revision)	9792(Part 1):1987 06
Maximum demand indicators (class 1)	8530:1977 04
Testing equipment for AC electrical energy meters	12346:1988 05

Application guide for the selection of High Voltage fuses for transformer circuit applications.	12534:1988 02
Carriers and bases used in rewritable type electric fuses for voltages up to 650 V (third revision) (Superseding IS:8724)	2086:1993 07
High voltage fuse-links for motor circuit applications)	10624:1983
High voltage fuses for the external protection of shunt power capacitors.	9402:1980 04
High voltage fuses: Part 1, Current limiting fuses.	9385(Part I):1979 10
High Voltage fuses: Part 3, Application guide for high voltage fuses.	9385(Part 3):1980 07
LV Fuses for voltages not exceeding 1000 V AC or 1500 V DC: part I, General requirements {Superseding IS 9224 (Part 1):1979}	13703(Part 1):1993/IEC 269-1(1986) 15
LV Fuses for voltages not exceeding 1000 V AC or 1500 V DC: Part 2, fuses for use by authorized persons, Section 1, Supplementary requirements {Superseding IS 9224 (Part 2):1979}	13703(Part 2-Section 1):1993/IEC-269-2(1993)
LV Fuses for voltages not exceeding 1000 V AC or 1500 V DC: Part 2, fuses for use by authorized persons, Section 2, examples of standardized fuses.	13703(Part 2-Section 2):1993/IEC-269-2-1(1987)
LV Fuses for voltages not exceeding 1000 V AC or 1500 V DC: Part 4, Supplementary requirements for fuse links for the protection of semiconductor devices {Superseding IS 9224 (Part 4):1980}	13703(Part 4) : 1993/ IEC-26942(1980)
Application guide for measuring devices for high voltage testing	8690:1977 09

Methods of high voltage testing: Part 1, General definitions and test requirements, (first revision) (Superseding IS:2070-1972)	2071(Part 1):1993
AC contactors of voltage above 1000 V up to and including 11000 V	9046:1978 08
Alternating current disconnections (isolators) and earthing switches for voltage above 1000 V: Part 1, General and definitions.	9921(Part 1):1981
Alternating current disconnections (isolators) and earthing switches for voltage above 1000 V: Part 2 Rating.	9921(Part 2):1982
Alternating current disconnections (isolators) and earthing switches for voltages above 1000 V: Part 3, Design and construction	9921(Part 3):1982
Alternating current disconnections (isolators) and earthing switches for voltages above 1000 V: Part 4, Type tests and routine tests.	9921(Part 4):1985
Dimensions of terminals of high voltage switchgear and control gear.	10601:1983
General requirements for circuit breakers for voltages above 1000 V.	13118:1991
General requirements for switchgear and control gear for voltages exceeding 1000 V	12729:1988
Guide for testing of circuit breakers with respect to out-of-phase switching.	9135:1979
Interconnecting bus bars for AC voltage above 1 kV up to and including 36 kV	8084:1976
Metal-enclosed switchgear and control gear for voltage above	

1000 V but not exceeding 11000 volts (with amendment No.1)	3427:1969
Methods of synthetic testing of high voltage alternating current circuit breakers.	13516:1993
Switches and switch isolators for voltages above 1000V: Part 1 General and definitions.	9920(Part 1):1981
Application guide for voltage transformers (first revision)	4146:1993
Current transformers: Part 1, General requirements (second revision)	2705(Part 1):1992
Current transformer: Part 2, Measuring current transformers (second revision)	2705(Part 2):1992
Current transformers: Part 3, Protective current transformers (second revision)	2705(Part 3):1992
Current transformer: Part 4, Protective current transformers for special purpose applications (Second revision)	2705(Part 4):1992
Voltage transformers: Part 1, General requirements (second revision)	3156(Part 1):1992
Voltage transformers: Part 2, Measuring voltage transformers (second revision)	3156(Part 2):1992
Voltage transformers: Part 3, Protective voltage transformers (second revision)	3156 (Part 3):1992
Voltage transformers: Part 4, Capacitor voltage transformer (second revision)	3156(Part 4):1992
Circuit Breakers for over current protection for household and similar installations (first revision)	8828:1993

Code of practice for selection, installation and maintenance of switchgear and controlgear: Part 1, General	10118(Part 1):1982
Code of practice for selection, installation and maintenance of switchgear and control gear: Part 2, Selection	10118(Part 2):1982
Code of practice for selection, installation and maintenance of switchgear and control gear: Part 3, Installation.	10118(Part 3):1982
Code of practice for selection, installation and maintenance of Switchgear and control gear: Part 4, Maintenance.	10118(Part 4):1982
Distribution pillars for voltages not exceeding 1000 Volts (first revision)	5039:1983
Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000 V (second revision)	2675:1983
Guide for marking of insulated conductors (first revision)	5578:1983
Identification of terminals of contactors and associated overload relays	10705:1983
LV switchgear and control gear, Part I, General rules (Superseding IS 4237:1982 & IS 2147:1962)	13947(Part 1):1993
LV switchgear and control gear, Part 2, Circuit breakers (superseding IS 2516(Part 1 & 2/ Section 1):1985	13947(Part 2):1993
LV switchgear and control gear Part 3, Switches, disconnections, switch-disconnections and fuse combination unit (Superseding IS 4064(Part 1 & 2)	13947(Part 3):1993
LV switchgear and control gear Part 4, Contactors and	

motor starters Section 1, Electromechanical {Superseding IS 2959 and IS 8544 (all Parts)}	13947(Part 4-section 1):1993
LV switchgear and control gear Part 5, Control circuit devices and switching elements, Section 1 Electromechanical control devices {Superseding IS 6875 (All parts)}	13947(Part 5-Section 1):1993
Miniature circuit breaker boards for voltage up to and including 1000 volts AC.	13032:1991
Specification for low voltage switchgear and control gear assemblies: Part 1, Requirements for type-tested and partially type tested assemblies (first revision)	8623(Part 1):1993
Specification for low voltage switchgear and control gear assemblies: Part 2, Particular requirements for bus bar trunking systems (bus ways) (first revision)	8623(Part 2):1993
LV Switchgear and control gear assemblies: Part 3, Particular requirements for equipment where unskilled persons have access for their use.	8623(Part 3):1993
Code of practice for installation and maintenance of power cables up to and including 33 kV rating (second revision)	1255:1983
Compression type tubular in-line connectors for aluminum conductors of insulated cables (first revision)	8308:1993
Compression type tubular terminal ends for aluminum conductors of insulated (with amendment No.1)	8309:1993
Conductors for insulated electric cables and flexible cords (first revision)	8130:1984
Cross linked polyethylene insulated PVC sheathed cables: Part 1 for working voltage up to and including 1100 V	7098(Part 1):1988

(first revision)

Cross linked polyethylene insulated PVC sheathed cables:
Part 2 for working voltage from 3.3 kV up to and
including 33 kV (first revision) (with amendment No.2)

7098(Part 2):1985

Drums for electric cables.

10418:1982

Methods of test for cables :Part 0, General

10810(Part 0):1984

PVC insulated cables for working voltages up to and including
1100 V (third revision)

694:1990

Application guide for electrical relays for AC systems: Part 1, Over
current relays for feeders and transformers

3842(Part 1):1967

Application guide for electrical relays for AC systems: Part 2, Over
current relays for generators and motors

3842(Part 2):1966

Application guide for electrical relays for AC systems: Part 3,
Phase unbalance relays including negative phase sequence relays
(with amendment No.1)

3842(Part 3):1966

Application guide for electrical relays for AC systems: Part 4,
Thermal relays (with amendment No.1)

3842(Part 4):1966

Application guide for electrical relays for AC systems: Part 5,
Distance protection relays

3842(Part 5):1968

Application guide for electrical relays for AC systems: Part 6,
Power relays.

3842(Part 6):1972

Application guide for electrical relays for AC systems: Part 7)
Frequency relays.

3842(Part 7):1972

Application guide for electrical relays for AC systems: Part 8,
Voltage relays.

3842(Part 8):1976

Application guide for electrical relays for AC systems: Part 9,

Relays for bus bar protection.	3842(Part 9):1977
Application guide for electrical relays for AC systems: Part 10, Relays for transverse differential protection	3842(Part 10):1976
Application guide for electrical relays for AC systems: Part 12, Differential relays for transformers.	3842(Part 12):1976
Specification for electrical relays for power system protection (with amendment No.4)	3231(Part 0):1986
Application guide for on-load tap changers	8478:1977
Application guide for power transformers	10561:1983
Cable sealing boxes for oil immersed transformers suitable for paper insulated lead sheathed cables for highest system voltages from 12 kV up to and including 36 kV.	9147:1979

3. ASSOCIATED CIVIL WORKS.

Following civil works associated with the installation are excluded from the scope of this contract. These shall be executed by other agencies in accordance with approved shop drawings of, and under direct supervision of the Contractor.

- I. RCC foundation for Equipment
- ii. PCC foundation blocks with angle iron frame work edging
- iii. concealed wiring /concealed items as required.

5. ASSOCIATED SERVICES WORKS.

The Contractor shall co-ordinate his Working Drawings with required co-ordination of all other works simultaneously going on at site.

6 PERFORMANCE GUARANTEE

The Contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The Contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver

the required end result.

The Contractor shall guarantee that the system as installed shall perform as per technical parameters contained in the in the specifications. Complete set of architectural drawings is available in the Architect/Consultant's office and reference may be made to same for any details or information.

The Contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

7. COMPLIANCE WITH STATUTORY AND OTHER REGULATIONS.

7.1 STATUTORY REGULATIONS:

Comply with all relevant statutory instruments and regulations current at the date of tender and in particular the following:

1. The requirements of STATE electricity Board.
2. The requirements of CHIEF ELECTRICAL INSPECTARATE OF GOVT
3. Any other local Bye-Laws and Regulations.

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation

7.2 OTHER REGULATIONS:

Comply with British Standard BS.7671:1992 "Requirements for Electrical Installations" (IE Wiring Regulations, Sixteenth Edition), incorporating all current amendments.

8 ELECTRICITY SUPPLY.

8.1 The electrical supply will be STATE ELECTRICITY BOARD standard 230/415 volt \pm 6% 50 Hz 3 phase 4 wire with separate neutral and protective conductor.

9. RATING FOR CONTINUOUS SERVICES AT LOCAL AMBIENTS.

9.1 All materials, apparatus and equipment provided will be required to perform or operate successfully in the climatic conditions prevailing in the site Location.

9.2 Materials, apparatus, plant or equipment exposed to direct sunlight must be suitably protected and capable of withstanding long exposure to U.V. radiation without undue degradation or embitterment of any parts or components.

10. EXTENT OF WORKS.

10.1 LABOUR AND MATERIAL:

Provide all labor and, unless otherwise indicated, all materials and equipment to form a complete design and installation. All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per list enclosed. Any item which is of different brand/ make/model from the approved list, if proposed by the Contractor, shall be supported by the credit to the Owner's account (Savings). All such proposals shall be got approved in writing from the Architects, Consultants or Owner. The Contractor shall be responsible for safe storage and custody of all materials and shall have insured them, indemnifying the Architects, Consultants or Owner.

10.2 SUNDRY COMPONENTS:

Provide all incidental sundry components necessary for the complete execution of the works and for the proper operation of the installation, with their labor charges, whether or not these sundry components are mentioned in the Contract Documents.

10.3 TESTS:

1. Carry out all tests, adjustments and commissioning described in this Specification in order to give an effective working installation to the satisfaction of the Engineer. The work package contractor shall establish a database of all tests and test results and ensure that this is kept up to date. A record of the test results/ progress shall be recorded at each site meeting.
2. Adequate notice shall be given to allow the engineer to study, assess and review any test procedures to be witnessed. The minimum notice required shall be forty eight (48) hours.
3. The contractor shall submit a full method statement indicating the tests, and testing procedures to be carried out/ witnessed etc. Details of all instrumentation used shall be recorded.

4. The original test sheet of all tests witnessed by the Engineer must be signed and witnessed by the engineer and a copy of the test sheet handed over to the engineer immediately following the test(s). Any unsigned test record shall be rejected by the engineer and the specific equipment/ plant item retested. Any cost associated with this retesting shall be borne by the work package contractor.

5. **10.4 WORKMANSHIP:**

Carry out all installations in a neat and workmanlike manner to the satisfaction of the Engineer.

10.5 WORKING DRAWINGS:

Provide drawings as described in this Specification.

10.6 INSTRUCTION MANUALS:

Provide manuals as described in this Specification.

11. MANUFACTURES.

11.1 Provide materials and equipment for each service or function, as far as practicable, of one manufacture.

12. SUPERVISION.

12.1 Provide, throughout the whole period in which installation work is being carried out, a suitably qualified site supervision to oversee the complete installation work.

12.2 Supervision by the Engineer shall in no way relieve the Contractor from fully supervising the correct installation of the works.

13. SITE ENGINEER.

The Contractor shall employ a competent, licenced qualified full time electrical Engineer to direct the work of electrical installations in accordance with the drawings and specifications. The Engineer shall be available at all times on the site to receive instructions from the Architect/Owner in the day to day activities throughout the duration of the contract.

The Engineer shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of Local Administration.

14. QUALITY ASSURANCE.

Continually monitor the quality of material and workmanship on site to ensure that only approved materials are employed and that they are installed in the proper manner for their purpose and entirely in accordance with the approved standards and installation methods.

15. SUBSTITUTION OF NON-APPROVED MATERIALS.

15.1 Should any material or equipment be used without approval, the Engineer reserves the right to request the substitution of the correct material or equipment. Should any substitution be necessary the Contractor will bear the cost of any associated builder's work or making good.

15.2 The acceptance of alternatives must be agreed and confirmed in writing by the consultant /client Engineer. Adequate time shall be given in order to allow the Engineer to study, assess and review any alternatives offered.

15.3 consultants /client approval must be taken with authentication for any items before procurement and installation ,execution of works.

16. SAMPLES:

16.1 Provide samples of any materials to be used on site as and before procurement and execution of works

16.2 Note that the Engineer may require the samples to be subjected to tests to ensure compliance with British Standard and other relevant specifications. The cost of such tests shall be borne by the Contractor. Adequate time shall be given in order to allow the Engineer to study, assess and review any sample offered.

16.3 Client / Consultant inspection of the electrical items /equipments for physical & functional checks before dispatch should be arranged by the tendered. The cost of transport and incidental expenses to be borne by the tendered. Two weeks clear notice to be given for carrying out the inspection.

17. TEMPORARY USE OF INSTALLATIONS.

Do-not use any of the installations for any temporary purpose, except installation and commissioning tests, without approval from the Engineer.

18. TEST AND INSPECTION OF CONTRACTOR'S WORK.

18.1 The Engineer shall have access at all reasonable times to such parts of the Contractor's work as may be necessary for the purpose of inspecting and testing the materials, workmanship and performance of the plant.

18.2 The Contractor shall provide all labor, apparatus and instruments for carrying out routine tests in the presence of the Engineer.

19. WORKING DRAWINGS.

Prepare and submit to the Engineer for comments. Four paper prints of detailed drawings for the accurate and proper execution of the works. Ensure that before commencing all Architect's and Structural Engineer's drawings have been consulted and, where available, installation drawings from other trades and specialist equipment suppliers. Amend and resubmit any drawing as requested.

20 FORMATS:

All drawings shall be prepared in C.A.D. to the Client procedural notes, capable of being accessed by Autodesk ACAD 2007. Drawings shall be A1 metric size to BS3429:1975 and in accordance with BS 308: Part 1: 1972 or equivalent Indian standards. Text shall be sized such that it can be easily read when the drawings are reduced to A3 size.

20.1 INSTALLATION DRAWINGS:

1. Show routes and sizes of all multi-core cables.
2. Show routes, fixing methods, separation details and sizes of all cable ladder, trays and trunking.
3. Show location of all distribution equipment, control panels, and terminal equipment.

20.2 WIRING DIAGRAMS:

1. Provide wiring diagrams for all systems detailing all circuitry within equipment together with inter-connecting wiring to associated equipment.
2. Indicate containing system for external circuit wiring.
3. Indicate the sizes and types of all cables together with the ratings of all such items as switches and control devices.
4. Show all terminal markings.
5. Arrange the circuit diagrams, where possible, so that the main sequence of events is from left to right and from top to bottom of the diagram and produce the diagrams generally in compliance with BS 3939.
6. Provide a schedule on each drawing to explain the abbreviations employed for the designation of components.
7. Securely fix and protect by non flammable transparent material a print of each of the circuit and layout diagrams to the inside of the hinged front door of the panels, as appropriate, or in such other positions as may be agreed with the Engineer. Reduce the prints to a suitable size in cases where inadequate space exists.

8. Individual circuit and layout drawings from component manufacturers will not be accepted in lieu of an overall drawing.

21. MANUFACTURER'S DRAWINGS:

1. Provide manufacturer's certified 'as made' general arrangement drawings ,GTP and illustrative literature.
2. Detail all internal circuitry and arrangement of GA equipment .
3. Detail external layout of equipment including terminals and indicate any Restrictions of access to equipment, lifting information and fixing recommendations.
4. Indicate all component ratings, terminal references and wiring sizes.

22. BUILDERS WORK DRAWINGS:

1. Provide Builders work drawings showing full dimensions of all foundations, Bases, plinths, holes and the like as well as the overall size and mass of the plant concerned.
2. Holes, fixings and the like other than in plant rooms, switch rooms and roof areas May be marked out on site, with the agreement of the Engineer, instead of on drawings.

23. CONTRACTOR'S RESPONSIBILITY:

1. Comment by the Engineer on any drawings will not relieve the Contractor of his Responsibility with respect to the accuracy of such drawings, nor to provide suitable equipment as specified, provide that any discrepancies, errors or omissions are not due to inaccurate information or particulars furnished in writing by the Engineer.
2. Any delay resulting from the failure to provide accurate and sufficient drawings And other information in time to suit the construction programmed will be the Contractor's Responsibility.
3. The Contractors attention is drawn to the need to provide extremely Comprehensive documentation with regard to the plant & materials associated with the convention meetings, in order to allow fault finding / remedial action to be carried out as quickly as possible.

24. PROGRESS DRAWINGS:

1. Maintain on site a set of drawings showing the progress of the works and any modifications carried out during the installation stage. The progress drawings shall be transferred/ maintained/ kept up to date via the C.A.D. drawings, which shall ultimately form the record drawings.
2. Progress drawings shall be available to the Engineer for his inspection during the contract period.

25. RECORD DRAWINGS:

25.1 Produce a comprehensive set of 'as installed` drawings, based on the Progress Drawings, for the purpose of providing a complete and clear record of the Works for the future users.

25.2 FORMAT:

Produce the final drawings, after corrections to take into account any comments by the Engineer, to a standard A1 metric size to BS 3429 : 1975 and in accordance with BS 308 : Part 1 : 1972 to ensure suitability for micro-filming

25.3 C.A.D. RECORD DRAWINGS:

The Contractor shall together with the paper prints of the Record Drawing hand over two copies on separate CD- Readable media C.A.D. files in D.X.F. format of all Record drawings. Each disk shall also contain an A.S.C.I. "README.TXT" detailing the contents of the disk and any special information relating to the use of the disk.

25.4 TITLE:

Incorporate an approved 'Title Block` on all drawings with the following information clearly indicated.

1. Name of project
2. Scale of drawing
3. Title of drawing incorporating the name and location of the service or services shown.
4. Drawing number in accordance with an approved numbering system designed for use by all trades.
5. Name and address of the Main Contractor and the Sub-Contractor.
6. Contract number for the Main Contractor and the Sub-Contractor.
7. Date of completion of the installation.

25.5. CONTENT:

Ensure that the drawings contain the following information for each service installed.

1. The precise location of all multi-core cables.
2. The routes of all cable ladder, trays and trucking including number and sizes of the cables associated with them.
3. Location of distribution equipment, control panels and terminal equipment.
4. The name of the manufacturer, model and type number and all details of duty and rating of all items of equipment.
5. The precise locations, sizes, types and duty of all conduits concealed within the building structure including draw-in. boxes.
6. The precise locations, depths, sizes and duty of all underground services, including cables,

pipes, inspection chambers, cable markers, and precise entry points to buildings.

25.6 DRAWINGS.

1. Provide to the Engineer for comments at the time of the final inspection two paper prints of each of the preliminary Record Drawings.
2. Provide the Employer with two paper prints and one polyester negative of each final drawing within two weeks of practical completion.

25.7 CONTRACTOR'S RESPONSIBILITY:

Comments by the Engineer on any Record Drawing will not relieve the Contractor of his responsibility with respect to the Accuracy of the drawing, nor will it imply the Engineer's acceptance of responsibility for the accuracy of completeness of the drawing.

1. The Contractors attention is drawn to the need to provide extremely comprehensive documentation with regard to the plant & materials associated with the convention meetings, in order to allow fault finding / remedial action to be carried out as quickly as possible.

26. INSTRUCTION MANUALS.

26.1 GENERAL:

Compile a comprehensive set of Manuals for the purpose of providing the future users with a clear and complete understanding of the correct procedures for operating and maintaining all installations, plant and equipment installed under the electrical section of the work.

26.2 CONTENT:

Provide the following information:

1. Detailed description of all operation procedures.
2. Full details of the regular maintenance procedures recommended by the Manufacturer's for each item of equipment.
3. List of spare parts to be kept in store for each item of equipment in accordance with the manufacturer's recommendations.
4. Manufacturer's printed manuals, regarding operating and maintenance procedures for all items of equipment.
5. Fully detailed manufacturer's drawings showing the construction of each item of equipment.
6. Fully detailed internal and external wiring diagrams.
7. Where two or more items of equipment are identical then one set of instructions will be accepted, but in the case of similar, but not identical items, then a set of instructions must be provided for each item.

26.3 INDEXING:

Clearly indicate on the cover or on the inside front page of the Manuals the following information:

1. Document Index and/or Content List. The index may include only the main headings of all sections of the document, but in that case the individual sections should be preceded by a content list giving full details of the documentation included within the section.
2. Name, address and telephone number of the Contractor.
3. Date of installation.

27 ISSUE:

1. Supply one copy of the preliminary manuals to the Project Manager for comments not less than eight weeks prior to the final inspection preceding the 'hand over to the Employer.
2. Provide the Employer with two copies of the final and approved manuals at the date of 'hand over' of the completed Contract.
3. contractor has to submit the Shop drawings for consultant /clients approval before execution ,after completion contractor has to submit the AS built Drawings [record drawings]

28 FORMAT:

Compile the final copies of the manuals after corrections to take into account any comments made by the Engineer, into adequately bound volumes with suitable covers to withstand continual usage.

29 FAILURE OF INSTALLATION:

Failure of any part of the installation subsequent to the 'hand over` that can be attributed to lack of maintenance or incorrect operation by the User caused by omitting to supply adequately detailed Operating and Maintenance Procedures at the time of 'hand over`, must be rectified at no expense to the Employer.

The Contractors attention is drawn to the need to provide extremely comprehensive Documentation with regard to the plant & materials associated with the convention Meetings, in order to allow fault finding / remedial action to be carried out as quickly As possible.

30. INSTRUCTION OF EMPLOYER'S STAFF:

30.1 COMMISSIONING PERIOD:

Set all the installations to work during the commissioning period, and employ competent personnel (including manufacturer's representatives as necessary) to demonstrate and explain to the Employer's staff, with the aid of the Instruction Manuals, the correct procedures for

operating and maintaining the complete installation.

31 SWITCHROOM NOTICES.

31.1 SCHEMATIC DIAGRAM:

Provide in each main switch room a durable non-fading print of the schematic diagram on a varnish timber base with a perspex front cover, or equal, and erect it on the switch room wall using screw fixings.

31.2 TREATMENT FOR SHOCK CARD:

1. Provide in each main switch room a card which indicates the action necessary in the Treatment of persons injured by electric shock.

2. Mount the card on a varnished timber base with a perspex front cover or equal and Erect it on the switch room wall using screw fixings.

31.3 INSPECTION NOTICE:

1. Provide a Periodic Inspection Notice in the form prescribed in the IEE Regulations, with the addition of the Installing Contractor's name.

2. Mount the notice on a varnished timber base with a perspex front cover, or equal and erect on the main switch room wall beside the schematic drawings using screw fixings.

32. MATERIALS TO BE HANDED OVER.

32.1 Hand over to the Employer, tools, loose equipment and the like (where specified) and obtain the Employer's signature of receipt for such material.

33.2 Submit a copy of each receipt with the final account for the Contract, together with an inventory of the materials handed over.

33.3 Spare parts and tools

33 SPARE PARTS:

Hand over to the Employer the spare parts specified.

34 TOOLS:

Provide specialist tools sufficient to carry out maintenance and major repair work on Switchgear, electrical equipment and plant items included in the Contract.

35 APPLICATION FOR POWER SUPPLY, FEES, PERMITS, TESTS AND INSPECTION/APPROVAL BY LOCAL AUTHORITIES:

The contractor shall be responsible for filing and follow up of application for getting the drawings/scheme approved by the Electrical Inspector and finally the whole installation shall be got approved by the Electrical Inspector. The contractor shall pay all fees and the same shall be reimbursed by the Owners at actual on submission of receipts, on completion of this work, the contractor shall obtain and deliver to the Architects/Owners certificate of final inspection and approval by the Local Electrical supply authority. The Architect/Owners shall have full powers to require the materials or works to be tested by an independent agency at the Electrical Contractors expenses in order to establish their soundness and adequacy.

36 QUIET OPERATION AND VIBRATION ISOLATION.

All equipment shall operate under all conditions of load without any sound or vibration, which is objectionable in the opinion of the Owner's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The Contractor shall guarantee that the equipment installed shall maintain the specified NC levels.

37. ACCESSIBILITY

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his ducting and piping. His failure to communicate insufficiency of any of the above shall constitute his acceptance of sufficiency of the same. The Contractor shall locate all equipment, which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed control damper, valve or other requiring attendance, should be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Accessibility (Access panel / Access) shall be standardized for each piece of equipment / device / accessory and shall be clearly nomenclature / marked.

38. COMPLETION CERTIFICATE (By Contractor's Licensed Personnel)

On completion of the installation, a certificate shall be furnished by the Contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The Contractor shall be responsible for getting the entire installation for the system duly approved

38.1 FACTORY INSPECTION AND TESTING.

The Owner may carry out inspection and testing at Manufacturer's works for equipment covered herein. All such testing and inspection expenses shall be to Contractor's account. Such tests shall generally prove that the equipment to be supplied complies the Specifications and relevant Standards. Tests shall also demonstrate suitability in terms of site conditions, operational and control facilities, circuitry of controls, protection etc.

If performance tests are not satisfactory, the Contractor shall, at his own expenses, rectify the defects observed, and re-conduct the tests to Owner's satisfaction. . The equipment shall be tested again after removal of defects, found if any, and shall be delivered and installed only after approval by the Owner's representative. Equipment shall be delivered without the consent from Owner, in writing.

38.2 ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labor and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the Contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed. A certificate to the effect that adequate training has been imparted shall be obtained by Contractor from the Owner's designated official.

39. MAINTENANCE DURING DEFECTS LIABILITY PERIOD.

1.1 Complaints.

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

1.2 Repairs.

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Maintenance runs concurrently with the defects liability period, all replacement parts and labor shall be supplied promptly free-of-charge to the Owner.

40. UP TIME GUARANTEE.

The Contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period,

the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all, power consumption, voltage, amperage, p.f. and all other parameters related to the installation, ambient temperature, temperature of the equipment, starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tendered shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tendered shall include a list of other projects where such an Operation Assistance has been provided.

42. INVENTORY:

Provide an inventory in duplicate, which lists and identifies by manufacturer's references each spare part or tool handed over to the Employer at the Practical Completion of the Contract.

43. GENERAL SCOPE.

43.1 The Contractor shall furnish all tools, welding equipment testing equipment, test connections and kits, etc. required for complete installation, testing and commissioning of the items included in the contract work.

43.2 The rates quoted by Contractor shall include all necessary MS channels, angles, etc. required for erection of panels, distribution boards, etc. in floor / walls/ cable trenches as required unless otherwise specifically mentioned as extra.

43.3 The contractor shall co-operate through the Architect/Owner/Engineer with other contractors at site, in all matters of common interest, so as not to obstruct operation of others and to ensure the safety of all personnel and works covered under this specification.

43.4 The work shall be carried out strictly as per the instructions and execution drawings. In case of any doubt/misunderstanding as to correct interpretation of the drawings or instructions, necessary clarifications shall be obtained from the Owner/Architect. This contractor shall be

held responsible for any damage to the equipment consequent to not following the Manufacturer's instructions correctly. All necessary drawings, Manufacturer's equipment manuals shall be furnished to the owners and a copy to Architects.

43.5 All thefts of equipments/component parts, after take over by the Contractor, till the installation is handed over to the Owner, shall be made good by the Contractor.

43.6 The Contractor shall have a separate cleaning gang to clean all equipment under erection and as well as the work area at regular intervals to the satisfaction of the Owner/Architects. In case the cleaning is not to the Owner's satisfaction he will have the right to carryout the cleaning operations and any expenditure incurred by the Owner in this regard will be to the Contractor's account.

43.7 In order to avoid hazards to personnel moving around the equipment such as switchgear, etc. which is kept charged after installation before commissioning, such equipment shall be suitably cordoned off to prevent anyone accidentally going near it.

43.8 The Contractor shall carry out touch-up painting on any equipment indicated by the Owners/Architects, if the finish paint on the equipment is soiled or marred during installation handling.

43.9 Equipment shall be installed in a professional manner so that it is novel, plumb, and square and properly aligned and oriented. No equipment shall be permanently bolted down to foundation or structure until the alignment has been, checked and found acceptable by the Owner/Architects.

44 TOOLS, TACKLES AND OTHER MATERIALS.

44.1 The Contractor shall also furnish all necessary consumables like anchor bolts and nuts, raw plugs, hacksaw blades, taps, dies, drills, files, wire brushes, necessary pipe scaffolding, ladders, wooden and consumable material like oxygen, acetylene, greases, cleaning fluids, fasteners, gaskets, temporary supports, cotton waste and all other miscellaneous supplies of every kind required for carrying out the work under the contract.

44.2 The Contractor shall not dispose off transport or withdraw any tools, tackles, equipment and material provided by him for the contract without taking prior written approval from Owner/Architect. Owner/Architect at all times shall have right to refuse permission for disposal, transport or withdrawal of tools, tackles, equipment and material if in his opinion, the same will adversely affect the efficient and expeditious completion of the project.

45. HANDING OVER AND TAKING OVER OF WORKS/EQUIPMENT/SYSTEMS.

The Contractor shall hand over and the Owner shall take over the works/equipments/systems covered under this contract only after they have been completely installed, tested and commissioned in all respects by the Contractor to the entire satisfaction of the Owner/Architect and after the said operation. And all relevant test forms/certificates operation and maintenance manual's, as built drawings, etc. Incomplete/partly commissioned works/equipments/system will not be taken over by the Owner. In this regard, the decision of the Owner/Architect will be final and binding on the Contractor.

46. CHANGE IN QUANTITY.

Purchaser reserves the right to amend the quantities to be supplied and erected as necessary and for any such amendments the unit rates offered by Contractor shall apply. Actual Quantity may vary from tender BOQ.

47. ACTUAL QUANTITIES.

The Contractor shall verify the exact quantities of Electrical items / materials/ equipments etc., as per site measurements and as per shop drawing / execution drawings issued by the Client engineer before procuring get the procurement clearance for each schedule and non scheduled items from Consultant / client .

2 - SPECIFICATION FOR 33 KV INDOOR VCB PANEL

The VCB shall be manufactured as per the following specification , tender BOQ and drawings . In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization , In absence of such deviation, it will be presumed that equipment offered is exactly similar to the specification , tender BOQ and drawings. client /consultant decision is final

1.0 STANDARDS

33 KV switchgear shall conform to IS: 2516 –1980 or latest with subsequent modifications there of Cubicle shall conform to IS: 3427 Part 1, 3 PH enclosures. , Indoor Switchgear and control gear fully type tested according to IEC 62271-200 standards. The Circuit Breaker shall confirm to IEC-62271-100.

2.0 GENERAL

The switch gears offered shall be suitable for Indoor operation, designed on well proven technology incorporating the latest developments. The switch gear shall be suitable for 33 KV 3 phase 3 wire 50 Hz solidly grounded

Each of these panels shall be complete with vertical isolation horizontal draw out VCBs. They shall include current transformer, potential transformer, Multi- function Meters, Digital Numerical relays mimic diagram (test blocks) with Semaphore Indication & Indicating lamps, terminal blocks switches, Annunciations , etc. as stated.

3.0 FEATURES

The breaker shall be of draw out type, compact and with light weight operating mechanism of Motorized, Breaking current rating shall be 26.3 KA and making current of 50KA. The design has to be got approved by Chief Electrical Inspectorate. Operation shall be free of unusual noise. The breaking unit shall be housed in a vacuum interrupter ensuring maintenance free operation.

4.0 CUBICLES

Each breaker shall be housed in a sheet steel cubicle made of 3mm thick CRCA Sheet Steel and 2mm thick partition sheets forming stationery housing of rigid construction with rails on the base for the movement of the truck. The panel shall be dead front type and of robust construction. These shall be suitable for extension on both sides. The panels shall have easily interchangeable with the other same make VCB's. The cubicle shall be of IP-54 protection.

Locking facility shall be provided for safety shutters in the bottom housing, to ensure safety after removing the VCB truck. It should also be possible to lock shutters of the with draw able PT in closed position and when it is not racked in Mechanical emergency trip shall be provided for operation through cubicle door, in addition to tripping and closing the push buttons.

Necessary bus bar inter connections and barriers from panel to panel through out the length of the switch board shall be provided and between and adjacent existing panels wherever needed.

All control and supply cables will be routed in a trench under the cubicles. The cubicles shall be of sheet steel of thickness 3mm and light steel sections. The construction shall be insect, vermin and dust proof. Hinged doors with locking facilities shall be provided to prevent unauthorized and inadvertent access to live components.

4.1 OPERATION:

The operating mechanism shall be in the front portion of the circuit breaker and should be easily accessible on opening the front door.

The closing/ tripping button operation provided on the front shall also indicate the position in the switching indicator and number of operations shall be counted by the operating counter. Control supply of 110V DC is made available for operations .shunt trip coil voltage is 110 V DC supply to be considered

The breaker shall be designed for the trip free i.e. it shall allow the circuit breaker to open if tripped at any point in the closing stroke.

The circuit breaker shall be provided with self aligning sockets contacts designed to engage the plugs in the spouts located on the fixed portion of the unit. The fixed main contact shall also be self aligning type.

4.2 INTER LOCKS

Integral mechanical inter locks shall be provided to ensure safety of the operating personnel as well as the equipment. Misfire interlock: Once the VCB is closed, further re-closing shall be blocked till the VCB is tripped.

Main closing interlocks: VCBs shall not be withdrawn or plugged in the closed position. The VCB shall not be in a position to be closed in any intermediate position except service or test/withdrawal position.

4.3. SHUTTER GEARS

There shall be automatic sliding plates for the complete enclosure of bus bars and feeder orifices. These shall open and close mechanically by insertion of the moving truck portion of the tank. Means shall be provided to open these manually and retain in open position by a catch. These catch shall be released automatically when the truck is inserted in the fixed portion of the unit.

In addition to the above sliding plates, it is preferable to have independently hinged shutters to

cover the bus bars and feeder orifices and preferably pad locked separately.

4.4. BUSBAR AND BUSBAR CHAMBER

Bus bars shall be of high conductivity Electrical grade **Copper** shall be closed in air insulated chambers and shall be of uniform cross section through out the length of the switch board. Bus bar chamber shall be air tight and during rainy season, there shall not be any tracking of supply. Panel Heaters shall be provided in panels. Maintainability of Bus-bar chamber: In case of failure of Bus bar section, to attend faulty section, provision shall be available in Bus bar chamber to isolate faulty section and energise healthy section.

Comprising the 3 single phase **Aluminium /COPPER** busbars and the connections to the circuit breaker compartment. The busbar system shall be air insulated. The bus system is also required to withstand the specified impulse voltage level without the use of filled compounds, hand wound tapes etc.

Bus bars shall be rated to withstand all dynamic and thermal stresses for the full length of the switchgear. Bus bars shall be constructed from hard drawn, high conductivity, extruded **Aluminium /Copper**. Solid or tubular bars shall make connections to the main bus bars. No other wiring shall be included in the busbar compartment. The main bus bars in the busbar compartment shall be of either flat, round or tubular Aluminium

The frame and all other metallic non-current carrying parts of the switchgear shall be bonded together and earthed through the external connection to a through going earth bar along the switchgear. There are terminals for connection to the external station earth bar at the bottom of each cubicle.

4.5. CABLE BOX

These shall be mounted at the rear and should be designed for 33 KV, 240/300 Sq.mm / 3C X 1 Run, Cross linked polythene cables. The cable box shall be mounted in the cubicle above the floor level. Sufficient Clearance shall be available from Live Conductors to cover.

These Cable Box shall be Dust, vermin Proof and Protection level will be IP-54.

Multi core terminal boxes for control wiring shall be provided at the rear and should have required number of terminal boards and glands.

5.0 POTENTIAL TRANSFORMER

All voltage transformers shall comply with IS 3156 , Voltage transformers shall be of dry type,

with ratings and ratios as required. Voltage Transformer (VT) shall be cast-resin with built-in primary fuses, VT's shall be draw out type. Voltage transformer shall be independent of circuit breaker carriage

They shall be Resin Cast, draw out type, suitable for open delta connection. They shall have fuse protection on both HT & LT sides. They shall be of the draw out type and the fuses shall come out along with the potential transformers. The ratio of the potential transformer shall be 33 KV/110V and shall have a burden of 200VA. The potential transformer shall conform to IS: 3156/1978 and subsequent modification thereof.

6.0 CURRENT TRANSFORMER

The current transformer shall be suitable for metering and Protective relaying purpose as detailed. They shall conform to IS: 2705-1981 part I, II & III. The burden of CT shall be 15VA for both metering and protection and the secondary shall be 5 Amps. The rated primary current , turns ratio, knee-point voltage and resistance of the secondary windings (corrected to the maximum service temperature) will be according to submitted schedule for approval.

7.0 DIGITAL NUMERICAL RELAYS

Relays will be provided as specified in class 22.3. These will be operated in conjunction with 24V/48V /110V DC shunt trip relays. The relays shall be of fixed / draw out type, flush mounted and back connected and shall have test plugs for testing.

8.0 SPECIFICATION FOR DIGITAL, NUMERICAL, PROGRAMMABLE OVER CURRENT AND EARTHFAULT RELAY

8.1 Numerical Combined relay with three phase fault poles and one earth fault pole with two independent transient free hi-set elements, the relay must be numerical type with a minimum of 9 inputs and 7 outputs.

8.2 The over current protection element can be used as definite time lag and inverse definite minimum time lag protection. The inverse time mode should have normal inverse, very inverse, extremely inverse and long time inverse characteristics.

8.3 Relay (current relays) should have 1A/5A site selectable feature.

8.4 Relay should be suitable for auxiliary voltage of 110VDC with + 20% variation.

8.5 Output contacts: Minimum two for tripping and two for annunciation. These should be user programmable each of this can be programmed at site either as Hand Reset/ Self Reset. Output contact minimum energizing time shall be programmed at site (100ms to 500ms)

8.6 Digital input: Minimum four digital inputs should be provided. These should be user programmable. Each of this status input shall be used as time delay on pick-up or time delay on drop-off or both. The Programmable status inputs to be provided to accommodate transformer faults such as Buchholz, Oil temperature and winding temperature for both alarm and trip function. It should be possible to program the text message for these status inputs, which will appear in the front LCD of the relay in the event of respective fault.

8.7 Multiple setting groups: Relay should be provided with multiple setting groups with facility to switch from one group of settings to another to suit alterations in the power system configuration. A minimum of 8 (eight) Programmable groups to be available as standard in the Numerical relay.

8.8 Relay shall have the following additional features:

Circuit breaker fail protection

Trip circuit supervision – it should be possible to monitor the trip coil both in ON/OFF

Condition of circuit breaker and in case of trip circuit failure, a message should be flashed On the relay. CT Supervision feature.

8.9 Data Records: Following Data stamped data records should be available

- Event Recorder, which can record minimum of 100 events with data and time stamping.
- Disturbance Recorder, which can record minimum of five records.
- The front fascia of the relay should have a LCD display and it should be possible to read minimum of 3 fault records with date and time stamping on the front facial.

8.10 Self monitoring: The relay should incorporate a number of self-monitoring features, which cover both hardware and software.

8.11 User interface relay shall have a user interface for setting, operation and interrogation of the relay. The interface shall consist of:

- Liquid crystal display.
- Light emitting diodes for indicating “Protection healthy”, “trip” etc.
- Keypad for controlling the functions of the relay.

8.12 The Numerical relay should have a local HMI. It should be possible to download the information from the relay and interrogate with the relay from remote,

8.13 The relay should also have the Fibre Optic communication port as an in-built feature of the relay.

8.14 Relay shall have open protocol namely IEC 60870-5-103.MODBUS-RTU, or Ethernet for TCP/IP Communication

8.15 Relay should have non-volatile memory (for settings & fault data information). Even in case of DC failure the data should be stored.

8.16 Relay in general should confirm IEC-255 and with specific reference to Ratio Frequency interference, fast Transient and Electro Static Discharge.

Suitable terminal shorting devices for current circuit and fuses properly marked for potential circuits shall be provided to facilitate the relays and meters to be tested and calibrated.

9.0. INSTRUMENT PANEL

These shall be separate assembly suitable for flush mounting type instruments and relays and Mounted above the fixed portion of the circuit breaker cubicles.

10.0 MULTIFUNCTION METER

The Multi- Function Meter shall be of switch board Flush mounted type industrial grade, boxes Connected are flush mounted with dust tight cases suitable for tropical climate.

11.0 MULTI-FUNCTION METER SPECIFICATION

a). Multifunction Meter Characteristics

All parameters (of each bay) shall be measured by direct input to a single IED. The IED shall have the following characteristics

Accuracy	:	Class 0.5
Connection	:	3 Phase 3wire, Direct / CT Connected
Voltage Variation	:	-40% to +20%
Current	:	10A (60A), 20A (80A) – Direct Connected meters (or Suitable rating) 1A (1.2A), 5A (6A) – CT Connected Meters
Frequency	:	50Hz, +/- 5%
Power Consumption	:	<1.5W & 8VA per phase in voltage circuit <2VA in current circuit
Display	:	LED / LCD
Mounting Type	:	Projection / Flush Mounted (Preferred)

b). Measurement Functions

The Multifunction meter shall measure the following parameters

1. 3 Phase Current
2. 3 Phase Voltage
3. KVAR
4. KVA
5. KWH Import
6. KWH Export
7. KVARH Import
8. KVARH Export
9. KVAH
10. Power Factor and
11. Frequency

The programmed for KWH indication alone shall be part of programming. The Performance and testing of the meter shall conform to the standards like ISI 13779 / IEC 62053 / IS14697

Communication Capability

The multifunction meter shall be provided with a Galvanic ally isolated optical communication port as per the standard IEC 1107 for flush mounting type so that the metering data can be easily down loaded through CMRI and with hardware locking arrangement so that it can be easily connected to a CMRI (Common Meter Reading Instrument) for data transfer and a RS485 port for data exchange./transfer on Mod bus RTU protocol or Ethernet. The Software for interfacing to Desktop PC for future analysis shall be part of supply

OPTIONALLY

There is a proposal to connect Multi function Meters to real time energy Monitoring System at RWF, hence suitable Provision shall be available in the Multi Function Meters. This shall be quoted separately as Annexure A and this cost shall be not being taken for Evaluation.

Cable Requirement

The cable from the multifunction meter to the RTU shall be Shielded Twisted Pair RS485 cable with 0.75 Sq. mm minimum core cross-section.

12. WIRING

The wiring shall be single core multi stranded and half tinned annealed copper wire, PVC insulated 1100V Grade and shall be of grouped type, laid out in flat formation and by means of cleats.

The wire shall run straight and shall be given right angle bends (and in case of wires running from

cubicle to cubicle they shall be properly protected). Ferruling of control cable is to be done with at end of cable in flexible conduit

The size of the wiring in different circuits shall not be less than those specified below.

10. PARTICULARS	11. SIZE
(a) Metering and relay circuit connections to current transformers or through	6 sq.mm
(b) Potential circuits for metering, relaying, indicating Alarm etc.	6 sq.mm

Terminal ends of all wired shall be provided with properly numbered ferrules for circuit identification.

COLOUR OF WIRE	12. 13. CIRCUITS WHERE USED	COLOUR OF FERRULE
Red Yellow Blue Green Black	Red phase of instrument transformer circuits Yellow phase of instrument transformer circuit Blue phase of instrument transformer circuits Neutral connection AC 240/415V supply	Red Yellow Blue Green Respective phase Red, yellow

13. INDICATING LAMPS

Lamps covered by suitable colour translucent material shall be used to indicate the position of the circuit breaker. The lamps shall be of low voltage switch board type, suitable for replacement from the front of the panel. 15% of lamps used initially shall be supplied to serve as spares.

14. TEST BLOCKS

Test blocks with contactor rated for 10A continuously and 150A for at least 1 Sec on 250V shall be provided for testing. They shall be of stud & disconnecting type. Devices for short circuiting the terminals of the current transformer shall be provided. Suitable identification mark shall be fixed near the test blocks for the purpose of identification of the circuits.

15. MIMIC DIAGRAM

6mm wired mimic diagram shall be provided on the top of the switch board to represent the single line arrangement of the system. They shall be provided with red and green lamps , Semaphore Indicators, indicating switch positions.

16. CONTROL SWITCHES

Circuit breaker control switches will be spring return type with pistol grip having ON and OFF momentary operating position and automatic neutral return normal release position. The control spring shall be strong enough to prevent inadvertent operation due to light touch. Selector switches for ammeter shall short circuit the current transformer circuit before it opens and removes the short circuit after the ammeter is inserted in the circuits.

17. SAFETY EARTHING

Earthing of juice free metallic part of the equipment on the switch board shall be done with soft drawn single conductor, bare copper. The main earth connection shall not be less than 50 sq.mm and the tail connection shall not be less than 137 sq.mm.

18 . VACUUM CIRCUIT BREAKER PANEL (Technical details):

18.1 System: 33 KV, 3 phase, 50Hz (26.3 KA fault level) effectively earthed.

18.2 Scope and location: incomer panels and outgoing panels factory assembled flush front metal enclosure switch gear with 3 phase air insulated continuously rated bus bars of 400A current carrying capacity with provision of extension on both ends.

18.3 Instruments and control: This panel shall have instruments and control switches as follows.

18.4 (A) INCOMER BREAKERS: Qty.- Nos

- | | |
|---|--------------------|
| (i) One set of CTs for combined metering and protection with dual Accuracy, bushing type of ratio 200/1-1 A | } One each per VCB |
| ii). 3phase draw out type PT having output of 200VA and accuracy Class 0.5 with primary and secondary fuses PTR 33 KV/110V- | } |
| iii). Instruments and control switches in each breaker panel- | } |
| iv). Multifunction Meter | } |
| v). Digital Numerical Relays | } |
| vi). Local/Remote selector switch | } |
| vii). VCB open and close indicator lamp | } |
| viii). VCB control switch trip neutral – close | } |

(B) OUTGOING BREAKERS: Total No

- i). One set of CTs for combined metering and protection with dual Accuracy, bushing type of ratio 100/1-1A } One each per VCB
- (ii) 3phase draws out type PT having output of 200VA and accuracy Class I with primary and secondary fuses PTR 33 KV/110V- }
- iii). Instruments and control switches in each breaker panel- }
- iv). Multifunction Meter }
- v). Digital Numerical Relays }
- vi). Local/Remote selector switch – }
- vii). VCB open and close indicator lamp }
- (viii) VCB control switch trip neutral – close

18.5 VACUUM CIRCUIT BREAKER:

The TP vacuum circuit breaker shall be of proven design incorporating latest developments in vacuum technology suitable for indoor application. This vertical isolation and horizontal draw out type shall be safe to operate, maintenance free and highly reliable. Other details as follows.

- (i) Standards : IS: 2516 / IEC-56
- (ii) Rated / Nominal voltage : 36KV / 33 KV
- (iii) Rated current : 800 A
- (iv) Rated breaking current(S/C) : 20KA
- (v) Rated making current(S/C) : 50KA
- (vi) Breaking capacity(crest value) : 350MVA at 33 KV
- (vii) (a) Rated short time current for 1sec : 26.3 KA
- (b) Rated breaking time (cycles) : 1
- (viii) Rated insulation level (a) 75KV peak-lighting (1x40hms) impulse stand voltage.
- (b) 28KV peak-1 minute power frequency withstand voltage
- (ix) Rated frequency : 50 Hz
- (x) Rated transient recovery voltage : As per IS: 2516 / 1980
- (xi) Rated operating sequence : OFF: ON: OFF suitable for rapid Auto re-closing

(xii) Earthing of neutral	: Neutral earthed system
(xiii) Ambient temperature	: 40 degree centigrade maximum.
(xiv) Class	: Indoor application duty
(xv) Closing operation	: Motor charged spring operation with 110V DC closing coil, closing power
>370W and manual also	
(xvi) Tripping	: Shunt trip, tripping power>400W
(xvii) (a) Operating duty	: 0-min-CO-3-min-CO
(b) Operating time	: 0.03 sec
(xviii) Auxiliary switches	: 06 NO + 06 NC
(xix) Current transformer	: 200/5A, 150A protection and
Ammeter – 03 Nos.	
(xx) Interlocks	: Mechanical – 01 set
(xxi) Shutters	: Automatic safety shutter – 01 set
Including pad locking arrangement	
(xxii) Bus bar chamber	: Air insulated COPPER bus bar chambers 800A rating.
(xxiii) Potential transformer	: 01 No of 33 KV 110V of 100VA ----- / ----- $\sqrt{3}$ $\sqrt{3}$
(xiv) Multifunction Meter	: One each with selector switches
(xxv) Numerical Relay	: TP, non-directional Numerical Relays
(xxvi) Housing	
: Metal clad housing with truck having integral circuit breaker (Raising and lowering mechanism).	
(xxvii) Counter	: Mechanical operation counter
(xxviii) Vacuum interrupters	: Ideal for substation application of make Alstom, C.G.
(xxix) Special tools	: Manual charging handle –
01set/VCB Raising / Lowering – 01 set	

NOTE :

1. The suitable current transformers have to be used as per the system requirement and approval of engineer-in-charge
2. Cable trench has to be modified as per the site condition
3. UG Cable connection has to be carried out from Existing Cables

19.0 PAINTING

The frame work and the unfinished surface of steel panels shall be sand blasted to remove rust, scales and foreign adhering matters. Then the parts shall be given a primary coat of corrosion resistant paint which shall be followed by two coats of machine gray. The finishing coat shall be SIEMENS GREY of RAL 7032 shade.

20.0 Annunciate Unit

All Control Panels shall be provided with Static and Audible and visible fault indications. The Scheme shall be so designed to give the following indications and shall be suitable for operation from available sources. The circuit Breaker trips on fault the minimum indications are as follows,:

- a) Bucholtz relay Operation
- b) High Oil Temperature
- c) High winding temperature
- d) Low Oil Level
- e) Earth fault
- f) Spares 4 to 6 windows for future usage

Provision shall be made for transmitting signal if required to remotely locate signaling system to indicate tripping of incoming Circuit breaker on fault. Provision shall be made to transmit the alarm and tripping to 33 KV panel.

The annunciate shall be complete with relay unit, Push Button, hooter, all wired up. The auxiliary relays for Transformer Bucholtz relay, temperature indication and tripping & unit shall be mounted on the Panel. All wiring from these terminal Boards stop the Switch gear section shall be external to Bus duct. It shall have Test, Accept & reset facility.

22.0 General Notes for the Tenderers

22.1 Supply includes pipe line material along with other hardware Materials & fasteners.

22.2 The above contract includes Civil Engineering works like Cable trenches shall be made of brick masonry, with Cable racks and chequered plate covers as per Drg.

22.3 Fabrication work includes Angular Supports for HT VCB panels.

22.4 All necessary tools, tackles, welding equipments, brazing equipments shall be brought by contractor.

22.5 The Tendered shall ensure after Service & service Backup for minimum 6 to 8 Years including Spares Availability for all Critical Electrical and Electronic Equipments.

22.6 The Tendered shall submit Designs, Drawings to Consultant / Client for approval, and after obtaining approval the execution of work shall be started.

22.7 The above Electrical & Electronic equipment of latest design/version which is Superior in facilities shall be acceptable.

23.0 Inspection

The Transformer, VCB, Digital Numerical Relays, Multifunction Meters shall be inspected at firms premises as per IS relevant Specifications. The Tendered shall arrange Inspection facilities at the Works Premises, and 10 days prior information shall be informed to Consultant / Client. All testing Facility shall be made available at Works Premises.

All Boarding & Lodging expenses for 2 persons to be arranged by contractor.

24.0 PERFORMANCE TEST

The Tendered shall establish to the satisfaction of the client for the operational capability of the equipments at manufacturer facility to meet the standard output stipulated here under in the Tender Part of Technical Specification. After satisfying himself by confirming the equipment has been installed properly and necessary adjustments are made.

25.0 DOCUMENTATION

The Tendered shall supply 4 sets of relevant drawings consisting of General Arrangement showing Location of Electrical Items in Drawing, Layout of Panels, Circuit Diagram, and Wiring Diagram. The same shall be given in CD form also.

The relevant Test certificates of OEMs, Calibration Certificates traceable to National Standards shall be part of documents Catalogues, Technical Literatures, of Electrical Items shall be part of document

Instruction and Maintenances Manual of Electrical diagrams shall be part of Documents.

Details of IC, Memory Chips of Proprietary in nature shall be furnished in Manuals.

26.0 TRAINING :

Training shall be imparted to Supervisors, Technicians, of client staff regarding Operation and Maintenances, Programming of Multifunction meters, Digital Numerical relays, Calibration of Multi function Meters, and other relevant Instruments as deems necessary.

27.0 SPECIFICATIONS:

In case of deviations to specifications mentioned above, Consultant / Client shall be approached for such deviations. A written request shall be made to Consultant / Client for his approval.

SPECIFICATION FOR ERECTION, TESTING & COMMISSIONING OF 33 KV VCB PANELS

1. Unloading, Inspection, Storage, Installation, Testing & Commissioning of Switchgear shall be in accordance with (IS latest edition) and manufacturers instruction.

2. HANDLING :

Switchgears and all its accessories shall be handled carefully in its upright position as indicated in the packing case. Lifting lugs and jacking pads shall be used for lifting of the switchgear, while using jacking pads utmost care shall be taken in proper application of jacks. Where switchgear is dragged or pulled on sleepers or rollers, traction eyes provided at the bottom frame shall be used with suitable wire ropes and shackles.

3. STORAGE

Equipment shall be stored under shelter in a well ventilated dry place and covered by suitable polythene or tarpaulin covers for protection against moisture. Where excess moisture/damp conditions prevail, and storage is for longer durations. Space heaters provided shall be energized temporarily.

4. General Requirements

Environment within the switch room shall be kept to acceptable limits to allow equipment storage and installation to take place without damage.

Under no circumstances shall any item of equipment be forced. Every fit will have been checked in the Manufacturer's works and if force is required the equipment shall be rechecked, realigned and the necessary corrective action taken until force is not required.

Only the correct size and type of tools shall be used in the erection of switchgear.

Should finish paint chip off or crinkle during transit/handling installation, the contractor shall arrange for repainting the equipment at site at his own cost.

5. Foundations and Positions

Base plates for switchgear shall be installed before final screening of the switch room floor. Panels shall be installed over a trench.

Switch room floor screening shall be completed and levelled before switchgear is brought into the substation and installed.

Floor fixings shall be checked to ensure that they are level, in the correct position to match the fixings of the switchgear, and in accordance with dimensions given on the drawings. Correct clearances and also location of cables inlet / outlet shall be checked in relation to trenches holes through slabs, ducts, etc.

6. Installation

Before installation starts switch room floor shall be clean and tidy.

Installation of switchgear shall be executed in accordance with the Vendor's information

Only nuts, bolts and washers supplied with switchgear shall be used for bolting switchgear, bus bars, etc.

The center section shall be installed first (in its final position), such that when the complete switchboard is finally erected, correct clearances are obtained. The centre section shall be checked to ensure that it is vertical.

The centre section shall be kept as flush to the floor as possible. It shall, if possible, be in direct contact with the fixing channel, so allowing any out-of-level flooring to be evenly spread over the whole length of the switchboard. Initially, fixing bolts shall be hand-tight only.

Before placing each section, checks shall be made for any items such as bushings, taps, wires, links, packing, etc., that need to be threaded or inserted, before placing of the adjacent section, ensuring that such items are not tightened.

Final placing of sections to either side of the centre section shall be undertaken alternately, with levelling and shimming as necessary.

Serial numbers of each unit shall be checked against arrangement drawings to ensure that each section occupies its correct position.

Bolts shall be placed through each side panel and hand-tightened accurately, ensuring lining-up the switchboard until the whole switchboard is installed.

Each section shall be bolted, and tight, to the fixing channel.

Fixing bolts shall be used in every position that has been provided for them.

Bus bar contact surfaces and tee-off connector surfaces shall be checked to ensure that they are clean on both sides.

After cleaning, faces shall be wiped with a clean rag to remove all dust; particular care shall be taken to keep metal dust from bulbar insulation.

Starting at the center section and working outwards in each direction, floor fixing bolts shall be tightened on each unit in turn, taking up even pressure on each bolt.

As each panel is complete, checks shall be made to confirm that it is perfectly vertical. All units shall be complete in this manner. Between fixing of sections, Bus bar and insulators shall be checked to ensure that no strain is placed on them.

Following tightening of each section, alignment shall be checked to ensure that all withdraw able units can be inserted and withdrawn. All doors shall be checked for proper operation.

Working from the center, each pair of side panels shall be tightened together. All buses and earth connection shall be tightened.

Working from the center section, bus bars shall be tightened and insulators checked.

Positioning and tightening of bus bars shall be such that no strain is placed on insulators, tee-off connectors, etc. and bus bars are correctly aligned.

All extraneous material, objects, etc. shall be removed from the bulbar chamber and bulbar covers replaced.

7. Earthing and Bonding

Switchboard shall be earthed and bonded in accordance with the Earthing layout design drawings, the Manufacturer's instructions.

8. Instruments and Relays

Any instruments or relays supplied loose with switchboards shall be fitted, and connected in accordance with the vendor's diagrams.

All relays shall be cleaned of dust, and shall have all packing and shipping stops removed. Compressed Air shall not be used to clean internal relay parts.

Before any loose items are fitted they shall be checked against the drawings to ensure that they are fitted in the correct position on the correct section.

9. Wiring

Switchboard will be completely internally wired in the Manufacturer's works, but all internal inter panel wiring shall be done at site; they shall be connected in accordance with the wiring diagrams.

When loose items of equipment have been fixed, they shall be connected in accordance with the wiring diagrams.

10. TESTS :

The following preliminary checks and pre commissioning tests shall be carried out before commissioning the Switchgears in the presence of Buyers/Architect's representatives.

11. Preliminary Checks :

- 1.1.1. Check name plate details according to specification.
- 1.1.2. Check for physical damage.
- 1.1.3. Check tightness of all bolts, clamps and connecting terminals.
- 1.1.4. Check earth connection.
- 1.1.5. Check cleanliness of insulators and bushings, arc chambers.

- 1.1.6. Check all moving parts are properly cleaned and lubricated.
- 1.1.7. Check space heaters provided.

PRECOMMISSIONING CHECKS:

Check alignment of breaker trucks for free movement. Check correct operation of shutters.
Slow closing/opening operation.

Check control wiring for correctness of connections, continuity and IR values.

Manual operation of breakers.

Power closing/opening operation manually and electrically.

Breaker closing and anti-pumping operation.

Breaker local / remote opening closing.

Values, resistance and minimum pick up voltage of coils.

Contact resistance of all site assembled bus bars.

Simultaneous closing of all three phases.

Pole discrepancy tests.

Check electrical and mechanical interlocks provided.

Check on spring charging motor correct operation of limit switches and time of charging.

Check on C.Ts / P.Ts Polarity / ratio.

All functional checks with the relays, meters, alarm scheme, interlock as per scheme with primary / secondary injection kits.

High voltage tests on Control and Power Circuits.

TESTS

12.1. TYPE TESTS

Cubicles shall be type tested in accordance with latest IEC standards. The following type tests have been performed and available

- Short time and peak withstand current test
- Temperature rise tests
- Dielectric tests
- CB make break duty test
- Ingress protection test
- Internal Arc Test for 26.3KA for 1 sec

Cubicle and circuit breakers are to be of supplier's own products.

12.2. ROUTINE TESTS

Routine tests shall be carried out in accordance with IEC 62271-200 standards. These tests shall ensure the reliability of cubicle. Below listed test shall be performed as final acceptance tests before the delivery of cubicles;

- Withstand voltage at power frequency
- Withstand voltage on the auxiliary circuits
- Operation of functional locks, interlocks, signalling devices and auxiliary devices
- Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism
- Measurement of the resistance of the main circuit
- Verification of wiring
- Visual inspection

3. TECHNICAL SPECIFICATION FOR 33KV 3 PHASE, 50 Hz SYSTEM ONAN DISTRIBUTION TRANSFORMER

The transformer shall be manufactured as per the following specification , tender BOQ and drawings . In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization , In absence of such deviation, it will be presumed that equipment offered is exactly similar to the specification , tender BOQ and drawings. client /consultant decision is final

1.0 SCOPE:

Transformer shall be suitable for continuous rating as stated in BOQ, Specification and on drawings. The following Specification covers the supply of transformer required for the proposed Project.

2.0 : GENERAL INFORMATION:

2.1 Transformer shall be designed, manufactured and equipped with accessories in accordance with this Specification and the applicable Standards indicated below

2.2 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance and service life.

2.3 Transformers shall be suitable for the following ambient conditions:-

2.4 Design ambient temperature : 5 degree C Maximum Temperature + 50 degree C.

2.5 Maximum humidity : 100%

The transformer shall be double copper wound core type, oil naturally cooled suitable for **Indoor /Outdoor** Installation. The transformer shall be designed and manufactured as per IS 2026-1977 with up to date amendments and Transformer shall be selected, Installed & Maintained as per IS Code of Practice IS 10028 (Part I) - 1985 with up to date amendments and having no load voltage ratio as 11000/433V. Rating of Transformer shall be as per BOQ item.

3.0 CODE AND STANDARDS:

3.1 The transformers shall conform to the requirement of the latest revisions of the following Codes & Standards.

IS: 10028	: Installation and Maintenance of Transformers, Code of Practice
IS: 2026(Part 1 to V)	: Power Transformer
IS: 3639	: Power Transformers, fittings and accessories
IS: 335/	: Specification for new insulating oils for transformers
IS: 12463	&switchgear
IS: 2099	: Bushings for alternating voltage above 1000V
IS: 5 - 1951	: Colours for ready mixed paints and enamels
IS: 648	: Non-oriented electrical steel sheets for magnetic circuits
IS: 1866	: Code of practice for maintenance of insulating oil
IS: 2166	: Guide for insulation co-ordination
IS: 6600	: Guide for loading of oil-immersed transformers

3.2 Wherever Indian Standards are not available, the Transformer shall conform to relevant International Standard.

4.0 DESIGN CRITERIA:

4.1 The Transformers shall be oil-filled and designed for natural cooling, Natural oil cooling by means of pressed/round tubes around transformer tank (ONAN).

4.2 The Transformer impedance shall be as specified to limit the fault level on the LV side. The neutral of the low voltage winding will be solidly grounded.

4.3 The Transformers with all accessories shall be capable of withstanding the thermal and mechanical effects of short-circuits at the terminals of any winding without adverse effect.

4.4 Account shall be taken of the different forms of system fault that can arise in service, such as line to earth faults and line faults associated with the relevant system and transformer earthing conditions. The short-circuit levels will be as specified in the Data Sheet.

4.5 The Transformers shall be capable of continuous operation at its rated output without exceeding the temperature limits as below (50°C above ambient temperature)

In top oil by Thermometer	:	50°C
In winding by resistance	:	55°C

4.6 Overloads shall be allowed within the conditions defined in the loading guide of the applicable Standard. Under these conditions, no limitations by terminal bushings on load tap changers or other auxiliary equipment shall apply.

4.7 The Transformers shall be capable of continuous normal operation at its rated output under the following conditions:

Voltage varying by $\pm 10\%$
Frequency varying by $\pm 3 \%$

4.8 The Transformer shall be designed and constructed so as not to cause any undesirable interference in radio communication circuits.

4.9 Steel bolts and nuts exposed to the atmosphere shall be either galvanized or zinc-passivated.

4.10 Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washers or locknuts.

4.11 Transformer design shall take care of protection against surge voltage.

4.12 Internal design of Transformer shall ensure that air is not trapped in any location.

4.13 The neutral terminal windings shall be designed for the highest over current that can flow through this winding.

4.14 The design of Transformers shall be such as to reduce noise and vibration to the level obtained in good modern practice. The noise ratios, impedance, load losses and no-load losses as per ECBC standards, the Supplier's guarantees shall be within the tolerance given in applicable Standards.

4.15 Vector Group

Corresponding to the vector symbols Dyn-11.

4.16 Connections :

H.V. side of transformer shall be provided with cable box suitable for 3 core 240 /300/400 Sq.mm XLPE cable. Indoor heat shrinkable termination kit shall be used for termination of HV Cable. MV side of transformer shall be suitable for Bus Trunking / Bus Duct connection arrangement.

4.17 Tapping

ON load tap changing arrangement on 11kv side. The range for circuit taps which shall be provided on HV side shall be plus 10 % to minus 10% in steps of 1.25 %.

4.18) Temperature Rise :

The transformer shall conform to the requirements of temperature rise specified in IS 2026 (Part II) 1977. Continuously rated for full load, temperature rise not to exceed 50 degree C by thermometer in oil (55 degree C by resistance).

4.19) Insulation Levels

The insulation level shall be in accordance with IS : 2026 (Part III) 1977.

4.20) Terminal Markings, Tapings & Connections,

The terminal marking, tapings & connections shall be in accordance with IS 2026 (Part -IV) 1977.

4.21) Requirement with regards to ability to withstand short circuit As per IS : 2026 (Part I) 1977.

4.22) Impedance Voltage

As per table 3 of IS : 2026 (Part I) 1977.

4.23) Tap changing switch

An externally hand operated on load tap changing switch with handle and a position Indicating plate & locking device.

4.24) Parallel Operation

Transformer shall be suitable for parallel operation with similar unit of same rates.

5.0 TRANSFORMER TANK:

5.1 The tank shall be of electrically welded construction and fabricated from sheet steel of adequate thickness. Tanks shall be hydraulically tested to ensure that they are leak-proof and subjected to vacuum test.

5.2 The tank shall have adequate strength to withstand without any deformation (i) Mechanical shock during transportation and (ii) oil filling by vacuum

5.3 The tank shall also be provided with two numbers grounding pads for Earthing.

5.4 The transformer tank shall be provided with sets of bi-directional flat wheels for rolling the transformer parallel to either centre lines.

5.5 Jacking pads, lifting eyes and pulling lugs shall be provided to facilitate lifting and movement of the transformer, filled with oil. All heavy removable parts shall be provided with eye bolt for ease of handling.

5.6 The transformer top shall be provided with a detachable tank cover with a bolted flanged gasket joint. Lifting lugs shall be provided for removing the cover. If necessary, the surface of the cover shall be suitably sloped so that it does not retain rain water.

5.7 Adequate space shall be provided at the bottom of the tank for collection of sediments.

5.8 The Transformer base shall be designed to permit skidding of the complete Transformer unit in any direction. Pulling eyes shall be provided for moving the Transformer in either direction.

5.9 The material used for gaskets shall be rubberized cork sheet. Casketed joints for the tank and manhole covers bushings and other bolted attachments shall be oil-tight and so designed that the gasket will not be exposed to the weather.

5.10 Tank shall be provided with a pressure release devices which shall operate at a pressure below the test pressure for the tank and radiators. The device shall be rain-proof after blowing and shall be provided with a device visible from ground to indicate operation. An equalizer pipe connecting the pressure relief device to the conservator shall be supplied.

5.11 Materials in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or Cadmium plated.

5.12 Inspection covers of manholes of sufficient size shall be provided for access to leads, windings, bottom terminals of bushings and taps.

5.13 Oil sampling taps shall be provided with valve at top and bottom to collect sample of oil from the tank for testing.

5.14 To facilitate the oil filtration by streamline filter, suitable inlet and outlet taps with valves at the bottom and at the top of the tank on diagonally opposite corners shall be provided. The valve at the bottom may be used as drain valve.

5.15 Thermometer pocket for top oil temperature measurement by liquid thermometer shall be provided.

5.16 Marshalling kiosk boxes, etc. shall be weatherproof having a degree of protection to IP 54.

5.17 Cooling tubes or radiators shall permit every part of the cooling surface to be cleaned by hand and shall be suitably braced to project them from mechanical shock. Each radiator bank shall be detachable type and provided with oil isolating valves at either sides.

5.18 The Transformer tank shall be fitted with a double diaphragm type of explosion relief vent at the top with equalizer pipe connection to oil conservator.

5.19 Explosion relief vent should be located on the top cover and directed in such a way that on bursting of diaphragm; the oil forced out will not fall in any of the auxiliary equipment of the transformer and the other electrical equipment in the vicinity.

6.0 CORE AND COIL:

6.1 The core shall be built of high quality, low loss, non-ageing high permeability grain-oriented, cold rolled silicon steel lamination with very low magnetization losses and annealed to relieve stresses and develop excellent magnetic properties.

6.2 The core clamping frame shall be provided with lifting eyes for the purpose of taking and inspecting the core with windings mounted thereon and shall have ample strength to take the

full weight of the core and winding assembly. The core assembly shall be electrically connected to the transformer tank for effective core Earthing.

6.3 All insulating materials shall be of proven design. Coils shall be so insulated that voltage stresses are minimum.

6.4 The windings shall be from electrolytic copper conductor of high conductivity with suitable Class "A" insulation. The windings shall be duly sectionalized. Accessible joints braced or welded and finished smooth shall connect similar coils.

6.5 Coil assembly shall be securely positioned with spacers, pressed board cylinders, barriers and shall be so arranged as to allow free circulation of the oil.

6.6 All leads from the windings shall be suitably supported to prevent damage from vibration or short-circuit stresses.

6.7 The core and coil assembly shall be rigidly braced and fixed on to the tank so that no shifting or deformation occurs during transport and installation or during short circuits.

6.8 The finally assembled core with all clamping structure shall be free from deformation and shall not vibrate during operation.

6.9 The core clamping structure shall be designed to minimize eddy current loss.

6.10 The end turns on the high voltage windings shall have reinforced insulation to withstand any of the voltage surges likely to occur during switching or any other abnormal system condition.

7.0 INTERNAL EARTHING:

7.1 All internal metal parts of the transformer, with the exception of individual laminations, core bolts and their individual clamping plates shall be earthed.

7.2 The top clamping structure shall be connected to the tank by a copper strap. The bottom clamping structure shall be also earthed.

7.3 The magnetic circuit shall be connected to the clamping structure at one point only and this shall be brought out of the top cover of the transformer tank through a suitably rated bushing. A disconnecting link shall be provided on transformer tank to facilitate disconnections from the ground for IR measurement purpose.

8.0 TAPPINGS:

8.1 **ON LOAD circuit taps** as specified shall be provided on the high voltage winding

8.2 The Transformer shall be capable of delivering its rated output at any tap position.

8.3 The winding including the tapping arrangement shall be designed to preserve the electromagnetic balance between HV and LV winding at all voltage ratios.

9.0 INSULATING OIL:

9.1 The insulating oil shall conform to the latest revision of IS: 12463 properly inhibited for prevention of sliding.

9.2 The necessary first filling of oil, shall be supplied for the transformer. 10% excess oil shall also be provided (to take care of wastes) in non-returnable containers suitable for outdoor storing.

10.0 TRANSFORMER BUSHING:

10.1 All transformer bushings shall conform to the requirement of the latest revisions of IS

10.2 All porcelain used in bushings shall be homogenous, nonporous uniformly glazed to brown colour and free from blisters, burns and other defects.

10.3 Stresses due to expansion and contraction in any part of the bushing, shall not lead to deterioration.

10.4 Fittings made of steel or malleable Iron, shall be galvanized. Each bushing shall be so coordinated with the transformer insulation that all flash over will occur outside the tank.

10.5 The bushings shall be located so as to provide adequate electrical clearances between the bushings and also between bushing and ground.

11.0 . TERMINAL ARRANGEMENT:

11.1 The HV terminals shall be brought to an air-insulated disconnecting chamber forming a weatherproof assembly.

11.2 The secondary terminations shall be brought to an air-insulated disconnecting chamber which in turn connected to bus duct able box connection as required forming a weatherproof assembly.

11.3 The cable boxes shall have all standard facilities suitable for XLPE/PILC/PVC cables/Copper/Aluminium wire bus duct as mentioned in the data sheet.

11.4 The disconnecting chamber shall be air-insulated. Bushings, drain breather, removable covers, shall be provided for the disconnecting chamber, Plates through which high current carrying conductors pass, shall be non-magnetic.

11.5 Phase to phase and phase to ground clearances within the chamber, shall be such as to enable either the Transformer or each cable to be subjected separately to H.V. tests.

12.0 NEUTRAL TERMINAL:

12.1 The size of the neutral bushings shall be as that of phase bushings. On the LT side, two bushings shall be provided for neutral, one through top side wall bushings to the LV bus duct and other connection to Earthing. A neutral CT of required ratio, burden and knee point voltage shall be mounted inside the Transformer LV cable box for restricted earth fault protection. This will be a matched current transformer which will be mounted in H.T. Switchgear. Secondary of the C.T. to be brought out to a marshalling box of IP 54 suitable for connection to control cable.

12.2 Earth portion of the Cable End Box shall be provided with 2 Nos. grounding pads suitable for Purchaser's 50 x 10 mm G.I./Copper flat.

13.0 AUTOMATIC ON LOAD TAP CHANGER (OLTC) WITH RTCC AND AVR.

1. The equipment shall be of high speed, transition resistance type conforming to IS : 8468 and suitable for outdoor installation.

2. The OLTC shall employ rotary snap action switching with both selector and diverter duties combined.
3. The OTCL shall have 16 steps of 1.75% each to give a total voltage adjustment limit of 28%.
4. The OLTC must be suitable for mounting externally on a flange provided on transformer Tank and shall have an independent oil filled chamber. The oil in the changer tank shall not mix with oil in the main tank. An oil surge relay with alarm contact shall be provided.
5. The OLTC operating mechanism shall be housed in a separate enclosure, which shall be totally dust and weather proof with a cable entry gland plate at the bottom.
 - a. The control equipment shall comprise the following.
 - b. Mechanical tap position indicator.
 - c. Handle for manual operation.
 6. Tap change operation counter.
 - a. Technical stopper to prevent over cranking of the mechanism beyond extreme tap Position.
 - b. Driving mechanism chamber locking arrangement.
 - c. Terminal boards with connector for transformer tap leads.
 - d. Phase reversal protection relay.
 - e. The control equipments shall further include the following for auto operation.
 - f. Incoming power supply ON-OFF TPN load break switch.
 - g. Driving motor suitable to operate on 415V, 3phase, 50Hz ,AC supply, the motor shall be of the totally enclosed, horizontal foot mounted type with class-B insulation.
 - h. Over load and short circuit protections for the motor.
 - i. Contractors for `Forward` and `Reverse` operation along with protective.

- j. Anti-condensation heater
- k. Selector switch for `Lower` and `Raise` operation.
- l. Safety limit switches for `Lower` and `Raise` extreme limits.
- m. Direction sequence switch and stepping relay
- n. One PT of suitable VA burden for sensing the degree of correction
- o. Interlock between manual and electrical operations.
- p. Any other accessories as may be required for the satisfactory operation of the unit.
- q. One automatic voltage sensing and tap changing relay (AVR) with adjustable time gap between tap changer.
- r. One digital tap position indicator.
- s. One 16 window 24 V DC alarm annunciate and auxiliary contactors for fault contact multiplication
- t. One auto-manual selector switch and one control supply `ON-OFF` switch.
- u. One indicating lamp to show Tap change in progress with hotter and one lamp for tap changer failure indication, remote hotter provision to be made.
- v. One local / remote selector switch.
- w. One spring return to neutral types raise / lower switch.
- x. Set of terminals for incoming and outgoing cables.
- 7. One set of control MCBs, Elmex terminals, wiring, Earthing etc.
- 8. The following accessories shall be provided with transformer:

14.0 ACCESSORIES

- a. Temperature Indicator.
- b. Built on radiators.
- c. Conservator tank.
- d. Marshalling Box.
- e. Gas & oil Actuated Relay (Buchholz relay).
- f. Wiring for above.
- g. Metal treatment and painting.
- h. Tolerance on performance guarantees – As per IS.

15.0 High Speed Resistor ON Load Tap Changer

General

High speed resistor On-Load-Tap Changer shall be provided with the transformer wherever Specified. The high speed, resistor, OLTC shall be for rated voltage up to 11KV, rating current of 100 Amp, 3 phases, 17 steps conforming to IS 8468-1977 complete with AVR & RTCC panel.

Type and Construction

OLTC shall be a compact unit for use with three phase distribution and substation transformer. It shall be completely self contained and designed to bolt directly to a part flange on the transformer.

The assembly comprises of :

- (a). Tank
- (b). Selector Switch
- (c). Driving Mechanism
- (d). Barrier Board
- (e). Local Control Gear
- (f). Control Cable Terminations
- (g). AVR & RTCC Panel

Tank

The complete tap changer shall be housed in a single tank of welded sheet steel construction. The tank shall be divided into two separate compartments to house the selector switch, Driving Mechanism and Local Control Gear. Access to the compartments shall be made easy by means of

removable covers and a weatherproof door. Anti-condensation heater shall be provided in the compartment which houses driving mechanism and control gear.

Selector Switch

The three phase of the tap-changer shall be adequately spaced for full interphase insulation but Mounted as a common assembly using vertical synthetic resin bonded insulating boards, each carrying a circle of fixed contacts. Insulating rods and tubes shall be used for the horizontal spacing of the phases and the fixed contacts shall be connected via the barrier board to appropriate tapings in the transformer winding. Each phase shall have a single rotary contact support ring with sliding contact take off connection. This ring carries separately insulated spring loaded snap connected by a non inductive resistance unit accommodated on the contact carrier. One main moving contact shall be connected directly to the centre boss take off point, the second; transition moving contact shall be connected to the resistor. The three contact support rings shall be attached to the central insulating.

Drive shaft, which rotates in self aligning ball bearings in the two outer phase boards. This centre shaft shall be of glass reinforced synthetic resin construction. Access to the selector switch shall be via removable cover on the top of the tank.

Drive Mechanism

Operation of the selector switch shaft shall be by means of a stored energy spring device having a positive snap-action for rotating the moving contacts quickly through the angle required for each tap change. The driving mechanism compartment shall be external to the oil filled switch tank. The rotary drive from the driving mechanism to the selector switch shall pass through a frictionless positive oil-tight gland. The angular movement of selector switch shaft shall be controlled by an indexing wheel which shall positively lock by the periphery of the operating cam except during the actual time of tap-change operation. The operating cam shall be freely mounted on its shafts, rotation being imparted to it by means of tension springs attached radially between the operating cam hub and the periphery of a concentric spring carrying gear wheel. The spring carrying gear wheel shall be rotated by a driving motor through cam. When the drive pin on the operating cam enters the slot in the indexing wheel the lock shall disengage but rotation shall be prevented by the locking arm pawl engaging in another slot of indexing wheel. The spring carrying gear wheel continues to rotate thus charging the springs. When sufficient energy has been stored a trip pin on the gear wheel shall lift the locking arm restraining the indexing wheel and the spring energy shall be released to move the tap selector switch one position, the cam locking coming in operation, accurately controlling the angular movement. The

operation of the selector switch shall be thus positively assured and shall be dependent only upon the quick release of the spring energy. It shall be thus independent of the motor drive. The tap changing sequence shall now complete and the driving motor shall bring to rest by the resetting of auxiliary switches and mechanical friction device. For protective purpose automatic declutching by shear pins shall be incorporated in the drive. The mechanism shall be provided with the auxiliary switches necessary for its operation. A step by step switch for position indication shall also be fitted and additional paralleling & out of step switches provided. A tap change mechanical counter, mechanical tap position indicator, mechanical end stops and electrical limit switch shall be provided. A detachable handle for hand operation shall also be provided. The fitting of this handle shall automatically disconnects the motor drive shaft by the operation of a simply spring loaded dog clutch and at the same time isolates the electrical control supply.

Barrier Board

The connections from the transformer winding shall be taken through an insulating terminal barrier board, which shall be supplied loose for clamping to the transformer port flange. Thus the transformer shall be treated and filled with oil before the tap changer is fitted. This arrangement allows the tap selector switch contacts to be inspected or the complete tap changer to be handled separately without disturbing the oil level in the transformer.

Local Control Gear

The motor reversing contactors and associated local control gear shall be housed in the same compartment as the driving mechanism with a common hinged weatherproof door. Weatherproof local control switches when required shall be mounted in an accessible position below the door.

Operating Mechanism

An impulse is received, either from a remote control panel or from a local manual operation switch, which energises the appropriate raise/lower contactor to initiate a tap changer in the required direction. The contactor when energised seals itself via its own contact and the driving motor commence to run. At a predetermined point a directional sequence switch closes, taking over the holding duties of the contactor whose original self-hold circuit shall be isolated. At the completion of the tap change the directional sequence switch opens and de-energises the driving motor. This arrangement ensures that a short period initiating pulse shall be accepted by the control gear.

16.0 TECHNICAL PARTICULARS TO BE FURNISHED BY BIDDERS FOR TRANSFORMERS

<u>Sl.No.</u>	<u>Description</u>	<u>kVA,</u>
1.	Name of Manufacturer	:
2.	Rated kVA	:
3.	Type of Cooling	:
4.	Vector Group Reference	:
5.	No load voltage ratio on all tapes	:
6.	Power factor on existing current at 100% 100% voltage at 50 CPS.	: :
7.	Iron losses at 50 Hz and 100% rated Voltage.	: :
8.	Copper losses (at 75 Deg.C) at rated Full load.	: :
9.	Resistance voltage (kVA at 75 Deg. C in %)	:
10.	Reactance voltage (kVA at 75 Deg.C in %.	:
11.	Impedance voltage (kVA at 75 Deg.C in %)	:
12.	Zero phase sequence impedance	:
13.	Resistance of windings 75 Deg.C	
	a) H.V. per phase	:
	b) L.V. per phase	:

14. Regulation % at

a) Full load : Unity PF :

0.8 PF (Lag) :

b) $\frac{3}{4}$ Load : Unity PF :

0.8 PF (Lag) :

c) $\frac{1}{2}$ Load : Unity PF :

0.8 PF (Lag) :

15. Efficiency at 75 Deg C

Full Load :

a) Unity P.F. :

b) 0.8 P.F. (Lag) :

$\frac{3}{4}$ Load :

a) Unity P.F. :

b) 0.8 P.F. (Lag) :

$\frac{1}{2}$ Load :

a) Unity P.F. :

b) 0.8 P.F. (Lag) :

16. Magnetizing in rush current peak at
Instant of switching :

17. Symmetrical short circuit current
(Assume infinite source). :

18. Time of withstand without any damage :

Under symmetrical short circuit conditions.

19. Thermal time constant :
20. Max. Flux density in core of 100% rated Voltage. :
21. Current density at rated load
- a) H.V. winding. :
- b) L.V. winding. :
22. Insulation level of windings HV/LV :
- a) Impulse full wave. :
- b) Separate source Voltage test. :
- c) Induced voltage Over test :
23. Maximum noise level. :
24. Temperature rises above 50 Deg.C Ambient temp. :
- a) In oil by thermometer :
- b) In winding by resistance :
- 25. TAP CHANGER:**
- a. Type and make of Tap changer :
- b. Tap voltage range as of rated Voltage :
- c. Number of taps :

d. Time required for one tap change Of OLTC Gear :

e. Whether OLTC operated conforms :
To specification complete :

f. Dimension of OLTC control panel :
(LxWxH) :

26. WIRING:

a. Details of wiring between various :
Equipments of OLTC Gear/ Control
Panel.

27. WEIGHTS:

a.Weight of core & windings :

b. Tank with fittings :

c. Oil :

d. Total Weight :

e. Quantity of oil for complete filling

1. for Transformer :

2. for OLTC Chamber :

F. Total dimension of Transformer :

1) L x B x H :

2) Whether transformer conforms to :

3) Specification and data sheet, if not,

4) List out the deviations

a.Whether accessories tools and spares :

b. As specified included. If not please

c. Specify deviations.

d. Whether all technical catalogues :`

e. Furnished.

**17.0 TECHNICAL PARTICULARS FOR ON LOAD TAP CHANGER WITH RTCC & AVR FOR
.....KV/433V TRANSFORMER**

Design, Manufacture and supply of 3 Phase 50 Hz, copper wound, Oil immersed, Core type Distribution transformer with OLTC, RTCC & AVR and following specifications.

Ref Standard	IS 2026
Installation	indoor / Outdoor
Rating	-----KVA
Voltage Ratio	11000/433 Volts
Vector Group	Dyn11
Tap Range	+10 % To -10% in steps of 1.25% through OLTC.
Insulation class	A
Cooling	ONAN
Temperature rise @ 50°C ambient	
In oil by thermometer	50°C
In winding by resistance	55°C
Impedance	5 / 6.3 / 7 %
Paint Shade	632 of IS 5
First filling of oil	Conforms to IS 335

Terminal Arrangement: HV Cable box

Terminal Arrangement: LV Bus duct

Quantity 2 Nos.

18.0 THE TRANSFORMER WILL BE HOUSED IN A WELDED STEEL TANK AND BOLTED COVER CONSTRUCTION WITH THE FOLLOWING FITTINGS:-

1. Rating & Diagram Plate	9. Jacking lugs
2. Earthing terminals	10. Insepection cover
3. Lifting lugs	11. Oil level indicator
4. Thermometer pocket	12. Drain cum bottom filter valve
5. On load tap changer with RTCC+AVR	13. Top filter valve with plug
6. Air release hole with plug	14. Bi-directional rollers
7. Oil conservator with drain plug	15. Slicagel breather
8. Pressure relief valve .	16. Cooling Radiators

19.0 EXTRA ACCESSORIES:

- 1) Buchholz Relay with alarm and trip contacts.
- 2) Marshalling box with OTI & WTI with alarm and trip contacts.
- 3) Magnetic oil level gauge with alarm contacts. Oil immersed Neutral CT

20.0 ON LOAD TAP CHANGER. -----KV-200A

(Suitable for 415V- 3 ph. 50 Hz operation)

Main fittings provided with OLTC

1. Single phase FHP Motor 1 No.
2. Motor drive contractor & overload protection 1 Set
3. Electrically locked forward and reverse contractors 2 Nos.
4. Raise and lower push buttons type of switches 1 set.

5.	Limit switches and Mechanical stops	1 Set
6.	Suitable devices to permit only one tap at a time	1 No.
7.	Manual operating device.	1 No.
8.	Mechanical counter (max operations)	1 No.
9.	Tap changer indicator (mechanical)	1 no.
10.	Space heater, door, saw, Internal light, MCB & Thermostat	1 set.
11.	Hinged door and locking device.	1 Set.
12.	Terminal blocks and internal wiring	1 Set.
	Auxiliary control transformer	1 No.
13.	First filling of filtered oil. (IS 335)	230 Ltrs.
14.	Tap pos. sensing devices for digital tap pos indicator	1 set.
15.	Oil filling plug	1 no.
16.	Drain plug	1 No.
17.	Inspection chamber	1 no.
18.	Surge operated relay (with 1 set of contacts)	1 No.
19.	Oil compartment for OLTC in main conservator with gauge	1 No.
20.	Other necessary interlocks MCBs and wiring	1 no.

NOTE: Inter connection cables between OLTC, RTCC & Marshalling box is in your scope of supply

21.0 REMOTE TAP CHANGER CONTROL PANEL (single transformer operation).

RTCC Panel shall be provided to operate OLTC from Control Room located in Substation. RTCC shall be provided with main switch, a sequence selector switch. RTCC shall be provided with lower push button & raise push button, tap change in progress & complete, A.C. supply ON/OFF lamp indicator & AVR relay operated indication. Cubicle panel shall be totally enclosed, floor mounting and fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness. All sheet steel work forming the exterior of RTCC panel shall be smoothly finished and all steel work used in construction of RTCC panel shall undergone a rigorous metal treatment process consisting of effective cleaning by hot alkaline degreasing solution followed by cold water rinsing, pickling in dilute sulphuric acid to remove scales and rust formation, a recognized phosphate process, passivating in deoxalite to retain & augment the effects of phosphate, drying with compressed air and dust free atmosphere, primer coating with two coats of highly corrosion resistant primer applied under strictly controlled conditions and finished coat of stoving synthetic enameled paint of grey color.

Suitable for auto/Manual operations with the following fittings:

- | | |
|--|--------|
| 1. Raise & lower push button switches | 1 Set |
| 2. Digital tap position indicator | 1 No. |
| 3. Auto manual (maintained contact type) selector switch | 1 set. |
| 4. Upper limit indicator | 1 No. |
| 5. Lower limit indicator | 1 No. |
| 6. Tap changer in progress lamp | 1 No. |
| 7. Tap changer isolation switch | 1 no. |
| 8. Space heater, Lamp, Fuses, door switch and thermostat | 1 set |
| 9. Potential Transformer 433V/110V (LV sensing for AVR) | |
| 10. Undrilled gland plate and lifting eyes. 24/ 110V DC Buzzer | |

All necessary terminal blocks & internal wiring.

22.0 . AUTOMATIC VOLTAGE REGULATOR (Electronic)

Solid state Automatic Voltage Regulator shall be provided for regulation of the secondary voltage of power transformer with on load tap changer (OLTC). The band width control shall allow the dead band to be set in terms of upper (LOWER VOLTS) and lower (RAISE VOLTS) voltage limits around a particular nominal value with a specified sensitivity. AVR shall be provided with time delay control to allow the regulator to respond only to voltage fluctuations lasting for period greater than a selected time delay. Where the voltage correction requires more than one tap change, the time delay shall be reinitiated before further tap changes. Regulation shall reset automatically after voltage correction. Solid state lamps (LED) shall be provided to indicate voltage outside the preset limits & control relay operation.

(Suitable for 110V AC Auxiliary supply mounted on RTCC Panel).

23.0 AUDIO VISUAL ANNUNCIATOR (Solid state 24V /110V DC)

(Mounted on RTCC panel)

9 Windows labelled indications for:

1. AC/phase sequence/motor fail.
2. Spare.

3. PT over voltage
4. Top oil temp. high
5. Buchholz Relay with alarm (trf)
6. Buchholz Relay with trip (trf)
7. Surge relay trip(OLTC)
8. Low oil level indicator
9. Winding temp. alarm

24.0 DRAWING:

OLTC GA drawing shall be sent us within a week for your approval after receipt of technically and commercially clear order at your end.

SPECIFICATION FOR ERECTION, TESTING & COMMISSIONING OF DISTRIBUTION TRANSFORMER

- 1 Unloading, Inspection, storage, installation, testing and commissioning of transformers shall be in accordance with IS 1886 (Latest Edition), and manufacturer's instructions.
2. Whenever stated, transformers will be delivered without oil, filled with inert gas and without bushings and externally mounted accessories as applicable. The contractor shall:
 - 2.1. Assemble the transformers with all fittings such as bushings, cooler banks, radiators, conservators, valves, piping, cables boxes, marshalling boxes, etc.
 - 2.2. Arrange for oil filtration before filling. If necessary, the oil filtration equipment shall be arranged by the Contractor.
 - 2.3. Provide wedges/clamps to rigidly station all transformers on rails.
 - 2.4. Connect up the transformers terminals.
 - 2.5. Lay and terminate the Owner's cables/conduits between all the accessories mounted on the transformer, marshalling Kiosk, etc.

Care shall be taken during handling of insulation oil to prevent ingress of moisture or foreign matter. In the testing, circulating, filtering or otherwise handling of oil, rubber hoses shall not be

used. Circulation of filtering of oil, the heating of oil by regulated short-circuit current during drying runs and sampling and testing of oil shall be in accordance with the manufacturer's instructions and specified Code of Practice.

3. HANDLING

Transformers and all its accessories shall be handled carefully in its upright position as indicated in the packing case. Lifting lugs and jacking pads shall be used for lifting of the transformer. While using jacking pads utmost care shall be taken in proper application of jacks. Where transformer is dragged or pulled on sleeper or rollers, traction eyes provided at the bottom frame shall be used with suitable wire ropes and shackles.

4. STORAGE

Transformer shall be stored under shelter in a place free from fire and explosion hazards. Care should be taken to see that moisture will not contaminate Oil inside the tank by checking all gaskets, bolts and nuts and accessories.

5. CABLING AND EARTHING

Cable shall be terminated at cable boxes only after IR value are measured and found to be in order. Neutral of the transformer shall be connected to two separate and distinct earth station through double run of earth tapes of suitable size. Where REF provided for Transformer Protection, C.T. Supplied loose shall be mounted in the transformer LV Box (Neutral) or a suitable weather proof box shall be mounted externally, as advised and the CT mounted in it. Either of the above shall be carried out as mentioned on the working drawings. The body of the transformer shall also be provided with effective Earthing as per the drawings and specifications.

6. MOUNTING AND ERECTION

The transformer shall be lifted by lugs or shackles or by any other suitable means (such as dragging on rollers) and mounted on the concrete plinth prepared for the purpose. Care shall be taken to see that transformer is not tilted during lifting and erection of transformer. The roller shall be checked to prevent movement of the transformer after being positioned on the plinth. Adequate and necessary clearance from walls, other equipments, etc. shall be provided as indicated on the drawings.

All the accessories and parts such as conservator tank buchholz relay, breather, explosion vent,

thermometer etc. should be mounted on the transformer. Tighten all bolts and nuts and check for any leakage. Leakage's if any shall be rectified.

Check the oil level and top it up if necessary with new oil. Dielectric strength of oil shall be tested as per IS/BS specifications, with an electric gap of 4 mm + or -0.02 mm polished electrodes of 12.5 mm dia using three samples of oil drawn from the oil drain valve of the transformer. The test voltage shall be raised from 5 KV to 50 KV in about 10 seconds. At least two samples of oil must withstand 40 KV voltages for one minute. Each drum of oil being used for topping up shall be tested before being used. The insulation resistance of the winding shall be measured with 5 kV/1kV DC megger and results shall correspond to the factory test results.

If dielectric strength of oil is not as per the requirement, the drying of oil shall be done with the help of suitable streamline oil treatment plant. While drying of oil is being done, the transformer shall be provided with suitable lagging all rounds. The temperature of oil in the spray tank shall not exceed 80 C during the purification process. After treatment, the oil must conform to the conditions laid down in IS Specifications. Phasing out test with 415 Volts applied to HV winding and voltage across LV winding being checked.

Measurement of neutral and body earth resistance with earth testing megger shall be carried out. The values shall not exceed 1 to 2 ohms as required. Functioning of buchholz relay (for alarm & trip), thermometer, and oil level indicator shall be checked and adjusted, if necessary. The transformer shall be charged only after the above tests are conducted and approval of the local authorities is obtained. The Earthing of neutral and body of the transformer shall be done as per I.E. regulations and requirements of local authorities.

The contractor shall supply all the materials and labour for unloading, storing, erection and commissioning of transformers.

7. TESTS

The following Preliminary checks and Pre commissioning tests shall be carried out before commissioning the transformers.

8. PRELIMINARY CHECKS

- Compare name plates details with the specifications.
- Check for any physical damage, in particular of bushings/Oil Leaks.

- Check tightness of all bolts, nuts, clamps, gasketing and connecting terminals.
- Check cleanliness of bushings.
- Check for oil leakage and oil level.
- Breather condition, check whether breathing line is free, silica-gel is reactivated, oil is available at the bottom.
- Check for clearances, particularly in case of bus ducts.
- Water tightness of terminal boxes and bus ducts.
- Earthing of transformer tank and neutral bushing.
- Releasing of air from bushing (very important) Buchholz Relay.
- Check that the transformer is correctly installed with reference to its HV / LV Terminals.

9. **PRECOMMISSIONING TESTS :**

RATIO, POLARITY AND PHASE RELATIONSHIP:

Check ratio on all taps and between all the windings, and compare with the values indicated in the test report. Check polarity and interface connection.

10. **WINDING RESISTANCE:**

Check winding resistance's at normal tap, and for other tap positions record the readings separately.

11. **FITTINGS**

The followings accessories and fittings shall be provided with the transformer.

(i). **Lifting Lugs** : The arrangement of lifting the active part of the transformer along with the cover of the tank by means of lifting lugs without disturbing the connections. Also complete transformer lifting lugs shall be provided.

(ii). **Rollers** : The transformer to be provided with 4 Nos. rollers fitted on cross channels to facilitate the movement of transformer.

(iii). **Oil Conservator:** The transformer to be provided with a conservator with welded end plates. It is to be bolted to the cover and can be dismantled for purposes of transport. It has to be provided with oil level gauge with marking for minimum level and an oil filling hole with a cap which can be used for filtering of oil. For draining purposes a plug is to be provided. A connection pipe between the conservator and main tank is to be provided, which projects inside the conservator.

(iv). **Air Release Valve:** An Air release valve shall be provided on top of the tank cover to facilitate the release of the entrapped air while filling of oil.

(v). **Breather :** The transformer shall be provided with an indicating dehydrating silicagel Breather of sufficient capacity.

(vi). **Drain Valve With Plug** : The transformer to be provided with drain valve with plug at the bottom of the tank.

(vii). **Diagram And Rating Plate** : One diagram and rating plate indicating the details of transformer connection, diagram vector group, tap changing diagram etc.

(viii). *Thermometer* : Dial type thermometer (100mm dia) with maximum set pointer 75 degree C. _

(ix). **Explosion Vent:** Explosion Vent or pressure relief device shall be provided of sufficient size of rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank.

(x). **Filter Valve** : Filter valve on the top of the tank.

(xi). **Bucholtz** : Oil & gas actuated relay equipment shall conform to IS 3637-1966 (Amended up to date) and shall be double float type having contacts which close following oil surge or under incipient fault condition. Bucholtz relay shall have contacts for alarm and trip.

(xii). **Winding Temperature Indicator:** Winding temperature indicator with electrical

contract for alarm and trip.

(xiii). **Oil Temperature Indicator** : Oil temperature indicator with alarm & trip contacts.

(xiv). **Marshalling Box** : The transformer shall be provided with suitable size marshalling box to terminate the control cables of thermometer and bucholtz relay. Control cabling between bucholtz relay / Marshalling box to H.T. Panel shall be deemed to be including in quoted rate of Transformer.

(xv). **Transformer Oil** : First filling of oil.

(xvi). **Earthing** : Two separate earthing terminals are to be provided at the sides of the tank on both sides for earthing.

12. Instrumentation Manual

The successful bidder shall submit three copies of manual of complete instructions for the installations, operation, maintenance and repair, circuit diagrams, foundation and trenching details shall be provided with the transformer.

13. Shop Drawings

Manufacturer shall prepare and furnish shop drawings for the approval by the Architect / Project Managers (PMC) / Engineer-in-Charge before commencing fabrication/manufacture of the equipment. Shop drawings shall be based on requirement laid down in the specification. The manufacture of equipment shall be commencing only after the shop drawings have been approved in writing by the Architect / Consultant / Project Managers (PMC). Transformer shall be manufactured as per approved specification of Local Supply Authority.

14. Installations:

(i). the transformer shall be installed as per installation manual of the transformer supplier and conforming to Indian Standard IS 10028 (Part-II) 1981 with upto date amendments.

(ii). the transformer is to be erected on suitable cement concrete foundation / flooring. The transformer supplied shall be lifted by all lifting lugs for the purpose of avoiding imbalance in transit.

(iii). the transformer wheels shall be locked by suitable locking arrangement to avoid Accidental movement of the transformer.

- (iv). The transformer cable end boxes shall be sealed to prevent absorption of moisture.
- (v). Dehydration at all the stages upto the handing over to the Owner shall be done by the Contractor free of cost.
- (vi). The transformer neutral earthing and body earthing shall be done as shown on the Drawing and shall conform to Indian Standard IS : 3043-1987 with upto date amendment.
- (vii). Two earths shall be provided for body earthing and two earths for neutral earthing. Copper shall be used for neutral earthing.

15. Factory Tests :

The transformer shall be subjected to test as laid down in IS 2026 (Part-I) 1977 at the Factory/manufacturing unit prior to despatch of the transformer to the site. All original tests Certificate shall be furnished.

16. Test at Site

Prior to commissioning of the transformer the following tests shall be performed.

- (i). Insulation resistance of the winding between phases and earth of H.V. and M.V. Side.
- (ii). Winding resistance of all the winding on all tap positions shall be taken.
- (iii). Di-electric strength of transformer oil shall be checked in accordance with IS 335-1963. Incase the test is not satisfactory, the oil shall be filtered till proper dielectric strength of oil is obtained. A certificate for the same shall be given to Owner.

Contractor / Manufacturer shall give sufficient advance information about the test schedule to enable the Project Managers to appoint his representative.

4. SPECIFICATION FOR SUPPLY & ERECTION OF 415V, 50HZ, LV SWITCHGEAR PANELS -

[TYPE : FORM -3B]

All the panels shall be manufactured as per the following specification, tender BOQ and drawings . In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization , In absence of such deviation, it will be presumed that equipment offered is exactly similar to the specification, tender BOQ and drawings

FORM 3B: Separation of bus bars from the functional units and separation of all functional units from one another. Separation of the terminals for external conductors from the units, but not from each other. The terminals for external conductors are separated from the bus bars

44 SCOPE

This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, Wooden packed for transportation complete in all respects with all components, fittings and accessories for efficient and trouble free operation.

45 GENERAL INFORMATION

2.1 The equipment's shall be designed, manufactured and equipped with accessories in accordance with this specification and the applicable codes standards indicated below. Materials and components not specifically stated in this specification but which are necessary for satisfactory and trouble free operation and maintenance of the equipment shall be supplied.

2.2 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance and service life as specified herein.

2.3 Switchboards shall be suitable for an ambient temperature of 40 C.

46 CODES AND STANDARDS

(a) The equipment covered by this specification shall unless otherwise stated be designed, constructed and tested in accordance with the requirements of the Indian Electricity Act and Rules and latest revision of the following standards.

(b) All codes & standards mean the latest, wherever not specified. The manufacturing shall Generally follow the Indian Standard codes of practice or the relevant British Standard Codes of Practice in the absence of corresponding Indian Standard.

IS 375	:	Arrangement of bus bars, main connection and auxiliary wiring.
IS 335	:	Insulating coils.
IS 722	:	AC electricity meters.
IS 1248	:	Direct acting electrical indicating instruments.
IS 13947	:	Motor starters AC, for voltage not IS 8544: exceeding 1000 V (Part-4, Sec 1) Direct-on-line AC starters.
IS 13947	:	Degree of protection provided by enclosures for low voltage (Part: - I) switchgear and control gear
IS 2419	:	Dimensions of panel mounted electrical Indicating and recording instruments.
IS 13947	:	Circuit Breakers.(Part 2)
IS 2607	:	Air-break isolators for voltage not :exceeding 1000 Volts.
IS 2705	:	Current Transformers.
IS 4201	:	Application guide for CT's
IS 13947	:	Contractors for voltages not exceeding (Part 4,sec 1) 1000 V AC or 1200 V DC.
IS 3072	:	Installation and maintenance of switchgear
IS 3231	:	Electrical relays for power system protection.
IS 13947	:	Air-break switches, air-break dis-connectors and for voltages not exceeding 1000 V AC or 1200 V DC.

- IS 3842 : Application guide for electrical relays for AC System.
- IS 4047 : Heavy duty air break switches and composite units of air break switches and INCOMER voltages not exceeding 1000 V.
- IS 4146 : Voltage Transformers. S 3156
- IS 13947 : General requirements for switchgear and control gear for (Part 1) voltages not exceeding 1000 Volts.
- IS 4483 : Preferred panel cut-out dimensions for electrical relays.
- IS 5124 : Induction motor starters, AC (voltage not exceeding 1000 V) installation and maintenance of code of practice.
- IS 5987 : Selection of switches (voltage not exceeding 1000 V)
- IS 6875 : Control switches for voltages up to and including 1000V AC &1200 DC.
- IS 8588 : Code of practice for thermostatic bimetals Part-I general requirements and method of tests.
- IS 8623 : Factory built assemblies of switchgear and control gear for voltages up to and including 1000 V AC and 1200 V DC.
- IS 8828 : Miniature air-break circuit breakers for voltages not exceeding 1000 Volts.

47 SCOPE OF SUPPLY UNDER THIS SPECIFICATION/CONTRACT

As per Schedule Bill of Quantities enclosed.

48 EQUIPMENT/SCOPE EXCLUDED FROM THIS SPECIFICATION/CONTRACT

All concrete foundations.

49 DESIGN REQUIREMENT

6.1 The switchboards shall be designed for 415 V, 3 phases, 4 wires, 50 Hz supply. Switchboards shall be rated for minimum fault level as mentioned in data sheets / Drawings.

6.2 Control power supply of the switchboards shall be 240 V, 1 Phase, 50 Hz AC supply tapped from the respective module itself or 110V DC supply with power pack .

6.3 The switchboards manufacturers shall apply all de-rating factors necessary to all components of the switchboards to comply with the conditions detailed in this specification.

6.4 The ratings of motors, control-gears, Circuit Breakers etc. furnished in the drawings are for tender purposes only. Any changes in the above will be intimated at the time of placement of purchase order or before fabrication of panels.

6.5 The panels shall be modular in construction and fixed type for all incoming & outgoing Compartments except Air Circuit Breakers.

50 THE SWITCH BOARDS CONSTRUCTIONAL FEATURES:

7.1 FORM 3B

7.2 Separation of bus bars from the functional units and separation of all functional units from one another. Separation of the terminals for external conductors from the units, but not from each other. The terminals for external conductors are separated from the bus bars

7.3 Totally metal enclosed, indoor, floor mounted, free standing, cubicle type with 14SWG CRCA Sheet for Base Frame and doors and 14 SWG for partition sheets for sections and non-loading members. The panel shall be compartmentalized design.

7.4 Made up of the requisite vertical sections, which when coupled together shall form continuous single front switch boards. Vertical bus bar section should have minimum **75% of** the main bus bar rating

7.5 Provide dust and vermin proof protection, the degree of protection being not less than IP 42 for indoor panels and IP 55 for all out door panels as per IS 2147. Readily extensible on both sides by the addition of vertical sections after removal of the end covers. Provided front access to the

feeders, bus bars and rear access to cable termination, cable alley etc.

Each vertical section shall comprise :

7.6 Framed structure of rolled / folded sheet steel channel section, of minimum 2 mm thick CRCA Sheet steel, rigidly bolted or welded together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, molded case circuit breakers, main horizontal bus bars, vertical risers and other front mounted accessories.

7.7 The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation. Each compartment shall be provided with a hinged door interlocked with switch/breaker housed inside the compartment so that door cannot be opened unless the switch/breaker is in 'OFF' position.

7.8 cable chamber of minimum width 400 mm shall be provided for the cable end connections of power/control cables. The design shall ensure generous availability of space for ease of installation and maintenance of cables and adequate safety for working in one vertical section without having accidental contact with other live parts in adjacent section. Each cable chamber shall have cable entry from bottom/TOP and suitable removable gland plates shall be provided for this purpose. The cable chamber shall be provided with suitable supporting arrangement between the gland plate and terminals, in the middle. The cable chamber shall have a minimum width of 400 mm depending upon the outgoing cables

7.9 A cover plate at the top of the vertical section, provided with a ventilation hood where ever necessary. Any aperture for ventilation shall be covered with a perforated sheet having **less than 1 mm diameter** perforations to prevent entry of vermin.

7.10 Front and rear doors shall be fitted with tight neoprene gaskets with easy operating type fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust. The doors shall have concealed hinges. Removable screwed covers shall be provided on the rear of the cubicles.

7.11 A set of horizontal main bus bars shall be provided at the top or bottom as required. The vertical bus bars shall be housed in separate fully enclosed chamber of min. width **300 mm** and accessible from front and shall be tapped off from main horizontal bus bars.

7.12 All incoming/outgoing terminals of the individual feeders shall be provided with insulated shrouds to avoid accidental contact with live parts.

7.13 Circuit breakers, MCCB, etc shall be arrangement in multitiers except for ACB which shall not be more than **two in a single tier**.

7.14 The height of the panel should not be **more than 2100 mm**. The working height shall be limited to a maximum height of 1800 mm and a min. height of 300mm from FFL. The total depth of the panel shall be adequate to cater for proper cabling space. Panels arranged side by side or in same room shall have same height and depth.

7.15 Covers and partitions shall be of minimum 14 SWG CRCA sheet steel, whereas doors and main frame shall be of min. 14 SWG CRCA sheet steel. All sheet steel work forming the exterior of switch boards shall be smoothly finished, leveled and free from flaws. The corners should be rounded.

7.16 All switches, push buttons etc. shall be opera table from the front and shall be flush / semi-flush mounted. The apparatus and circuits shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary of degree of safety.

7.17 Apparatus forming part of the switchboards shall have the minimum clearances as per relevant IS standards. Clearances shall be maintained during normal service conditions. Creep age distances shall comply with those specified in relevant standards.

7.18 All Bus bar insulating material shall be of DMC/SMC to withstand the effects of high humidity, high temperature, tropical ambient service conditions etc. All panels shall be provided with suitable cable alley and vertical bus bar alley. Vendor shall submit Busbar Calculation confirming the suitability of Bus bars offered along with the bid

7.19 Foundation bolts and nuts for each panel shall be supplied along with the respective switchboard. The lifting eyes for each shipping section and danger notice plates shall be provided for each switch boards.

7.20 Compartment door shall be inter-locked with the switch unit in such a way that the door cannot be opened when the feeder switch is ON. The door of the compartment and busbar chamber shall be fully removable type and not hinged

7.21 Equipment to be mounted outside cubicles shall be flush mounted on cubicle door. No

externally mounted equipment shall be mounted above **2.0m or below 0.4m** above floor level

7.22 All similar materials and removable parts of the panel shall be interchangeable. The panel shall be filled with the same family of switches for various ratings with a view to ensure uniformity of design, maintenance and replacements. A horizontal wire way with screwed cover shall be provided at the top/bottom to take inter-connecting control wiring between different vertical sections. Separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contractors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker busbar connections.

7.23 Earth Busbar shall be provided all around the cubicle at the bottom & it shall be of the same size as neutral busbar

Functional units such as circuit breakers and switches

Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with Main bus bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

Cable termination's of one functional unit, when working of those of adjacent unit/units. All covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorized access. Provision shall be made for permanently earthing the frames and other metal parts of the switchgear by the independent connections.

51 METAL TREATMENT AND FINISH

(a) All steel work used in the construction of the switchboards should undergo through seven-tank process treatment. Painting shall be done by surface coating comprising pre-treatment, Electrostatic Powder spraying & curing. The surfaces to be coated shall be chemically derusted & degreased, Zinc Phosphatised & then Passivated after proper drying subjected to spraying of powder. (All panels shall undergo 7 tank pre-treatment procedures strictly). All the panels shall be coated using Siemens Grey shade (RAL 7032)

(b) All surfaces to be painted including interior and exterior of panels, and other metal parts shall be chemically treated to remove all rust, scale, grease and other adhering foreign matters. All

parts shall be coated with two coats of highly corrosion resistant primer followed by two coats of POWDER Coating of SIEMENS GREAY (RAL 7032) Shade. The finish shall be mat finish.

(c) The complete treatment, painting, and drying with compressed air operations shall be done in dry and dust free atmosphere. Should finished paint chip off or crinkle during transit/handling/installation, the contractor shall arrange for repainting the equipment at site at his own cost.

52 BUSBARS CHAMBER

(a) The bus bars shall be air insulated and made of high conductivity, Aluminum Conductor, complying with the requirements of grade E91E of IS 5082 and suitable for 415 Volts, 4 wire 50 Hz system.

(b) The bus bars and connections shall be suitably supported/ braced with non-hygroscopic DMC/SMC supports to provide a fault withstand capacity as specified. High tensile electrolytic grade bolts and spring washers shall be provided at all bus bar joints.

(c) The bus bars shall be liberally sized and shall have uniform cross section throughout, and shall be capable of carrying the rated current at 415 V continuously. The bus bars shall be designed to withstand a temperature rise of 45 C above the ambient.

(d) A current density of 1.3 Amps/ Sq.mm shall not be exceeded for sizing of copper bus bars and 0.8 Amps/ Sq.mm. for Aluminum. All bus connections, joints and taps shall be short and as straight as possible, and applied with contact grease in the mating surface.

(e) The main horizontal bus bars shall be run through the entire length of the panel and shall be accessible for maintenance from the front as well as rear. Bus bar chamber shall have separately screwed covers. All bus bars, links etc. shall be provided with insulating cover to prevent accidental contacts. The neutral bus bars shall have a continuous rating of at least 50% of the phase bus bars.

(f) The busbar shall be PVC sleeved with colour strips of red, yellow, blue and black and the same shall be arranged in accordance with IS-375. An aluminum earth bus of size not less than 75 x 10 mm shall run through the length of switch boards at top or bottom as required.

(g) All bus bars shall be fully screened by means of PVC sleeves in their own compartment

running throughout the length of the panel and also suitable allowance shall be made for bus expansion. Suitable segregation shall be provided in between busbar Chamber and adjoining compartments. Bus bars shall run throughout the length of the chamber and shall be of extendable type on either side

53 CIRCUIT BREAKERS

1. The breakers shall comply with the requirements of IS 13947 (Parts II & II/Sec. I) - 1977- Short Circuit Performance Category P-2, ICE 60947 (Part -1&2) and shall have : A short circuit breaking capacity of not less than 50 KA, RMS at 415 Volts 50 Hz AC. A short circuit making capacity of 105 KA. A short time withstand circuit of 50/80 KA for 1 second.
2. Mechanical and electrical endurance for 2000 operating cycles out of which 100 cycles should be for electrical endurance. Electrical overload performance at 6 times the rated current, 110% of the rated voltage as recovery voltage and 0.5 power factors. Dielectric test of 2.5 KV applied for one minute on main circuits. Test evidence from a recognized independent Laboratory / Institution shall be furnished for compliance of the breakers with the above requirements.
3. The circuit breakers shall be fitted with detachable arc chutes on each pole designed to permit rapid dispersion, cooling and extinction of the arc. Interface barriers shall be provided to prevent flash-over between phases. Arcing contacts shall be of hard wearing material of copper tungsten or silver tungsten and shall be readily replaceable. Main contacts shall be of pure silver of high-pressure butt type of generous cross section.
4. The operating mechanism shall be of robust design, with a minimum number of linkages to ensure maximum reliability. EDO / Manually operated circuit breakers shall be provided with spring operated closing mechanism, which are independent of speed of manual operation. Electrically operated breakers shall have a motor wound spring charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring.
5. The operating mechanism shall be such that the breaker is at all times free to open immediately the trip coil is energized. Mechanical operation indicators shall be provided to show open and closed position of the breaker. Electrically operated breakers shall be additionally provided with mechanical indications to show charged and discharged conditions of the charging spring. Means shall be provided for slow closing and opening of the breaker for maintenance purposes, and for manual charging and closing of electrically operated breakers during

emergencies.

6. Provision shall be available for fitting a minimum of five trip devices- three over current, a shunt trip and an under voltage release or two over current, and earth fault release, a shunt trip and one under voltage release. The breakers shall be of the shunt or series trip type as specified. For static trip device either a shunt trip or an under voltage coil shall be provided.

7. Circuit breakers shall be individually housed in sheet metal cassettes provided with hinged doors. The breaker along with its operating mechanism shall be mounted on a robust carriage moving on guide rollers within the cassette. Isolating contacts for both power and control circuits shall be of robust design and fully self-aligning. The assembly shall be designed to allow smooth and easy movement of the breaker within its cassette.

8. The breaker shall have three distinct positions within the cassette as follows:

a) 'Service' position with main and auxiliary contacts connected.

b) 'Test' position: with power contacts fully disconnected and control circuit contacts connected.

c) 'Isolated' position: with both power and control circuit contacts fully disconnected. It shall be possible to achieve any of the above positions with the cassette door closed. Mechanical position indicators shall be provided for the three positions of the breaker.

d) The moving portion of the circuit breaker shall be so interlocked that :

e) It shall not be possible to isolate it from the connected position, or to plug it in from the isolate position with the breaker closed

f) The circuit breaker can be closed only when it is in one of the three positions or when it is fully out of the cassette.

g) It shall not be possible to open the hinged door of the cassette unless the breaker is drawn to the isolated position.

h) Inadvertent withdrawal of the circuit breaker too far beyond its supports is prevented by suitable stops.

- i) Moving portions of breakers of the same ratings shall be interchangeable. Provision shall be available for the padlocking of the circuit access flaps in any of the three positions.
- j) Automatically operated safety shutters shall be provided to screen the fixed isolating contacts when the breaker is drawn out from the cassette.
- k) The moving portion of the circuit breaker shall be provided with a heavy duty self aligning earth contact, which shall make before and break after the main isolating contacts during insertion into and withdrawal from the service position of the breaker. Even in the isolated position positive Earthing contact should exist.
- l) Auxiliary switches directly operated by the breaker operating mechanism and having 4 NO and 4 NC contacts, shall be provided on each breaker. The auxiliary switch contacts shall have a minimum rated thermal current of 10 Amps.

54 PROTECTION DEVICE.

Breaker shall be provided with CT Operated Digital Protection against Overload, Short Circuit and Ground fault. (Earth Fault).

Overload Protection – The release shall provide inverse time-current characteristics against over load and shall be adjustable from range of **50% to 100% of the normal current**. It shall also be suitable for three different trip timers 2.5 Second , 13 second , 25 second at the six times the rated current.

B) Short Circuit Protection- The release shall provide a wide range of protection against Short Circuit Condition.

(I) current continuously adjustable for 2 to 10 times the normal current.

(ii) Time delay continuously adjustable from instantaneous to 400mSec.

(iii) Ground Fault protection - The Time delayed protection against ground fault. The device shall have current and 'Time delay' adjustable continuously from a range of **0.2 to 0.5 time the normal current and 100 m Sec to 400 mSec** respectively.

Under Voltage Release:- Breaker shall also provide with “Under Voltage release” to trip the system on low system voltage. It shall be of type MVR with a built in time delay of 3+1 Sec to prevent

undesirable tripping of breaker in case of volt-drips due to transient faults. It shall be suitable for 415V,50 Hz with range of operation as (i) Pickup :-80% of standard voltage(ii) drip off from 35% to 65 % of standard voltage.

55 MOULDED CASE CIRCUIT BREAKERS:

a) The MCCB shall be complying with IS: 13947 Part II& III and ICE -60947(Part 2).

b) MCCB's shall be triple pole (TP) / four pole (FP) Thermo-Magnetic / Micro Processor based releases with quick break and quick make type and shall be trip free.

Capacity of MCCB	Overload Range	Short Circuit Release
Up to 125 Amps	Adjustable thermal Release	Adjustable magnetic releases
160 or 250 Amps	Adjustable thermal Release	Adjustable magnetic release
Above 250A	Microprocessor based release	Microprocessor based release

c) Short circuit withstanding capacity shall be as indicated in the respective drawings.

d) The insulating case of the MCCB's shall be made of high strength heat resistant, flame retardant and thermosetting material so as to provide the following important functions.

e) Safety of operating personnel.

f) Very high dielectric strength

g) High withstanding capacity against thermal and mechanical stresses.

h) The contact system shall be maintenance free with arc extinguishing devices & Properties.

i) Terminations:

The following features shall be provided for terminals;

- (a) Interchanging capability for line & load ends
- (b) Extended terminals to connect Aluminum cables of required runs & sizes. cable termination without extended termination accessories.
- j) Visual indications:

The following visual indications shall be provided for the MCCBs;

 - (a) "ON"
 - (b) "OFF"
 - (c) The MCCBs shall have adjustable/fixed thermal overload setting and adjustable/fixed magnetic setting as per the drawings or specifications.
- k) The MCCBs shall be of Manual type as per the requirements indicated in the drawings and specifications.
- l) Minimum one No. (1 No.) NO / NC / Change Over auxiliary contact shall be available for "ON" & "OFF" positions.
- m) For 4 pole MCCBs, the neutral contact shall make earlier than the phase but while tripping, the neutral contact shall break later than the phase for safety purposes.
- n) Positive indication of neutral shall be available.
- o) Accessories:

The following accessories Rotary handle operating mechanism with locking arrangement as indicated in the drawing & specifications.
- p) The MCCB shall comply with the requirement of IS 13947. MCCB's shall be provided with spring assisted quick make, quick break manually operated Trip free mechanism. MCCB's shall be provided with tripping device with inverse time characteristics for short circuit protection.

56 INDICATING LAMPS (LED TYPE)

Indicating Lamps shall be cluster LED type suitable to operate on 240 V AC , indicating lamps shall be provided wherever called for in the control schematic diagrams. The lamps assembly shall be complete with cluster of LED's, holders and lenses.

57 SPACE HEATERS

- i. Each of the switch boards shall be insulated barricade to prevent accidental contact with adjacent section, also provided with thermostat controlled space heaters rated for 240 Volts + or - 10%, single phase, 50 Hz. The heaters shall have individual ON-OFF switch.
- ii. Wiring of space heaters in each switchboard shall be grouped and brought out to easily accessible terminals for connection to power supply, .
- iii. Each switchboard shall be provided with plug-socket with switch SWITCHES for connection of hand lamp rated 240 V, 50 Hz. single phases.

58 MCB

- iv. MCB's shall be provided for all control circuits. -Unless otherwise stipulated in this specification, the M.C.Bs. shall comply with the latest version of I.S.8828/1996

59 CURRENT TRANSFORMERS

- (a) Current transformers shall comply with the requirements of **IS 2705**. They shall have ratios outputs and accuracy is as specified / required.
- (b) Current transformers wherever required and called for in the single line diagram and/or required shall be furnished.
- (c) The CTs shall be bar primary, in epoxy-encapsulated type, rated for 415 V. The CTs shall be designed to withstand the thermal and mechanical stresses resulting from the Maximum short circuit current.
- (d) The vendor shall ensure that the VA output of the CTs is adequate for the relays, Meters and loads connecting them.
- (e) The CTs shall be provided with **Class A/Class B** insulation and proper polarity markings in a suitable manner.
- (f) Current transformers shall be **resin cast type**, with Minimum 15 VA burden & class-1 accuracy. All the CT's shall be provided with CT shorting links.

60 INDICATING/INTEGRATING METERS

- (a) All indicating instruments shall be of flush mounting industrial pattern, conforming to the relevant standard. All the meters shall be of **Class – 0.5 / 1 accuracy**. Ammeters and Voltmeters shall be of digital type. They shall be industrial grade and shall have means of zero adjustment from the front without dismantling them. They shall be capable of carrying the normal full load current (via CTS) and shall not be damaged by effects of rated fault current. The instruments shall have an accuracy **class of 0.5 / 1.0 as per IS - 1248**.
- (b) Energy Meters shall be 3 Element & switchboard mounting type suitable for unbalanced load.
- (c) The instruments shall have non-reflecting bezels, clearly divided and indelibly marked scales and shall be provided with respect to adjusting devices in the front.
- (d) Integrating instruments shall be of flush mounting switchboard pattern, conforming to the relevant standards.
- (e) Meters shall be provided with circular 90 scales with square casing of specified size.
- (f) MT instruments shall **have + or - 1% accuracy** on full scale. Each meter shall be magnetically screened.

61 CABLE TERMINATIONS

- I. Cable entries and terminals shall be provided in the switchboard to suit the number, type and size of Aluminum conductor power cables and copper conductor control cable specified in the detailed specifications.
- II. Switchboard shall be designed either for top or bottom or combined entries and outgoing, Which Architects will confirm at the time of drawing approval. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Removable un-drilled plates shall be furnished for fitting the cable glands.
- III. Sufficient space shall be provided to avoid sharp bending and for easy connection. A minimum space of 400 mm from the gland plate to the nearest terminal block shall be provided.

IV. Multi way terminal blocks complete with screws, nuts, washers and marking strips shall be furnished for terminating the internal wiring and outgoing cables.

V. Power and control terminals shall be washer head screw type or stud type complete with crimping type connectors. Screw type terminals with screws directly impinging on conductor are not acceptable.

VI. Each control terminal shall be capable for connection of 2 Nos. 4 mm standard copper wires at each ends.

VII. Not more than two wires shall be connected to any terminal. If necessary a number of terminals shall be jumper together to provide wiring points.

VIII. At least 20% spare terminals shall be provided in each module.

IX. Terminal blocks for current transformer secondary lead wires shall be provided with shorting and Earthing facility.

X. Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

XI. Cable risers shall be adequately supported to withstand the effects of rated short circuit Currents without damage and without causing secondary faults.

62 CONTROL WIRING

a. The wiring shall be complete in all respects so as to ensure proper functioning of control, protection and interlocking scheme.

b. All wiring shall be completed up to terminal blocks on the side of each unit-module.

c. All control wiring shall be carried out with 1100/660 V grade single core PVC cable having stranded copper conductors of minimum 2.5 Sqmm.

d. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wires shall not be spliced or tapped between terminal points.

e. Numbered ferrules at each end shall identify wires. The ferrules shall be of the ring and of non-deteriorating material. They shall be firmly located on each wire so as to prevent free

movement, and shall be interlocking type.

- f. All control circuits to be controlled by MCB's and shall be mounted in front of the panel and shall be easily accessible.
- g. All spare contacts of relays and switches shall be wired up to the terminal blocks.
- h. Each of the DC circuit shall be provided with two Switches one in the positive and the other in the negative for **2 wire DC underground system** of specified voltage
- i.

63 GROUND BUS

- a) An aluminum ground bus rated to carry maximum fault current shall be furnished along the entire length of each switchboard. Each stationary unit shall be connected directly to this ground bus by two separate and distinct connections in accordance with Indian Electricity Rules.
- b) Grounding terminals on the ground bus shall be provided. Connectors shall be provided at either end of switch board for connection to station ground mat.
- c) All the metal parts of all equipment supplied within the panel (including doors and gland plates) other than those forming part of all electric circuit, shall be connected by means of two independent earth conductors to continuous earth bar of size 50 x 6mm running along the full length of the panel.
- d) The panel shall be provided with two brass earthing stud terminals, with suitable nuts, washers etc. for connection to ground bus.

64 TERMINAL BLOCKS

- a. Terminal blocks shall be of 1100 Volts grade of stud type. Insulating barriers shall be provided between adjacent terminals.
- b. Suitable provision shall be made to terminate control/power connections in the respective module.
- c. Terminal blocks shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions. The wire terminations to the blocks shall be of

screw type suitable for crimp type socket.

65 NAME PLATE

- i. The panel as well as feeders compartments shall be provided with name plate of anodized aluminum, with white engraving on black background. They shall be properly secured with self-tapping screws at the top of the cubicles. The panel/feeder descriptions shall be as indicated in the drawings/employers. The size of the nameplates shall be proportionate to the respective equipment's.
- ii. Also individual panel number and danger plate shall be furnished at back of panel.

66 ACCESSORIES

- The following accessories shall be furnished along with each switchboard.
- One (1) no. SWITCHES pulling handle for each switchboard.
- One (1) no. winding handle for withdrawing breaker from the cubicle.
- Other accessories as deemed necessary for trouble free and efficient operation of the equipment offered.

67 DRAWINGS AND MANUALS

- (a) The following drawings shall be supplied for each switchboard.
- (b) General arrangement drawing for each type of board showing constructional features and space required in the front for withdrawal of breaker, power and control cable entry points, location of various devices, terminal blocks, cross sectional details, bus bar supports, number of buses, etc. shall be submitted within 15 days from the date of letter of intent for approval.
- (c) Foundation plan and anchor hold details including dead load and impact load.
- (d) Drawing and data sheet for each component.
- (e) Electrical wiring diagram.
- (f) Terminal block arrangement drawing for outgoing feeders.

(g) Complete relay technical particulars and recommended settings.

(h) Operation, maintenance and installation manuals, (one set to Consultants).

(i) Technical Catalogues /Leaflets of CTs, meters, lamps, etc. shall be submitted along with Offer.

(j) The approval of the drawing does not absolve the vendor from his obligation of ensuring Proper and correctness of functioning/operation of the system.

68 TESTS

69 ROUTINE AND TYPE TEST

(a) Type test certificates and results as per relevant Standards (Specification) for all the equipment offered under the scope of this specification shall be furnished.

(b) All routine tests on all major components shall be made as per relevant specification.

(c) Inspection: Inspection of the Switchboards including inspection of wiring and electrical operational tests by the Owner/Architect before dispatch should be arranged by the tendered. The cost of transport and incidental expenses to be borne by the tendered. Two weeks clear notice to be given for carrying out the inspection.

70 Dielectric Tests

i. Insulation of the main circuit that is the insulation resistance of each pole to the earth and that between the poles shall be measured.

ii. Each switch board will be completely assembled, wired, adjusted and tested for operation under simulated conditions to ensure correctness of wiring and proper functioning of all equipment's.

iii. All current carrying parts and wiring shall be subjected to a high potential test.

71 PANEL TESTS

- a. Electrical & Mechanical operation test.
- b. Heat run test at Tarred Current.
- c. **HIGH VOLTAGE TEST:-** high voltage test with 2.5 KV for one minute shall be applied between the pole and earth. Test shall be carried out on each pole in turn with the remaining poles earthed. All units racked in position and the breakers closed. Originals test certificate shall be submitted along with panel.
- d. Megger test by 1000C megger.
- e.

72 PACKING AND TRANSPORT

Road Transport packed in Wooden Crates shall send the switchboards to site. The packing should be of high quality to avoid any damage to the equipment's during transit. They shall be wrapped with polythene sheets before being placed in crates to prevent damage to the finish.

SPECIFICATIONS FOR ERECTION, TESTING & COMMISSIONING OF 415 VOLTS SWITCHGEAR PANELS

73 SCOPE

Receiving Inspection, Unloading Storage, Installation, Testing and Commissioning of the Switchgears shall be in accordance with the specified code of practice and manufacturer's instructions. The panels shall be aligned properly and bolted, to the flooring by at least four bolts for each division of Transport. The cable shall be terminated into the panel through glands fixed to bottom /top plate. The panel shall be bonded to the earth by connecting leads to the panel earth bus.

74 HANDLING/UNLOADING

Switchgears and all its accessories shall be handled/unloaded carefully in its upright position as indicated in the packing case. Lifting lugs and jacking pads shall be used for lifting of the switchgear. While using jacking pads utmost care shall be taken in proper application of jacks. Where switchgears is dragged or pulled on sleeper or rollers of the traction eyes provided at the bottom frame shall be used with suitable wire ropes and shackles.

Unloading from the lorry shall be carried out using a mobile crane or tripod with chain pulley block or rolling over to a platform.

75 STORAGE

Equipment's shall be stored under shelter in a well-ventilated, dry place and covered by suitable polythene or tarpaulin covers for protection against moisture.

76 ERECTION

Panels shall be installed over a trench. The panels shall be aligned properly and bolted to the flooring by at least four bolts. The cables shall be terminated into the panel through bottom plate. The panel shall be bonded to the earth by connecting Earthing leads to the panel earth bus.

77 TESTS

The following preliminary checks and Pre-commissioning tests shall be carried out before commissioning the Switchgears in the presence of Buyer/Architect's representatives.

78 PRELIMINARY CHECKS

- i. Check nameplate details according to specification.
- ii. Check for physical damage.
- iii. Check tightness of all bolts, clamps and connecting terminals.
- iv. Check oil level air pressure and leakage (wherever applicable)
- v. Check earth connections.
- vi. Check the cleanliness of insulators and bushings, arc chambers.
- vii. Check that all moving parts are properly cleaned and lubricated.
- viii. Check if space heaters provided.

- (a) Check alignment of breaker trucks for free movement. Check correct operation of shutters.
- (b) Slow closing/opening operation.
- (c) Check control wiring for correctness of connections, continuity and IR values.
- (d) Manual operation of breakers.
- (e) Power closing/opening operation manually and electrically.
- (f) Breaker closing and tripping time.
- (g) Trip free and anti pumping operation.
- (h) I.R.Values, resistance and minimum pick up voltage of coils.
- (i) Contact resistance.
- (j) Simultaneous closing of all three phases.
- (k) Pole discrepancy tests.
- (l) Single and three phase auto-reclose operation.
- (m) Check electrical and mechanical interlocks provided.
- (n) check on spring charging motor correct operation of limit switches and time of charging.
- (o) Check on C.Ts
- (p) All functional checks with the relays, meters, Alarm Scheme, interlock as per scheme with primary injection kits.
- (q) High voltage tests on Control and Power circuits (2.5 KV)

5. SPECIFICATION FOR BUS DUCT:

All the bus duct shall be manufactured as per the following specification, tender BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization. In absence of such deviation, it will be presumed that equipment offered is exactly similar to the specification, tender BOQ and drawings, client /consultant decision is final.

80 SCOPE

This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, Wooden packed for transportation complete in all respects with all components, fittings and accessories for efficient and trouble free operation.

81 Rating:

Bus Duct shall be of rated CURRENT capacity and designed for an ambient temperature of 40 Deg C and a temperature rise of 45 Deg C above ambient.

82 Construction:

Bus duct shall be made of 14 SWG CRGA sheet. Bus duct shall be of non-segregated, dust, Vermin proof, Outdoor type with IP-65 (or) be IP54 for indoor type protection. Bus duct shall be rectangular cross section.

All sheet steel shall undergo seven tank process treatments for degreasing, de rusting and phosphate followed by epoxy powder coating of RAL 7032 shade (Siemens grey). Bus duct dimensions should be coordinated with Transformer Marshalling box and Main L.T Panel.

90 deg. bends should be considering as per site requirement and will be finalized within 15 days from the date of finalization of order.

83 Marking of bus-bar and Main Connections.

For Making Bus bars and main connections the following colors or Letters or both as given in ARE: 375 shall be used.

Sl No	Bus Bar Main Connections	Color	Letter or Symbol
1	Three Phase	Red, Yellow & Blue	RYB
2	Two Phase	Red & Blue	RB
3	Single Phase	Red	R
4	Neutral Connection	Black	N
5	Connection to Earth	Green	E
6	Phase Variable(such as in connection to reversible motor)	Gray	Grey or GY

84 . Material:

Bus Bars should be of E91E grade Aluminum with a maximum current density of 0.8A/sqmm. Bus bars should be properly supported at regular intervals on SMC/DMC supports to with stand required short circuit level. Temperature rise calculations should be made and forwarded to client/consultant for necessary approvals.

Adequate spacing between phases and phase to neutral to be maintained through out the length of the bus duct. 10x50 Sq mm of G.I Bus should run on both sides of the Bus duct for Earthing. Proper Alignment and co-ordination regarding sequence etc. between the bus duct, Transformer, PMCC termination etc. shall be vendor's responsibility.

85 General

a) The busbar trunking system (800A and above), both feeder and plug-in, shall be sandwich construction. All busbar trunking products and fittings (straight length, elbow, tees, flanged ends, cable tap box and circuit breaker, etc.) shall be in accordance with IEC 60439:2005 or UL857 and from the same manufacturer as the busbar trunking system. The degree of protection of the busbar trunking system should be IP54 for indoor / outdoor type with IP-65 protection. In accordance to IEC 60529.

b) Rated operation voltage of the busbar trunking is 1000V. 3 – Phase, 4 or 5 Wire with 50% capacity continual integral/internal earth busbar. The neutral conductor should have the same cross-sectional area as the phase conductor. The earth busbar must be one continuous piece

without bolting on housing

c) The ampere ratings, approximate footage, fitting, plug-in units etc. are shown on the plan. The electrical contractor shall be responsible for routing the busbar trunking to coordinate with the other trades. Final field measurements shall be made by the contractor prior to release to the busbar trunking for fabrication by the manufacturer.

86 Certificate

d) The busbar, of full range and each rating, should pass full type tests specified in IEC 60439:2005. The certificate shall be issued by an international independent testing authority (e.g. ASTA, KEMA, UL).

e) A product safety mark (e.g. KEMA-KEUR, ASTA DIAMOND, UL) should be on the product offering a visible assurance to all of full product safety testing, factory inspection and ongoing surveillance under independent authority to ensure the ongoing safety of product.

87 JOINT

The busbar trunking system should pass seismic tests with actual physical product and being certified complying with UBC seismic Zone 4 condition by an international recognized earthquake research body, e.g. Asian Pacific Network of Centers for Earthquake Engineering Research (ANCER).

88 Short Circuit Ratings and Tests:

The whole busbar trunking system shall be capable of withstanding the short circuit of the electrical installation without damaging the electrical, mechanical and thermal stress under fault condition at a service voltage of 1000V 50Hz. The minimum rated insulation voltage shall be 1000V.

a) The minimum certified short circuit ratings of the busbar trunking shall be as follows:

Rating	KA/1 sec.	KA Peak	Rating	KA/1 sec.	KA Peak
800A	40	84	2500A	75	165
1000A	50	105	3200A	90	198
1250A	50	105	4000A	100	220

1600A	60	132	5000A	120	264
2000A	60	132	6000A	120	264

89 Basic Construction

1. Housing

- a) The busbar trunking housing shall be constructed of electro galvanized steel and aluminum to reduce hysteresis and eddy current losses and shall be provided with a suitable protective finish of ANSI 49 grey epoxy paint.
- b) The busbar trunking housing shall be totally enclosed non-ventilated for protection against mechanical damage and dust accumulation. And it shall pass at least 500 hours salt spray test to ensure the anticorrosion ability.
- c) The totally enclosed housing shall be manufactured by the busbar trunking manufacturer. Modifications of busbar trunking to make it totally enclosed by other than the busbar trunking manufacturer voids the manufacturer's warranty. Busbar trunking so modified is unacceptable without the written consent of the manufacturer.

90 Busbars

- a) Busbars shall be of hard drawn silver-plated high conductivity copper of 99.9% purity or aluminum with copper cladding utilized Molecular Fusion technology.
- b) There shall be no bolts passing through the busbars of the busway.
- c) Each busbar shall be insulated with Class B (130 °C DuPont Mylar) or Class F rated (155°C Du Pont Melinex) polyester film. Epoxy insulation is not allowed.
- d) The temperature rise at any point of the busbar trunking enclosure shall not exceed 55 degree Centigrade rise above ambient temperature when operation at rated current.

91 Joint

- a) The busbar trunking joint shall be of the one-bolt type which utilizes a high strength steel bolt(s) and Belleville washers to maintain proper pressure over a large contact surface area.
- b) The bolt shall be torque indicating and at earth potential.
- c) The bolt shall be two-headed design to indicate when proper torque has been applied and require only a standard long handle wrench to be properly activated.
- d) Access shall be required to only one side of the busbar trunking for tightening joint bolts.
- e) It shall be possible to remove any joint connection assembly to allow electrical isolation or

physical removal of a busbar trunking length without disturbing adjacent busbar trunking lengths.

92 Plug-in Opening:

- a) The connecting jaw of the plug-in unit shall plug directly onto the busbar and have full contact with busbar itself. Welded tab at plug-in busbar is not allowed.
- b) All contact on joint and plug-in opening should be silver plated copper.
- c) On plug-in busbar trunking there shall be three dead front, hinged cover type plug-in openings on each side.
- d) All openings shall be usable simultaneously.
- e) Busbar trunking shall be installed so that plugs are side mounted to permit practical use of all plug-in openings.
- f) It shall be possible to inspect the plug-in opening and busbars prior to the installation of the plug-in units.

93 Support of busbar Trunking

- a) Hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations.
- b) Indoor feeder and plug-in busbar trunking shall be approved for hanger spacing of up to 3 meters for horizontally mounted run and 4.88 meters for vertically mounted runs. Outdoor feeder busbar trunking shall be approved for spacing of up to 1.5 meters for horizontally or vertically mounted runs.

94 Voltage drop

- a) The voltage drop (input voltage minus output voltage) specified shall be based on the bus way operating at full rated current and at stabilized operating temperature in 45 °C ambient.
- b) The three-phase, line to line voltage drop shall not exceed 3.4 volts per hundred feet at 40% power factor concentrated load which may exist during motor starting.
- c) The line-to line voltage drop shall not exceed 4.1 volts per hundred feet at the load power factor which produces maximum voltage drop in the bus way.

95 Plug-in Units

- a. The plug-in jaw shall be spring design composed of different metal to ensure the firm and tight contact with the busbar

- b. The earthing contact of the plug-in unit shall always be made before that of the live conductors and the last to break during removal. And it must connect to the earth bar of bus way to ensure the safety.
- c. Covers of all plug-in units must have interlocks to prevent the cover from being opened when the switch is in the ON position.
- d. Plug-in units (circuit breaker type or fusible switch type) shall be operated with visible blade quick-make and quick-break mechanism
- e. Presence of Transparent shield shall be inside to avoid direct contact of human
- f. The plug-in units shall be equipped with internal barriers to prevent accidental contact of fish tape and conductors with live parts on the line side of the protective device during time of wire pulling.

96 TESTS

1. ROUTINE AND TYPE TEST

- a. Type test certificates and results as per relevant Standards (Specification) for all the equipment offered under the scope of this specification shall be furnished.
- b. All routine tests on all major components shall be made as per relevant specification.

97 INSPECTION

Client / Consultant inspection of the bus duct for physical & functional checks before dispatch should be arranged by the tendered. The cost of transport and incidental expenses to be borne by the tendered. Two weeks clear notice to be given for carrying out the inspection.

98 DIELECTRIC TESTS

- a) Insulation resistance of the main power circuit like between phase to phase, phase to neutral and phase to earth shall be measured.
- b) Insulation resistance to earth of control wiring should be tested with 1000 V megger.
- c) Insulation test shall be carried out both before and after high voltage test.
- d) All current carrying parts and wiring shall be subjected to a high voltage test.

99 HIGH VOLTAGE TEST

A high voltage test with 2.5 KV for one minute shall be applied between the phases, phase to neutral and phase to earth. Test shall be carried out on each phase in turn with the remaining phases earthed. All units racked in position and the breakers closed. Originals test certificate shall be submitted along with panel.

6. SPECIFICATION FOR H.T, LT CABLES

The Cable shall be manufactured as per the following specification, BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization /work order finalization , In absence of such deviation it will be presumed that equipment offered is exactly similar to the specification . Client /consultant decision is final

1. SCOPE

- a) This specification covers the technical requirements of design, manufacture, test and supply of **3 core / multi core**, cross linked polyethylene insulated **HT cable** complete for efficient and trouble free operation. These cables shall be suitable for the 3 phase AC-50 Hz system with the nominal voltage these cables shall primarily be designed for effectively earthed neutral system. The cable shall be manufactured strictly conforming to IS:7098 (Part 2) - 1985 amended up to date and shall bear ISI mark
- b) The cables have to be procured directly from the manufacturers. Invoices for the cables shall be produced to client / consultant for conducting **the QC inspection** at the time of receiving.
- c) The laying, testing and commissioning of cable at site shall be done by Electrical Contractor. The cables shall be properly packed for transportation, supply and delivery at site.
- d) The scope of the job includes manufacturing, loading and transporting the tested cables in cable drums to the site

2. STANDARDS

2.1 The materials covered by this specification shall unless otherwise stated, as designed, constructed and tested in accordance with latest revisions of the relevant Indian Standard of latest versions.

IS : 692-1994 - Paper insulated sheathed cables.

IS : 8130-1976 - Conductors for Insulated Electric Cables and Flexible Cords.

IS : 3975-1979 - Mild Steel wires, strips and tapes for armouring of Cables.

IS : 3961-1967 - Recommended current rating for cables.

IS : 1255-1967 - Code of Practice for installation and maintenance of paper insulated power cables (up to and including 33 KV).

IS : 7098-1977 - XLPE Cables.(Part I - 1977)({Part II - 1985)

3. RATING

4. The conductors shall be made from E1 critical grade high conductivity aluminum wires of Stranded type to form sector shaped conductor. The conductors shall conform to IS 8130-1976 (amended up to date and IS 7098 (Part- 2)/1985.
5. Aluminum conductor used in Ht Cable Shall be Stranded, Compacted and round to achieve minimum electrical stress.
6. The Aluminum conductor shall have a semi- conductor layer of XLPE suitable thickness wrapped in such way that it covers the conductor entirely.
7. The main insulation shall be of cross linked polyethylene (XLPE) in natural color and shall be free of air voids and foreign material.
8. The insulation shall be covered with another layer of semi conducting layer followed by copper tape to provide suitable earthing around the each core to keep the electrical stress radial.
9. Each Core shall have a numbered /colored polyester tape applied over the copper tape for identification of all three core.
10. Inter sheath over the laid up cores shall be of **thermoplastic extruded type** and armouring over the inner sheath shall be galvanized steel wire or stripes of adequate size to give mechanical protection and PVC **FRLS(Flame Retardant low Smoke) outer sheath over** the armour shall also be adequate thickness all as specified in the IS.
11. The XLPE Cable shall be suitable to withstand minimum conductor temperature of 90°C and 250°C operation and short circuit respectively and these cable shall be manufactured by triple extrusion using single (common) cross head extrusion technique and dry cure inert gas cured cross linking process.

4. CURRENT RATINGS

4.1 The continuous current ratings of the cables shall be based on the following conditions

- | | | |
|----------------------------------|---|------------|
| a) Maximum conductor temperature | - | 90°C |
| b) Ambient Air temperature | - | 40°C |
| c) Ground Temperature | - | 30°C |
| d) Thermal resistivity of soil | - | 150 C cm/w |
| e) Depth of laying | - | 900 mm |

5.0 **SHORT CIRCUIT RATING**

5.1 The short circuit rating for one second shall be as per IS 692 1973 (up to date) and based on the following :

- a) Maximum conductor temperature - 90 °C
Under full load condition.
- b) Maximum permissible temperature - 250 °C
Of conductor during short circuit.

6.0 **TESTING AND INSPECTION**

6.1 Tests shall be carried out at manufacturer's works under his care and expense.

6.2 The cables shall be subjected to 'Routine Tests' i.e. conductor resistance at 20 C and A.C voltage test as per relevant IS.

6.3 Type test certificates and results as per IS 692 shall be furnished.

6 copies each of the above test certificates shall be submitted to the Owners.

7.0 **PACKING, MARKING AND TRANSPORT**

7.1 The cables shall be supplied on strong wooden drums of suitable size barrel diameter. The inner end of the cable shall protrude out from the drums flange and is fully protected against any mechanical damage and effectively sealed against increase of moisture with heat shrink end caps. The drum is overall lagged with wooden battens and steel straps.

Each cable drum is marked with particulars of cable size, voltage class, length, direction of rolling, position of outer end, gross weight ISI certification mark.

8.0 SPECIFICATION FOR INSTALLATION OF H.T CABLES

1.0 HIGH TENSION CABLES

HT cables shall be laid in trenches unless otherwise specified. Generally, laying, jointing and commissioning shall be as per regulations of local authorities.

2.0 CABLE INSTALLATION

2.1 Storing

On receipt of HT cables at site, cables shall be inspected to detect any damage. The ends of cable shall be in sealed condition. After inspection, cable shall be located in a proper place with battens of cable drums being replaced. The cable drums shall not be stored 'on flat' with flanges horizontal. Owners/Architects will inspect the cables before storing. Contractor shall take out samples from the drums as per their instructions and send them to the manufacturer to conduct the approval tests. After the receipt of the test analysis, the cable will be accepted by the client.

2.2 Cables and Cable Entries

Particular attention is drawn to the Contractor's responsibilities in safeguarding cables Stored / laid in outdoor locations and unfinished buildings. Such equipment is particularly vulnerable to damage from water and dust penetration. The Contractor shall ensure that cables are protected in this respect while installation work is proceeding. covers temporarily removed from trenches/entries for purpose of installation shall be reassembled on completion of the work and replaced when such Work is suspended or otherwise left incomplete. Similarly, all entries shall at times be effectively sealed against ingress of water and dust, eg., Duct entries shall be sealed by the insertion of proprietary stopper plugs or approved means.

2.3 Handling of Cables

Storage & handling of cable before and during installation shall be executed with regard to manufacturer's recommendations. Cable drums shall be rotated only in the direction indicated on the drum, and open ends of cable shall be effectively sealed after cutting to prevent ingress of

moisture, using heat shrink end caps.

2.4 Cable Pulling

Armoured cables shall be installed with the aid of specifically manufactured rollers, in order to prevent damage to outer sheaths. Cables up to 38 mm diameter shall be installed by hand. However, larger cables, with the approval of the Company Site Representative, may be installed with the assistance of a winch. Any such winch shall be equipped with a suitable tensioning device and indicator, and operated by a competent operator.

Cable shall never be installed directly from a drum mounted on a moving vehicle.

Drum jacks, cable rollers, cable winch and other equipment shall be of the correct type for the cable being installed.

2.5 Cable Bending

At all times utmost care shall be exercised to prevent excessive bending or twisting of cable during installation.

Changes in direction in cable trenches, racks or trays shall provide for a minimum cable bending radius of twelve times the overall cable diameter.

2.6 Cable Jointing

Cables shall be run in continuous unbroken lengths. Any requirement for cable jointing shall be executed only with the approval of the Company Engineer-in-charge.

Fully trained workmen who have passed an approved course of instruction in such work for the operating voltage level concerned shall execute all cable jointing. The Contractor shall furnish written confirmation in this respect to the Company Engineer-in-charge.

2.7 Protection from Moisture

Each cable system shall be installed either where it will not be exposed to rain, dripping water, steam, condensed water, etc., or be of a type designed to withstand such exposure.

In damp situations and wherever they are exposed to weather, all metal sheaths and armour of cables, metal conduit, ducts, ducting trucking clips and their fixings, shall be of corrosion-resistant

material or finish, and shall not be placed in contact with other metal with which they are liable to generate electrolytic action.

For conductors insulated with impregnated paper, exposed conductor & insulation at termination's and cable joints shall be protected from ingress of moisture by being suitably sealed.

99.2 Cable Termination

Cable boxes for straight through or termination joint shall be in the form of "kits" with jointing instructions and literature / test certificate . The Kit shall also carry the name of manufacturer, date of manufacture and expire date on the kit also size type and or cable for which suitable.

All the cable termination accessories such as cable sockets, compression joint sleeves, conducting jelly, cable glands reducing bushes and check nuts etc. shall be best quality available.

Fully trained & competent workmen who have passed an approved course of instruction in such work for the operating voltage level concerned shall execute all work on the termination of cables. The Contractor shall furnish written confirmation in this respect to The Company Site Representative.

Within terminal boxes, an adequate length of cable loop shall be provided to enable each cable core to be connected to any terminal, in accordance with the approved method of termination for each equipment.

For multi core terminal /junction boxes, an adequate length of cable loop shall be left to allow for remaking and termination of each core, i.e. a 25mm diameter loop prior to entry of cable core into each terminal.

All connections at a cable termination shall be mechanically & electrically perfect and shall be protected against mechanical damage or any vibration liable to occur. They shall not impose any appreciable mechanical strain on fixing of the connection and shall not cause any harmful mechanical damage to the cable conductor or equipment. Conductors of cables shall be terminated in a manner suitable for the terminal arrangement of the equipment concerned.

Prior to final connection, all cable shall be checked for continuity and insulation resistance and correct installation.

2.8.1 AC Voltage Withstand test (as per IEC 68)

The appropriate check sheets shall be complete by the Contractor and accepted by The Company Site Representative, prior to final connection.

Te Test Certificate from Manufacture for termination Kits.

- 2.8.2 Partial discharge test
- 2.8.3 Impulse withstand test (as per IEC-68)
- 2.8.4 Load cycling test (as per VDE-2078)
- 2.8.5 Thermal Short circuit Test.

- 2.8.6 Humidity test (as per IEC-166)
- 2.8.7 dynamic Short circuit test(as per VDE-2078)
- 2.8.8 Salt Fog(Outdoor termination only) test.
- 2.8.9 Impact test (for joints only)

2.9 Glands, Seals and Shrouds

The entire body of a cable shall enter a gland, & the outer sheath of a cable shall not be removed before entering the weatherproof seal. Cable shall be on a straight axis from a point immediately before entering a gland.

Cable glands shall securely retain the cable without damage to the outer sheath or armour.

Glands shall be correctly sized and of a type suitable for installation in each respective type of enclosure.

All glands shall be correctly sized and of a type which will maintain the integrity of the equipment within into which they are to be installed. Such factors as use of insulated plastic enclosure and explosion proof type protection shall be taken into account when selecting glands.

All mechanical glands shall be of the hexagon double compression type, knurled type glands shall not be used.

Earth continuity of brass glands & termination's shall be achieved by rigid clamping of armour within each gland and intimate contact between threaded components of glands and equipment.

Brass glands terminating in unthreaded enclosures shall be provided with earth continuity by attachment of earth continuity bonds.

Terminations of mineral insulated cable shall be provided with sleeves having a temperature rating equal to that of the seals.

Cores of sheathed cables, from which the sheath has been removed, and non-sheathed cables at terminations of conduit, ducting or trucking, shall be enclosed according to the design specification.

2.10 Terminal Connecting Lugs

Cable loops of conductors of 10Sq.mm and above shall be fitted with compression-type terminal connection lugs, using tools specially designed for use with such lugs.

At all terminal connections, cable conductors shall be fitted with correctly sized cable sockets of the crimped compression type. Soldered connections shall be employed only where their use is unavoidable. Solder used shall have a melting point of not less than 185 Deg.C, and cable lugs or thimbles shall be the correct type and size for each conductor. Packing of oversized lugs shall not be permitted.

Compression joints shall be made using proprietary sets of lugs and indent dies, correctly sized and shaped for each specified conductor concerned. Use of mixed lugs and dies of different manufacture or systems shall not be permitted.

2.11 Sealing of Cable Transits

Openings made or provided in or through building walls, floors, etc., shall be effectively sealed. Cable entries into trenches (in switch rooms, etc) shall be effectively sealed after cables have been laid. Unused cable entries and cable entries in equipment also shall be effectively sealed.

Openings through roofs and external walls shall be made weatherproof, including installation of flashing and / or rain hoods to prevent the entry of driving rain, seepage of water, dust, etc.

2.12 Single-Core Cables

Each set of single-core cables comprising a three-phase circuit shall be run close together in trefoil formation.

All cable gland mounting plates for single-core cables shall be inspected to ensure they are non-magnetic material.

When installed in ducts, each trefoil group shall be installed in a single duct.

2.13 **Cable Supports**

Every cable and conductor used as fixed wiring shall be supported in such a way that it is not exposed to undue mechanical strain and so that there is no appreciable mechanical strain on the terminations of the conductor. Account shall be taken of the mechanical strain imposed by the supported mass of the cable or conductor.

Conduit, ducting and trucking shall be properly supported and of a type that is either suitable for any risk of mechanical damage which may be met in normal conditions of service, or adequately protected against such damage.

Installation shall take into account longitudinal expansion and contraction that may occur with variation of temperature under normal operating conditions.

2.14 **UNDERGROUND CABLES**

2.14.1 General Requirements

All excavation, cable protection, back filling and surface restoration and installation of cable markers, protection tiles and warning tape shall be in accordance with the Electrical drawings.

Construction of cable trenches, their bedding and back filling shall be executed in accordance with Electrical Drawings.

Where excavations are required near footings, foundations, concrete floors, etc. earthwork under and in the vicinity of these excavations shall not be disturbed and all back fill shall be well consolidated.

Installation shall be so arranged that all trenches are excavated and back filled in a minimum period of time, care shall be taken to ensure that all cable's. For a particular route are made available at site, before trenches are excavated.

When planning the excavation sequence for cable trenches, the contractor shall take care to not obstruct access.

Adequate safety precautions shall be observed at all excavations by the provision of safety barriers, warning notices, shoring, etc.

Cables installed under roads shall be in accordance with the Electrical Drawings. An additional number of pipes, 3 to 5, depending on space, shall be installed at normal cable laying depth to accommodate future cables.

Cables to be installed in underground ducts, conduits or pipes, shall be of a type that incorporates a sheath and/or armour, suitably resistant to any mechanical damage likely to be caused during drawing in.

Physical separation between HV, LV, tele-communication and instrument cables laid within the same cable trench shall be in accordance with Electrical Drawings.

Underground cable routes shall avoid close proximity to pipe crossings and parallel pipe runs. Physical separation between cables and pipes shall be not less than 300 mm and cables should cross underneath pipes.

If a cable route is in close proximity to underground pipes carrying hot liquids or gases, or which are regularly steam cleaned, the pipe shall be insulated in order to limit its outside temperature to a maximum of 60 Deg.C. In these cases cables may be run above pipes.

Buried cables shall be identified with their full cable numbers, as detailed on the cable schedule, at both termination points. Cable number shall be embossed on a metallic strip and installed on cables using proprietary cable ties. Sample of which shall be approved before use.

Cable route and cable joint markers shall be installed visibly at ground surface level in accordance with the Electrical drawings.

When cable routing is not definitely indicated on a design layout drawing, the Contractor shall submit full details of his proposed routing to The Company Site Representative for approval. Routing details shall be shown clearly on the Contractor's working drawings.

2.14.2 Cable Installation

Installation of direct buried cables shall not be commenced until the entire route has been excavated and prepared ready to receive the cable.

If cable is left exposed above ground, it shall be coiled and suitably protected against damage. Alternatively, such cable may be left on the drum, which shall be lowered from its jacks and firmly anchored.

Laying patterns, as indicated on the layout drawings, shall be adhered to.

Unavoidable crossings shall be made either in the cable cellar directly underneath the corresponding switchgear panel, or at the branching-off point of a particular cable from the main trench. Care shall be exercised to keep the whole installation tidy in these areas.

Ends of hard-floored cable trenches, ducts or pipes shall slope down into surrounding soil, to avoid cable damage following possible settling of soil.

2.15 ABOVE GROUND

2.15.1 General Requirements

Cable shall be laid on racks or trays in accordance with laying patterns indicated on layout drawings.

All cable outlets from a duct system, all joints in a duct system, and all joints between such a system and another type of ducting or conduit shall be formed so that joints are mechanically sound. During cable pulling cables shall not be damaged.

Spacing between cable racks, trays, or cable ladders, and structures, wall or columns, shall be at least 50 mm.

Metal parts of cable racks and trays shall be bonded between each section, and connected to the common earth grid.

Cables shall be fixed to cable racks and trays by proprietary metal ties, metal straps and / or MSI clamps shall be provided with in 18" (450mm) distance. The cable straps and clamps shall be capable of retaining the cables during short circuit stresses, and if ties are used they shall be corrosion-resistant.

Where cables, conduits, ducts or trucking pass through fire-resistant structural elements such as walls and floors designated as fire barriers, openings made shall be sealed according to the appropriate degree of fire resistance. In addition, where cables, conduits or conductors are installed

in channels, ducts, trucking, or shafts that pass through such elements, suitable internal fire-resistant barriers shall be provided to prevent spread of fire.

Enclosure for conductors and their joints / termination's which are subjected to dust conditions shall be protected to IP 54 (refer to IEC 79)

Cables shall not be installed on exterior wall faces of buildings, ceilings or support structures without the specific approval of The Company Site Representative. Spacing between cable and structure or similar shall be at least 10 mm.

For horizontal runs of cable on structures, cables shall be adequately cleaned such that no sags occur in cabling.

All cables shall be supported by saddles, cleats or other supports as indicated on the layout drawings such that no mechanical forces are imposed on cable glands.

Cable saddles shall be double-fixing. Half-section saddles shall not be used. Fixing of saddles by means of explosive tools shall not be permitted.

Cleats shall firmly clamp cable without distorting or damaging cable.

Cables sheathed with rubber, PVC or equal, may be supported by a catenary's wire, either continuously bound to supported cable or attached at intervals. For cables supported by a catenary's wire incorporated in accordance with minimum heights indicated on the layout drawings.

For spans without intermediate supports, terminal supports, terminal supports shall be arranged so that undue strain is not placed on conductors or insulation of cable. Adequate precautions shall be taken against any risk of chafing of cable sheath. Minimum specified height above ground and length of spans shall be in accordance with the layout drawings.

2.16 **Testing :**

Cables shall be tested at site as follows:

Before shifting of cables drums from the yard to the site, insulation resistance shall be carried out on the cable and readings recorded in the presence of the Site Representative.

On cable being laid prior to sand bedding an I.R. shall conducted and recorded in the presence of the Site Representative.

On the cable trench route being completed and commission done an I.R shall be conducted and recorded in the presence to the Site Representative.

No backfilling of trenches shall be done till the trench/sand padding/ cables are inspected and tested.

Before end terminations are made an I.R shall be conducted to ensure the cable is in order.

On termination's being completed prior to connecting to the equipment. The following test shall be conducted.

An I.R. done on the cable/Termination.

Cable/term subject to a pressure test for 15 minutes. The voltage to be applied shall be as per manufacturer's recommendations and in co-ordination with Owners/Consultants.

An I.R. done on completion of the above Hi pot test and compared to Item (5.1).

All tests shall be done and recorded in the presence of the Site representative.

SPECIFICATION FOR SUPPLY & LAYING OF LOW TENSION CABLES

SCOPE

This specification covers the technical requirements of supply, laying, testing and commissioning of Heavy duty medium voltage cables up to 1100 Volts for power, control and lighting application for efficient and trouble free operation.

The cable shall be properly packed for transportation, supply and delivery at site.

2 CODE AND STANDARDS

The materials covered by this specification shall unless otherwise stated as designed, constructed, manufactured and tested in accordance with latest revisions of the relevant Indian Standards.

IS 7098 (Part I) : XLPE insulated cables for working voltages up to

and including 1000 V.

IS 5831 - 1984 : PVC insulation confirming to requirement of ST2 compound for Outer sheath of electric cables.

IS 8130 - 1984 : Conductors for insulated electrical cables.

3 RATING

2.1 The cable shall be 2/3/3.5 or 4 Core Aluminum conductors, XLPE insulated heavy duty and suitable for 1100 Volts.

2.2 Aluminum conductor shall be standard, compacted and circular shaped and the main insulation shall be cross linked polyethylene (XLPE) with inner sheathing PVC extruded and each core of the cable shall have color identification all as specified in IS.

2.3 Armour over the inner sheath shall be either of strip or wire type and outer sheath shall be extruded PVC Conforming to IS.

2.4 Cable Shall be suitable to with stand maximum conductor temperature of 90oC and 250oC during operation and short circuit respectively.

4 SELECTION OF CABLES:

Cables should be selected considering the conditions of maximum connected load, ambient temperature, grouping factor, and allowance for voltage drops. However it is the responsibility of the contractor to recheck the lengths before cables are procured. Contractor should submit the cable length calculation to client / consultant for approval before procuring cables.

5 INSULATION:

The conductor is insulated with suitably compounded PVC applied to the conductor by the extrusion.

The PVC compound used for insulation shall have reduced flame propagation property. This shall also have reduced emission of hydrogen-chloride gas fumes etc. when severely overheated during fires.

6 CORE IDENTIFICATION:

The cores of the cables shall be provided with the color scheme of PVC insulation as per IS for any easy identification.

7 ARMOURING:

The armoring of multi core cable consists of either GI round steel wires or GI flat strips and in case of single core cable armouring shall be of non-magnetic material such as hard drawn aluminum or aluminum alloy wires or strips.

8 OUTER SHEATH:

The PVC compound used for outer sheath shall be resistant to termites, fungus and rodent attacks and shall also have reduced flame propagation property as specified above.

9 IDENTIFICATION:

The manufacturer's name, voltage grade of cable, year of manufacture, nominal cross-sectional area of conductor shall be embossed on the outer sheath of the cables throughout the length of the cable at regular intervals.

10 PACKING, MARKING AND TRANSPORT:

The cables shall be supplied in strong, non-returnable wooden drums of heavy construction.

Each cable drum is marked with particulars of cable size, voltage class, length, direction of rolling, position of outer gross weight, ISI certification marking etc.

11 STORING, LAYING, JOINTING AND TERMINATIONS:

- **STORING:**

All the cables shall be supplied in drums, on receipt of cables at site, the cables shall be inspected and stored in drums with flanges of the cable drum in vertical position.

Employer/Architects will inspect the cables before storing. Contractor shall take out samples from

the drums as per their instructions and send them to the manufacturers to conduct the approval tests. After the receipt of the test analysis, the Employer will accept the cable.

- **LAYING:**

Cables shall be laid as per the specification given below:

- **Cables in Outdoor Trenches:**

Cables shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not be less than 75 cms. from the Formed Ground Level (FGL) which has to be ascertained from the Architects. The width of the trenches shall not be less than 50 cm. A spacing of not less than the cable diameter shall be allowed between the cables. The trenches shall be cut square with vertical side walls and with uniform depth. Suitable shoring and propping may be done to avoid caving in of trench walls. The floor of the trench shall be rammed level. Cable unreeling from drums shall be done only with the help of cable drum rolling supports. The cables shall be laid in trenches over the rollers placed inside the trench. The cable drum shall be rolled in the direction of the arrow for rolling. Wherever cables are bent, the minimum-bending radius shall not be less than 12 times the diameter of the cable. 15 cm thick layer of sand cushioning to be provided full of stones and pebbles. Cable shall be taken lifted and placed over this and cushion. The cable shall then be covered with a 15cm thick sand cushion, where cable is laid in rocky situation. Extra thick cushioning of sand as may be required/decided by the Project Manager/Architects shall be done without extra charge. Over this, a course of cable protection Precast Concrete Cable Cover shall be provided to cover the cables by 5 cm on either side. Unless otherwise specified, the cable shall be protected by concrete tiles/stone slabs of minimum 25 mm thick placed on top of the trench breadth wise for the full length of the cable. Trench shall be back filled with earth and consolidated. Cables shall be laid in Hume pipes at all road crossings and in GI pipes / PVC pipes at the wall entries. Approved cable markers made of concrete blocks indicating the voltage grade and the direction of run of the cables shall be installed at regular intervals of 25 Meters. The depth of concrete blocks shall be at least 300 mm below ground and 50 mm above ground.

Precast Concrete Cable Covers

Precast Concrete Cable Covers shall comply with IS 5820-1970, Specification for Precast concrete cable covers and shall be of class and type as indicated. The Concrete used in the manufacturing of the covers shall be grade not lower than M-20.

CLAS S	Type No.	Description of cable over	Minimum average breaking load for un-	SIZE			Conditions where normally used.
				L	W	T	

			reinforced covers Kg.				
1	2	3	4	5			6
EHV	1	Reinforce Precast Concrete with Peak	450	450	230	50	For underground power cable of voltage rating 22KV and 33KV
	2	Ditto	750	600	230	50	
HVP	1	un-reinforce Precast Concrete with Peak	300	300	180	40	For power cable of Voltage rating above 11KV excluding 22KV and above.
	2	Ditto	350	450	180	40	For Power cable up to and including 11KV
HV	1	Un-reinforce Precast Concrete with Flat	300	300	180	40	
	2	Ditto	350	450	180	40	
LV	1	Un-reinforce Precast Concrete with Flat	200	250	180	40	
	2	Ditto	200	300	180	40	
	3	Ditto	200	450	180	40	

- **Cables in Indoor Trenches:**

Cables shall be laid in indoor trenches wherever specified. Suitable painted MS base plate clamps, saddles, GI nuts/bolts or alternatively UV resistant tie wraps shall be used for securing the cables in position at an interval not more than 450 mm. Spacing between the cables shall not be less than 15 mm center to center. Wherever specified, trenches

shall be filled with fine sand and covered with steel chequered trench covers or RCC slabs.

All chases and passage if necessary for the laying of service cables at the entry or of premises shall have to be cut and made good to the satisfaction of the Project Manager/ Consultants.

All cables entries into the buildings/cable trenches/ducts, etc. shall be suitably sealed as required by

the Project Manager/Consultants without extra cost.

6. JOINTING ,END TERMINATIONS CABLE TAG

Cable jointing shall be done as per the recommendations of the cable manufacturer. Qualified cable jointer under strict supervision shall do jointing. Sample crimping of different size cables shall be subjected to contact resistance and heating tests in the presence of the Consultant / Engineer – in – charge.

Each termination shall be carried out using Electroplated Brass double compression glands and copper cable sockets and approved jointing materials are to be used. **Hydraulic crimping tool shall be** used for making the end terminations. Cable gland shall be bonded to the earth by using suitable copper wire with earth tags. The cable armoring is to be earthed properly so that the earth continuity is maintained. All outdoor terminations shall be provided with PVC shroud's to make them water vermin proof.

Cable tag with cable size should be provided with regular interval

11.TESTING:

11.1 Cables shall be tested at factory as per the regulations of IS:1554 Part I. The tests shall incorporate routine tests, type tests and acceptance tests. Copy of such test certificates shall be furnished to the Owner.

11.2 Cables shall be tested at site after installation and results shall be submitted to Consultants / Engineers.

11.2 Insulation resistance between conductors and neutral and conductors and earth.

7. SPECIFICATION FOR SUPPLY AND ERECTION OF LT 415V, 50Hz DIESEL GENERATOR

All the DG Sets shall be manufactured as per the following specification, tender BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization , In absence of such deviation, it will be presumed that equipment offered is exactly similar to the specification , tender BOQ and drawings.

1.0 SCOPE

This specification defines the minimum requirements for the supply, installation, testing and commissioning of self excited Internal Combustion Engine driven Diesel generator Sets complete with automatic voltage regulator, control panel, generator breaker and other accessories as specified. Unless otherwise specified the Diesel generator Set shall be supplied complete with

- a) Brush less excitation system complete with AVR.
- b) Local control panel with AMF Relay including control cubicle and associated auxiliary devices, generator breaker, battery and charger.
- c) Any other part / accessories not specifically mentioned above but considered necessary for safe and reliable operation.

2.0 CODES AND STANDARDS

Unless they are in variance with the clause of this specification the Internal Combustion Engine driven generator system and its components shall comply with the latest edition of the applicable standards listed below. For imported electrical equipment corresponding local codes and standards shall apply.

IS - 2253 Designation for type of construction and mounting
arrangement of rotating electrical machines.

IS - 4691 Degree of protection provided by enclosures of
Rotating Electrical Machinery

IS - 4722 Rotating electrical machines.

IS - 4728 Terminal marking and direction of rotation for rotating

electrical machinery.

IS - 4889 Methods of determination of efficiency of rotating electrical machine.

IS - 6362 Designation of Methods of Cooling of Rotating Electrical Machines.

IS - 7132 Guide for testing synchronous machines.

IS - 7306 Methods of determining synchronous machines quantities from tests.

IS - 7816 Guide for testing of insulation of rotating machines.

IS - 12065 Permissible limits of noise level for rotating electrical machines.

IS - 12075 Mechanical vibration of rotating electrical machines with shaft heights 56mm and higher - measurements, evaluation and limits of vibration severity.

IS - 12802 Temperature rise measurement of rotating electrical machines.

IS - 13364 AC Generators driven by reciprocating internal combustion engines.

IS - 13947 Low voltage Switchgear and Control gear: General Rules.

IS – 10000 Specifications for DG sets

IEC - 34 Rotating Electrical Machines.

b) below and meet the requirements of following authorities

- Electrical inspectorate
- Fire Protection Manual

- Factory Inspector,
- Tariff Advisory Committee
- Central Electricity Authority
- State Electricity Board
- Pollution Control Authority

The equipment shall also conform to the provisions of Indian Electricity rules and other statutory requirements currently in force. In case of any contradiction between the standards listed above and this specification, the requirement laid down in this specification shall prevail.

3.0 PERFORMANCE REQUIREMENTS

4.0 Site Conditions

Generator shall be suitable for operating satisfactorily in humid and corrosive atmospheres; Work covered by this contract shall include design, manufacture, supply, transportation, delivery, Installation, testing and commissioning of Diesel Generator Sets and auxiliaries required for **prime Power** generation. The generator set shall consist of a diesel engine directly coupled to an electric generator, together with the necessary control panel, battery, diesel tank etc and accessories to provide prime electric power for the duration of any failure of the normal **AC source**.

The vendor should

Visit the site and obtain on the spot information required by him and having bearing on This work.

- | | | |
|-----------------------------------|-------|-------------|
| - Maximum Ambient temperature | - -- | 45 Degree C |
| - Minimum Ambient temperature | ----- | 9 Degree C |
| - Maximum Relative Humidity | ----- | 97% |
| - Minimum Relative Humidity -- | --- | 30% |
| - Altitude above mean sea level - | --- | 1000 mtr |

4.1 Voltage Regulation

The voltage regulation of the machine shall be within ± 2 % of the nominal voltage under following conditions:

- Between no load and nominal load with p.f . of 0.8 lag to unity.
- With the machine cold or warm.
- At speeds drop of approximately 3% of the nominal speed.

$\pm 0.5\%$ regulation (steady state) shall be performed by a solid state type AVR (Automatic Voltage Regulator). The response of regulator shall be such that the generator voltage is Recovered to set value on application or rejection of rated load at rated PF within a period of 0.5 sec. Further adjusting the set voltage up to $\pm 5\%$ of rated voltage shall be possible by the potentiometer provided for the purpose.

4.2 Voltage setting range

The generator terminal voltage shall be adjustable with a continuously variable potentiometer. The adjustment range shall be $\pm 3\%$ of the nominal voltage. Under transient operating condition, the time of return to within $\pm 3\%$ of steady state voltage when permitted step down load is suddenly applied shall be less than one second (assuming speed to be constant). Further the Speed drop due to such loading shall be corrected to ensure 50 Hz $\pm 1\%$ Hz within less than 3 seconds (momentary fluctuation in frequency shall be less than ± 1 Hz). Governing system shall ensure minimum fluctuation during load changes. Inertia constant of the rotating system shall aid the governing system. Class A1 governing system preferably using wood ward PSG governor shall be offered. Speed drop shall be continuously adjustable.

4.3 Unbalanced Load

The generator shall be capable of withstanding without injury the effects of a continuous current unbalance corresponding to a negative - phase sequence current of 8 % of the rated current for cylindrical rotor machines or for salient pole machines provided none of the phase current exceeds rated current.

4.4 Frequency Limits

The generator shall be suitable for continuous operation at rated load for a frequency variation of $\pm 3\%$ of rated value. In addition the vendor shall furnish the short time under-frequency operating limits.

4.5 Over Current Requirement

The generator shall be capable of withstanding without injury stator current of 1.5 p.u. for 30 seconds and 1.1 p.u. for one hour.

The Generator & its excitation system shall withstand the 10% overloads for 1 hour in 12 hour

intervals. The stator winding withstands even higher overloads for short duration such as 1.5 times rating for 30secs and also withstands the stresses caused by the maximum asymmetrical short circuit current. Generator & its excitation system shall withstand over speed of 120%

4.6 Short circuit conditions

The generator shall be capable of withstanding with out damage, three phase or a line to line or line to earth or two line to earth short circuit for a period of 3 seconds when operating at rated speed and rated load and with an excitation corresponding **to 5 % over voltage**.

The Generator shall withstand short circuit current equivalent to its sub transient reactance for 3 sec. The Excitation System shall be designed to maintain this short circuit current.

4.7 Parallel Operation

The Generator set shall be suitable for parallel operation with other DG Set.

4.8 Excitation support system

Excitation system shall be provided with short-circuit support equipment (series compounding) to maintain **three times the rated current for three seconds** in case of short-circuit to ensure proper fault clearance in outgoing feeders. The alternator shall have brushless self exciter mounted on the same shaft.

5.0 DESIGN AND CONSTRUCTION (ALTERNATOR)

The generator design shall meet the ambient conditions Alternators shall be industrial type, provided with insulation Class of 'H' with temperature rise limited to class 'F' and Degree of protection of enclosure shall be IP 23. The alternator shall be mounted on common base frame together with the engine. No external supply shall be required during starting & running of generator.

- 4.2 The generator shall be mounted on a common base frame together with prime mover unless otherwise agreed. The generator shall be provided with necessary lifting hooks and two earth terminals on opposite sides for connection to main earth grid. The generator winding shall be of **class 'H' insulation with temperature rise limited to class F**. The windings and overhangs shall be braced to withstand the short circuit forces.
- 4.3 The stator winding shall be star connected and all windings shall be brought out to six

insulated terminals in a terminal box. The stator neutral side connection shall be brought in neutral cubicle having protection CT's. The terminal boxes for the line terminals and neutral shall have sufficient space for the terminals of cable size specified in Schedule. The terminal boxes shall be complete with lugs and Single compression cable glands. Current transformers shall be as specified in Schedule.

- 4.4 All parts and accessories shall be suitable to withstand stresses due to over speed / overload / short circuit conditions specified.
- 4.4 Bearings shall be anti friction, shielded and pre lubricated. Grease in the bearing enclosure shall provide additional lubrication to bearing as well as provide sealing against dust and moisture.
- 4.5 The generator shall be air cooled unless otherwise specified. Generator enclosure shall be as specified in data sheet.
- 4.6 The direction of rotation of the rotor of the machine shall be compatible with that of the prime mover. A clear indication of the direction of rotation shall be given on either end of the machine.
- 4.7 Field winding shall have class 'H' insulation. The field winding shall be capable of operating at a field voltage of 125 % of field voltage at rated load for at least one minute starting from stabilized temperatures at rated conditions.
- 4.8 All cabling on the generator set skid shall be in GI perforated cable trays/ conduits. All cables shall be identified close to their termination point. Single compression type cable glands shall be used for cable termination.
- 4.9 Rating plate of stainless steel shall be fixed on the generator frame and shall give the information as per IS : 4722.

6.0 EXCITATION SYSTEM

The generator shall be provided with brushless type solid-state self - excitation system with automatic voltage regulator. The excitation system shall include the automatic voltage regulator, AC exciter and rotary rectifier. All components shall be mounted considering the effects of the

centrifugal forces. Automatic solid state voltage regulator shall be provided with the following features as a minimum.

- Short circuit protection.
- Manual voltage control
- Voltage build up circuitry
- Test mode

7.0 Auto Mains Failure scheme

7.1

This shall be effective in Auto position of Auto / Manual selector button of AMF Relay located in local control panel. The generator set shall normally be at rest. Upon failure of normal supply, an impulse shall be extended from purchaser's equipment. Upon receipt of this impulse, generator set shall start automatically and rated speed and voltage shall be built up. All accessories required for starting and completion of various sequence of operation for the above purpose shall be provided as part of DG set. Immediately after this, voltage-monitoring relay located in control panel shall extend an impulse for closing generator breaker and switching Off of Normal supply breaker in Purchaser's Panel.

7.2 Manual start in service mode

This shall be effective in manual position of Auto / Manual Button of AMF Relay and service position of service / test selector switch located in control panel. The scheme of operation shall be same as of auto mode as per clause above except that starting impulse shall be extended manually through the push button either in local control panel or purchaser's control panel.

7.3 Test mode

This shall be effective in test position of service / test selector switch. The scheme of operation shall be same as that of manual start in service mode as clause above except that the closing impulse for generator breaker shall not be extended automatically.

8.0 Shut-down

Unless otherwise specified, stopping the generator set in all cases for a normal shut down shall only be done manually by means of push button in either local control panel or remote panel.

8.1 Starting time

The total time from the receipt of the starting impulse for the generator set till reaches rated speed and generator reaches rated voltage shall not be more than **10 seconds**. If this time is exceeded, an annunciation in the local control panel shall be provided with a facility for repeat annunciation in purchaser's panel.

8.2 Starting System:

Electrical starting system shall be provided for the engine. Battery of adequate capacity shall be provided with all necessary hardware and accessories. Battery charger with float and boost charging facility shall be provided in the control panel and shall have adequate capacity of giving 4 consecutive starts up kicks with voltage monitoring and alarm devices. The battery charging circuitry shall be such that when engine is running, the engine mounted dynamo charges the battery and when engine is not running, the battery charger, charges the battery. Necessary changeover scheme shall be employed in the control panels.

Necessary mechanism shall be provided for automatic starting of engine in conjunction with the fuel oil, lube oil and cooling system. The starting solenoid valves shall be provided with manual bypass valve for local starting.

8.3 Black start facility

The generating unit shall be provided with all necessary 'black start' facilities. External power at 415 V TPN shall be made available by purchaser at one point for any equipment operation during stand still period of generator set. This power shall not be available during start-up of the generator set. All D.C. supplies and chargers including batteries for start - up of prime mover, wherever applicable, shall be supplied along with the generator.

All auxiliary motors shall be three phases, 415 V, 50 HZ squirrel cage type suitable for DOL starting. Insulation class shall be 'B' as a minimum. All motors shall have IP - 55 enclosures and shall conform to relevant Indian Standards.

9.0 GENERATOR CONTROL PANEL

The local generator control panel for the ----- KVA generator sets shall comprise of the following data unless otherwise specified in the attached data sheet. Electrically operated Draw out type 4 pole, ACB with microprocessor based releases for over load and short

circuit , E/F. This Breaker should be in a CRCA sheet steel enclosure and mounted above the alternator terminal box and suitable for Bus Duct termination.

9.1 Auto mode

This shall be effective in Auto position of AUTO / MANUAL Selector switch located in Main control and protection panel. The diesel generator set will normally be at rest. Upon failure of plant normal supply, an impulse will be extended. The impulse shall be normally from an under voltage relay. Upon receipt of this impulse, D.G.Set shall be started automatically and brought to rated speed and generator voltage brought to rated value. All accessories required for starting and completion of various sequences of operation for the above purpose shall be provided. In case the DG fails to start and run up on first attempt the engine cranking shall be repeated two more times. When engine does not respond to three impulses, it shall be locked out and alarm given. Contacts for repeat alarm shall be provided.

Vendor to ensure that upon failure of supply, DG-1 shall always be available within maximum 10 seconds to take care of load. Suitable scheme to achieve this shall be developed by Vendor within Main Control and protection Panel.Immediately after the diesel set reaches rated speed and generator reaches rated voltage, a Voltage and frequency monitoring relay located in Main Control and protection panel shall extend an impulse for closing generator breaker.

9.2 Manual Test Mode

Facility for manually starting the diesel generator sets for routine testing shall be provided. This shall be done by putting the AUTO / MANUAL Selector switch in Manual Position and by pressing the Push Button on engine control panel. The scheme of operation shall be such that the closing impulse for Generator breaker shall not be extended.

10.0 Synchronization Panel:

- a) Electrically operated Draw out type 4 pole, . along with separate neutral isolation **with microprocessor** based releases for over load and short circuit ,E/F FURTHER DETAILS AS PER boq ,Single line diagram.
- b) AMF relay modules for each Generator.

Synchronization Relay with Synchro scope, Dual Scale Voltmeter, Dual Scale Frequency Meters & Guard Relay

- c) Rise / Lower Push Button stations
- d) Potential transformers for Bus & Incomers
- e) Reverse Power relays on DG Incomers, plcs
- f) Metering equipments and Indicating instruments such as Digital Voltmeter, Digital Ammeter, KW Meter and Digital KWH Meter, Frequency meter.
- g) Auto / Manual Selector switch.
- h) Load sharing Relays.
- i) Indicating lamps for "ON / OFF / ENGINE TRIP/ POWER SHUT OFF/POWER ON/LOAD OFF/LOAD ON".
- j) Push Buttons actuators with NO / NC auxiliary elements.
- k) 24V DC Hooter.
- l) Auxiliary contactors with 2NO + 2NC auxiliary contacts.
- m) 0-60secs. On-Delay Timer.
- n) Control Transformers.
- o) MCB
- p) Battery charger suitable to charge 2 sets of Batteries.
- q) 24V, DC Operated, 9 Window Annunciator along with Hooter for each incomer

Any other accessory required to make the generator set operational, as a package shall be included in scope of supply. If required the generator synchronization panel shall be split into various functional sections viz. metering, control, and regulation etc.

The breakers shall also be part of the control panel unless otherwise specified. The breaker rating shall be as specified. This breaker shall serve the purpose of local isolation. The breaker shall be of electrically operated and draw out type.

For Synchronization of 415 V generators, breaker shall be of three poles and a separate contactor or breaker to be considered for neutral isolation.

Unless otherwise specified, the DC control supply required for AMF / local control panel and for any other purpose shall be met by DC system consisting of battery and battery charger of suitable capacity to be supplied by the generator set manufacturer.

The battery shall be sealed maintenance free, high discharge automotive type suitable for engine starting duty. The battery shall be placed on battery stands made of steel with suitable PVC coating. The battery capacity shall be adequate for three consecutive starts of the engine under cold engine condition, without recharging, with additional 10% spare capacity.

- 7.3 The battery charger shall have 3-phase full wave controlled bridge rectifier with their protective devices. The charger shall be of solid state design, constant voltage type with current limiting feature suitable for automatic and manual, normal and quick charging of batteries. The output voltage shall be stabilized to $\pm 1\%$ for mains variation of $\pm 10\%$ and load variation of 0 to 100 %.

The charger shall be complete with all interconnections within the panel. All connections shall be made using 1100 V grade PVC insulated wires /cables with adequately sized copper conductors for power connections and copper conductor of size 1.5 mm size for control connections.

ON / OFF switch for incoming power supply, float/boost selector switch, potentiometer for coarse and fine control of output voltage and backup timer shall be provided on the front of the panel in addition to AC incoming voltmeter and ammeter with selector switch and DC output voltmeter and ammeter. Indication lamps for AC power on (3 lamps) charger in float, charger in boost, charge failure shall also be provided.

- 7.4 The generator control panel shall be free standing, metal enclosed fabricated with cold rolled sheet steel of 2mm thickness, dust and vermin proof type with a hinged door and having a degree of protection IP 54 unless otherwise specified. Power and control

equipment shall be segregated inside the panel as far as practicable. The maximum height shall not be more than 2275mm. All hardware shall be corrosion resistant and bolts; nuts and washers shall be made of galvanized, zinc passivated or cadmium plated high quality steel. Unless otherwise specified the panel shall be suitable for bottom cable entry. The Panel shall be powder coated with Siemens Grey after seven-tank treatment for sheet

Necessary removable type un-drilled gland plate shall be provided with the panel.

All auxiliary devices for control, indication, measurement and alarm such as push button, control / selector switches, indicating lamps, metering instruments, annunciators etc. Shall be mounted to the front door of the panel. Adequate number of potential free contacts shall be provided in the control panel for any remote control, monitoring of the generator set.

- 7.5 All indicating instruments shall be Digital type of size 96 x 96mm min. All control / selector switches shall be rotary back connected type having a cam-operated contact mechanism with knob type handle 'Stop' push buttons shall have a cam-operated contact mechanism with knob type handle. 'Stop' push buttons shall be stay put type.
- 7.6 Wiring for power, control and signaling circuits shall be done with PVC, FR insulated copper conductors having 1100 V insulation grade. Minimum size of control wires shall be 1.5 mm with Clip-On type terminals shall be acceptable for wires up to 10 mm size and for conductors larger than 10 mm bolted type terminals with crimping lugs shall be provided. A minimum of 10 % spare terminals shall be provided on each terminal block.
- 7.7 60 x 10 mm Aluminum or equivalent copper earth bus shall be provided in the panel for connection to the main earth grid. All non current carrying metallic parts of the mounted equipments shall be earthed. Doors and movable parts shall be earthed using flexible copper connections.
- 7.7 Engraved nameplates shall be provided for all devices mounted on the front of the panel. Nameplate or polyester adhesive stickers shall be provided for each equipment mounted inside the panel.

11.0 PRIME POWER RATED DIESEL ENGINE:

Diesel Engine shall be suitable for generating set application developing suitable BHP at 1500 powered by multi cylinder. The engine shall be of heavy-duty type suitable for cold starting and

equipped with a minimum of the following accessories. The Engine shall be **Radiator Cooled**, rated for **continuous duty** and shall be capable of developing the Torque required for desired Overload capacity of the Alternator. Prime power continuous Duty rated sets with the facility for 10% overload for the period of 1 hrs. in 12 hrs. of running. DG Sets are suitable for unlimited running

- a) Fly wheel to suit flexible couplings with guard
- b) Air cleaner
- c) Corrosion proof radiator with guard
- d) Fan with guard
- e) Water pump-centrifugal type, engine mounted
- f) Fuel pump
- g) Fuel filter
- h) Governor-Electronic type
- i) Fuel injection equipment
- j) Exhaust silencer (Residential Silencer)
- k) Electric starting equipment comprising of starting motor on 24V DC supply
- l) Lubricant oil cooler
- m) Lubricant oil pump-gear type, engine mounted
- n) Lubricant oil filter
- o) Turbo charger (exhaust gas driven)
- p) Battery charging generator with voltage regulator-24V DC
- q) 24V Battery of suitable AH capacity with stand.

11.1 Instrument panel shall consist of:

- a) Starting switch with key
- b) Lubricating oil temperature gauge
- c) Lubricating oil pressure gauge
- d) Water temperature gauge
- e) Battery charging ammeter
- f) Circuit breaker
- g) Safety control for low lubricating oil pressure
- h) Safety control for high water temperature
- i) Hour meter (mech.) and RPM indicator

The Instruments (a) to (d) & (i) can be mounted on the Engine itself.

11.2 Base frame:

The engine alternator shall be perfectly aligned and assembled on a sturdily fabricated adequately machined base frame, made out of high quality MS channels. The base frame should be provided with lifting facilities and pre-drilled foundation holes suitable for installation either on concrete foundation or with anti-vibration mountings.

11.3 Fuel tank :

Fuel tank of 990ltrs capacity for the set with inlet-outlet pipe connections, filling cap, drain plug, scaled level indicator to indicate the amount of diesel in stock and floor mounting pedestal along with hand operated fuel transfer pump and suitable hose shall be provided.

12.0 ACCOUSTIC ENCLOSURE:

12.1 Scope:

Supply and erection of Acoustic Enclosure for each set. The enclosure shall be suitable for out door installation to withstand the weather conditions mentioned.

12.2 Construction Features:

- a. The construction and design of the Acoustic panels shall be very rugged, durable and shall be virtually maintenance free. The external body of the enclosure shall be made out of 16 SWG CRCA sheets bent/fabricated as per the required sizes for better performance, providing rust proof red-oxide and two coats of enamel paint; the colour scheme shall be approved by the Architect. A glass window with 6 mm thick glass with frame shall be provided on either side to inspect the DG during running. Inner panels shall be made of 24 SWG G.I. Sheets with 3 - 4mm perforation to allow noise to be absorbed by mineral wool. RP tissue shall be provided between perforated sheet and the mineral wool to prevent slipping of the mineral wool due to vibration. Silver colour paint shall be provided over perforated sheets to give better and final finish.
- b. The acoustic panels shall be filled with a special grade high-density mineral wool 150mm thick of density 64Kg/m³ retained by perforated GI sheets specially designed for optimum sound attenuation.
- c. All structural members such as angles / channels used in the construction of the enclosure frame shall of TISCO / SAIL make only.

- d. All materials used for Acoustic treatment shall be fire resistant / fire retardant grade.
- e. The sheet steel treatment shall consist of degreasing, de rusting and phosphate followed by two coats of zinc chromate primer, followed by two coats of Zinpholite surface for superior corrosion resistance and two coats of finish paint.
- f. For effective Acoustic sealing, necessary casketing material shall be provided.
- g. All hardware and fittings used shall be passivity with zinc.

The enclosure shall be suitable for DG set with an air inflow suitable for aspiration of the engine to ensure engine develop rated output & also ensure that the temperature inside the DG enclosure is within the specified limits. Necessary air intake exhaust fans of suitable capacity & numbers shall be provided if the static of the engine radiator fan is not adequate to generate the required airflow. Necessary intake & exhaust louvers of adequate size with acoustic treatment shall be provided.

The fans, control panels with requisite starters & cabling from control Panel to the fans shall be in the Contractors scope of work. Suitable interlock will be provided to the incomer of the panel so that the fans are 'ON' only when the DG is working. Necessary timer for 3-10 min time delay will be provided to ensure the fans working after EB power resumption to effect necessary cool down. Calculations showing the selection of the fans shall be submitted along with the offer. The fans shall be mounted in front of the air intake baffles with protective guard.

13.0 Performance:

With the above treatment, the sound pressure levels when measured at a distance of 1mtr outside the DG enclosure louvers shall be not more than 70 To 75 dB (A) under free field conditions.

The enclosure shall be provided with suction fans to ensure that the adequate cooling and combustion air is made available to the engine and the temperature within the enclosure is limited to 5 °C above ambient. The fan shall be designed with sufficient static to draw the requisite quality of air from the louvers provided for this purpose. Calculations shall be furnished to prove the adequacy of the ventilation system offered. The suction fans shall start automatically when the temperature in the enclosure reaches 40 °C and shall continue to run for 5 to 10 minutes after the load is disconnected. A temperature controller shall be provided for this purpose housed in sheet steel enclosure. With the installation of the acoustic system, there shall not be any derating of the DG set. The maximum temperature of oil and water shall not exceed the limits prescribed by the

manufacturer of the engine. The DG set shall give rated output continuously.

The ventilation system shall be designed to provide an air volume of not less than 80,000CFM whenever the DG set is in operation. The ventilation fan shall be of the axial flow type designed to handle the static pressure estimated based on the inlet air duct size and length.

Notes:

- i. The above noise level is defined with all background ambient noise levels from any other source being less than 70 db (A) so as not to influence this noise level.
- ii. The section of the exhaust piping within the enclosure from the engine exhaust manifold onwards upto and including the Residential silencer, must be adequately cladded with thermal insulation to limit surface temperature as also reduce noise level to less than 70 db (A).

13.1 Painting:

The entire system shall be coated with Red oxide paint. After erection rust preventive painting must be essential. After erection one coat of Grey color synthetic enamel to be made.

13.2 Dimensions:

The overall dimensions of the enclosure shall be such as to provide free movement all round the DG set inside the enclosure. Two sliding doors of adequate size shall be provided on either side of the DG set to facilitate easy inspection and carryout maintenance works.

The enclosure shall be completely weather proof and is suitable for Outdoor application. The DG set Control panel & Fuel tank shall be mounted within the enclosure

14.0 PIPING & ACCESSORIES:

- a. The piping shall be of Class "B" M.S pipe of 20 /25 /40 /60 mm dia.
- b. All accessories such as strainer, isolating valves, non-return valves etc. shall be supplied as required based on approved piping layout drawings.
- c. The piping schematic shall be submitted with the bid which should include supply, over flow return from engine & drain pipes.

d. The piping shall be painted with one coat of primer and two coats of finishing paint of approved color.

e. One number manual gear pump for filling the day tank shall be supplied per DG.

14.1 SPARES:

The DG set will be supplied with the following spares which shall be handed over at the time of commissioning.

- 2 sets of renewable parts of oil, fuel & air filters.
- 2 Nos. fan belts.
- 5 Nos. spare fuses of each type & size used.
- 2 spare relays of each type.
- 2 sets of fuel injectors.
- 1 No. Manual gear pump

14.2 EXHAUST STACK:

- 12.1 Exhaust stack shall be separate for each set.
- 12.2 The height of the stack shall not be less than 30 m and shall conform to the requirements of pollution control board.
- 12.3 Sampling points shall be provided as required.
- 12.4 The design of the stack shall be taken into account maximum wind velocity and shall be subject to approval of the consultants / clients.
- 12.5 The stack shall be aluminized both inside and outside to retard corrosion. The thickness of aluminization shall not be less than 150 microns. The agency carrying out installation shall be subject to approval of the clients.
- 12.6 The stack shall be supported by MS support structure adequately designed for the stack load and wind load. It shall be painted with 2 coats of aluminium paint over two coats of primer.

15.0 INSTALLATION:

The bidder shall undertake the installation work at site. The general scope of installation work shall include but not be limited to the following.

15.1 DIESEL GENERATOR SET :

- a. The assembled Diesel Generator set shall be installed in the container on anti- vibration mounts. The unit shall be visually inspected for any transit damage.
- b. The contractor shall arrange for the inspection of the set by the diesel engine manufacturer's authorized representative and obtain his approval before rolling the set.
- c. The fuel oil day tank shall be installed over the drip tray at the location indicated.
- d. The batteries shall be fully charged, installed and connected.
- e. The battery charger shall be heavy duty.

15.2 FUEL PIPING :

- a. The fuel piping shall include supply and installation of Class "B" MS pipes of adequate size with necessary valves and accessories required for the supply & return lines from day tank to the engines. The pipes shall be painted with primer over which 2 coats approved colour paint shall be applied.
- b. The joints in the line shall be properly sealed to avoid any leakage of fuel.

15.3 EXHAUST PIPING & STACK:

- a. The exhaust piping shall be fabricated from 6mm thick MS pipes.
- b. The exhaust piping and the silencers shall be insulated using 50mm thick mineral wool inside the container & up to the exhaust stack. The insulation shall be clad with 24G aluminum sheet.
- c. The exhaust pipe shall be supported using spring suspension supports.

d. The shipping sections of the stack shall be welded at site and erected over the MS frame work. The entire length including the flanges, bolts and washers shall be aluminized inside and outside to inhibit corrosion. A weather cowl shall be provided on top.

e. All tools and tackles used for the erection shall have valid safety certification.

f. Aviation obstruction light with cabling & lightning arrestor shall be provided on top of the Chimney. The cabling will be brought down from the aviation lamp to the DG / Panel room and terminated to a switch provided.

15.4 ELECTRICAL INSTALLATION:

a. The electrical power cabling from alternator to the panel will be carried out by other agencies. However the DG control cabling from the DG to the DG Panel will be carried out by the DG vendor and required control cable will be supplied as a free issue item to vendor.

b. The contractor shall appoint an experienced full time engineer throughout the installation period till the set is handed over. One-month maintenance from the date of commissioning shall be carried out by the DG vendor.

c. The contractor shall carry out the control cabling from the engine control panel to the breakers in the main panel.

d. Connecting block with wiring diagram shall be provided in the DG Panel for integrating with the EB Panel.

16.0 TESTING:

16.1 AT MANUFACTURER'S WORKS

The routine tests and full load test on Engine, Alternator shall be carried out manufacturer's work in accordance with applicable Indian standards and test certificates shall be submitted in triplicate.

16.2 TESTING AT 'OEA's WORKS

14.a The purchaser or his authorized Representative may visit the works during

manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.

14.b Detailed test procedures along with the facilities available at vendor's works shall be furnished by the vendor.

14.c Minimum Acceptance tests :

On completion and before handing over of the work, the following tests shall be carried out by the contractor to the entire satisfaction of the Engineer-in-Charge.

16.3 A) Phase-I Test :

i) Insulation resistance test - Sectional and overall

ii) Continuity resistance test-sectional and overall

iii) Earth resistance test

iv) All instruments and relays shall be tested under normal operating conditions.

v) Visual examination to ensure that the plant equipment and accessories are provided and the finish and general appearance of the work are as per contract specification.

vi) A no load test for a period of 15 Minutes continuously to see that the engine, alternator and other accessories are functioning normally.

The duration of the test may be increased if necessary and as directed by the authorized representative of the accepting officer.

16.4 B) Phase-II Test :

On completion of the Phase-I tests to the entire satisfaction of the authorized representative of the accepting officer. A load test shall be carried out at factory dispatch as given below.

25% Load : 1 hour, 50% Load : 1 hour, 75% Load : 1 hour, 100% Load : 1 hour 110% Load : 30 minutes Similar tests to be carried out at site after erection as part of commissioning.

All necessary arrangements for testing under artificial load conditions, such as cables, electrodes etc., shall be provided by the contractor for factory and site tests and the charge for the same is deemed to be included in the rate quoted in the schedule. However the engine shall be with the first filling of lubricating oil.

16.5 C) Tests on Alternator:

- i) Routine tests for alternator as per IS : 4722.
- ii) Phase sequence test

16.6 SITE TESTING

Following tests shall be conducted at site in the presence of the client's representative before energisation. The contractor shall provide all testing equipment, labour and consumables required for the testing.

- a. Checking the alignment by engine manufacturer's representative and obtaining approval.
- b. Insulation resistance test on alternator, control panel and cabling / Bus bar trunking.
- c. Checking the AMF operation both on auto and manual mode.
- d. Checking the engine safeties for satisfactory operation.
- e. Checking vibration levels.
- f. Testing of individual protective devices on engine and alternator and ensuring that the wiring is carried out properly.
- g. Full load running for 8 hours continuously. All the readings shall be logged to evaluate the fuel consumption, lube oil pressure, water & oil temperature vis-à-vis the electrical load.
- h. One hour overload testing at 110% load shall be carried out at the end of the full load

trial.

- i. The guaranteed specific fuel consumption shall not exceed 150grams / BHP. HR with a tolerance of + 2.5 %. The same shall be proved during the load trial.
- j. The noise level at 1m from the enclosure and the temperature rise inside the enclosure shall be measured.
- k. Any deviation from the guaranteed parameters shall be made good and these performance parameters should be measured once again till the required results are achieved.
- l. The DG set shall be deemed to be commissioned after satisfactory performance of all associated equipment. Successful conduct of the tests and after submission of performance test reports including equal load sharing like KVA, KW, KVAR when synchronized and running in parallel.

17.0 TAKING OVER

The clients will take over the DG set for operation on completion of the following:

- a. DG set are installed, tested and commissioned as per the specifications.
- b. Original test certificates are furnished for engine, alternator, and acoustic enclosure, centrifuge and all other bought out items.
- c. Load trials are successfully conducted including the performance of acoustic enclosure and ventilation fans.
- d. Approvals are obtained from Pollution Control Board and Electrical Inspectorate.
- e. 6 sets of AS BUILT documentation, spare parts list, maintenance chart and operation and maintenance manual are to be submitted.
- f. The set shall be handed over with first fill of lube along with spares mentioned.

18.0 GUARANTEE

18.1 DG SET

The DG set and accessories shall be guaranteed for satisfactory operation for a period of 12 months from the date of commissioning. Any defects noticed during this period shall be rectified at free of cost.

The supplier shall indicate the type of records to be maintained so that the warranty claims if any are honored by the manufacturer.

The design and installation of acoustic treatment shall ensure that the noise level at 1Mtr from the DG Room at any point shall not exceed 70dBA while operating the set at rated load.

18.2 MAINTENANCE

The response time for any break down call shall not be more than 2 hours.

During the guarantee period, the bidder shall carry out regular servicing of the unit every three months or 250 hours whichever is earlier. The consumables required for this will be made available by the clients.

18.3 PAINTING, PACKING AND DESPATCH

All metal surfaces shall be thoroughly cleaned of scale, rust, and grease etc. Prior to painting. cleaned surfaces shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.

The equipment shall be shipped to site suitably packed to prevent any damage during transit. Each package shall have labels to show purchaser's name, purchase order and equipment no. Suitable lifting lugs etc. Shall be provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period of 6 months.

19.0 DOCUMENTATION

As a part of the equipment supply, following documentation shall be furnished:

- a. General arrangement plan of DG set.
- b. Piping schematic diagram
- c. Chimney fabrication drawing.
- d. Layout of fuel and exhaust piping.
- e. Layout and constructional details of acoustic treatment.
- f. Calculations for ventilation system design.
- g. Engine wiring diagram.
- h. Test certificate for engine and alternator.
- i. Installation, operation and maintenance instructions for diesel engine, alternator.
- j. Spare parts list.
- k. Approval from Pollution Control Board and CEIG.
- l. Layout of AMF / synchronization Panel & control drawing.

20.0 SCHEDULE OF PARTICULARS AND GUARANTEE ON DIESEL OIL ENGINE DRIVEN GENERATING SETS

DATA TO BE FILLED IN BY TENDERER

Item No	Description	Particulars
<hr/>		

OIL ENGINE

1. Make
2. Type
3. No. and arrangements of cylinders
 - A) No. of cylinders
 - b) Arrangement of cylinders
4. Method of starting
5. Rated Speed (RPM)
6. Time required for starting from cold
7. Type of Governor
8. Guaranteed limits of governing
 - a) Permanent variations
 - i) Full load thrown off
 - ii) Full load put on
9. Total speed variation which can be effected by hand speed regulating gear
10. Specification of lubricating oil recommended
11. Specification of fuel oil recommended
12. Rated output at normal temperature and Pressure conditions as defined in BS: 649 latest in the case of Diesel Engine i.e. at 1000 M above mean

Sea level and ambient temperature
Above 45degrees C

13. Overloaded for one hour at standard operating conditions
14. Guaranteed output at site (continuous running for 12 hours under the worst atmospheric conditions specified in the schedule of requirements)
15. Over load for one hour at site
16. Guaranteed fuel oil consumption
(A) under standard temperature and pressure (S.T.P)

i) at full rated output (liters/metric horse power/hour
ii) at 3/4 rated output ,,
iii) at 1/2 rated output ,,

(B) at site conditions

i) at full rated output ,,
ii) at 3/4 rated output ,,
iii) at 1/2 rated output ,,

17. Guaranteed lubricating oil consumption at full rated output Liters

18. Mechanical efficiency %

19. Thermal efficiency %

20. Details of standard accessories offered with the engine

21. Safety protections

- a) Whether over speed trip provided or not
- b) Whether low lubrication oil trip provided or not

- 22. Direction of rotation when looking from engine towards the driven machine
- 23. Whether the engine is 2 stroke or 4 stroke
- 24. Method of aspiration (Eg. natural, turbo, or super charged etc.)
- 25. Method of cooling

ALTERNATOR

- 26. Make
- 27. Type
- 28. Rated continuous maximum rating in KVA to BS 2613-57
- 29. Rated continuous output in KW at 0.8 PF
- 30. Rated speed (RPM)
- 31. Rated voltage
- 32. Number of phases
- 33. Overload capacity
 - a) 10 percent for Hrs
 - b) 50 percent for Hrs

34. Temperature rise of the windings measured by thermometer after continuous run at full rated output, rated voltage, frequency and PF and with surrounding air temperature at 45degrees C (Amb. temperature)
35.
 - a) Efficiency at 0.8 PF at full load
 - b) Efficiency at 0.8 PF at 3/4 load
 - c) Efficiency at 0.8 PF at 1/2 load
36. Inherent voltage regulation (increase in voltage from full load to no load with constant speed and excitation)
37. Are damper windings fitted on poles ?
38. Radial clearance between stator and rotor (air gap)
39. Peripheral speed of the rotor
40. Critical speed of the rotor
41. Method of lubrication
42. Direction of rotation
43. Excitation voltage
44. Alternator excitation current at full load on
 - i) Unity PF
 - ii) 0.8 PF

21.0 Statutory Approval:

Each DG system along with associated accessories and layout shall be acceptable to statutory bodies like Electrical Inspector, Tariff Advisory Committee, Electricity Board,

Pollution Control Board etc. Any Changes required by them shall be carried out by Vendor without additional cost. Getting the approvals is in Vendor's scope. Statutory fees will be paid by Purchaser.

8. LIST OF APPROVED MAKES

Consultant's approval must be taken for Each and Every items sample guaranteed Technical particulars and General arrangement of manufacturers drawings with authentication for any items before procurement, Supply and installation, execution of works.

1	ACBs	:	Siemens- 3WL / Schneider- NW / L&T U-POWER
2	MCCBs	:	Siemens-3VA / Schneider- NSX / L&T –D-SINE
3	Capacitor' Heavy Duty	:	Siemens / EPCOS / Schneider/ L&T
4	APFCR - PF Relay	:	Siemens / EPCOS / Schneider/ L&T
5	Protective Relays	:	Siemens / Schneider / L&T
6	HT , LT & Control Cable	:	Universal / CCI / KEI / RPG /RR /
7	Cable Glands & Bimetallic lugs	:	Comet / HMI , dowels/ HEX
8	Flame proof Cable Glands & Bimetallic lugs	:	Comet / HMI , dowels/ HEX
9	Switch disconnecter fuse units	:	Siemens / Schneider / L&T
10	Load break isolator	:	HPL Socomec / Siemens /Schneider
11	Load break change over SFU /isolator	:	HPL Socomec / Siemens /Schneider
12	HRC Fuses / Base	:	Siemens / Schneider / L&T
13	HRC Fuse link for FDSU	:	Siemens / Schneider / L&T
14	MCB, ELCB, ELMCBO & MCB Distribution boards	:	Legrand /Hager/ L&T / Schneider

15	CTs & PTs (resin cast)	:	Kappa / A.E / KALPA
16	Control Switches	:	Kaycee / Salzer / Siemens /Schneider/ L&T
17	MODULAR type Switch, socket & Electronic fan (steps) regulator	:	MK India wraparound plus / Legrand (Mosaic) / Anchor Woods,
18	Pvc Tape [ISI approved heavy duty]	:	Steel Grip
19	Industrial type socket outlets &(plastic molded plug & socket)	:	Legrand /Hager/ L&T / Schneider
20	Selector Switches	:	Rishab / Kaycee / Salzer// Siemens /Schneider/ L&T
21	Light fittings with lamps (Industrial / commercial)	:	Phillips / Wipro / Crompton Greaves/BAJAJ
22	Ceiling Fans -5 Star Rated	:	Crompton Greaves / Usha /polar
23	Exhaust Fans with louvers – heavy duty	:	Crompton Greaves / Usha /polar
24	Wall mounted Fans	:	Almonard /Crompton Greaves / Usha /polar
25	Indicating Lamps(LED Type)/Push buttons	:	Teknic / Vaishnav / Siemens / Schneider /L&T
26	FR, FRLS & ZHFR Wires 1100V Grade.	:	FINOLEX / LAPP / KEI / RR
27	Power & auxiliary Contactors / Relays & starter	:	Siemens / Schneider /L&T
28	PVC Conduits &accessories [Heavy duty 2mm thick ISI approved]	:	Precision / Avon Plast
29	MS & GI Conduit With all accessories.	:	Supreme/ jk tubes / TATA /Gupta brothers.

30	Fire Extinguishers	:	Usha / Fire pro.
31	Battery (SMF,VRLF)	:	Exide / Amaraja / Rocket /Panasonic
32	Battery charges	:	Amaraja / Exide /universal /AE /BCH / volt stat
33	High Efficient Low Losses Transformers	:	Crompton Greaves Volt Amps ABB Transformers & Rectifiers India Ltd Kirloskar Electric Company Limited Alstom T&D India
34	Flame proof items like light fixture MCB DB etc	:	FCG / BALIGA / SUDHIR
35	HT cable terminations.	:	Raychem.
36	PVC wall raceway	:	MK / Legrand.
37	Street light octagonal GI poles	:	Bajaj / Crompton Greaves
38	Digital meter / Load managers	:	conzerv / Siemens / Schneider /L&T
39	UPS	:	Emerson / Socomec /Numeric/ SCHNIEDER
40	Lighting Inverters	:	Emerson / Socomec /Numeric/ SCHNIEDER
41	11KV GOS /LA's	:	State electricity board approved.

42	Panel board manufacturers [as per IEC 61439 series of standards [consists of seven parts:]] should be Total Type tested & approved .	:	Adlec Systems Private Limited - New Delhi , Advance Panels & Switchgears Pvt Ltd - New Delhi, Engineers & Engineers (Electricals) pvt Ltd - Jaipur Tricolite Electrical Industries Limited - New Delhi, Neptune Systems Pvt. Ltd- Noida-201301 (U.P),
43	Perforated, Ladder type cable trays & floor race ways.	:	PROFAB Engineers pvt Ltd -/ Indiana Grating Pvt Ltd
44	Telephone tag block	:	Krone.
45	Telephone Sockets	:	Avaya /Molex / Systemax.
46	Telephone wires & cables	:	Finolex / DELTON / Dlink
47	Active & Passive components for LAN	:	Avaya / Molex / Systemax /Legrand
48	TV coaxial cable	:	Finolex / L&T / DELTON
49	Lightning Protection system	:	INDELEC /
50	Telephone jelly filled armoured	:	Delton / Finolex/ Dlink /CCI /KEI /universal
51	EPABX System	:	Siemens / Avaya /Molex / Systemax.
52	Terminals	:	Elmex / Wago- Finger touch proof.
53	Ferrules	:	Mayfair
54	Nameplates	:	Screen printed acrylic.
55	DG	:	Cummins / CATER PILLAR /
56	Busbar duct/rising main	:	C & S / Schneider / L&T
57	Steel items	:	Jindal / Vizag / Tata /SAIL
58	Earthing Cast iron	:	Kapilansh Dhatu Udyog Pvt. Ltd,

59	TVSS with indication	:	EMERSON / OBO / legrand /SCHNIDER /
60	HT/EHT PANEL (VCB/SF6) :	:	SIEMENS /ABB /SCHINIDER
61	GI Floor raceways & junction boxes	:	PROFAB Engineers pvt Ltd / Indiana Grating Pvt Ltd
	Important Note		
1	Please Tick (") the Each make of material considered in tender.		
2	In case of any deviation from the make of material , vendor shall bring in to notice immediately before commercial bid opening or before work order finalization , In absence of such deviation in the specific period, it will be presumed that make of material offered is exactly similar to the material list		
3	Detail submittals in the form of catalogues, GTP specification, Data sheets, and samples Wherever called for, shall be submitted within Three week from the date of order and approvals shall be obtained on the type of accepted make ,Model Number , Before procurement is made.		
4	Out of the approved makes of materials mentioned above, the make of materials to be Used on the work should be as decided by the Consultant/Owner jointly		
5	In respect of materials for which approved makes are not specified above, those Makes will be decided by the Consultant/Owner jointly and as per sample Approved before procurement		
6	All the items must be as per the specification, tender BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization , In absence of such deviation, it will be presumed that equipment offered is exactly similar to the specification, tender BOQ and drawings		

9. SPECIFICATION FOR EARTHING SYSTEM:

The EARTHING SYSTEM shall be manufactured as per the following specification, BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization /work order finalization , In absence of such deviation it will be presumed that equipment offered is exactly similar to the specification ,client /consultant decision is final

1.0 SCOPE

This specification covers the requirements of supply, installation, testing and commissioning of earthing systems. The work shall be carried out in accordance with relevant layout drawings, typical drawings and installation notes etc. All metal conduits, cable sheathes, switchgear, distribution boards, light fixtures, fan and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes.

2.0 CODES AND STANDARDS

2.1 The Earthing systems shall comply with all currently applicable standards, regulations and safety codes of the locality where the installation is to be carried out. Nothing in this specification shall be construed to relieve the Contractor of this responsibility.

2.2 The installation work shall conform to the latest applicable Electricity Rules, Relevant Indian Standards and Codes of Practices as follows:

2.2.1 IS 3043 - Code of Practice for Earthing.

2.2.2 IS 732 - Electrical Wiring Installation.

2.2.3 IS 3975 - Galvanized round steel wire.

Indian Electricity Rules 32, 61, 67 and 68 of IER 1956.

3.0 EARTHING ELECTRODES

3.1 Earthing electrodes shall be designed as per the requirements of IS 3043. The resistance of earth electrodes shall be as low as possible, the maximum allowable value being one Ohm.

Earth electrodes shall be as far as possible embedded below permanent moisture level. Earth pits shall be further treated with salt and charcoal to improve the soil resistivity. In rocky areas where the

required earth resistance cannot be attained using the standard earth electrode. Configuration then application of deep well earth pits should be examined.

4.0 EARTHING SYSTEM

4.1 GENERAL

Each installation shall have one common earth grid connected to at least two groups of earth electrodes.

The earth grid shall extend throughout the installation in the form of a ring circuit with branch connections to the equipment and structures to be earthed.

4.2 EARTHING CABLES AND CONNECTIONS:

Earth systems shall be of solid copper/galvanized flats type, of cross-section specified on the relevant design earth layout drawing.

Connections between earth electrodes and main ring earth conductors shall be executed in accordance with Electrical Drawings and in such a way as to facilitate the inspection and testing the earth resistance of each individual earth electrode group without disconnection of the earth system main ring.

All UN insulated parts of earth conductors shall be suitably protected against direct contact with the soil to prevent electrolytic corrosion. This may be achieved by lap wrapping bared sections with green PVC adhesive tape.

All Earthing terminations shall be made with compression type cable lugs. Interconnections shall be directly clamped with compression type branch connectors as detailed in Electrical Drawings.

Execution of earth cable branch connection by means of exothermic welding shall require the approval of The Company Site Representative, who will take into account the suitability of the welding equipment and the previous experience of the Contractor's personnel.

The resistance between each earth electrode configuration and the general mass of earth shall not exceed 5 ohms when isolated from the main earth grid.

Location of earth electrodes, earth conductor's connections and earth cable routes shown on the

installation earth layout drawing shall be considered as diagrammatic only, and site inspection shall be necessary to determine earth connection onto equipment's locations and conductor routes prior to installation.

Within buildings, strips of high conductivity copper/GI, sized in accordance with the layout earthing design drawing, should be utilized.

Where copper tape or cable is fixed to building structure it shall be by means of purpose made saddles. Fixings shall be made using purpose made lugs and clamps.

Fixings requiring drilling of holes through stripes shall be used, considering the effective cross-section of the particular run is within relevant regulations.

Where tape or cable is run in the ground or fixed externally, and is liable to corrosion, it shall be wrapped with corrosion-resistant material. Alternatively, PVC wrapped tape or cable may be used.

Joints in copper tape shall be tinned before assembly, riveted with a minimum of two rivets, and sweated solid.

Where holes are drilled in the earth tape for connection to items of equipment, effective cross-sectional area of connections shall be not less than required to comply with the relevant Regulations.

Bolts, nuts and washers for any fixings of earth tape shall be of high-tensile grade.

4.3 ELECTRICAL EQUIPMENT

Metallic enclosures of all electrical equipment shall be earthed at two ends by connection to the common earth grid.

Cross-sectional area of the equipment earth connections shall be in accordance with the earth layout design drawing.

4.4 NON-ELECTRICAL EQUIPMENT

All metallic equipment used for storage, processing, transportation or pumping flammable liquids, vapors or gases, and their associated supporting structure or skid, shall be electrically bonded to the installation main earth ring.

Electrical bonding of associated metal work, in handrails, walkways, etc., is not necessary if it is demonstrated by testing that they are electrically continuous with the structure. However, the same shall be bonded to earth at one point.

Piping which is not in electrical contact with its associated tank or vessel, such as an open discharge line into a tank, shall be bonded to the tank.

In installations that do not contain electrical equipment, the resistance between each earth electrode configuration and the general mass of earth shall not exceed 5 ohms when isolated from the main earth grid?

4.5 BONDING

Metal sheaths and armour of all cables operating at low voltage, metal conduits, ducting, trunking, and protective conductors associated with such cables, which might otherwise come into contact with adjacent fixed metalwork, shall be effectively either segregated from, or bonded to, adjacent metal work.

Metallic sheaths and / or non-magnetic armour of all single-core cables in the same circuit normally shall be bonded together at one end only have there run (solid bonding) unless specified otherwise.

All interior metal, water and gas piping shall be bonded together and made electrically continuous. Non-conductive coatings (such as paint, lacquer and enamel) on equipment to be earthed shall be removed from threads and other contact surfaces to ensure good electrical continuity.

10. SPECIFICATION FOR LIGHT FITTINGS AND ACCESSORIES AND POINT WIRING, CONDUIT

The LIGHT FITTINGS shall be manufactured as per the following specification, BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization /work order finalization , In absence of such deviation it will be presumed that equipment offered is exactly similar to the specification ,client /consultant decision is final

1.0 SCOPE:

This Specification also covers the design, material specification, manufacture, testing at works, inspection and delivery at site of light fittings and their associated accessories.

2.0 STANDARDS:

The light fittings and their associated accessories such as lamps/tubes, reflector, housings, ballasts etc. shall comply with the latest applicable standards and codes.

3.0 GENERAL REQUIREMENTS:

Fittings shall be designed for continuous trouble-free operation under hot humid atmospheric conditions, at an ambient of 40°C without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weatherproof and waterproof type.

The fittings shall be designed so as to facilitate easy maintenance, including cleaning, replacement of lamps/starters etc.

Connectors between different components shall be made in such a way that they will not work loose by small vibration.

For each type of light fitting, the Manufacturer/Vendor shall supply the utilization factor to indicate the proportion of the light emitted by the bare lamp, which falls on the working plane.

The fittings shall be supplied complete with lamps.

The fittings and accessories shall be designed to have low temperature rise. The temperature rise above the ambient temperature shall be as indicated in the relevant Standards.

All HID fittings shall be completed with accessories like lamps, ballasts, power factor improvement capacitors, starters/igniter's wherever applicable etc. These shall be mounted as

far as possible in the fitting assembly only. If these cannot be accommodated inside, then a separate metal enclosed box shall be included to accommodate the accessories and in addition with a fuse and a terminal block suitable for loop-in, loop-out connections by 1100V Grade PVC insulated wires up to 4Sq.mm.

Outdoor type fittings shall be provided with outdoor type Control gearbox. The fittings shall be power factor corrected to 0.95 (maximum)

Each fitting shall have a terminal block suitable for loop-in, loop-out T-off connection. The internal wiring shall be completed by the manufacturer by means of stranded Copper wire and terminated on the terminal block.

All hardware used in the luminaries, shall be Cadmium plated.

4.0 EARTHING:

Each light fitting shall be provided with an Earthing terminal suitable for connection to the Earthing conductor. All metal or metal-enclosed parts of the housing shall be bonded to the Earthing terminal so as to ensure satisfactory earth continuity throughout the fixture.

5.0 PAINTING/FINISH:

All surfaces of the fittings shall be thoroughly cleaned and de-greased. The fittings shall be free from scale, sharp edges and burns.

The housing shall be stove-enameled/epoxy stove-enameled/vitreous enameled powder-coated of anodized as indicated under various types of fitting.

The finish of the fitting shall be such that no bright spots are produced either by direct light source or by reflection.

All the fittings shall be provided with identification numbering using Paint or STickering.

6.0 ACCESSORIES FOR LIGHT FITTINGS:

Fluorescent tube lamp s, Fitting and accessories .shall comply with fallowing standard. I) IS 1596 Capacitor for use in tubular fluorescent, high pressure mercury and low pressure sodium vapor discharge lamp circuit.

- ii) IS 1777 Industrial luminaries with metal reflectors?
- lii) IS 2215 Starters for fluorescent lamps?
- iv) IS 2418 (Part 1 to 4) Tubular fluorescent lamps for general lighting services?
- v) IS 3323 Bi-Pin lamps holders for tubular fluorescent lamps?
- vi) IS 3324 Holders for starters for tubular fluorescent lamps.
- vii) IS 3287 industrial light fittings with Plastic reflector?

6.1 Reflectors:

The reflectors shall be made of CRCA sheet steel. Aluminum / Silvered glass as indicated, for the above-mentioned fittings.

The thickness of Steel / Aluminum, shall comply with relevant Standards. Reflectors made of Steel, shall have stove-enameled/Vitreous-enameled/Epoxy-coating finish.

Aluminum used for reflectors, shall be anodized / Epoxy Stove-enameled/Mirror polished.

Reflectors shall be free from scratches or blisters and shall have a smooth and glossy surface having an optimum light reflecting co-efficient such as to ensure the overall light output specified by the manufacturer.

Reflectors shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools; they shall be securely fixed to the housing by means of positive fastening device of captive type.

6.2 LAMP/STARTER HOLDERS:

Lamp Holders shall comply with relevant Standards. They shall have low contact resistance, shall be resistant to wear and shall be suitable for operation at the specified temperature without deterioration in insulation value. They shall hold the lamps in position under normal condition of shock and vibration met within normal installation and use.

Lamp Holder for the fluorescent lamps shall be of the spring loaded bi-pin rotor type. Live parts of the lamp holder shall not be exposed during insertion or removal of the lamp or after lamp has been taken out. The lamp holder contacts shall provide adequate pressure on the lamp cap pins when in working position.

Starter holders for fluorescent lamps shall conform to the relevant Standards. All material used in the construction of the holder shall be suitable for tropical use.

The Starter Holder shall be so designed that they are mechanically robust and free from any operational difficulties. They shall be capable of withstanding the shocks met within normal transit, installation and use.

2.9. BALLASTS:

The ballasts shall be designed, manufactured and supplied in accordance with the relevant Standards. The ballasts shall be designed to have a long service life and low power loss.

The electronic ballasts shall be fully enclosed in an aluminum housing shall include a divided wiring compartment to separate the power leads from the control leads. All leads to be color coded.

The electronic ballast shall be multi voltage capable and operate from a voltage range of 180 – 305V at 50Hz.

The electronic ballast shall incorporate a micro processor controller to provide for optimum starting and operation.

The electronic ballast input current shall have THD of less than 15% when operated at nominal line voltage.

The electronic ballasts shall have a power factor greater than 0.9

The electronic ballast shall have a lamp end-of-life detection and shut down circuit.

The electronic ballast shall be sound rated A

The electronic ballast shall be thermally protected to shut off when operating temperatures

reach unacceptable levels.

The electronic ballast shall not contain Polychlorinated Biphenyl (PCB's).

The electronic ballasts shall carry a three year warranty from the date of manufacture for operation at an ambient temperature of 55 Deg. C or less and when operated as a stand alone.

Separate ballast for each lamp shall be provided in case of multi lamp fittings.

The ballast for each lamp shall be provided in case of multi lamp fittings.

The ballasts for Metal Halide lamps shall not be constant wattage type

2.10. LAMPS:

The fluorescent lamps shall be "Cool Day Light" type unless otherwise specified and shall be provided with features to avoid blackening of lamp ends. The fluorescent lamps shall have a high lumen output of 3250 lumens. The lamp shall have triple coil electrode with an anode ring and a tri-band Phosphor coating.

The lamps shall be capable of withstanding small vibrations and the connections at lead in wires and filaments/electrodes, shall not break under such circumstances.

Lamps/Tubes shall conform to relevant Standards and shall be suitable for supply voltage and frequency specified.

7.0 LIGHT FITTINGS

The light fittings shall be of specified type and complete with Polyester filled copper choke, HPF condenser holder, ignition, control gear, lamp/bulb of appropriate wattage and type, connectors, fuses etc. whether specified or not in the Bill of Quantities.

8.0 SPECIFICATIONS FOR DISTRIBUTION SYSTEM, CONDUITS, WIRING & ACCESSORIES

7. GENERAL

This Specification of Medium/ Low Voltage Distribution System shall be applicable for wiring 3 phase, 4 wire 415 Volts, 50 Hz AC and single phase, 2 wire 230 Volts, 50 Hz, AC supply.

8. RIGID STEEL/PVC CONDUITS & ACCESSORIES

All conduit and conduit fitting and accessories shall be of rigid steel conduit or rigid non metallic PVC conduit as indicated and shall comply with following Indian standards.

9. IS 3837-Specification for accessories for rigid steel conduit for electrical wiring?
10. IS 2667-Specification for fittings for rigid steel conduit for electrical wiring? The conduit fittings shall be made off steel, cast iron or malleable cast iron; malleable iron casting shall be well annealed.
11. IS 3480 -Specification for flexible steel conduit for electrical wiring.
12. IS 4649 -Specification for adaptors for flexible steel conduit.
13. IS 3419 - Specification for fittings for rigid Non metallic conduit. Conduit fittings shall be of un-plastics
14. IS 9537 Part -2-Rigid steel Conduit.
15. IS 9537 Part -3 Plain rigid conduit of insulating material?

2.1 GI conduits shall be of welded and screwed sheet steel construction. Conduits shall be black stove enameled inside and outside. The conduits shall conform to the requirements of relevant IS (latest edition) in all respects. The conduits shall have uniform wall thickness/cross section throughout. Conduits shall bear the name, trademark of the manufacturer and size of conduit on each length. The conduits shall be delivered to the site in original bundles. Conduits of **less than 25 mm dia. shall not be used**. The minimum wall thickness of conduits shall be as follows:

Rigid G.I Conduits : a) 25 & 32 mm - 16 gauge.
: b) 38 mm & above - 14 gauge.

Rigid PVC Conduits : 2 mm. (Heavy Duty)

2.2 **Conduit Accessories**: Conduit accessories such as bends, inspection bends, inspection tees, elbows, reducers, draw boxes, junction boxes, etc. shall be of approved makes. Boxes shall have internally tapped spouts; junction boxes/inspection boxes shall be internally tapped table covers. Necessary pull boxes of adequate sizes shall be provided wherever required at no extra cost.

2.3 All conduits shall be of ample size for easy 'draw in' and 'draw out' of all the wires in the conduits. In no case the total cross section of wires measured over all be more than forty percent of the area of the conduit.

2.4 All the conduits shall be adequately protected while stored on site prior to erection and no damaged conduit shall be used.

2.5 All conduit accessories shall be made out of 16 Gauge thick G.I enclosures.

16. **PREPARATION OF CONDUIT:**

The inside surface and ends of conduits and threads and fittings used shall be clean, smooth, cut square and free from burrs and other defects. Powdered soapstone, talc or prepared compounds shall be used as lubricants to facilitate the smooth pulling in of conductors.

17. **ERECTION OF CONDUIT**

11.4 The conduit shall be properly and tightly screwed between the various lengths and to the boxes to which it runs and terminates. No part of the conduit shall be under mechanical stress and the whole conduit system shall be electrically and mechanically continuous throughout.

11.5 Conduits shall be installed with provision for ventilation self drainage in the event of ingress of moisture due to condensation or any other reason and prevent sweating.

4.3 A suitable drainage hole shall be drilled in the bottom of the lowest conduit box in every 9 Mts. of horizontal length.

12 **INSTALLATION OF RECESSED CONDUIT SYSTEM**

5.1 The conduits shall be installed in such a manner that running can be carried out from the fittings boxes and switch boxes only.

5.2 Conduits, which are to be taken in the ceiling slab, shall be laid on the prepared shuttering work of the ceiling slab before concrete is poured, and tied to bars at every 500 mm. The conduits shall be made water-tight by using bituminous compound at the screwed ends. The conduits in ceiling slab shall be straight as far as possible.

5.3 Conduits recessed in walls shall be secured rigidly by means of steel hooks/staples at 0.8 mts. intervals. Before conduit is concealed in the walls, all chases, grooves shall be neatly made to proper dimensions to accommodate the required number of conduits.

- 5.4 The outlet boxes, point control boxes, inspection and draw boxes shall be securely fixed by means of counter sunk steel screws and crawl plugs. They shall be firmly grouted in position prior to plastering fixed as and when conduit is being laid. The recessing of conduits in walls shall be so arranged as to allow at least 12 mm plaster cover on the same. All grooves, chases, etc. shall be refilled with cement mortar and finished up to the wall surface before plastering of walls is taken up by the general contractor. The top edge of the conduit shall be at least 25 mm below the finished surface of wall. Wherever conduits terminate into point control boxes, distribution boards, etc. conduits shall be rigidly connected to the boxes, boards, etc. with check nuts on either side of the entry to ensure electrical continuity.
- 5.5 After conduits, junction boxes, outlet boxes, etc. fixed in position their outlets shall be properly plugged with PVC stoppers or with any other suitable materials so that water, mortar, vermin's or any other foreign material do not enter into the conduit system.
- 5.6 To facilitate easy drawing of wires in conduit necessary GI pull wires of 16 SWG shall be inserted into the conduit immediately after shuttering is removed.
- 5.7 The Electrical Contractor shall be present during the pouring of concrete to ensure that the conduits and accessories are not displaced or blocked.**
- 5.8 The conduits shall be swabbed out by drawing dry swabs of rag through the conduit to remove all moisture prior to drawing of wires.
- 5.9 Where vertical concealed conduits pass through floors or beams and horizontal concealed conduits required passing through columns or beams, these shall be taken through rigid PVC/GI pipes to be inserted in the floors /columns/beams, etc. during casting for which no extra payment shall be entertained.
- 5.10 Extension collars of suitable depth shall be used as necessary to leave all boxes absolutely flush with the finished wall or ceiling surface.
- 5.11 Conduits shall not be buried or plastered etc. unless and until the work has been inspected by the client / consultant.

INSTALLATION OF SURFACE CONDUIT SYSTEM

6.1 Conduits shall run in square and symmetrical lines. Before the conduits are installed, the exact routes shall be marked at site and approval of the Architect shall be obtained. Heavy gauge GI base plates, saddles, secured to suitable crawl plugs, at an interval of not more than 1 meter, shall fix conduits. Conduits shall be joined by means of screwed couplers and screwed accessories only. In long distance straight runs of conduit, inspection type couplers or running type couplers or pull boxes shall be provided.

6.2 Bends of conduit runs shall be done by pipe bending machine. Bends, which cannot be negotiated by pipe bends, shall be accompanied by introducing inspection boxes or inspection bends. Not more than three equivalent 90 C bends shall be used in a conduit run from outlet to outlet.

6.3 All the conduit openings shall be properly plugged with PVC stoppers/bushes. The conduits shall be adequately protected against rust by applying two coats of approved synthetic enamel paint after the installation is completed.

6.4 Wherever conduits terminate, conduits shall be rigidly connected to the box/board with brass hexagonal check nuts with compression washers on either side of the entry to ensure proper electrical and mechanical continuity.

6.5 The crossing of surface conduits shall not be generally permitted and to avoid such crossings, adopter boxes shall be used at junctions/crossings.

6.6 All unused conduit entries shall be blanked off in an approved and where conduits terminate in adopter boxes. All removable box covers shall be firmly secured to provide complete enclosure.

7.0 CONDUITS ABOVE FALSE CEILING

7.1 In the false ceiling area, the conduits shall be run above the false ceiling frame work supported by means of M.S straps secured and fixed to both conduits and structural ceiling, keeping the outlet box as near as possible to the fittings/fans for connections. The conduit boxes for fittings/fans are independently supported by means of separate fixing arrangements to the box and structural ceiling so that the box is held rigidly.

8.0 ENCLOSURE FOR ELECTRICAL ACCESSORIES

8.1 Enclosure for electrical accessories shall conform to IS:5133-Part I. The wall thickness of MS enclosures shall be not less than 1.6 mm. The enclosure boxes shall be provided with a minimum of four fixing lugs located at the corners for fixing the covers. All fixing lugs shall have tapped holes to take machined brass screws.

99.2.1 Sufficient number of knockouts shall be provided for conduit entries. The enclosures shall be adequately protected against rust or corrosion both inside and outside. The enclosures shall be provided with 5 mm thick overlapped white PVC or perspex sheet cover with rounded corners and beveled edges for mounting switches, sockets etc. Wherever different phase conductors are brought into the same enclosure, phase barriers shall be provided.

99.2.2 Minimum size of the box shall be 75 x 75 x 75 mm.

99.2.3 Draw boxes of ample dimension shall be provided at convenient points on walls/ceilings to facilitate pulling of long runs of wire. These boxes will be as few as possible and located where found necessary and approved by Architects at no extra cost.

99.2.4 Where flush conduits are required to terminate at surface mounted equipment, the conduit shall terminate at a flush box and the back of the equipment should fully cover the flush box and brass screws shall be used between the equipment and the box in addition to any other means of fixing and earthing arrangement.

The alternative arrangement to the above shall be by means of fixing a terminal extension box to the flush conduit box in which case a break joint ring shall be fitted between boxes.

9.0 **WIRING CONDUCTORS**

9.1 All wiring conductors shall be PVC insulated, copper conductors of 1100 V grade, and shall conform to IS:694 Part II (Latest Edition).

9.2 Wiring conductors shall be supplied in Red, Blue, Yellow, Black and Green colors for easy identification of wires. The wires shall be supplied in sealed coils of 100 mtr. Length and shall have manufacturer's trademark, name, Voltage grade etc.

10.0 **INSTALLATION OF WIRING CONDUCTORS/CABLES**

10.1 The wiring conductors shall not be drawn into the conduits until all the works of any nature

that may cause damage to the wires are completed. The installation and termination of wires shall be carried out with due regard to the followings

10.1.2 While drawing the wiring conductors, care shall be taken to avoid scratches and kinks, which cause breakage of conductors. There shall be no sharp bends in the conduit system

10.1.2 Strands of the wires shall not be cut for connecting to the terminals or lugs. The terminals shall have adequate cross section to take all the strands.

10.1.3 Oxide inhibition grease shall be applied at all terminals and connections.

10.1.4 Brass flat washers of large area shall be used for bolted terminals.

10.1.5 Bi-metallic connectors should be used wherever aluminum conductors are tapped from copper mains or vice-versa.

10.2 Wiring for power and lighting circuits shall be carried out in separate and distinct wiring systems.

- The wiring system envisaged is generally shown on the layout drawings and line diagrams. However, a brief account of the general wiring system is given below:

- Sub mains wiring - Wiring from Meter boards/switch boards to the individual distribution boards, and shall consist of wires, conduits, and all conduit and fixing accessories as required and specified. The sizes of conduits and number of wires shall be as specified in Schedule of Quantities. Wires shall be drawn in conduits as required without being damaged, with necessary draw boxes if required. The wire lengths must be adequate for terminating at either end and identifying ferrules shall be provided at termination. The wiring shall be color coded. The rate shall include all materials, connections, labor etc. as specified above.

- Circuit wiring - Wiring from DB's to the first point control boxes for lighting, fans, 5A sockets, call bells, etc. The scope of work shall be same as in sub main wiring.

10.3.3 Power wiring - The wiring from DB's to heating supplies, 15 A 3 pin socket outlets, etc.

The scope of work shall be same as in sub-main wiring.

10.4 Each sub-main/circuit main/power wiring circuit shall also have its own earth continuity wire as specified.

10.5 All the wiring shall be carried out in loop-in-loop system only and phase or line conductors shall be looped at switch box and neutral conductor can be looped from light, fan or sockets.

10.6 The maximum number of various size conductors that could be drawn into various sizes of conduits shall be as per table II of IS:732 (Latest Edition). The wiring shall be color coded for easy identification of phases and neutral. The following color codes shall be adopted.

Phase's - Red, Yellow and Blue.

Neutral - Black.

Earth - Green or Bare wire as specified.

10.7 All sub mains and circuit wiring shall be provided with printed PVC identification ferrules at either end bearing the circuit number and designation.

11.0 SWITCHES, SOCKETS AND ACCESSORIES

11.1 Sockets outlets , surface or flush type ,5A or 15 Amp, 250 Volts shall three pin shuttered / non shuttered or interlocking type as indicated and shall comply with the following Indian Standard

11.1.1. IS 1293-2005 Specification for 3 pin plugs and sockets outlets.

11.1.2. IS 4615 Switch sockets outlets (non interlocking type)

11.1.3. IS 4160 – Specification for interlocking switch sockets outlets.

11.1 **GENERAL REQUIREMENTS:** General control switches shall be of a 5A rating and shall be of approved make/type suitable for flush mounting.

11.2 All sockets, 5A and 15A ratings shall be of flush mounting type with combined control switches of the same rating as that of the sockets. All sockets outlet shall be of 3-pin type.

11.3 The switch, plug socket or regulator boxes shall be made of GI/sheet steel of minimum 16 SWG on all sides except in the front. Depth of boxes shall not be less than 75 mm and

suitably increased where fan regulators are mounted in flush pattern. The boxes shall be provided with suitable Earthing studs. Wherever required switches/fittings shall be fixed on metal strip, which in turn are welded to the box.

11.4 Fan regulators shall be flush type and earthed with earth continuity conductor. The fan regulator shall be of electronic type.

12.0 **LAMPHOLDERS, CEILING ROSES, ETC.**

12.1 Accessories for light outlets such as lamp holders, ceiling roses, etc. shall be in conformity with requirements of relevant specification. Only approved make of accessories shall be supplied.

12.2 Screwed holder shall be used in brackets and pendants, light fittings shall have brass holders on T.W. round blocks.

12.3 Ceiling roses for recessed system of wiring shall be porcelain make and flush type. For surface type of wiring this shall be bakelite.

Above all Follow the Indian Standard

IS 371 Specification for ceiling rose having two or three terminal plates? Outer Diameter not less than 63.5 mm.

IS 1258 Specification for bayonet lamp holder? Lamp holder shall be suitable for fixing in pendent or bracket or angular.

13.0 **INSTALLATION OF SWITCHES, SOCKETS AND ACCESSORIES**

All the switches shall be wired on phases. Connections shall be made only after testing the wires for continuity, cross, phase etc. with the help of megger. Regulators shall be fixed on adjustable MS flat straps inside the enclosure. The arrangement of switches and sockets shall be neat and systematic. Covers for enclosures accommodating switches, sockets etc. (point control boxes) shall be of modular type and fixed to the enclosure in plumb with counter sunk head. Outlets shall be terminated into a flush type fan box for fan points. For wall plug sockets, the conductors may be terminated directly into the switches and sockets. The outlets point control boxes etc. shall be set out as shown on the drawings. Before fixing these, the contractors shall obtain clearance from the client / consultant with regard to their proper locations. The enclosures of sockets/and 3rd pin of

the sockets shall be connected to the ground through an earth continuity wires, as specified.

14.0 CAPACITY OF CIRCUITS

Light points, 5A socket points, fans, and call bell points may be wired on a common circuit. Such of those circuits shall not have more than 10 nos. of Light/fan/socket points or a load of 800 W whichever is less. Not more than two numbers of 15A socket outlets shall be wired on the same circuit.

15.0 POINT WIRING

Point wiring shall commence from the first point control box/local control box for the points connected to the same circuit. Point wiring for lights, ceiling and exhaust fans, 5A sockets, call bells etc. shall be carried out with 1100 V Grade PVC insulated wires. The point wiring shall be inclusive of conduits of not less than 25 mm size, switches, wiring along with conduit accessories such as bends, inspections bends, reducers, pull boxes, junction boxes, switch boxes, fan boxes, covers etc. together with wiring accessories such as ceiling roses, brass lamp holders, T.W Blocks, loose wires up to 1 Mtr. long at outlet end connectors point control boxes (enclosure for electrical accessories) switches, etc. Point wiring shall be provided with earth continuity wire as specified for Earthing 3rd pin of sockets, luminaries and fan fixtures. Light control shall be either single, twin or multiple points controlled by a switch, as specified.

The point wiring for Light/Fans/5A sockets etc. shall include the supply and installation of all materials specified above. Any item not specifically included but required for satisfactory completion of the point wiring shall also be included. No separate extra price will be allowed for any item under point wiring.

A dependent socket point shall mean the combination 5A switch socket outlet/point mounted on the same switchboard as any other point/points and shall include the 5A switch and socket.

The fan point shall be complete with fan hook box flush mounted in slab, control switch mounted in switch box and electronic regulator, complete with cover. The measurement will be numbers of each kind of point and as specified in Schedule of Quantities.

16.0 FIXTURES/FANS:

16.1 LIGHT FITTINGS:

Unless otherwise specified, light fittings shall be generally fixed as directed by client / consultant.

16.1.1 Fittings such as wall brackets shall be fixed at 2200 mm from FFL.

16.1.2 All CFL Luminaries shall be fixed on false ceiling as shown in drawings.

2.4.1 The fluorescent fittings shall be fixed in such a manner that the wiring conductors

Shall not terminate in a ceiling rose but in a junction box 300 mm away from the center of the fitting along the length of the fitting so that no exposed wiring is seen from outside.

4. One sample installation to be get approved by client / consultant.

17.0 **FANS**

17.1 **CEILING FANS**

Ceiling fans shall be suspended from the special fan hook boxes. The fan wiring shall be terminated in porcelain/PVC multi way connector.

Each fan shall have a separate switch and speed regulator. The canopy at the top of the suspension rod shall effectively hide the suspension hook.

The control switch and the electronic regulator for the fan shall be included in the point wiring.

18.0 **TESTING OF ELECTRICAL INSTALLATION**

18.1 **TESTING OF INSTALLATION SHALL BE AS PER IS 732-1982**

12. The insulation resistance shall be measured by applying between earth and whole system of conductors of any section thereof with all fuses in place and all switches closed and except in earthed concentric wiring all lamps in position or both poles of the installation otherwise electrically connected together, where a direct current pressure of not less than twice the working pressure provided that it need not exceed 500 Volts for medium voltage circuits. Where the supply is derived from the three wires (A.C or D.C) or a poly phase system, the neutral pole of which is connected to earth either direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the outer or phase conductor and neutral.

18.1.2 The insulation resistance measured as above shall not be less than 50 mega-ohms divided by the number of points on the circuits provided that the whole installation shall be required to have an insulation resistance greater than one mega-ohm.

18.1.3 Control rheostats, heating and power appliances and electric signs may, if required be disconnected from the circuit during the test but in the event of the insulation resistance between the case or frame work and all live parts of each rheostat appliances and all live parts of each rheostat and sign shall be less than that specified in the relevant Indian Standard Specification or where there is no such specification shall not be less than half a mega-ohm.

18.1.4 The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or the neutral or to the other pole or phase conductors of the supply and its value shall not be less than specified in sub-clause 17.1.2.

19.0 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor including metal conduits and metallic envelopes in all cases shall be tested for electrical continuity and the electrical resistance of the same along with the Earthing lead but excluding any added resistance or earth leakage circuit breaker measured from the connection with the earth electrodes to any point in the earth continuity conductor in the completed installation shall not exceed one ohm. For checking the efficiency of Earthing, the earth resistance of each earth electrode shall also be measured. This test shall preferably be done during summer months.

20.0 TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCHES

In a two-wire installation, a test shall be made to verify that all non-linked, single pole switches have been fitted in the same conductor throughout and that such conductor has been connected to an outer or phase conductor or to the non-earthed conductor of the supply.

20.1 The contractor shall be responsible for providing the necessary instruments and subsidiary earth for carrying out the tests. The earth coordinating tests shall comply with the IS specifications as may be applicable. Should the above tests not complete with the limits lay down, the contractors shall do the necessary rectification of the fault till the required results are obtained.

SPECIFICATION FOR DUMMY CONDUITS, FOR COMMUNICATION & DATA SYSTEM

The conduits for the telephone system as well as Intercom System and Data System shall be same as explained and specified elsewhere for other work. The minimum size of conduits used

For Telephone System/Intercom shall be of 25 mm dia.

All distribution boxes shall be flush mounting, flat fronted, 16 Gauge sheet steel enclosed boxes flush with wall and properly joined to conduits. The distribution boxes shall incorporate terminal strips of the combined soldering screw type/tag blocks as required.

The telephone outlet boxes made of 16 Gauge sheet steel shall be of minimum 75 x 75 x 75 mm. These shall be flush mounting type installed with an approved cover matching with all other outlets in the electrical system and consisting of a CAT 5 RJ 45 outlet and approved by the structured data and communication cabling system.

The telephone boxes shall be generally mounted at 450 mm FFL unless otherwise specified/indicated in drawing.

The contractor shall consult and co-operate with the telephone department when installing the telephone wiring and conduit system and shall abide by their requirements, rules and regulations, shall furnish all work and material to secure their approval of the completed installation.

The contractor for approval to the telephone department and the consultant shall submit detailed drawings showing the telephone terminal and junction boxes fabricated in accordance with above requirements.

Rates shall include a GI fish wire left in the conduit to draw telephone wires. The end of conduit shall be sealed to prevent dirt, dust, mortar or any foreign matter going into telephone conduits.

The telephone indoor wires shall be 0.5 mm annealed tinned copper conductor, PVC insulated, twisted into pairs, laid up, taped and overall PVC sheathed, or CAT 5# UTP/STP cable.

The telephone outdoor cable shall be 0.5 mm annealed copper conductor, polythene insulated, color coded, twisted into pairs, laid up, jelly filled with petroleum jelly compound, wrapped with non-hygroscopic tape under moisture barrier poly-al-laminated foil tape and embedded with water proof polythene material.

11. SPECIFICATION OF LIGHTNING PROTECTION SYSTEM

The LIGHTNING PROTECTION SYSTEM shall be manufactured as per the following specification, BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization /work order finalization , In absence of such deviation it will be presumed that equipment offered is exactly similar to the specification ,client /consultant decision is final

- **SCOPE.**

This specification covers the requirements of supply, installation, testing and commissioning of lightning protection system in conformity with the requirements of IS:2309, consisting of vertical air termination the horizontal air terminations, down conductors and earth stations.

- **AIR TERMINATION'S.**

The air terminations shall be provided at the points shown on the drawings. The vertical air termination's shall consist of copper spikes fixed onto 25 mm dia copper/GI Rod of at least 1 Meters. Long grouted to the surface of the roof with base plate as approved by Consultants. The horizontal air terminations shall consist of a rigid network of tapes fixed to the surface of the roof. All exposed metal work and roof structures forming part of the structure to be protected shall be bonded to the net work by the conductors of the appropriate cross section.

- **DOWN CONDUCTORS.**

Air terminations shall be connected to the earth terminations by tapes fixed onto walls of the structures with spacers. The tapes shall be securely fixed to walls by means of brass saddles and metallic fasteners. Where the down conductors are laid underground, they shall be laid at a depth of 750 mm below the ground level, buried in trench, covered with a 100 mm thick layer of sand and protected by cable protection tiles. All metallic parts of the building above the main roof level including ducts, towers , pipes gutters and other mechanical equipment's shall be bonded to the down conductors.

- **STANDRDS**

Complete supply and installation of the lightning protection system shall be followed for engineering, construction and installation in accordance of the following standards and with the latest revision with update amendments.

- NF C 17 – 102 ESE type Lightning arrester air terminals.

- IEC 60-1:1989 High Voltage Impulse Test for Storm aster ESE Air terminals.
- HVSC Cable, Lightning Strike Recorder
- the requirements of IS:2309,
- NF C 15-100 Installations
- NF C 90-120 Materials
- NF C 17-100 Protection of Structures against Lightning
- GENERAL.

The materials shall be free from rust, scale and other electrical and mechanical defects. The size, materials and quantity shall be as specified.

Steel earthing conductors above ground shall be hot dip galvanized. If painted it shall be given two coats of approved bit mastic paint/anti-corrosive paint.

Test links in suitable enclosures shall be installed by the contractor at no extra cost for connection between each lightning conductor down conductor and earth electrode.

The scope of installation of lightning conductors on the roof of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods where necessary, laying, fastening/cleating/welding of the down-comers on the walls/columns of the building and connection to the test links above ground level, and up to earth station.

Lightning protection conductors shall not be connected to other general earthing conductors. The lightning protection air termination rods and/or horizontal air termination conductors shall be fixed in such a way that they remain in their installed position even during adverse weather conditions.

The down conductors shall follow a direct path to earth. There shall not be any sharp, turns and kinks in the down conductors.

All joints in the down conductors shall be of welded/brazed type. All metallic structures within 2 m vicinity of down conductors shall be bonded to the lightning protection system.

Every down conductor shall be provided with a test link at about 1000 mm above ground level. The test link shall be directly connected to the earthing system/electrode.

The lightning protection system shall not be in direct contact with the underground metallic

service ducts, cables, cable conduits and metal enclosures of electrical equipment's.

Lightning conductors shall not pass through or run inside G.I conduits.

Wherever required, if indicated in drawings, for fuel oil and other inflammable liquid storage tanks lightning and protection shall be provided with horizontal conductors strung between tall poles covering the entire areas.

- JOINTS BONDING.

The system shall have preferably no joints and they shall be made mechanically and electrically strong and effective. Bolted joints should only be used on test points or on bonds to as existing metal. Generally jointing/connections/installations shall be as in earthing system.

- EARTH TERMINATION'S.

Suitable number of earth terminations shall be provided. The earth termination shall consist of pipe/plate earth electrode as specified elsewhere in the Earthing Specification, and generally conforming to IS : 3043. The earth terminations shall be complete in all respects with chamber and cover, etc. as per the detailed specifications.

Before installing the lightning protection system, the contractor shall obtain approval from the Engineer with respect to the locations of air termination's and the routes for the down conductors.

- TEST CLAMPS/LINKS.

Test clamps/links shall be manufactured from phosphor bronze or approved equivalent with four fixing holes. Tape conductors shall be fixed to flat roof surfaces by means of suitable fixing arrangement as approved. All fixing screws shall be brass.

- TESTING.

Suitable testing links be provided at required points as per the code of practice CP 326/IS 2309. The contractor shall carry out tests on completion of the installation and submit the readings for approval.

12. SPECIFICATION OF SOLAR LIGHTING SYSTEM

- **SCOPE.**

This specification covers the requirements of supply, installation, testing and commissioning of lightning protection system in conformity with the requirements of IS:2309, consisting of vertical air termination the horizontal air terminations, down conductors and earth stations.

(A) Solar Street Lighting System (LED Based)

1.0 Definition

1.1 Light Emitting Diode (LED) is a p-n junction device which emits light when forward electric current passes through it. A LED based solar street lighting system aims at providing solar electricity for operating LED lights for specified hours of operation per day. The broad Performance specifications of a White Light Emitting Diode (W-LED) light source based solar street lighting system are given below.

2.0 Technical Specification

2.1 The White LED Based solar street lighting shall be of indigenous make and should conform to the following specifications:

BROAD PROFORMANCE PARAMETERS

Light Source	White Light Emitting Diode (W-LED)
Light Out put	White color (color temperature 5500 ⁰ -6500 ⁰ K) minimum 15 LUX when measured at the periphery of meter diameter from a height of ... meter. The illumination should be uniform without dark bands or abrupt variations, and soothing to the eye. Higher light output will be preferred.
Mounting of light	Minimum 5-7 meter pole Mounted
PV Module	140 Wp / 2 x 120 Wp under STC, measured at 16.4 V at load. Module Voc minimum of 21V
Battery	Tubular Lead acid or gel type VRLA, 12 V- 40 AH @ C/10, Max DoD 75%
Electronics	Min 95% total efficiency
Average duty cycle	Dusk to dawn

Autonomydays (Minimum 42 operating hours per permissible discharge)
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3.0 Duty Cycle

3.1 The LED solar street lighting system should be designed to operate for dusk to dawn, under average daily isolation of 5.5 kWh /sq.m. On a horizontal surface.

4.0 LIGHT SOURCE

4.1 The light source will be of white LED type. Single lamp or multiple lamps can be used.

Wider view angles of a minimum of 120° or more. The luminous Performance of individual LED used should not be less than 100 lumen/watt when measured luminaries as whole. The color temperature of white LEDs used in the system should be in the range of 5500° K – 6500° K. Use of LEDs which emits ultraviolet light will not be permitted.

4.2 The light output from the white LED light source should be constant throughout the duty cycle.

4.3 The lamps should be housed in an assembly suitable for outdoor use. The temperature of LED should not increase more than 15° above ambient temperature. This condition should be compiled even after 48 hours of operation at its maximum operation voltage (i.e. just before over-voltage cut-off).

4.4 The make, model number, country of origin and technical characteristics of white LEDs used in the lighting system must be furnished to the test centers and to the buyers. In absence of this data the solar street lighting system will not be tested by the test center.

5.0 Battery

5.1 Tubular Lead acid or gel type VRLA battery should conform to latest BIS standards. A copy of the test certificate for the battery (including its make, country of origin and model number) used in the system should be provided to the test center.

5.2 At least 75 % of the rated capacity of the battery should be between fully charged & load cut-off conditions

5.3 The battery will have a minimum rating of 12V, 150 /270Ah (at C/10) discharge rate.

6.0 Electronics

6.1 The total electronic efficiency of DC-Dc converter should be at least 85 %

6.2 Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery throughout the year

6.3 The light output should remain constant with variations in the battery voltages.

7.0 PV Module (s)

7.1 The PV module (s) shall contain mono/multi-crystalline silicon solar cells with IEC

61215(revised) certification or equivalent National or International Standards. The manufacturer should have the required certification for at least one of their regular modules. Further, the manufacturer should certify that the submitted module is also manufactured using same design and process.

7.2 The operating voltage corresponding to the power output mentioned above should be 16.4

V. The I-V curve of the sample module should be submitted to the test center at the time of system qualification testing.

7.3 The open circuit voltage of the PV modules under STC should be at **least 21.0 Volts.**

7.4 The terminal box on the module should have a provision for opening for replacing the cable, if required.

7.5 A strip containing the following details should be laminated inside the module so as to be clearly visible from the front side.

Name of the Manufacturer or distinctive logo.

ii. Model or Type Number

iii. Serial Number

iv. Year of Make

7.6 Models of reputed make shall be offered.

7.7 Monogram along with following details translated in to English/ script shall be screen printed in indelible ink or paint on the back side of each PV module:

- Solar Photo Voltaic
- Not for sale or transfer
- Statutory action would be taken by vendor, if it found sold or transferred under different Sections of IPC.

7.8 Frame of PV module shall be painted with Dark Brown color.

7.9 A strip containing the following details should be mentioned in Hindi and pasted in permanent manner at the back of the module :

- Cost of the System
- Government subsidy on the system
- Beneficiary's contribution for the system

8.0 Electronic Protection

8.1 The system should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.

8.2 Fuses / MCB should be provided to protect against short circuit conditions.

8.3 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 PV module.

8.4 Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

8.5 Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery throughout the year.

9.0 Mechanical Components

9.1 Metallic frame structure (with corrosion resistance paint) to be fixed on the pole to hold the SPV module(s). The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that it can be installed at the specified tilt angle.

9.2 It should be possible to mount the light source on a metallic arm attached to the pole.

The metallic arm for holding the light assembly should be extended at least 1.5 meters from the pole and set at a suitable angle to maximize uniform illumination of desired level over the specified area.

9.3 A vented metallic / plastic box with acid proof corrosion resistance paint for housing the storage battery outdoors should be provided.

10 Other Features

10.1 The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red light to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged.

10.2 The ON/OFF switch used in the SSLS must be suitable for use in DC circuit and be

Reliable with long life. A cable (2core×1.5 Sq. mm.) of suitable length should be provided for inter connection between module and SSLS.

10.3 The following details should be marked indelibly on the body of SSLS.

- i. Name of the Manufacturer or distinctive logo.
- ii. Model or Type Number
- iii. Serial Number
- iv. Year of Make

10.4 Components and parts used in LED Solar Street Light Systems should confirm to the latest BIS specification, whichever such specifications are available and applicable.

11.0 Documentation

11.1 An operation, instruction, maintenance manual in English & in the local language should be provided with the Solar Street Light System. The following minimum Detail must be provided in the manual:

- (I) About Photovoltaic
- (ii) About Solar Street Light System – its components and expected Performance
- (iii) About PV Module. In case of imported modules it is mandatory to provide a copy of the international product qualification certificate to the test centre

(iv) About White LED Lights. The make, model number, country of origin and technical characteristics of LEDs should be stated in the product data sheet and furnished to the test centers

(v) About Battery and electronics used

(vi) Clear instructions about Mounting of PV Module(s) (vii) About Electronics

(viii) About Charging and Significance of Indicators. (ix) DO's and Don'ts

(x) Clear instructions on Regular Maintenance and Trouble Shooting of LED Solar

Street Light System..

(xi) Name and address of the person or service center to be contacted in case of failure or complaint.

13- SPECIFICATION FOR SUPPLY & ERECTION OF 230V/ 415V, 50HZ, LV POWER AND LIGHTING DISTRIBUTION BOARDS

All the DB's shall be manufactured as per the following specification, tender BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization , In absence of such deviation, it will be presumed that equipment offered is exactly similar to the specification, client /consultant decision is final

100GENERAL

This specification is applicable to 415 Volts, 3 phase 4 wire A.C supply and shall conform to the following Indian Standards (Latest Version).

IS-8623 Factory built assemblies of switch gear and control gear for voltages up to and including 1000 V AC and 1200 V DC.

IS-8828 Miniature circuit breakers for voltages not exceeding 1000 Volts.

IS-2675 Specification for enclosed distribution boards and cut outs for voltage not exceeding 1000 Volts.

IS-2208 HRC cartridge SWITCHES links 650 Volts.

IS-732 Code of practice for electrical wiring installation.

101TYPE AND CONSTRUCTION:

- (a) MCB type distribution boards shall be either single phase or 3 - phase type horizontal or vertical, depending upon whether outgoing circuits are single phase or 3 phased / 1 phase.
- (b) All MCBDBs shall have provision for accommodating MCB type isolators and RCCB (ELCB) at incoming in single pole or multiple configurations.
- (c) -All MCBDBs unless specifically mentioned and/or having different circuit configuration than the standard manufacturing range shall be factory fabricated and completely pre -wired and ready

for installation at site.

- (d) MCB DBs shall be fabricated out of 1.6/2 mm thick sheet steel with stove enameled paint finish and shall be wall mounted type if not specified otherwise.
- (e)-The boards shall have adequate provision for entry of incoming and outgoing cables / wires through knockout holes with or without detachable plates
- (f) Distribution boards shall be made of Robust and rigid construction and of totally enclosed dead front safety type. The enclosures shall be made of MS sheet steel of not less than 14/ 16 gauges. The sheet steel shall be treated by seven-tank process treatment followed by epoxy powder coating of approved shade. The distribution boards shall comprise of MCCB's or miniature circuit breakers or ELCB's as incoming and required number of miniature circuit breakers as outgoing.
- (g) All the Distribution Boards are of Double Door type with top door of acrylic type and with IP 55 Degree of protection..
- (h) The main switch and outgoing shall have rating as specified in the drawings and schedule. The boards shall be designed to have adequate cabling space for either top or bottom entry of both incoming and outgoing cables.

102BUS BARS

Suitable color coded bus bars made of high conductivity aluminum/Copper strips and mounted on non-hygroscopic insulating supports shall be provided. Neutral bus bars shall be of full the size of phase bus bar. The earth bus shall be also provided of material and size as required.

103MINIATURE CIRCUIT BREAKERS

Miniature circuit breakers shall have a minimum breaking capacity of **10 KA**. Circuit breakers shall be equipped with individual insulated, braced and protected connectors. The front face of all the breakers shall be flush with each other. The breakers shall have 'quick break trip free' mechanism with current limiting and overload and short circuit tripping characteristics. The mechanism shall be such that the circuit cannot be held closed when a fault occurs or persists.

The contacts shall be silver tungsten or other suitable material to give long contact life. Multiple units shall have an inter tripping mechanism thereby ensuring complete isolation in the circuit in the event of an overload or fault in anyone of the phases. The connectors shall be suitably shrouded.

104SAFETY & INTERLOCKS

All the live parts are shrouded such that accidental contacts with live parts are totally avoided. Distribution boards shall be provided with a front-hinged door. Distribution boards interior assembly shall be dead front with the front cover removed. Main lugs shall be shrouded. Suitable insulating barrier made of arc resistant material shall be provided for phase separation. Ends of the bus structures shall also be shrouded.

105CABINET DESIGN

The distribution board cabinet shall be totally enclosed type with dust and vermin proof construction. The interior components shall be mounted on a separate sheet, which is mounted and locked on to the studs provided inside the cabinet. Over this, a cover made of acrylic door shall be provided. Cabinets shall have 25mm knock out detachable glands plates at both top and bottom and sides. Robust fasteners enabling dust protection gasket to be compressed quickly and easily should secure the door. Unless specified other wise boards shall be flush mounted in walls.

106TERMINALS

Distribution boards shall be provided with a terminal block of adequate size to receive mains incoming cable and outgoing circuits. The location of the terminal block shall be so located that crowding of wires in the proximity of live parts is avoided. **A neutral link having rating equal to that of phase bus shall be provided.**

107DIRECTORY

Distribution boards shall be provided with a directory indicating the description of loads served by such circuit breaker, the rating of breakers, size of conductors, etc. The directory shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door. The DB's shall be provided with inscription plates. The size of letters shall be as approved and the wordings for inscription shall be given by Project Manager/Architects.

108INSTALLATION

Distribution boards shall be **surface mounted or recessed mounted** as required by the Consultants and at the locations shown on the drawings. The boards shall be fixed with suitable angle iron clamps and bolts. All the cables/conduits shall be properly terminated using glands/grips/check nuts, etc. Wiring shall be terminated properly using crimping/lugs sockets and PVC identification ferrules. The DB's shall be installed as **specified in IS 732 and National Building Code.**

109FASTENERS

All the screws, nuts, bolts, washers, etc. used for the current carrying parts shall be of brass or other approved non-ferrous material. Other fasteners shall be made of non-corroding materials. The screws used for fixing the top plate and the washers shall be of MS with nickel-plated.

110TESTING

Distribution boards shall be tested at **factory as per Indian Standard**. The tests shall include insulation test, high voltage test, etc. Distribution boards shall be tested for insulation resistance after the erection.

It should conform to all national and international standards like IS 8828 : 1993, IS 12640 – 1988, BS 4293 – 1983, CEE 27 (International commission Rules for the approved of electrical equipment).

111DRAWING APPROVAL:

The contractor shall submit the drawings for approval before execution

11229. TECHNICAL PARTICULARS TO BE FURNISHED BY BIDDERS (BREAKERS).

NAME OF MANUFACTURER :

TYPE OF BREAKER OFFERED :

NOMBER OF POLES :

SERVECE VOLTAGE :

NORMAL CURRENT RATING

a) IEC CONDITIONS :

b) SITE CNDITIONS :

FREQUENCY :

MAKING CPACITY IN PEAK KA	:
BREAKING CAPACITY	
a) SYMMETRICAL IN KA & MVA	:
b) AT RATED BREAKING CURRENT	:
OPENING TIME	
a) WITH NO CURRENT	:
b) AT RATED BREAKING CURRENT	:
ARCHING TIME	:
TOTAL BREAK TIME	:
MAKE TIME	:
SHORT TIME CURRENT FOR 1 SEC	:
IMPULSE WITHSTAND VOLTAGE	:
SHORT CIRCUIT TYPE TEST REPORT	:
a)AMPLITUDE FACTOR AT 10%, 70% &100%DUTY.	:
b)FREQUENCY 10%, 70% & 100% DUTY.	:
NUMBER OF BREAKES IN SERIES PER POLE	:
TOTAL LENGTH OF BREAK PER POLE	:
TYPE OF MAIN CONTACTS	:
MINIMUM CLEARENCE IN AIR	:
a) BETWEEN POLES	:
b) BETWEEN POLE & EARTH	:
METHOD OF CLOSING	:
WEATHER HAND OR POWER	:
WEATHER THE CIRCUIT BREAKER IS DESIGNED TO CLOSE AND LATCH ON MAKING OR IS FIITTED MAKING CURRENT RELEASE.	:

WHEATHER THE BREAKER IS FIXED TRIP OR
TRIP FREE RATED SUPPLY VOLTAGE OF
CLOSING MECHANISM :

POWER REQUERED AT RATED VOLTAGE TO
CLOSE THE CIRUIT BREAKER. :

NORMAL VOLTAGE OF SHUNT TRIP COILS :

POWER REQUERED AT NORMAL VOLTAGE PER
SHUNT TRIP COILS :

NUMER AND TYPE OF SPARE AUXILARY SWITCHS.:

WHEATHER SUITABLE FOR RECLOSING :

RECLOSING TIME :

DEAD TIME BETWEEN TRIPPING AND RECLOSING :

MAXIMUM OVER VOLTAGE DEVELOPED WHILE
BREAKING MAGNETISING CURRENT OF
TRANSFORMERS. :

MAXMUM LINE CHARGING CURRENT (CAPACITIVE
CURRENT) THE BREAKER CAN BREAK. :

WHETHER THE BREAKER IS CAPABLE OF BEING
UPDATED LATER ON IF O TO WHAT VALUE :

PANEL OUTLINE DRAWING (GA) :

a) EACH BREAKER VERTICAL WITH
RELAY / METERING COMPARTMENT.

13. HEIGHT :

14. DEPTH :

15. WIDTH :

16. BREAKER DRAW OUT DIMENSION :

B) COMPLETE PANEL

1 HEIGHT :

• DEPTH :

• WIDTH :

C) SHIPPING SECTIONS :

PANEL BUS BAR PHASE/ EARTH SIZING
WITH CALCULATIONS :

WEIGHT OF SHIPPING PANNEL :

WEIGHT OF COMPLETE PANEL :

MAKE OF COMPONENTS BEING OFFERED

REAYS :

METERS :

SWITCHES / SWITCHES BASE :

PT'S & CT'S :

INDICATING LAMPS

NOTE: ON ORDER BEING PLACED GA DRAWING OF DB WITH FLOOR FIXING DIMENSIONS /
ARRANGEMENT SHALL BE FURNISHED WITHIN 15 DAYS.

14. SPECIFICATION FOR CABLE TRAY

The Cable Tray shall be manufactured as per the following specification, BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization /work order finalization , In absence of such deviation it will be presumed that equipment offered is exactly similar to the specification ,client /consultant decision is final

1.0 SCOPE:

This specification covers the design, supply, fabrication fixing, aligning of G.I perforated & Ladder type cable trays and other steel frame works at site as required.

The cable trays shall be designed and fabricated out of 2 OR 3 mm thick CRCA sheet steel etc. and got approved by Consultants.

Before fabrication the sheet steel shall be properly cleaned to remove rust if any.

All materials used for fabrication of cable trays shall conform to IS 226 and fabrication shall be as per IS : 800.

After fabrication the cable trays and accessories shall be free from sharp edges, corners, burrs and unevenness, and followed by galvanizing.

The cable trays shall be welded to the mounting supports, which in turn are either welded to plate inserts or grouted to structural members.

Civil Contractor shall provide plate inserts for cable tray mounting supports.

Cable trays shall either run in cable trenches or run overhead and supported from available structure.

Minimum clearance between the top most tray tier and structural member shall be 300 mm.

The type and size of tray to be used shall be as required.

Each continuous length of cable tray shall be earthed at minimum two places.

All hard wares such as passivated bolts, nuts; washers, and other consumable required for the

fabrication and erection shall be included in the rate quoted by contractor. However, if any grip/Anchor bolts or fasteners are required, the same shall be paid extra.

The cable trays, accessories, covers etc. shall be galvanized. Where any cuts or holes are made or welding is done on finished steel work, the same shall be sealed against oxidation by red oxide primer followed by finished paint.

Perforated Cable Trays

1. Perforated trays should have longitudinal slots and not transverse slots. This is for better durability and load withstanding capacity.
2. Special High Grade Zinc of 99.995 % purity must be used for hot dip galvanizing. And the thickness of coating above 80 mm thick required.
3. All fasteners: Electro zinc plated only.
4. All size of trays load tested to be conducted within house testing facility. Load testing report for any given size of tray with required span to be provided by the manufacturer in the Presence of inspection done by CLIENT /PMC.
5. cable trays to be fabricated by using HR sheet steel , procured directly from reputed manufacturers like Jindal, Essar, ISPAT (now Jindal), etc confirming to IS 1079 Grade O i.e. ST 29 grade.

LADDER Cable Trays

6. Ladder type cable trays should bolted rung type ladder trays ,
7. Special High Grade Zinc of 99.995 % purity must be used for hot dip galvanizing. and the thickness of coating above 80 mm thick required.
8. all fasteners : Electro zinc plated only.
9. All size of trays load tested to be conducted with in house testing facility. Load testing report for any given size of tray with required span to be provided by the manufacturer in the Presence of inspection done by client/PMC .
10. cable trays to be fabricated by using HR sheet steel , procured directly from reputed manufacturers like Jindal, Essar, ISPAT (now Jindal), etc confirming to IS 1079 Grade O i.e. ST 29 grade.

GENERAL CONSTRUCTION PRACTICES

CONSTRUCTION PRACTICES FOR 11 KV SUB-TRANSMISSION LINES:

1. SURVEY AND MARKING: The preliminary survey of the line will be done jointly by and Contractor's Authorized representative. The survey done should be plotted on the map and submitted to Engineer-In-Charge of the work.

During preliminary survey crossings/proximity to buildings and to all categories of power lines as well as telecom lines under P&T Depts. should be clearly indicated in the route map. The detailed survey should be under taken only after the route alignment submitted is approved. The pit marking is then done at the locations. Any likely discrepancy in respect of ground/building clearance is sorted out first then the work shall be started. In case of erection to be carried out across power line, telegraph, telephone lines and public roads, the engineer in charge shall however furnish the required drawings of the crossings for the purpose. All necessary care should be taken by the contractor to avoid damage to crops and trees and properties while executing the work.

2. EXCAVATING PITS FOR ERECTION OF POLES: After the pit locations are located & peg marked on the ground, the pole pit of size 600x900x1500mm is dug. The base padding of 200mm thick with 1:3:6 cement concrete be done before erection of pole. The earthing coil should also be grounded 800mm below ground level by digging a separate pit & filling the pit with soil. The earthing coil is jointed with the earth wire provided in the base of the PCC pole and metallic fittings should be earthed with the embedded wire in the PCC pole at the top. The pole in the pole pit be erected in truly vertical position and the pit should be filled with boulders for line poles and PCC poles of DPS be concreted 0.3 Cmt. per pole. The pit is filled with 1:3:6 cement concrete mixture for size 450x600x1500mm. The poles should be erected with maximum span of 100 meters. In case of Rail Pole/H Beam the earthing coil is bolted with the same. . The pole in the pole pit be erected in truly vertical position and the Rail Pole/H Beam and poles for DP's and tangent locations should be concreted 0.5 Cmt. per pole with 1:3:6 cement concrete mixture for size 450x600x1500mm. The poles should be erected with maximum span of 100 meters.

3. FIXING OF 'V' CROSS ARM, TOP CLAMPS, DC CHANNELS etc. ON THE POLES:

The fitting such as V cross arm, top clamps, D.C. channel etc. should be fixed on poles as per standard practice adopted in . The fabrication of above fittings should also be got done as per standard

drawing

available in the . The general specification of steel sections are given below:

i. V Cross arm should be made out of M.S. Angle of size 65x65x6mm. The weight of one V cross arm is

approximately 10.45 Kg/Cross Arm.

ii. Top clamp should be made of M.S. Angle of size 65x65x6mm. The weight of clamp should be approximate 3.48 Kg/Top clamp.

iii. D.C. cross arm 4' centre should be made out of the M.S. channel of size 100x50x6 mm. The weight of

one DC cross arm comes out 46.00 Kg D.C. and length 2370 mm.

iv. Other special fittings if required may be got fabricated as per the standard drawings of . The clamps for holdings the fittings should be fabricated out of M.S. flat 65x8 mm size as per the standard drawings of weight 3.5 Kg/Pair clamp.

All nuts & bolts used shall be of M.S. with combination of plain and spring washer and machine made.

4. FIXATION OF INSULATORS AND HARDWARE OF PINS: Insulator shall be handled carefully in all stages of

loading and the individually checked for cracks, damages, loss of glaze etc. before assembling and erection of at site.

a) The 11KV galvanized steel pins made by process of forging suitable for 11KV pin insulators having

maximum failing load of 5 K.N. with small steel head as per fig IB of IS 2486 (ii)/1974 shall be used. The

dimension of pin shall conform to ref L-306N fig 69IS-2486 (ii)/1974. The pin shall be provided with nut

(hot dip galvanized) one plain washer and one spring washer (electro galvanized).

b) The disc insulators should be fitted with 11KV Hardware for tensioning the conductor 11KV hardware

should be fixed in the disc insulators as per the standard practice and in the correct position to bear the

Technical Specifications

tension of conductor. The 11KV strain hardware fitting of aluminium alloy suitable for required size of

Conductor (ACSR) should be used conforming to IS-2486 (Part-II) 1989.

The 4 feet centre DP are to be erected at the pre-decided location and six stays should be provided on

the DP. The location of pit for embedding the anchor plate and stay rod shall carefully be determined either in

true alignment. The overhead line or at angle locations as per the requirement of the case. The pit 0.4x0.6x1.6

mtr. shall be excavated and anchor plate with stay rod shall be suitably aligned in such a manner that the stay

wire when binded with anchor rod & stay clamp at pole, the same should make an angle of 30 degree to 45 degree from the pole in the tightened position. Cement concrete mix 1:3:6 shall be poured 0.2 cmt. in the pit, well packed with ramming adequately & cured properly. The stay clamp shall be located near and below the DC Cross arm to counter balance the tensile load of the line conductor. Stay wire shall be bound at both ends i.e. at the box and the stay rod. Fly guy/storm guy, as per the site conditions should be used after getting approval from . The stay set consisting of Anchor Rod, Anchor plate, turn buckle bow, thimble should be used at the tension locations.

The conductor shall be laid out in such a way that there is no damage to conductor. Reels of conductor should be handled carefully so that no damage to conductor strands occur.

5. STRINGING OF CONDUCTOR: Conductor should be laid out from a rotating wheel supported on jacks for easy unwinding of the conductor snatch blocks shall be used for stringing the conductor and shall have grooves of a shape and size to allow easy flow of conductor and ensure damage free operation. Come along clamps should be used to grip the conductor at the time of stringing.

6. SAGGING OF CONDUCTOR: All conductors sagging shall be preferred in accordance with the sag and tension tables. After the conductors have been pulled to the required sag, intermediate spans shall be checked to determine the correct sag. The conductor shall be installed on insulators secured to it by means of 6 SWG Aluminum binding wire. The jumpers at the tension locations should also be bound by 6 SWG aluminum binding wire. Before fixing the conductor on insulator and strain hardware, aluminum tape should be wrapped on the conductor.

7. GUARDING: The 11KV guarding cross arm is to be fitted on the pole as per the drawing available in the for guarding the line with 8 SWG GI wire as guard wire and 10 SWG GI wire for lacing. Guarding cross arm made of 75x40x6 mm angle 5 feet long should be clamped at 300mm below the bottom arm of 'V' cross arm.

8. ANTI-CLIMBING DEVICE: Barbed wire weighing 3.5 Kg per pole should be wrapped at a height of 3000 mm above ground level stretching in 900 mm length. Both ends of barbed should be clamped suitably to avoid coming down from its location.

a Danger Board for 11KV voltage and danger mark conforming to IS:2551-1963 should be fixed on each location.

16.0. SPECIFIC REQUIREMENTS OF UPS

6.1 UPS Rating :

Online Double conversion continuous rating UPS unit suitable for operating 100% non linear loads like SMPS. Units shall operate in parallel redundant mode.

6.2 Input Supply

- a) Voltage : 415V.
- b) Voltage Variation Limits : +/- 15%.
- c) No. of Phases : 3
- d) Frequency : 50 c/s
- e) Frequency Variation Limits : +/-5%
- f) Power Walk-in time : 2 – 10Seconds
- g) Input current Harmonic Distortion (THDi) : Less than 3%

6.3 Output Characteristic

- a) Voltage : 415V
- b) Voltage Variation limits
 - i. Steady state : +/- 1%
 - ii. Transient for 100% Load variation : +/- 3%
- c) Voltage Recovery time : Not more than 5 ms
- d) Voltage regulation : Within 2% for 100% Unbalanced load

- e) No. of phases : 3
- f) Frequency : 50 c/s
- g) Frequency variation limits
 - i. Synchronized to mains : -4%
 - ii. Internally generated : +/- 0.1%

6.4 Degree of protection for Enclosures : IP: 20

6.5 Type of cooling : Induced draught through fans

6.6 Ambient Temperature
Range for UPS design : 5 Deg., to 45 Deg. C

6.7 Over load rating : 110% for 1 hr.
125% for 10 minutes. 150% for 60 Sec.

6.8 Input Power Factor : Not lower than 0.95 lagging.

6.9 Efficiency (Overall) : Over 90%.

6.10 Rectifier Section : transistor bridge circuit (IGBT) may also be offered. This shall include the battery charger with adjustable trickle charge and boost charging provision. The design of battery charging system shall have battery manufacturer's approval.

6.11 Inverter Section : Transistor Bridge Circuit (IGBT) with 2 winding transformer and capacitors for filtering the harmonics. PWM technique shall be adopted in the Inverter.

6.12 Metering: - : Menu driven 2/4 line LCD shall be provided to indicate the following.

- a) Incoming phase and line voltage.

b) Output voltage on each phase.

C) Battery Voltage, charging current.

d) Input & output current in each phase.

The LC display shall also provide fault diagnosis assistance.

6.13 Isolation & Switching

The following switching and isolation facility shall be provided:

- a) MCCB backed up by semi conductor fuses shall be provided for the main Supply.
- b) MCCB backed up by semi conductor fuses for static bypass.
- c) Pole changeover switch (make before break type) for manual bypass.
- d) TP contactor for Inverter output switching.
- e) MCCB with shunt trip facility for D.C input supply from battery.

The physical layout and arrangement of switching equipment shall ensure that the maintenance of any section shall be possible when the remaining sections are in operation without compromising safety.

6.14 Protections

- a) Against Voltage Surge : Plug type Surge suppressors to be provided.
- b) Overload : Alarm and indication. The load shall
Be automatically transferred to static bypass
Without interruption.
- c) Short Circuit : HRC fuses designed for semi conductor
Protection. Fuse failure alarm to be annunciated.

d) Failure of rectifier : Alarm and indication. The load shall be Automatically transferred to battery without interruption.

e) Inverter failure : Alarm and indication.
The load shall be automatically transferred to the parallel redundant unit or to the static bypass.

f) D.C System : Alarm and indication on DC over Voltage and under voltage. Automatic cut off through a MCCB with shunt trip Facility when D.C voltage falls to minimum terminal voltage acceptable for Satisfactory performance of battery.

g) Over Temperature : Thermo switches to give warning.

h) Ventilation System failure : Over temperature alarm & indication.

6.15 Type of bypass arrangement : a) Static bypass with thyristor switch capable of taking up the operating load instantaneously without any interruption.

b) A manual bypass facility with make before break changeover switch shall be provided.

c) Provision shall be available to disable the Static bypass.

6.16 Type of Control : The control shall be micro processor based digital open and closed loop type. The components used shall be high reliability industrial grade electronics. The control unit shall have self diagnostic and monitoring features listed below:

- i. Fault occurrence record with causes.
- ii. Computation of battery back up time.
- iii. Storage of statistical data on all parameters.

Any other optional facilities available shall be quoted separately. Printer interface shall be provided to record all parameters Programmable software interface facility shall be provided for automatic shutdown of the system.

iv. To facilitate changeover from battery to mains / D.G supply a POWER WALK- IN facility shall be provided. The power walk-in time period shall be within the 20seconds.

v. Lan card facility for PC monitoring

6.17 Noise level : Not more than 65dBA at 1M distance
under full load conditions.

6.18 Wave form distortion : To be less than 5% for non linear loads and
2% for normal loads.

6.19 Environmental Condition : The unit shall be suitable for installation in
non air- conditioned but ventilated indoor location.

6.20 Enclosure & Batteries

The UPS shall be housed in a sheet steel enclosure fabricated out of 2mm thick CRCA sheet. The enclosure shall be treated using 7 tank process and shall be given powder coated finish. The color of the final coat shall be subject to purchaser's approval.

6.21 Fire / over temperature detection.

A temperature sensitive fire / over temperature protection feature shall be incorporated in the UPS. When the temperature exceeds preset value, a warning signal shall be given. If the temperature continues to rise and exceed the maximum permissible value, the unit shall automatically be switched off.

6.22 Display Panel

A door mounted display / control panel shall be provided. The control panel shall comprise of indicators, controls and LED display. The text shall be in English.

6.23 Parallel Operation:

The UPS shall have in built circuitry to facilitate parallel operation with other units of identical capacity. **Paralleling kit shall be provided.**

6.24 Remote Panel

A remote panel shall be offered as an optional item. This shall be generally identical to the Control Panel provided on the UPS. The necessary interfaces shall be provided in the UPS for connecting the remote panel.

6.25 HOT STANDBY OPERATION.

The UPS shall have in built circuitry to facilitate hot standby operation with other units of identical / non-identical capacity. During this operation, the hot standby unit shall be connected to load through the static bypass of main UPS, whenever the main unit fails.

7.0 HARMONIC FILTER – requirements subject to consultant Approval vendor should check with consultant before quoting the offer

A non compensated LC filter with contactor shall be built into the UPS to limit the total harmonic distortion of input **current to 3% at rated load**. The input P.F shall not be **lower than 0.99**. The unit shall be suitable for operation on the A.C system having fed from either EB supply or captive generation supply. Design calculations shall be furnished to support the performance of the unit.

8.0 BATTERY

- a) The battery shall be of the sealed maintenance free lead acid stationary type.
- b) The nominal cell voltage shall be 2.2Volts.
- c) Each UPS unit shall be backed by a battery bank.
- d) The AH rating shall be selected so as to provide **30 minutes** back up under **rated full load condition.** **Calculations shall be furnished to prove the adequacy of battery rating.**
- e) The batteries shall be explosion proof and shall be provided with safety valve made of synthetic rubber and a ceramic filter to prevent build up of gas pressure.

- f) The battery container and terminals shall be designed so as to prevent any leakage of electrolyte.
- g) The no. of cells shall be selected to suit the UPS requirement.
- h) A battery shall be designed for continuous duty in an environment maintained at 27 deg. C.
- i) The battery shall be designed for continuous float charge and equalizing charge when required.
- j) The design of the battery charging system in the UPS shall be subject to approval of the battery manufacturer.
- k) A battery enclosure shall be of 2mm thick epoxy painted sheet steel. The batteries shall be arranged in double tier/ three tier formation.
- l) All interconnecting links / wiring shall be supplied. The battery circuit breaker with necessary wiring shall be accommodated in the battery enclosure.

1) EARTHING

A copper earth bus of 25 x 6mm shall be provided in the UPS enclosure and connected to the body and doors. Provision shall be made at both ends of the earth bus for connecting the same to the main earth grid of the project.

2) DRAWING DOCUMENTATION

3)

The following drawings and documents shall be submitted at various stages with requisite number of prints / copies.

Sl. No.	Type of Document			No. of copies	
	For	With the	For Record	bid	Approval
1.	G.A Drawing of UPS, Harmonic filter & Battery			2	4

2. Block Diagram.		2	2	4
3. Schematic wiring diagram.	-	2	4	
4. Test Certificate		-	-	4
5. Operation & maintenance manual	-	-	4	

11.0 Q.A PLAN

The successful bidder shall submit the Quality Assurance Plan for approval of the Client / Consultant.

12.0 INSTALLATION

The UPS installation shall include the following.

- a) Unloading of the UPS unit and battery bank at site and shift to the permanent location.
- b) Installation and leveling of the UPS unit and battery bank.
- c) Installation of 1100V, copper conductor, FRLS grade flexible cable, between battery and UPS.
- d) Cable end terminations using heavy duty tinned copper crimping type lugs.
- e) Setting up and programming the unit.
- f) Testing of the units as specified and commissioning.

13.0 TESTING

13.1 Tests at Manufacturer's works All routine tests shall be conducted at the works and test certificates shall be furnished before dispatch.

13.2 Testing at site

Load test shall be conducted on each of the UPS unit at site after installation to prove the following.

- a) Continuous rating of the unit.
- b) Overload capability as specified by the manufacturer.
- c) Guaranteed battery back up time.
- d) Harmonic distortion on the input & output side for varying loads.

14.0 TAKING OVER THE INSTALLATION

The UPS system will be taken over after completing the following.

- a) UPS unit and batteries are installed at the locations indicated and all connections are carried out as per the design.
- b) All calibrations and settings are carried out for parallel/Solo operation.
- c) All routine tests are carried out.
 - d) Load trials are carried out.
 - e) All test certificates are furnished.
 - f) All AS BUILT documentation is submitted.
 - g) Operation and maintenance manual is submitted.

14.0 AMC (OPTIONAL)

The vendor shall undertake comprehensive annual maintenance inclusive of all spares for a period of two years after the guarantee period. The AMC charges shall be indicated separately in the tender.

15.0 TECHNICAL PARTICULARS

Technical particulars called for in Annexure-I shall be furnished.

ANNEXURE-I TO UPS SPECIFICATION

TECHNICAL PARTICULARS OF **kVA**

1.1	Make & type.	:
1.2	Continuous rating.	:
1.3	Input voltage.	:
1.4	Input voltage variation limits.	:
1.5	Input frequency.	:
1.6	Input frequency variation limits.	:
1.7	Output voltage.	:
1.8	Output voltage variation limits.	:
1.9	Transient voltage variation for 1 block loading.	:
1.10	Voltage recovery time.	:
1.11	Output frequency variation limits.	:
1.12	a) Synchronized to mains.	:
	b) Internally generated.	:

1.13	Crest factor.	:
1.14	Input power factor at rated load.	:
1.15	Input power factor at 50% load.	:
1.16	Input to output efficiency at rated load without filter.	:
1.17	Input to output efficiency at rated load with filter.	:
1.18	Input to Output efficiency at 50% Load without filter	:
1.19	Input to output efficiency at 50%load with filter.	:
	Protections provided.	:
1.20	THD (current) at input for 100% load without filter.	:
1.21	THD (current) at input for 100% load with filter.	:
1.22	THD (current) at input for 50% load without filter.	:
1.23	THD (current) at input for 50% load with filter.	:
1.24	Noise level at rated load.	:
1.25	Is static bypass provided?	:
1.26	Is Manual bypass facility provided?	:

1.27	D.C operating voltage range permissible.	:
1.28	Overall dimensions of UPS.	:
1.29	Overall dimensions of filter.	:
1.30	Overall dimensions of battery bank.	:
1.31	Weight of the UPS.	:
1.32	Weight of the harmonic filter.	:
1.33	Weight of battery bank.	:
1.34	Is paralleling kit included?	:
1.35	<u>Cabling</u>	
a)	Size of interconnecting cable between Battery & UPS	:
1.36	Make & type.	:
1.37	Continuous rating.	:
1.38	Input voltage.	:
1.39	Input voltage variation limits.	:
1.40	Input frequency.	:
1.41	Input frequency variation limits.	:
1.42	Output voltage.	:
1.43	Output voltage variation limits.	:

1.44	Transient voltage variation for 1 block loading.	:	
1.45	Voltage recovery time.	:	
1.46	Output frequency variation limits.		
1.47	a) Synchronized to mains.	:	
	b) Internally generated.	:	
1.48	Crest factor.	:	
1.49	Input power factor at rated load.	:	
1.50	Input power factor at 50% load.	:	
1.51	Input to output efficiency at rated load without filter.	:	
1.52	Input to output efficiency at rated load with filter.	:	
1.53	Input to Output efficiency at 50% Load without filter	:	
1.54	Input to output efficiency at 50%load with filter.	:	
	Protections provided.	:	
1.55	THD (current) at input for 100% load without filter.	:	
1.56	THD (current) at input for 100% load with filter.	:	
1.57	THD (current) at input for 50% load without filter.	:	

1.58	THD (current) at input for 50% load with filter.	:
1.59	Noise level at rated load.	:
1.60	Is static bypass provided?	:
1.61	Is Manual bypass facility provided?	:
1.62	D.C operating voltage range permissible.	:
1.63	Overall dimensions of UPS.	:
1.64	Overall dimensions of filter.	:
1.65	Overall dimensions of battery bank.	:
1.66	Weight of the UPS.	:
1.67	Weight of the harmonic filter.	:
1.68	Weight of battery bank.	:
1.69	Is paralleling kit included?	:
1.70	<u>Cabling</u>	
a)	Size of interconnecting cable between Battery & UPS	:

II BATTERY BANK for ----kVA

2.1	Make.	:
2.2	Type.	:
2.3	No. of units offered.	:

2.4	Voltage per unit.	:
2.5	Nominal voltage per cell	:
2.6	Permissible end cell voltage as per manufacturer	:
2.7	End cell voltage considered for Battery sizing.	:
2.8	AH capacity.	:
2.9	Is all capacities decided based on unity P.F	:
2.10	Battery backup time at rated load	:
2.11	Is battery circuit breaker included?	:
2.12	Overall dimensions of the cabinet	:
2.13	Weight of each battery bank	:

17. BATTERY AND BATTERY CHARGER.

BATTERY.

GENERAL

- i) VRLA SMF batteries are sealed lead acid type maintenance free and compact in size
- ii) They are designed to deliver the quality and reliable stand by power for critical applications.

BATTERY CHARGER

GENERAL

- i) The charger shall be natural air cooled, solid-state type with full wave, fully controlled, bridge configurations.
- ii) The charger shall be provided with automatic voltage regulation, current limiting circuitry, smoothing filter circuits and soft start feature.
- iii) Voltage shall be stepless, smooth and continuous.
- iv) The charger shall be self-protecting against all A-C and D-C transients and steady state abnormal currents and voltages.
- v) Voltage setters shall be provided for setting the output of the float boost charge. Setting shall be independent of each other so that setting of one voltage shall not require resetting the other.
- vi) There shall be separate transformers for float and boost charger.
- Vii) Charger A-C input and D-C output shall be electrically isolated from each other and also form panel ground.

CONSTRUCTION

- i) The charger shall be free-standing. Floor mounted with sheet steel enclosure with all access from the front.
- ii) The panel shall conform to the degree of protection IP 42. minimum thickness of the sheet metal shall be 2 mm.
- lii) Access doors shall be with concealed hinges and neoprene gaskets. Ventilating louvres shall be covered with fine wire mesh.

iv) All equipment within the panels shall be arranged in the modular units and laid out with sufficient space for easy maintenance.

v) Switches, meters, relays etc. shall be flush mounted on the front of the panels. Nameplates of the approved size and type shall be provided for all circuits and devices.

CHARGER EQUIPMENT

i) All power diodes and control rectifiers shall be silicon type. Rectifier transformer shall be dry type, double wound, with copper conductor and class B insulation.

ii) Blocking diodes shall be fully rated and redundant so that failure of a single diode shall not incapacitate the system in any way.

lii) Isolating switches shall be heavy-duty, load break type, operated by external handle with provision for padlocking in ON or OFF position.

iv) Change over switch shall be 3 position, 4 pole, and load break type with 2 NO+ 2 NC auxiliary contacts.

v) Contactor shall be air-break type with thermal overload relays being in built single-phase prevent or.

vi) Fuses shall be HRC type and arranged for easy replacement. Semi conducting device fuses shall be fast acting.

vii) Indicating lights shall be low-watt filament type with series resistor. Both lamps and lens shall be replaceable from the front.

viii) Meters shall be 96 x 96 mm switchboard type, 250 deg.scale, antiglare glass, $\pm 2\%$ accuracy with zero adjuster on the front.

ALARMS

i) One (1) ten-point alarm facia shall be provided on charger panel, complete with proper actuating devices, circuitry and legends.

ii) The arrangement shall be such that, on occurrence of a fault the corresponding window will light up and stays lighted until the fault is cleared and reset button is pressed.

iii) Each time a window lights up, a master relay will get energized to provide group alarm

signals for remote panel.

iv) Following minimum annunciation shall be provided:

- # A.C. supply failure *
- # D.C. voltage low
- # D.C. voltage high*
- # D.C. system ground*
- # Charger overload*
- # SCR fuse blown
- # Filter fuse blown
- # D.C. output fuse blown
- # Alarm points marked with an asterisk(*) shall have electrically separate set of contacts wired up to the terminal block.
- # Alarm contacts shall be rated 1A at 24V D.C. and 5A at 240V A.C

OUTGOING FEEDERS

- i) Each outgoing feeders shall be provided with double pole switch and with HRC fuses.
- ii) Outgoing feeders shall be located in separate module forming part of charger panel with separate cable alley for terminating outgoing cables.

LAMP/RECEPTACLES.

- i) The charger panels shall be provided with:
 - Internal illumination CFL lamp with door switch
 - Panel Cooling fan of 1 Ph, 230V 4" dia to be provided
- ii) Lamp, Cooling fan circuits shall have individual switch fuse units.

Requirements:

BATTERY

- i) Type : VRLA SMF
- ii) Nos. of cells per Battery : 12
- iii) Battery nominal voltage : 24 Volts.
- iv) Ten hour rating to 1.85 Volt/cell at 27 deg.c : 60Ah.

- v) Proposed method of working :
- a) Float charging (normal) : 2.15 Volts per cell.
 - b) Boost charging (After complete discharge) : 2.75 Volts per cell (Maximum)
- vi) Mounting : MS angle stand

BATTERY CHARGER

- i) Charger : Float & Boost
- ii) Float charging current : 25A.
- iii) Type : Solid state
- iv) A.C. Input supply : 415V, 3 phase, 50HZ, 4 wire.
- v) Ripple content in charger dc output : $\pm 1\%$
- Outgoing feeder 4 Nos : Each consisting of double pole switch fuse of 32A

18. SPECIFICATION FOR FLAME PROOF ITEMS

The FLAME PROOF ITEMS shall be manufactured as per the following specification, BOQ and drawings. In case of any deviation from the mentioned, vendor shall bring into notice immediately before tender finalization /work order finalization , In absence of such deviation it will be presumed that equipment offered is exactly similar to the specification ,client /consultant decision is final

1.0 SCOPE :

This specification covers design, construction, testing and supply of distribution boards, plugs, sockets, lamps and flameproof lighting fittings.

2.0 CODES AND STANDARDS

The design, installation, testing & commissioning shall be as per established codes, standards, and sound engineering practices and shall conform to the statutory regulations applicable in the country. The main codes, standards and statutory regulations are as follows. The latest edition of these shall be followed.

- Indian Electricity Rules
- Indian Electricity Act.
- The Factory Act.
- The Mines Act. (OMR-84)
- The Petroleum Rules (Ministry of industry, Govt. of India)
- State Electricity Rules
- DGMS Guidelines
- OISD Guidelines

3.0 SERVICE CONDITIONS:

The, distribution panel, plugs, sockets, lamps and flameproof lighting fittings shall be designed to operate under the Site conditions as specified .

4.0 CERTIFICATION

All offered equipment shall be of a type tested by CMRI (Dhanbad) and approved by CCE for use in Hazardous area's Flameproof items shall be suitable for **Zone 1 & 2**, gas group IIA / IIB & temperature class T-3.. BIS , ISI marking is mandatory for every items . Equivalent testing and certification of the country of origin may be acceptable for imported equipment. Type test certificates for each type of offered equipment shall be furnished along with the offer.

Third Party Inspection is must be done for all type of Flame proof items By Lloyds/BV/DNV/TUV/CEIL and the Charges shall be included in the quoted price.

5.0 FINISHING & PAINTING

All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The surface shall be prepared by applying a coat of phosphate paint and coat of yellow zinc chromate primer. The surface shall be made free from all imperfections before undertaking the finishing coat.

After preparation of the surface, the surfaces shall be powder coated with two coats of epoxy based final paint. Color shade of final paint shall be 632 as per IS:5. The finished panels shall be dried in stoving ovens in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint etc.

All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust formation. If these parts are moving elements then they shall be greased.

6.0 DRAWINGS AND DATA

Drawings and Test Certificates as stipulated in Vendor Document Requirements enclosed elsewhere shall be furnished.

7.0 TESTING AND INSPECTION:

- The panel shall be tested in accordance with the relevant standards. The following tests shall be conducted on all panels: Insulation resistance with 500 V megger.

- High potential test at 2 KV for 1 minute between phases and phase to earth. Test certificates shall be furnished along with the equipment for the above.
- CMRI test certificates along with CCE approval certificates as applicable shall be furnished for each type of fixture. All equipment shall be routine tested as per applicable Indian Standards.
- During inspection, facility shall be provided for impact testing of random sample. One well glass of each fixture type from each lot shall be tested for impart strength.

8.0 SPARES:

The Bidder shall provide with his quotation, separate priced list of recommended operation and maintenance spares.

9.0 Quality Assurance:

Quality Assurance shall follow the requirements of Tender documents, tender specification, drawings and Indian standards as applicable. Q.A. Involvement will commence at bid stage and follow through to completion and acceptance, thus ensuring total conformity to Purchasers requirements.

10.0 DEVIATIONS

Deviations from specification must be stated in writing at the bid stage. In absence of such statement, it will be assumed that the requirements of the specification are met without exception.

11.0 Flameproof & Industrial type Control Stations :

Construction:

Flameproof control station shall be made of cast light metal alloy and shall be free from frictional sparking hazard. The magnesium content in the alloy shall be as per IS-13346. Flameproof enclosure shall be suitable for zone 1 & 2, gas group IIA / IIB & temperature class T-3. The enclosures of the industrial control station shall be made of CRCA sheet steel (2 mm), dust & vermin proof and accessories suitable for installation in Industrial outdoor areas and shall have enclosure protection

as per IP-66.

The control stations shall be suitable for use in outdoor open locations and shall have IP-66 degree of protection. They shall preferably be provided with integral canopy. However, where the enclosure has been certified without integral canopy, a separate canopy can be accepted. The separate canopy shall be made of at least 14 SWG (2mm) galvanised sheet steel or FRP. The canopy shall be suitable for providing protection against rain from top and two sides.

Unless otherwise specified all control stations shall be suitable for 240 V AC control supply. The control stations shall be provided with gaskets made of non-inflammable and self-extinguishing material. All accessories like nuts, bolts, washers etc. shall be made of stainless steel SS-304.

The control stations shall be provided with two earthing studs with lugs on the external surface of the enclosures suitable for termination of 8 SWG GI wire. Each control station shall be provided with 2 nos. bottom cable entries and 1 no. flameproof nickel plated brass sealing plug. The control stations shall have external fixing lugs for mounting on wall or column. The holes provided on these lugs shall be of oblong type.

12.0 Component Specification:

Push buttons for START and STOP shall be of GREEN and RED colour respectively. Unless otherwise specified, each push button shall have one normally open and one normally closed contact. The STOP push button shall be mushroom type with stay put feature and lockable in pressed position.

Selector switches shall have three/ four positions (Local, Off & Remote) for Local Control Station. Unless otherwise specified, all selector switches shall have minimum two poles for each position. Each position shall be indelibly marked on the control station.

All ammeters shall be of moving iron type having an accuracy class of 1 and suitable for 1 Ampere CT secondary. Unless otherwise specified, min. size of ammeter shall either be 50 mm x 50 mm. 80% of the scale length shall cover 100% of the CT primary current uniformly and the balance 20% of the scale shall cover 100-600% of the CT primary. A red mark corresponding to the full load current of the motor shall be provided on the ammeter dial. The ammeter front glass shall be toughened (Type 'A' glass).

All push button and control switch contacts shall be rated for min. 5 Amps at 240 V AC-15.

Indicating lamp(s) wherever provided shall be clustered LED type (with minimum 3 nos. LEDs, preferably connected in parallel), mounted inside an enclosure of minimum diameter of 15mm.

13.0 Flameproof & Industrial Lighting and Power Panels

Construction

The enclosures of the flameproof lighting and power panels shall be made of cast light metal alloy and shall be free from frictional sparking hazard. The magnesium content in the alloy shall be as per IS-13346. Flameproof enclosure shall be suitable for zone 1 & 2, gas group IIA / IIB & temperature class T-3. The enclosures of the industrial lighting & power panels shall be made of 2mm thick sheet steel and shall be dust & vermin proof. All metal surfaces shall be cleaned free of rust. The enclosures shall be sized to facilitate easy maintenance and heat dissipation.

Panels shall be indoor / outdoor type as specified. Indoor type panels shall have IP-66 degree of protection and panels located in outdoor open locations shall have IP-65 degree of protection. The panels shall be suitable for surface or flush mounting on wall surface as specified. They shall preferably be provided with integral canopy. However, where the enclosure has been certified without integral canopy, a separate canopy can be accepted. The separate canopy shall be made of at least 2mm galvanized sheet steel or FRP. The canopy shall be suitable for providing protection against rain from top and two sides.

The lighting and power panels shall be provided with gaskets made of non-inflammable and self-extinguishing material. The enclosures shall be treated and prepared for painting with two coats of epoxy paint with final color shade (both internal and external) as Silver grey shade 628 (IS-5) All accessories like nuts, bolts, washers etc. shall be made of stainless steel SS-304.

All the non-current carrying metallic parts of the panel shall be inherently bonded together. Each lighting and power panel shall be provided with two earthing studs with lugs on the exterior of the panel enclosure suitable for termination of 10 mm dia GI wire rope. Each outgoing feeder shall be provided with distinct terminals for phase, neutral and earth. The terminal block enclosures shall be adequately sized to properly terminate the cables by taking into account the required bending radii of cable cores and shall have the following minimum gland to terminal distances:

Conductor Size	Up to 2.5 mm ²	Above 2.5 mm ² & Up to 10	Above 10 mm ² & Up to 35 mm ²	Above 35 mm ² & Up to 70 mm ²
Gland to terminal distance	40 mm	100 mm	150 mm	300 mm

The panels shall be provided with suitably sized cable entries at the bottom/ sides, for incoming and outgoing cables. Flameproof nickel plated brass sealing plugs shall be supplied, for plugging the unused cable entries. The quantity of sealing plugs shall be equal to 20% of the total number of outgoing cable entries. The panels shall have external fixing lugs for mounting on wall or column. The holes provided on these lugs shall be of oblong type.

Component Specification

Bus bars in the lighting and power panels shall be made of high conductivity copper, and shall be supported by non-hygroscopic insulators. Bus bars shall be colour coded for identification of phases and neutral. Unless otherwise specified, the incomer shall have one no. TP MCB with neutral link, 3 nos. fuses for maintenance and 3 nos. 30mA single phase ELCB for each circuit.

Unless otherwise specified, the outgoing feeders shall be provided with double pole 10A MCBs having overload and short-circuit releases. Unless otherwise specified, all MCBs shall be with 16kA (M9 category) interrupting capacity. The ELCB shall be hand reset type. One no. door mounted reset push button shall be provided.

The operating knobs (ON/ OFF/ RESET) shall be provided with a suitable rack and pinion arrangement for operating them smoothly from outside. Wherever the size of incoming cable to lighting, power panels is more than 35 sq.mm a suitable cable adapter box shall be provided and attached to the panel. The incoming cable leads shall be connected to terminal block (bolted type terminals) of required size. This terminal block shall be connected to TPN incomer unit through separate PVC insulated copper conductor wires/bus bars. Sufficient space shall be provided (minimum 300mm) between gland plate and the bottom of terminal block for easy termination.

14.0 Flameproof and Industrial Light Fixtures & Junction Boxes

Construction:

The enclosures of the flameproof lighting fixtures, control gear box and junction boxes shall be of LM6 cast light metal alloy and shall be free from frictional sparking hazard. The magnesium content in the alloy shall be as per IS-13346. Flameproof enclosure shall be suitable for zone 1 & 2, gas group IIA / IIB & temperature class T-3. The enclosure of the industrial lighting fixtures, control gear box and junction boxes shall be of CRCA sheet steel, dust & vermin proof. All equipment shall be suitable for use in outdoor open locations and shall have IP-66 degree of protection.

The enclosures shall be provided with gaskets made of non-inflammable and self-extinguishing material. The enclosures shall be treated and prepared for painting with two coats of epoxy paint with final color shade (both internal and external) as Silver grey shade 628 (IS-5) All accessories like nuts, bolts, washers etc. shall be made of stainless steel SS-304. All equipments on single phase supply shall be provided with an independent earth terminal with lug inside the enclosure for terminating the third (earth) core of the cable and shall have facility for looping.

15.0 Lighting Fixtures

Glass used for lighting fixture shall be clear and suitable for use under conditions involving exceptional risk of mechanical damage.

Well glass lighting fixture for Zone- 1& 2 classified area shall meet requirement of IS-8224. Mechanical strength of well glass shall satisfy requirement of IS-2206 (for type A glass) for flame proof lighting fixtures, and IS-6381 for Div. 2 lighting fixtures. All well glass fixtures shall be provided with a protective wire cage using minimum 5 mm welded steel construction and having mesh dimensions not exceeding 50mm x 70mm. The material of the cage shall be galvanized steel or epoxy powder coated mild steel.

The fixing parts of the enclosure, which are to be opened for replacement of bulb, shall be so fastened that they can be unfastened only with special tools. The lighting fixtures in Zone-2/ Zone-1 area, shall have approved type enclosed break lamp holder and complete enclosure certified as having restricted breathing type construction. In case of lighting fixtures, the holder shall additionally have a spring-loaded lock to hold the lamp in position and to prevent the lamp coming off loose in the holder. Lamp holder shall be Edison screw type.

All lighting fixtures shall be provided with 2 no. threaded entry and 1 no. double compression nickel plated brass cable gland. The glands shall be suitable for the specified cable size. All the fixtures having double cable entry shall be supplied with 1 no. nickel plated brass plug for sealing the unused entry. The top of all well glass lighting fixtures shall be identically drilled/ threaded to facilitate installation on pole/ column or ceiling.

The flood lighting fixtures shall be supplied with adjustable mounting arrangement both in horizontal and vertical plane. All lighting fixtures shall be provided with suitable mirror-polished aluminums internal reflector of suitable thickness to ensure adequate mechanical strength.

16.0 Control Gear Box (Integral Light Fitting)

Lighting fixtures suitable for discharge lamps shall be provided with power factor correction capacitor, choke starter etc., housed in separate compartment. The choke shall be copper wound. The complete control gear shall have power factor not less than 0.99.

The control gear boxes shall be provided with 3 nos. entries and 3 nos. double compression nickel plated brass cable glands. The glands shall be suitable for the specified cable size. 20% of the control

gear boxes shall be supplied with 1 no. nickel plated brass plug for sealing the unused entry. Control gear box for flame proof fixtures shall be flameproof type unless specified otherwise.

17.0 Junction Boxes

Unless otherwise specified, the junction boxes shall be of flameproof construction suitable for zone 1 & 2, gas group IIA/IIB, temperature class T-3. Each junction box shall be complete with requisite number of cable entries and double compression flameproof nickel plated brass cable glands to suit the specified cable size and flameproof sealing plugs.

18.0 Flameproof & Industrial type plugs & Sockets

Construction

The enclosures of the flameproof plugs, sockets & transformers shall be made of cast light metal alloy and shall be free from frictional sparking hazard. The magnesium content in the alloy shall be as per IS-13346. Flameproof enclosure shall be suitable for zone 1 & 2, gas group IIA / IIB & temperature class T-3. The enclosures of the industrial plugs, sockets & transformers shall be made of CRCA sheet steel, dust & vermin proof. The enclosures shall be sized to facilitate easy maintenance and heat dissipation.

The equipment shall be suitable for use in indoor & outdoor open locations and shall have IP-66 degree of protection. The sockets for fixed installation, i.e. 415 V three phase sockets and 240 V single phase sockets, shall be provided with integral canopy. However, where the enclosure has been certified without integral canopy, a separate canopy can be accepted. The separate canopy shall be made of at least 2mm galvanised sheet steel or FRP. The canopy shall be suitable for providing protection against rain from top and two sides.

The enclosures shall be provided with gaskets made of non inflammable and self extinguishing material. The enclosures shall be treated and prepared for painting with two coats of epoxy paint with final colour shade (both internal and external) Silver grey No. 628 (IS-5) All accessories like nuts, bolts, washers etc. shall be made of stainless steel SS-304. All the non current carrying metallic parts of the equipment shall be inherently bonded together.

The TPN sockets shall be provided with two earthing studs, with lugs on the exterior of the enclosure, suitable for termination of 10 mm dia GI wire rope. Internal earth terminal shall be provided in each enclosure for all single plugs and sockets for connecting the earth core of the cables. The terminal block enclosures shall be adequately sized to properly terminate the cables by

taking into account the required bending radii of cable cores and shall have the following minimum gland to terminal distances:

Conductor Size	Up to 2.5 mm	Above 2.5 mm & Up to 10 mm ²	Above 10 mm ² & Up to 35	Above 35 mm & Up to 70 mm ²
Gland to terminal distance	40 mm	100 mm	150 mm	300 mm

The sockets shall be provided with 2 nos. suitably sized cable entries at the bottom for specified cable sizes. The plugs shall be supplied with 1 no. suitably sized cable entry for specified cable size. Each socket shall be supplied with 1 no. flameproof nickel plated brass sealing plug, for plugging the unused cable entry.

The sockets shall have external fixing lugs for mounting on wall or column. The holes provided on these lugs shall be of oblong type.

- Flameproof sockets shall be provided with a switch and a mechanical interlock so as to break the electrical circuit before the plug is completely withdrawn and make the circuit after the plug is fully inserted.
- In order to prevent accidental removal of plug from socket, the engagement & disengagement shall be by two separate and distinct movement & positions.
- 415 V, 63 A, three phase flameproof plug and socket meant for welding receptacle / any other three phase auxiliary loads shall be provided with either 4 pins (3P+E) or 5 pins (3P+N+E) as required.
- 4-pin socket shall be provided with 63 A, three-pole heavy-duty switch whereas 5-pin socket shall be provided with four pole (TPN) heavy-duty switch. Both 24 V and 240 V, 15 A single phase flameproof plug and socket shall be provided with 3 pins (2P+E).
- Provision shall be made so that it shall not be possible to insert 24 V plug on to a 240 V socket.
- Each outlet shall be provided with either a spring loaded hinged cover, or with a cap connected through metallic chain, to close the outlet when not in service. All internal power wiring shall be done with 660 V grade PVC insulated copper wires of suitable size.

- Stud type terminals of suitable size shall be provided for all outgoing and incoming cables.
- All sockets shall be suitable for two cable entries with looping facility and shall be provided with two flameproof double compression brass cable glands and one flameproof brass-sealing plug per socket to seal the unused cable entry.
- 24 V socket outlet unit shall be provided with built in 240 V / 24 V transformer. The transformer shall be designed for 100 VA rating on continuous basis.
- HRC fuses shall be provided on primary and secondary side of the transformer. The transformer shall have an earthed screen between primary and secondary winding. The socket outlet unit with built in transformer, switch, fuse, internal wiring shall be flameproof as a complete assembly.
- All units shall be provided with one internal & two external earthing terminals.
- Scraping earth connection shall be provided between the plug and socket. Earth pin of plug shall first engage with earth pin of switch socket.
- The plug assembly shall be mechanically rugged, light and shall not unduly stress the socket or its own pins when fitted on to the socket.
- Each socket outlet unit shall have suitable mounting frame / bracket to facilitate installation on vertical surface of wall / structure.