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Name of Work: Different electrical works in NL-I parking area , CL-202A, NL-I-203, ACES-408, CL-105C & D, SL-109, Advance management cell at FB & ACES-408.

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NIT amounting to Rs. 2,08,021/- (Rupees Two Lacs Eight Thousand Twenty One Only) is approved.

[Certified that this N.I.T. contains 64 (Sixty Four pages only)].

**Executive Engineer
I.W.D. Elect. Division
I.I.T., Kanpur**

PART-A

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
INSTITUTE WORKS DEPARTMENT
ELECTRICAL DIVISION
E-TENDER NOTICE

NIT No. 74 /IWD/ED/482

Dated:28.12.2018

The Executive Engineer, IWD, I.I.T., Kanpur on behalf of Board of Governors of IIT Kanpur invites online item rate tender from empanelled contractor of IIT, Kanpur for the following electrical work:-

Sl. No	Name of work and location	Estimated cost put to tender (In Rs.)	Earnest Money (In Rs.)	Period of Completion	Last date & time of submission of tender	Period during which EMD, Cost of Tender Document, e-Tender Processing Fee and other Documents shall be submitted	Time & date of opening of tender
1	Different electrical works in NL-I parking area , CL-202A, NL-I-203, ACES-408, CL-105C & D, SL-109, Advance management cell at FB & ACES-408.	2,08,021/-	4,160/-	03 Months	Upto 3:30 PM on 11.01.2019	After last date and time of sub-mission of tender and upto 3:00 PM on 14.01.2019	At 3:30 PM on 16.01.2019

The e-tender documents is available on www.tenderwizard.com/IIT

(Raghvendra Singh)
Executive Engineer (Elect.)

Copy to:

1. Institute website: www.iitk.ac.in/iwd/tenderhall.htm
2. Notice Board

The enlistment of the contractors should be valid on the last date of submission of tenders.

In case the last date of submission of tender is extended, the enlistment of contractor should be valid on the original date of submission of tenders.

1. The intending tenderer must read the terms and conditions of FORM-6 for e-Tendering carefully. He should only submit his tender if he considers himself eligible and he is in possession of all the documents required.
2. Information and Instructions for tenderer posted on website shall form part of tender document.
3. The tender document consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents can be seen and downloaded from website www.tenderwizard.com/IIT or www.iitk.ac.in free of cost.
4. But the tender can only be submitted after uploading the mandatory scanned documents as per list given below.
5. The intending tenderer has to fill all the details such as Banker's name, Demand Draft/Fixed Deposit Receipt /Pay Order/ Banker's Cheque/Bank Guarantee number, amount and date.

The amount of EMD can be paid by multiple Demand Draft / Pay Order / Banker's Cheque / Deposit at call receipt / Fixed Deposit Receipts along with multiple Bank Guarantee of any Scheduled Bank if EMD is also acceptable in the form of Bank Guarantee.

6. Those contractors not registered on the website mentioned above, are required to get registered beforehand. If needed they can be imparted training on online bidding process as per details available on the website.
7. The intending tenderer must have valid class-III digital signature to submit the tender.
8. On opening date, the contractor can login and see the tender opening process. After opening of tenders he will receive the competitor tender sheets.
9. Contractor can upload documents in the form of JPG format and PDF format.
10. Contractor must ensure to quote rate of each item. The column meant for quoting rate in figures appears in pink colour and the moment rate is entered, it turns sky blue.

In addition to this, while selecting any of the cells a warning appears that if any cell is left blank the same shall be treated as "0".

Therefore, if any cell is left blank and no rate is quoted by the tenderer, rate of such item shall be treated as "0" (ZERO).

List of Documents to be scanned and uploaded within the period of tender submission:

- Enlistment Order of the Contractor.
- Certificates of Work Experience and EPF No. & ESI
- Copy of valid electrical licence

• **FORM -6 FOR e-Tendering**

The Executive Engineer, IWD, I.I.T., Kanpur on behalf of Board of Governors of IIT Kanpur invites online item rate tenders from approved and eligible empanelled contractors of IITK for the following works : Different electrical works in NL-I parking area , CL-202A, NL-I-203, ACES-408, CL-105C & D, SL-109, Advance management cell at FB & ACES-408.

- 1.1 The work is estimated to cost **Rs. 2,08,021/-** This estimate, however, is given merely as a rough guide.
- 1.2 The authority competent to approve NIT for the combined cost and belonging to the major discipline will consolidate NITs for calling the tenders. He will also nominate Division which will deal with all matters relating to the invitation of tenders.

2 Criteria of eligibility

The empanelled contractors for Electrical of IIT Kanpur are eligible to submit their tender.

3. Agreement shall be drawn with the successful tenderers on prescribed Form No. CPWD 7 (or other Standard Form as mentioned) which is available as a Govt. of India Publication and also available on website www.iitk.ac.in Tenderers shall quote his rates as per various terms and conditions of the said form which will form part of the agreement.
4. The time allowed for carrying out the work will be **03 Months** from the date of start as defined in schedule 'F' or from the first date of handing over of the site, whichever is later, in accordance with the phasing, if any, indicated in the tender documents.
5. The site for the work is available.*
6. The tender document consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents except Standard General Conditions of Contract Form can be seen on website www.tenderwizard.com/IIT or www.iitk.ac.in other necessary documents also can be seen in the office of the EE , IWD Electrical, IIT, Kanpur between hours of 11:00 AM to 3:30 PM from **28.12.2018 to 11.01.2019** every day except on Sundays and Public Holidays in free of cost.
7. After submission of the tender the contractor can re-submit revised tender any number of times but before last time and date of submission of tender as notified.
8. While submitting the revised tender, contractor can revise the rate of one or more item(s) any number of times (he need not re-enter rate of all the items) but before last time and date of submission of tender as notified.
9. When tenders are invited in three stage system and if it is desired to submit revised financial tender then it shall be mandatory to submit revised financial tender. If not submitted then the tender submitted earlier shall become invalid.
10. Earnest Money can be paid in the form of Treasury Challan or Demand Draft or Pay order or Banker`s Cheque or Deposit at Call Receipt or Fixed Deposit Receipt (drawn in favour of Director, IIT, Kanpur along with Bank Guarantee of any Scheduled Bank wherever applicable.

A part of earnest money is acceptable in the form of bank guarantee also. In such case, 50% of earnest money or Rs. 20 lac, whichever is less, will have to be deposited in shape prescribed above, and balance in shape of Bank Guarantee of any scheduled bank.

- (i) **Cost of Tender Document – Rs. 590/- (Including GST)** drawn in favour of the Director IIT, Kanpur through e payment.
- (ii) **e-Tender Processing Fee – Rs. 885/- (Including GST)** drawn in favour of "ITI Limited" payable at Delhi through e payment.

Treasury Challan or Demand Draft or Pay Order or Banker`s Cheque or Deposit at Call Receipt or FDR or Bank Guarantee against EMD, Cost of Tender Document and Cost of Tender Processing Fee shall be placed in single sealed envelope superscripted as "Earnest Money, Cost of Tender Document and Cost of Tender Processing Fee" with name of work and due date of opening of the tender also mentioned thereon.

Copy of Enlistment Order and certificate of work experience wherever applicable and other documents if required and specified in this bid document shall be scanned and uploaded to the e-Tendering website within the period of tender submission and certified copy of each shall be deposited in a separate envelop marked as "Other Documents".

Both the envelopes shall be placed in another envelope with due mention of Name of work, date & time of opening of tenders and to be submitted in the office of Executive Engineer after last date & time of submission of tender and up to 3:30: PM on **11.01.2019**. The documents submitted shall be opened at 03:30 PM on **14.01.2019**.

Online tender documents submitted by intending tenderers shall be opened only of those tenderers, whose Earnest Money Deposit, Cost of Tender Document and e-Tender Processing Fee and other documents placed in the envelope are found in order.

The tender submitted shall be opened at 03:30 PM on **16.01.2019**.

11. The tender submitted shall become invalid and cost of tender & e-Tender processing fee shall not be refunded if:
- (i) The tenderers is found ineligible.
 - (ii) The tenderers does not upload all the documents as stipulated in the tender document.
 - (iii) If any discrepancy is noticed between the documents as uploaded at the time of submission of tender and hard copies as submitted physically in the office of tender opening authority.
12. The contractor whose tender is accepted will be required to furnish performance guarantee of 5% (Five Percent) of the tendered amount within the period specified in Schedule F. This guarantee shall be in the form of cash (in case guarantee amount is less than ` 10000/-) or Deposit at Call receipt of any scheduled bank/Banker`s cheque of any scheduled bank/Demand Draft of any scheduled bank/Pay order of any Scheduled Bank of any scheduled bank (in case guarantee amount is less than ` 1,00,000/-) or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the prescribed form. **In case the contractor fails to deposit the said performance guarantee within the period as indicated in Schedule 'F', including the extended period if any, the Earnest Money deposited by the contractor shall be forfeited automatically without any notice to the contractor.**
13. Intending Tenderers are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their tenders as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves

obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their tender. A tenderers shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed. The tenderers shall be responsible for arranging and maintaining at his own cost all materials, tools & plants, water, electricity access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a tender by a tenderers implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work and local conditions and other factors having a bearing on the execution of the work.

14. The competent authority on behalf of the Board of Governors, IIT, Kanpur does not bind itself to accept the lowest or any other tender and reserves to itself the authority to reject any or all the tenders received without the assignment of any reason. All tenders in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the tenderers shall be summarily rejected.
15. Canvassing whether directly or indirectly, in connection with tenderers is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable for rejection.
16. The competent authority on behalf of Board of Governors, IIT, Kanpur reserves to himself the right of accepting the whole or any part of the tender and the tenderers shall be bound to perform the same at the rate quoted.
17. The contractor shall not be permitted to tender for works in the IIT Kanpur responsible for award and execution of contracts, in which his near relative is posted a Divisional Accountant or as an officer in any capacity between the grades of Superintending Engineer and Junior Engineer (both inclusive). He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any gazetted officer in the IIT Kanpur. Any breach of this condition by the contractor would render him liable to be removed from the approved list of contractors of this Department.
18. No Engineer of Gazetted Rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the Government of India is allowed to work as a contractor for a period of one year after his retirement from Government service, without the prior permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the tender or engagement in the contractor's service.
19. The tender for the works shall remain open for acceptance for a period of **ninety (90) days** from the date of opening of tenders if any tenderer withdraws his tender before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the tender which are not acceptable to the department, then the Government shall, without prejudice to any other right or remedy, be at liberty to forfeit 50% of the said earnest money as aforesaid. Further the tenderers shall not be allowed to participate in the retendering process of the work.
20. This Notice Inviting Tender shall form a part of the contract document. The successful tenderers/contractor, on acceptance of his tender by the Accepting Authority shall within 15 days from the stipulated date of start of the work, sign the contract consisting of:-
 - a) The Notice Inviting Tender, all the documents including additional conditions, specifications and drawings, if any, forming part of the tender as uploaded at the time of invitation of tender and the rates quoted online at the time of submission of tender and acceptance thereof together with any correspondence leading thereto.

b) Standard C.P.W.D. Form 7 or other Standard C.P.W.D. Form as applicable.

20.1.1 The tender document will include following three components:

Part A:-

CPWD-6, CPWD-7 including schedule A to F for the major component of the work, Standard General Conditions of Contract for CPWD 2014 as amended/modified up to **11.01.2019.**

Part B:-

General/specific conditions, specifications and schedule of quantities applicable to major component of the work.

Part C:-

Schedule A to F for minor component of the work. (SE/EE in charge of major component shall also be competent authority under clause 2 and clause 5 as mentioned in schedule A to F for major components), General/specific conditions, specifications and schedule of quantities applicable to minor component(s) of the work.

- 20.1.2 The tenderers must associate himself, with agencies of the appropriate class eligible to tender for each of the minor component individually.
- 20.1.3 The eligible tenderers shall quote rates for all items of major component as well as for all items of minor components of work.
- 20.1.4 Entire work under the scope of composite tender including major and all minor components shall be executed under one agreement.
- 20.1.5 Security Deposit will be worked out separately for each component corresponding to the estimated cost of the respective component of works. The Earnest Money will become part of the security deposit of the major components of work.
- 21. The EPF & ESI contribution paid to the contract worker shall be reimbursed on actual basis.

**Superintending Engineer
For & on behalf of the Board of Governors, IIT, Kanpur**

ITEM RATE TENDER AND CONTRACT FOR WORK

- | | |
|---|--|
| <p>(A) Tender for the work of:</p> | <p>Different electrical works in NL-I parking area , CL-202A, NL-I-203, ACES-408, CL-105C & D, SL-109, Advance management cell at FB & ACES-408.</p> |
|---|--|

TENDER

I/We have read and examined the Notice Inviting tender, schedule, A,B,C,D,E&F. Specifications applicable, Drawings & Designs, General Rules and Directions, Conditions of Contract, clauses of contract, Special conditions, Schedule of Rate & other documents and rules referred to in the conditions of contract and all other contents in the tender document for the work.

I/We hereby tender for the execution of the work specified for the Board of Governors, IIT, Kanpur within the time specified in Schedule 'F', viz., schedule of quantities and in accordance in all respects with the specifications, designs, drawings and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of contract and with such materials as are provided for, by, and in respects in accordance with, such conditions so far as applicable.

We agree to keep the tender **open for (90) ninety days from the date of opening of tender** and not to make any modifications in its terms and conditions.

A sum of Rs. **4,160/-** is hereby forwarded in Cash/Receipt Treasury Challan/Deposit at call Receipt of a Scheduled Bank/Fixed deposit receipt of scheduled bank/demand draft of a scheduled bank/bank guarantee issued by scheduled bank as earnest money. If I/we, fail to furnish the prescribed performance guarantee or fail to commence the work within prescribed period I/we agree that the said Board of Governors, IIT, Kanpur or his successors in office shall without prejudice to any other right or remedy be at liberty to forfeit the said earnest money absolutely. Further, if I/we fail of commence work as specified, I/we agree that Board of Governors, IIT, Kanpur or his successors in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said earnest money and the performance guarantee absolutely, otherwise the said earnest money shall be retained by him towards security deposit to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to therein and to carry out such deviations as may be ordered, up to maximum of the percentage mentioned in Schedule 'F' and those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 12.2 and 12.3 of the tender form.

Further, I/We agree that in case of forfeiture of earnest money or both Earnest Money & Performance Guarantee as aforesaid, I/We shall be debarred for participation in the re-tendering process of the work.

I/We undertake and confirm that eligible similar work(s) has/ have not been got executed through another contractor on back to back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for tendering in IIT, Kanpur in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee.

I/We hereby declare that I/we shall treat the tender documents drawings and other records connected with the work as secret/confidential documents and shall not communicate information derived therefrom to any person other than a person to whom I/we am/are authorized to communicate the same or use the information in any manner prejudicial to the safety of the State.

Dated _____ ** _____

Witness: **
Address: **
Occupation: **

**
Signature of contractor
Postal Address **

ACCEPTANCE

The above tender (as modified by you as provided in the letters mentioned hereunder) is accepted by me for and on behalf of the Board of Governors, IIT, Kanpur for a sum of Rs. _____ (Rupees _____)

The letters referred to below shall form part of this contract Agreement:-

- a) _____
- b) _____
- c) _____

For & on behalf of the Board of Governors, IIT,
Kanpur

Dated _____

Signature _____
Designation _____

Operative schedules shall be supplied separately to each intending tenderer)

SCHEDULE 'A'

Schedule of Quantities :

SCHEDULE 'B'

Schedule of materials to be issued to the contractor:

S. No.	Description of item	Quantity	Rates in figures & words at which the material will be charged to the contractor	Place of issue
1	2	3	4	5
-----NIL-----				

SCHEDULE 'C'

Schedule of Tools and Plants to be hired to the contractor

S. No.	Description	Hire charges per day	Place of issue
1	2	3	4
-----NIL-----			

SCHEDULE 'D'

Extra schedule for specific requirements/document for the work, if any: **As attached in tender form.**

SCHEDULE 'E'

Schedule of component of other Materials, Labour, POL etc. for price escalation : **N.A.**

SCHEDULE 'F'

Reference to General Conditions of contract.

Name of Work:	Different electrical works in NL-I parking area , CL-202A, NL-I-203, ACES-408, CL-105C & D, SL-109, Advance management cell at FB & ACES-408.		
Estimated cost of the work:	Electrical Items of Work	Rs 2,08,021/-	
Earnest money	Rs. 4,160/-		
Performance Guarantee	5% of the tendered value of the work		
Security Deposit	5% of the tendered value of the work		

General rules and direction:

Definitions:

2(v)	Engineer-in-Charge	
	For Electrical items of work	Executive Engineer, Institute Works Department IIT, Kanpur
2(vi)	Accepting Authority	Superintending Engineer, Institute Works Department IIT, Kanpur
2(vii)	Percentage on cost of materials and labour to cover all overheads and profits	15%
2(viii)	Standard Schedule of Rates:	
	Electrical Items of Work:	D.S.R. 2016 with up to date correction slips
2(ix)	Department:	Central Public Works Department
2(x)	Standard CPWD contract Form:	GCC 2014, CPWD form-7 as modified & corrected up to 11.01.2019 (Whether correction vide latest circulars are incorporated or not in this document).

Clause 1	i)	Time allowed for submission of Performance Guarantee from the date of issue of letter of acceptance	15 Days
	ii)	Maximum allowable extension beyond the period as provided in i) above	7 Days

Clause 2	Authority for fixing Compensation under Clause 2	Superintending Engineer, Institute Works Department IIT, Kanpur. Or successor thereof
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Clause 2 A	Whether Clause 2A shall be applicable	No
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Clause 5	i)	Number of days from the date of issue of letter of acceptance for reckoning date of start	22 Days
	ii)	Time allowed for execution of work	03 (Months)

Authority to decide	Extension of time	Superintending Engineer, Institute Works Department IIT, Kanpur
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Clause 6/ 6A **Only clause 6 applicable.**

Clause 7	Gross work to be done together with net payment/Adjustment of advances for material collected, if any, since the last such payment for being eligible to interim payment		Not applicable
Clause 10A	Material to be provided by the contractor.		Applicable
Clause 10B (ii), (iii)	Whether clause 10-B (ii) and 10-B (iii) shall be applicable.		Not Applicable
Clause 10 C	Component of labour expressed as percentage of value of work		---
Clause 10 CA	Materials covered under this clause.	Nearest material(other than cement, reinforcement bars and structural steel) for which All India Whole sale price Index is to be followed.	Base price of all the materials covered under clause 10 CA
	1. Cement (PPC)	Nil	NIL
	2. Steel	Nil	Nil
Clause 10 CC	Increase/Decrease in Price of materials/wages		Not Applicable
Clause 11	Specification to be followed for execution of work:		
For electrical works	CPWD specifications 2013 internal and 1994 external electrical works		
For Civil items of work	CPWD Specifications 2009 Vol. 1 and Vol. 2 with up to date correction slips.(Hereinafter called CPWD specifications also)		
Clause 12			
12.2 & 12.3	Deviation limit beyond which clause 12.2 & 12.3 shall apply for building work		---
12.5	Deviation limit beyond which clause 12.2 & 12.3 shall apply for foundation work		50%
Clause 16	Competent Authority for Deciding reduced rates:		
	For electrical/civil items of work	Superintending Engineer, Institute Works Department IIT, Kanpur	
Clause 18	List of mandatory machinery, tools & plants to be deployed by the contractor at site.	Ladders, drill machine, crimping tools, chase cutting tools , cable jointing tools, blower	
Clause 36 (i)		Requirement of technical Representative(s)	

For supervision of civil as well as electrical items of work, technical representatives of the respective disciplines will be required to be deployed.

**Clause
42**

- i) a) Schedule/ statement for determining theoretical quantity of cement & bitumen on the basis of Delhi Schedule of Rates 2016 printed by CPWD **D.S.R. 2016(with up to date correction slips)**
- ii) **Variations permissible on theoretical quantities**
 - a) Cement for works with estimated cost put to tender not more than Rs. 5 lakhs. **3% plus/minus**
For works with estimated cost put to Tender is more than Rs. 5 lakhs **2% plus/minus**
 - b) Bitumen all works **2.5% plus only & nil on minus side.**
 - c) Steel reinforcement and structural steel Sections for diameter, section and category. **2% plus/minus.**
 - d) All other materials **Nil**

RECOVERY RATES FOR QUANTITIES BEYOND PERMISSIBLE VARIATION

SI No	Description of items	Rates in figures and words at which recovery shall be made from the contractor	
		Excess beyond permissible variation	Less use beyond the permissible variation
1.	Cement (PPC)	N. A	NIL
2.	Steel reinforcement (TMT Bars)		NIL

SALIENT/MANDATORY REQUIREMENTS FOR THE TENDER

Name of Work: Different electrical works in NL-I parking area , CL-202A, NL-I-203, ACES-408, CL-105C & D, SL-109, Advance management cell at FB & ACES-408.

- 1 The tenderer is advised to read and examine the tender documents for the work and the set of drawings available with Engineer-in-charge. He should inspect and examine the site and its surroundings by himself before submitting his tender.
- 2 Separate schedule of quantity is included in this tender for civil and electrical items of work. If the tenderer wants to offer any unconditional rebates on their rates, the same should also be offered in the respective components of civil and electrical schedule separately. The contractor shall quote the Item rates in figures and words accurately so that there is no discrepancy in rates written in figures and words.
- 3 Time allowed for the execution of work is **03 (Months)**.
- 4 The contractor(s) shall submit a detailed program of execution in accordance with the master programme/milestone within ten days from the date of issue of award letter.
- 5 Contractor has to arrange and install field laboratory during the currency of work and nothing extra will be paid on this account.
- 6 Quality of the project is of utmost importance. This shall be adhered to in accordance with the provisions of CPWD specifications and guidelines given in the relevant paras.
- 7 Contractor has to deploy required Plant and machinery on the project. In case the contractor fails to deploy the plant and machinery whenever required and as per the direction of the Engineer-in-charge, he (Engineer-in-charge) shall be at a liberty to get the same deployed at the risk and cost of the contractor.
- 8 The contractor shall comply with the provisions of the Apprentices Act 1961, and the rules and orders issued there under from time to time. If he fails to do so, his failure will be a breach of the contract and the Superintending Engineer/Executive Engineer may in his discretion, without prejudice to any other right or remedy available in law, cancel the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.
- 9 Temporary Electric connection shall be issued as per request and the water charges shall be recovered as per rule.

PART-B

QUALITY ASSURANCE OF THE WORK

1. The contractor shall ensure quality control measures on different aspects of construction including materials, workmanship and correct construction methodologies to be adopted. He shall have to submit quality assurance programme within two weeks of the award of work. The quality assurance programme should include method statement for various items of work to be executed along with check lists to enforce quality control.
2. The contractor shall get the source of all other materials, not specified else where in the document, approved from the Engineer-in-Charge. The contractor shall stick to the approved source unless it is absolutely unavoidable. Any change shall be done with the prior approval of the Engineer-in-Charge for which tests etc. shall be done by the contractor at his own cost. Similarly, the contractor shall submit brand/ make of various materials not specified in the agreement, to be used for the approval of the Engineer-in-Charge along with samples and once approved, he shall stick to it.

3. Other Laboratories :

1. The contractor shall arrange carrying out of all tests required under the agreement through the laboratory as approved by the Engineer-in-Charge and shall bear all charges in connection therewith including fee for testing. The said cost of tests shall be borne by the contractor/department in the manner indicated below.
 - i) By the contractor, if the results show that the test does not conform to relevant CPWD Specifications / BIS code or specification mentioned elsewhere in the documents
 - ii) By the department, if the results conforms to relevant CPWD Specifications / BIS code or specification mentioned else where in the documents.
2. If the tests, which were to be conducted in the site laboratory are conducted in other laboratories for what ever the reasons, the cost of such tests shall be borne by the contractor.

Sampling of Materials :

1. Sample of building materials fittings and other articles required for execution of work shall be got approved from the Engineer-in-Charge. Articles manufactured by companies of repute and approved by the Engineer-in-Charge shall only be used. Articles bearing BIS certification mark shall be used in case the above are not available, the quality of samples brought by the contractor shall be judged by standards laid down in the relevant BIS specifications. All materials and articles brought by the contractor to the site for use shall conform to the samples approved by the Engineer-in-Charge which shall be preserved till the completion of the work.
2. The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material/work beyond set out tolerance limit shall be summarily rejected by the Engineer-in-Charge.
3. BIS marked materials except otherwise specified shall be subjected to quality test at the discretion of the Engineer-in-Charge besides testing of other materials as per the specifications described for the item/materials. Wherever BIS marked materials are brought to the site of work, the contractor shall if required, by the Engineer-in-Charge furnish manufacturers test certificate or test certificate from approved testing laboratory to establish that the material produced by the contractor for incorporation in the work satisfies the provisions of BIS codes relevant to the material and/or the work done.
4. The contractor shall procure all the materials at least in advance so that there is sufficient time to testing and approving of the materials and clearance of the same before use in work.

5. All materials brought by the contractor for use in the work shall be got checked from the Engineer-in-Charge or his authorised representative of the work on receipt of the same at site before use.
6. The contractor shall be fully responsible for the safe custody of the materials issued to him even if the materials are in double lock and key system.

ADDITIONAL TERMS AND CONDITIONS

1. Unless otherwise provided in the Schedule of Quantities/Specifications, the rates tendered by the contractor shall be all inclusive and shall apply to all heights, lifts, leads and depths of the work and nothing extra shall be payable to him on account of the same. Extra payment for centering/shuttering, if required to be done for heights greater than 3.5 m shall however be admissible at the rates arrived at in accordance with clause 12 of the agreement, if not already specified.
2. Other agencies doing works related with this project may also simultaneously execute their works and the contractor shall afford necessary facilities for the same. The contractor shall leave such necessary holes, openings etc. for laying/burying in the work, pipes cables, conduits, clamps, boxes and hooks for fan clamps etc. as may be required for the other agencies. Nothing extra over the Agreement rates shall be paid for doing these.
3. Some restrictions may be imposed by the security staff etc. on the working and for movement of labour, materials etc. The contractor shall be bound to follow all such restrictions/instructions and nothing extra shall be payable on account of the same.
4. The contractor shall fully comply with all legal orders and directions of the Public or local authorities or municipality and abide by their rules and regulations and pay all fees and charges for which he may be liable in this regard. Nothing extra shall be paid/reimbursed for the same.
5. The building work shall be carried out in the manner complying in all respects with the requirements of the relevant bylaws and regulations of the local body under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-charge and nothing extra shall be paid on this account.
6. If as per local Municipal regulations, huts for labour are not to be erected at the site of work, the contractor shall be required to provide such accommodation at a place as is acceptable to the local body and nothing extra shall be paid on this account.
7. The structural and architectural drawings shall at all times be properly co-related before executing any work. However, in case of any discrepancy in the item given in the schedule of quantities appended with the tender and Architectural drawings relating to the relevant item, the former shall prevail unless otherwise given in writing by the Engineer-in-charge.
8. For the purpose of recording measurements and preparing running account bills, the abbreviated nomenclature indicated in the publications Abbreviated Nomenclature of Items of DSR 2016 shall be accepted. The abbreviated nomenclature shall be taken to cover all the materials and operations as per the complete nomenclature of the relevant items in the agreement and relevant specifications.
9. In case of items for which abbreviated nomenclature is not available in the aforesaid publication and also in case of extra and substituted items for which abbreviated nomenclature are not provided for in the agreement, full nomenclature of item shall be reproduced in the measurement books and bill forms for running account bills.
10. For the final bill, however, full nomenclature of all the items shall be adopted in preparing abstract in the measurement books and in the bill forms.
11. The contractor shall take instructions from the Engineer-in-charge for stacking of materials. No excavated earth or building materials etc. shall be stacked/collected in areas where other buildings, roads, services, compound walls etc. are to be constructed.
12. Any trenching and digging for laying sewer lines/water lines/cables etc. shall be commenced by the contractor only when all men, machinery's and materials have been

arranged and closing of the trench(s) thereafter shall be ensured within the least possible time.

13. It shall be ensured by the contractor that no electric live wire is left exposed or unattended to avoid any accidents in this regard.
14. In case the supply of timber/steel frames/shutters for doors, windows etc. is made by some other agency, the contractor shall make necessary arrangements for their safe custody on the direction of the Engineer-in-charge till the same are fixed in position by him & nothing extra shall be paid on this account.
15. The contractor shall maintain in perfect condition, all portions executed till completion of the entire work allotted to him. Where however phased delivery of work is contemplated these provisions shall apply separately to each phase.
16. The entire royalty at the prevalent rates shall have to be paid by the contractor on all the boulders, metals, shingle sand etc. collected by him for execution of the work, directly to the Revenue authority or authorized agents of the State Government concerned or the Central Government, as the case may be.
17. The contractor shall bear all incidental charges for cartage, storage and safe custody of materials issued by the departments and shall construct suitable godowns, yards at the site of work for storing all materials as to be safe against damage by sun, rain, dampness, fire, theft etc. at his own cost and also employ necessary watch and ward establishment for the purpose, at his own cost. Materials to be charged directly to work and stipulated for issue free of cost shall also be issued to the contractor as soon as those are received at site or at the stipulated place of issue. The provision of this para shall apply equally and fully to those as well.
18. All materials obtained from the Institute Works Department store or otherwise on receipt shall be got checked by the Engineer-in-charge of the work or his representations before use.
19. Registers for the materials to be issued by the department shall be maintained as required by the Engineer-in-charge and these shall be signed by the contractor or his authorized agent and representative of Engineer-in-charge on each day of transactions.

Special condition for Safety at the Work Site

The contractor will identify one of the supervisors for taking care of implementation of Safety systems.

The Contractor should follow the following General Guidelines governing the safety rules as laid down under:

1. Smoking is strictly prohibited at workplace.
2. Nobody is allowed to work without wearing safety helmet. Chinstrap of safety helmet shall be always on. Drivers, helpers and operators are no exception.
3. No one is allowed to work at or more than three meters height without wearing safety belt and anchoring the lanyard of safety belt to firm support preferably at shoulder level.
4. No one is allowed to work without adequate foot protection.
5. Usage of eye protection equipment shall be ensured when workmen are engaged for grinding, chipping, welding and gas-cutting. For other jobs as and when site safety co-ordinator insists eye protection has to be provided.
6. All safety appliances like Safety shoes, Safety gloves, Safety helmet, Safety belt, Safety goggles etc. shall be arranged before starting the job.
7. All excavated pits shall be barricaded & barricading to be maintained till the backfilling is done. Safe approach to be ensured into every excavation.
8. Adequate illumination at workplace shall be ensured before starting the job at night.
9. All the dangerous moving parts of the portable / fixed machinery being used shall be adequately guarded.
10. Ladders being used at site shall be adequately secured at bottom and top. Ladders shall not be used as work platforms.
11. Material shall not be thrown from the height. If required, the area shall be barricaded and one person shall be posted outside the barricading for preventing the tre-passers from entering the area.
12. Other than electricians no one is allowed to carry out electrical connections, repairs on electrical equipment or other jobs related thereto.
13. All electrical connections shall be made using 3 or 5 core cables, having a earth wire.
14. Inserting of bare wires for tapping the power from electrical sockets is completely prohibited.

15. A tools and tackles inspection register must be maintained and updated regularly.
16. Debris, scrap and other materials to be cleared from time to time from the workplace and at the time of closing of work everyday.
17. All the unsafe conditions, unsafe acts identified by contractors, reported by site supervisors and / or safety personnel to be corrected on priority basis.
18. No children shall be allowed to enter the workplace.
19. All the lifting tools and tackles shall be stored properly when not in use.
20. Clamps shall be used on Return cables to ensure proper earthing for welding works.
21. Return cables shall be used for earthing.
22. All the pressure gauges used in gas cutting apparatus shall be in good working condition.
23. Proper eye washing facilities shall be made in areas where chemicals are handled.
24. Connectors and hose clamps are used for making welding hose connections.
25. All underground cables for supplying construction power shall be routed using conduit pipes.
26. Spill trays shall be used to contain the oil spills while transferring / storing them.
27. Tapping of power by cutting electric cables in between must be avoided. Proper junction boxes must be used.

(Rajeev Garg)
Superintending Engineer

SPECIAL TERMS & CONDITIONS

1. In the Contract (as hereinafter defined) the following definitions words and expressions shall have the meaning hereby assigned to them except where the context otherwise required.
 - i) Institute shall mean the Indian Institute of Technology (IIT), Kanpur
 - ii) The President shall mean the Board of Governor, IIT Kanpur.
 - iii) The Engineers In-charge, who shall administer the work jointly, shall mean the Executive Engineer (Electrical) for electrical works.
 - iv) Government or Govt. of India shall mean the Indian Institute of Technology represented by its Director.
 - v) The term Director General of Works shall mean the Chairman, Building & Works Committee of the Institute.
 - vi) Accepting authority shall mean the Director, IIT Kanpur or his authorized representative.
 - vii) Superintending Engineer shall mean the Superintending Engineer of the Institute, who as overall In-charge and head of the Institute Works Department, shall direct the contract.
 - viii) Site Engineers shall mean the Assistant Engineer & Jr. Engineer (Electrical) for Electrical & Air-conditioning works, appointed by the Institute Works Department.

2. **Duties & Powers :**
 - i) Site Engineers :

The duties of the Site Engineer(s) are to watch and supervise the works and the workmanship employed in connection with the works, and to test and examine any materials to be used. He shall have no authority to relieve the contractor of any of his duties or obligations under the contract nor, except as expressly provided here under, to order any work involving delay or any extra payment by the Institute, nor to make any variation in the works.

The Engineer-in-charge, from time to time in writing, delegate to the Site Engineer (s) any of the powers and authorities vested in them. Any written instruction or written approval given by the Site Engineer (s) to the contractor within the terms of such delegation (but not otherwise) shall bind the contractor and the Institute as though it had been given by the Engineer-in-charge / Architect provided always as follows :

 - a) Failure of the Site Engineer (s) to disapprove any work or materials shall not prejudice the power of the Engineer In-charge / Architect to subsequently disapprove such work or materials and to order the pulling down, removal or breaking up thereof.
 - b) If the contractor is dissatisfied by reason of any decision of the Site Engineer (s), he shall be entitled to refer the matter to the Engineer-in-charge / Architect, who shall thereupon confirm reverse or vary such decision.

3. The scope of contract comprises the construction, completion and maintenance of the works for (12) months after the completion and the provision of all labour, materials, construction of plant

equipment and transpiration, temporary works and everything, whether of temporary or permanent nature required in and for such construction, completion and maintenance so far as the necessity for providing the same is specified in or reasonably be inferred from the contract. The contractors shall make his own arrangements for the store storage of materials, accommodation for his staff etc. and no claim for the temporary accommodation from the contractor shall be entertained.

The contractor shall carry out and complete the said work in every respect in accordance with this contract and as per the directions and to the satisfaction of the Engineer-in-charge/Architect. Issue of further drawings and /or written instructions, detailed directions and explanations which are hereinafter collectively referred to as instructions of the engineer-in-charge/ Architect's in regards 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 materials brought thereon by the contractor and the substitution of any other material thereof.
- d. The dismissal from the works of any persons employed thereupon.
- e. The opening up for inspection of any work covered up.
- f. The amending /making good of any defects.

The contractor shall forthwith comply with and duly execute any instructions of work comprised in such engineers-in-charge instructions, provided always that the verbal instructions and explanations given to the contractor or his representative upon the works shall, if involving a variation , be confirmed in writing by the contractor within seven days and is not dissented in writing within a further seven days by the Engineer-In-Charge/Architect, such shall be deemed to be instructions of the Engineer-In-charge/Architect within the scope of the contract.

4. **Contract Document:**

- 4.1 The several documents, forming the contract, are to be taken as mutually explanatory of one another and in case of ambiguities or discrepancies the same shall be explained and adjusted by the Engineer-In-Charge who shall thereupon issue to the contractor its interpretation directing in what manner the work is to be carried out. In case the contractor feels aggrieved by the interpretation of the Institute then the matter shall be referred to the Superintending Engineer and his decision shall be final, conclusive and bind on both parties.
- 4.2 The drawings etc. shall remain in the custody of the Institute. Two complete sets of drawings, specification and bill of quantities shall be furnished by the Engineer-In-Charge to the contractor in such time which must not delay the progress of the construction and the Institute shall furnish copies of any additional drawings, which in their opinion may be necessary for the execution of any part of the work. One complete set shall be kept on the work site and the Engineer-In-Charge and his representatives shall be, at all reasonable times, have access to the same. The contractor shall study the drawings thoroughly before the commencement of work. In case of any discrepancy, the contractor shall seek clarification before proceeding with the works. Figured dimensions are in all case to be accepted in preference to the scaled sizes. Large scale details shall taken preference over small scale one.

The contractor shall give adequate notice in writing to the Engineer-in-charge of any further drawings or specification that may be required for the execution of the works or otherwise under the contract.

The Engineer-in-charge shall have full powers and authority to supply the contractor from time to time during the progress of the work such drawings and instructions as shall be necessary for proper execution and the contractor shall carry out and be bound by the same.

- 4.3 The successful tenderer shall be required to enter into an agreement with the Institute. The Bill of Quantities & rates filled by the successful tenderer in, the General Condition of the Contract for CPWD works 2014, CPWD specifications for Civil, Electrical & Air-conditioning works, the special conditions, additional specifications, negotiation letter and the award letter etc. shall form part of the agreement to be signed by the successful tenderer. The cost of stamp paper and stamp duty, required for the agreement, shall be borne by the contractor.

5. Contract Agreement:

The contractor shall, when called upon to do so, enter into and execute a contract agreement in the form annexed as annexure 'A' with such modifications as may be necessary. The contract agreement, inclusive of its enclosures, shall remain in the custody of the Superintending Engineer, Institute Works Department, IIT Kanpur and the made available him as and when required contractor shall however be supplied, an attested copy there free of cost.

6. All tenders are required to deposit earnest money in the form of FDR/CDR in the only duly endorsed in favour of Director, IIT Kanpur. Earnest money should be enclosed in a separate sealed envelope and tender documents should be enclosed in a another envelope superscribed “**EARNEST MONEY- NAME OF WORK “ ITEM RATE-TENDER-NAME OF WORK”**” on the top of envelope. At the time of opening of tender earnest money envelope will be opened first and in case earnest money is not found in the requisite form or amount envelope containing item rate tender of the party concerned shall be opened and will be summarily rejected and documents submitted will be confiscated by the Institute.
7. Canvassing in connection with tenders is prohibited and the tenders, submitted by the tenderers who resort to canvassing, are liable for rejection.
8. Tenderers shall have to sign the attached declaration (Appendix B) and if the declaration is not found to represent a true statement of facts the contract is liable to be cancelled, earnest money forfeited and the contractor shall have no claim on the Institute.
9. Tenderes are not allow to make additions and alterations in the tender document. Any additions and alternations, if incorporated in the tender, shall be at the tender's risk since the modified tender is liable for rejection.

Conditional tenders violative of the sprit and the scope or the terms & conditions of the tender, are liable to be rejected without assigning any reasons. Tenders with any form of rebate shall be rejected summarily.

10. Water and electricity required for electrical & air-conditioning works shall be supplied free of charge.

11. Stamps duty on the security money shall also be the born by contractor as per prevailing notification of U.P Govt.

12. Conditions for Electrical and Air-conditioning Works:-

- i. All chase cuttings in the wall, for recessed conduits & boxes and drilling the holes shall be done with power operated machines only. No chase shall be allowed to be cut manually with the use of hammer & chisel.
- ii. All cuttings in cement plaster and brick shall be made good by using cement mortar 1:3 (1 part cement, 3 part coarse sand)
- iii. The cut surfaces shall be repaired by an experienced mason only so as to match the repaired plaster with the original.
- iv. All such repaired surfaces shall be cured for 3 to 4 days to keep the surfaces wet, using water spray machine (hand/motor operated) and avoid unnecessary flooding of the area.

13. Payment shall be regulated as under

- a.) 75% of the tendered rate on receipt of materials at site.
- b.) 15% of the tendered rate on installation and connection.
- c.) 10% of the tendered rate on testing and commissioning.

14. Drawings/Data required prior to commencement of electrical/air-conditioning works:-

14.1 The following drawings shall be provided by the Architect/Engineer-In-Charge of the work:-

1. Conduit layout for lights, fans, socket outlets, telephone outlets, network & fire alarm system and sub mains showing size of conduits, no. of wires and size of wires in each run, location and size of accessories like junction boxes, ceiling boxes for hooks, draw boxes and switch boxed etc.
2. Cable routing drawings showing details of size, type and no. of cables and mode of installation.
3. Ducting /chilled water pipe line/drain pipe etc., drawing showing details of size, type and mode of installation.

14.2 Following drawings shall be furnished by the contractor for the approval of the Engineer-In-charge.

- a. G.A and schematic drawings of MV switchgear/distribution /Plant/AHU/ FCU/Fire Alarm panel showing material and size of sheet steel/bus bars / inter connections and make and ratings of switchgear i/c details of protection, metering, indicating and inter lock etc.
- b. Ducting /chilled water pipe line/drain pipe etc., drawing showing details of size, type and mode of installation.

15. **Completion drawings:**

On completion of works and before issuance of completion certificate, the contractor submit completion drawings in the form of three complete set of originals (reproducible) .

- i) As built GA and schematic drawings of MV panels, distributions boards, fire alarm panels, Plant, AHU & FCU etc. showing material and size of sheet steel/bus bars/ connections and make and rating of switchgear i/c details of protection, meter indicating and interlocks etc.
- ii) Technical literature, test certificates and operation and maintenance manuals required.

16. **Works Inspection and Testing of Equipment:**

Prior to dispatch of equipment the Institute reserves the right to inspect the same at the manufacturer's works and the contractor shall provide and secure every reasonable access and facility at the manufacturers works for inspection, for witness of all acceptance and routine tests as per relevant Indian Standards. Contractor shall give a reasonable notice of about 15 days for the purpose of test, and witness of all major equipments.

- a.) Pre-commissioning test: All routine tests shall be carried out on the electrical & air-conditioning equipment. Protective & measuring devices should be checked for calibration of Plant AHU & FCU's should be checked for air quantities. All grills/diffusers should be checked for balanced air quantities.

17. **Rates:** The work shall be treated as on works contract basis and the rates tendered shall be for complete item of work and all charges for items contingent to the work, such as packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor, watch and ward of all materials at the site, labour related expenses as per relevant labour laws, testing of materials/ samples etc excluding Goods and Service Tax (GST).

18. **Taxes & Duties:**

21.1 Being an indivisible works contract, no other tax is payable other than GST. The GST shall be as applicable to IIT Kanpur as per Government rules.

19. The earnest money of the unsuccessful tenderers shall be refunded on written request, within 1(one) month of the award of work. The earnest money of the successful tenderer shall however be adjusted towards the security deposit.
20. The tender document & drawings in respect of the work can be seen in the o/o Executive Engineer (Electrical).
21. The tender document contains _____ pages. No page of the tender document shall be removed, mutilated, detached or cancelled.
22. Rates for finished works shall be given for each items separately, both in words & figures. In the event of non compliance the tender shall be deemed incomplete and liable for rejection.
23. All entries by the tenderer should be made in one ink and one hand writing only. Tenders should be filled in legible hand writing and should not contain erasures, corrections and overwriting as far as possible. However if it becomes necessary, each correction etc. should be properly attested under dated signature.
24. The work shall be executed on the basis of the following CPWD specifications:
 - i) Electrical Works :
 - General specifications for Electrical Works Part-1 (Internal) 2014 with up to date corrections.
 - General specifications for electrical works (external) 1994 with upto date corrections.
 - General specifications for electrical works Part-VII (DG set) 2014 with upto date corrections.

- General specifications for electrical works Part-IV Sub-station- 2014 with upto date corrections.
 - General specifications of HVAC works 2004 with upto date corrections.
25. For the purpose of clause 12 of the General conditions of contract the following schedule of rates shall be applicable.
 - i) Electrical Works: Based upon prevailing market rates.
 26. The special conditions listed above shall take precedence over all above provisions of the contract. The General Condition of contract for CPWD works shall be generally followed including the clause 21 i.e. work shall not be sublet.
 27. The contractor shall have to execute the work in such place and condition where other agencies will also be engaged for other works such as site grading, filling and leveling, interiors, landscape, and electrical and mechanical engineering works, etc. No claim shall be entertained due to work being executed in the above circumstances.
 28. No contractor, to whom the provisions of the BOCW Act apply, shall be allowed to commence work on the campus unless he has produced the 'Registration Certificate' issued by the office of Dy. CLC (Central).
 29. The contractor shall engage only such workers who are registered as beneficiaries with U.P. BOCW Welfare Board and in case of engagement of new workers, he shall ensure the submission of applications for registration of such workmen within appropriate time.
 30. A certificate for administrative convenience shall be obtained from the contractor covered under BOCW Act whether he has engaged 10 or more workmen while working in the Institute and only thereafter, Cess @1% from the bills raised by him shall be deducted at source for all running works. Cess, so deducted shall be deposited with the BOCW Welfare Board.
 31. As per clause 36 (I) of GCC : It should be noted that license wire man shall only be allowed for the wiring work.

INDIAN INSTITUTE OF TECHNOLOGY - KANPUR
ADDITIONAL SPECIFICATIONS FOR ELECTRICAL WORKS
MEDIUM VOLTAGE SWITCHGEAR

1. STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Low voltage Switchgear and Controlgear specifications IS 13947 : 1993

Part I – General

Part 2 – Circuit Breakers

Part 3 – Switch Fuse Units

Part 4 – Contactors and Motor Starters

Part 5 – Control Circuit Devices

Electrical Relays for power system protection IS 3231 : 1986

Low voltage Switchgear and Controlgear assemblies IS 8623 : 1993

Marking of Switchgear busbars IS 11353 : 1985

Degree of Protection of Enclosures for low voltage switchgear IS 2147 : 1962

Code of Practice for selection, installation and maintenance of Switchgear IS 10118 : 1982

2. SWITCH FUSE UNITS

2.1 Switch fuse units, incorporated in switchboards wherever required shall conform in all respects to IS 13947 : 1993. Switch fuse units shall be suitable for 415 Volts 3 Phase 50 HZ AC supply and shall be suitable for AC - 23 A duty.

Unit housing shall be of robust construction designed to withstand arduous conditions. Sheet steel used shall be given rigorous rust proofing treatment before fabrication and painting Units shall have double break per phase in order to isolate fuse links when the switch is in OFF position.

Operating mechanism of units shall be crisp and positive in action with quick- make and quick-break silver plated contacts. Operating handle shall be suitable for rotary operation unless otherwise specified. Position of handle such as ON and OFF shall be clearly indicated.

All live parts inside the switch fuse units shall be shrouded to prevent any accidental contact.

All the terminals shall be liberally designed. All units above 100 A shall be provided with integral cable sockets.

All switch units shall be provided with suitable interlocks such that the door of the switchboard panel shall not open unless the switch is in OFF position. Provision for padlocking the switch in OFF position shall also be provided.

Routine and type tests as per IS 13947 : 1993 shall be conducted at works and test certificates furnished.

3. MOULDED CASE CIRCUIT BREAKERS

- i) Moulded case circuit breakers (MCCB) or fuse free breakers, incorporated in switchboards wherever required, shall conform to IS 13947 : 1993 in all respects. MCCBs shall be suitable either for single phase 240 Volts or 3 Phase 415 Volts AC 50 HZ supply.
- ii) MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIPPED indicators. Three phase MCCBs shall have a common handle for simultaneous operation and tripping of all the three phases. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermal/magnetic type provided on each pole and connected by a common tripe bar such that tripping of any one pole causes three poles to open simultaneously. Thermal/magnetic tripping device shall have IDMT characteristics for sustained over loads and short circuits.
- iii) Contact trips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances.
- iv) MCCBs shall be provided with following accessories, if specified in drawings/schedule of quantities :
 - Under voltage trip
 - Shunt trip
 - Alarm switch
 - Auxiliary switch

MCCBs shall be provided with following interlocking devices for interlocking the door a switch board.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent door being opened when the breaker is in ON position
- Deinterlocking device to open the door even if the breaker is in ON position.

MCCBs shall have rupturing capacity as specified in drawings/schedule of quantities.

4. METERING, INSTRUMENTATION AND PROTECTION.

The switchboard shall have required current and potential transformers as per schedule of quantities for metering and protection. The transformers shall comply to relevant ISS and class of accuracy required for metering and protection. Separate sets of CTs shall be provided for metering and protection.

4.1 Current Transformers

C/Ts shall conform to IS 2705 (part -I, II and III) in all respects. All C/Ts used for medium voltage application shall be rated for 1 kV. C/Ts shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 to 1 and for protection class SP 10. C/Ts shall be capable of withstanding magnetic and thermal stresses due to short circuit faults of 31 MVA on medium voltage. Terminals of C/Ts shall be paired permanently for easy identification of poles. C/Ts shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each C/T shall be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

4.2 Potential Transformer

PTs shall conform to IS 3156 (Part-I,II and III) in all respects.

4.3 Measuring Instruments

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -10° C and $+50^{\circ}$ C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from out side. Direction of deflection shall be from left to right. Suitable selector switches shall be provided for ammeters and volt meters used in three phase system. The rating type and quantity of meters, instruments and protective device shall be as per Schedule of Quantities /drawings

4.3.1 Ammeters

Ammeters shall be of moving iron type. Moving part assembly shall be with jewel bearings. Jewel bearings shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. Ammeters shall be manufacture and calibrated as per IS 1248

Ammeters shall normally be suitable for 5 A secondary of current transformers.

Ammeters shall be capable of carrying substantial over loads during fault conditions.

4.3.2 Voltmeters

Voltmeters shall be moving iron type range of 3 phase 415 volt voltmeters shall be 0-500. Volt meters shall be provided with protection fuse.

4.3.3 Watt meter

Wattmeter shall be of 3 phase electro dynamic type and shall be provided with a maximum demand indicator if required.

4.3.4 Power factor meters

3 phase power factor meters shall be of electro dynamic type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% readings. Phase angle accuracy shall be $\pm 4^{\circ}$.

4.3.5 Energy and reactive power meters

Trivector meters shall be two element, integrating type, KWH, KVA, KVARH meters. Meters shall conform to IEC 170 in all respects. Energy meters, KVA, and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy consumption of 500 hours corresponding to maximum current at rated voltage and unity power factor. Meters shall be suitable for operation with current and potential transformers available in the panel.

4.4 Relays

Protection relays shall be provided with flag type indicators to indicate cause of tripping. Flag indicators shall remain in position till they are reset by hand reset. Relays shall be designed to make or break the normal circuit current with which they are associated. Relay contacts shall be of silver or platinum alloy and shall be designed to withstand repeated operation without damage. Relays shall be of draw out type to facilitate testing and maintenance. Draw out case shall be dust tight. Relays shall be capable of disconnecting faulty section of network without causing interruption to remaining sections. Analysis of setting shall be made considering relay errors, pickup and overshoot errors and shall be submitted to Engineer in charge for approval.

4.4.1 Over current relays

Over current relays shall be induction type with inverse definite minimum time lag characteristics. Relays shall be provided with adjustable current and time settings. Setting for current shall be 50 to 200 % instead of 25%. The IDMT relay shall have time lag (delay) of 0 to 3 seconds. The time setting multiplier shall be adjustable from 0.1 to unity. Over current relays shall be fitted with suitable tripping device with trip coil being suitable for operation on 5 Amps.

4.4.2 Earth fault relay

Same as over current relay excepting the current setting shall be 10% to 40% in steps of 10%.

4.4.3 Under voltage relay

Under voltage relays shall be of induction type and shall have inverse limit operation characteristics with pickup voltage range of 50 to 90% of the rated voltage.

4.5 Power factor correction capacitors

Power factor correction capacitors shall conform to IS 2834 in all respects. Approval of insurance association of India shall be obtained if called for. Capacitors shall be suitable for 3 phase 415 volts 50 HZ supply and shall be available in single and three phase units of 5,10,15,20,25 and 50 kVAR sizes as per requirements. Capacitor shall be usable for indoor use, permissible overloads being as below.

- Voltage overloads shall be 10% for continuous operation and 15% for six hours in a 24 hours cycle.
- Current overloads shall be 15 % for continuous operations and 50% for six hours in a 24 hours cycle.
- Over load of 30% continuously and 45% for six hours in a 24 hours cycle.

Capacitors shall be hermetically sealed in sturdy corrosion proof sheet steel containers and impregnated with non inflammable synthetic liquid. Every element of each capacitory unit shall be provided with its own built in silvered fuse. Capacitors shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 volts or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnates. The capacitors shall withstand power frequency test voltage of 2500 volts AC for one minute. Insulation resistance between capacitors terminals and containers when a test voltage of 500 volts DC is applied shall not be less than 50 meg.ohms.

5.0 MEDIUM VOLTAGE SWITCH BOARDS

5.1 GENERAL

- All medium voltage switchboards shall be suitable for operation at three phase/three phase 4 wire, 415 volt, 50 Hz, neutral grounded at transformer system with a short circuit level withstand of 31 MVA at 415 volts or as per schedule of quantities.
- The Switch Boards shall comply with the latest edition with upto date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

5.2 SWITCH BOARD CONFIGURATION

- The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipment as called for in the Schedule of Quantities.
- The MCCB's shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.
- The Switch Boards shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear.

5.3 EQUIPMENT SPECIFICATIONS

All equipment used to configure the Switch Board shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and to the detailed technical Specifications as included in this tender document.

5.4 CONSTRUCTIONAL FEATURES

- The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.
- The Switch Boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.
- The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.
- All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.
- Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switch Boards.

5.5 SWITCHBOARD DIMENSIONAL LIMITATIONS

- A base channel 75 mm x 5 mm thick shall be provided at the bottom.
- A minimum of 200 mm blank space between the floor of switch board and bottom most unit shall be provided.
- The overall height of the Switch Board shall be limited to 2300 mm
- The height of the operating handle, push buttons etc shall be restricted between 300 mm and 1800 mm from finished floor level.

5.6 SWITCH BOARD COMPARTMENTALIZATION

The Switch Board shall be divided into distinct separate compartments comprising

- A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical busbars.

- Each circuit breaker, and MCCB shall be housed in separate compartments enclosed on all sides.
 - Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker/switch fuse unit in "on" and "off" position.
 - For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors 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, busbars and connections.
 - A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
 - Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.
 - Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top.
 - Adequate and proper support shall be provided in cable compartments to support cables.
- Following minimum clearances to be maintained after taking into consideration connecting bolts, clamps etc.

i)	Between phases	32 mm
ii)	Between phases and neutral	26 mm
iii)	Between phases and earth	26 mm
vi)	Between neutral and earth	26 mm

5.7 SWITCH BOARD BUS BARS

- The Bus Bar and interconnections shall be of electrolytic Copper/Aluminium and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. The maximum current density for copper shall be 1.2 amps per sq. mm. and for Aluminium shall be 0.8 amp per Sq. mm. and suitable to withstand the stresses of a 31 MVA fault level or at 415 volts for 1 second or as per schedule of quantities. .
- The bus bars and interconnections shall be insulated with insulation tape/ fiber glass.
- The bus bars shall be extensible on either side of the Switch Board.
- The bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.
- All bus bars shall be colour coded.
- All bus bar connections in Switch Boards shall be bolted with brass bolts, washers and nuts.

5.8 SWITCH BOARD INTERCONNECTIONS

- All connections between the bus bars/Breakers/ shall be through solid copper strips of adequate size to carry full rated current and PVC/fibre glass insulated.

5.9 DRAW-OUT FEATURES

Air Circuit Breakers shall be provided in fully drawout cubicles. These cubicles shall be such that drawout is possible without disconnection of the wires and cables. The power and control circuits shall have self aligning and self isolating contacts. The fixed and moving contacts shall be easily accessible for operation and maintenance. Mechanical interlocks shall be provided on the drawout cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

5.10 INSTRUMENT ACCOMMODATION

- Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and

the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switch Board.

- For MCCB's instruments and indicating lamps can be provided on the compartment doors.
- The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.

5.11 WIRING

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq. mm.

5.12 CABLE TERMINATIONS

- The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear of the panel.
- The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.
- The Switch Boards shall be complete with gland plates

5.13 SPACE HEATERS

The Switch Board shall have in each panel thermostatically controlled space heaters with a controlling 15 amp 230 volt switch socket outlet to eliminate condensation.

5.14 EARTHING

A main earth bar of G.I shall be provided throughout the full length of the Switch Board with a provision to make connections to earth stations on both sides.

5.15 SHEET STEEL TREATMENT AND PAINTING

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process or by using sand blasting method. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall be adequate.

5.16 NAME PLATES AND LABELS

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

6. INSTALLATION

The foundations prepared as per the manufacturers drawings shall be levelled, checked for accuracy and the Switch Board installed. All bus bar connections shall be checked with a feeler gauge after installation. The cable end boxes shall be sealed to prevent entry of moisture. The main earth bar shall be connected to the sub-station earths.

A 15 mm thick rubber matting of approved make on a 100 mm high timber platform shall be provided in front of and along the full length of the Switch Board. The width of the matting shall be 1000 mm. The rubber mat shall withstand 15 KV for 1 minute and leakage current shall not exceed 160 mA/sq. metre.

After installation the Switch Board shall be tested as required prior to commissioning.

7. OUTDOOR TYPE DISTRIBUTION FEEDER PILLARS

The feeder pillar shall be of the floor mounting type, totally enclosed, and weather proof, conforming to ISI IP 54 incorporating phenolic moulded fuse fittings with high rupturing capacity cartridge fuse links having a certified rupturing capacity of not less than 35 MVA at 433 volts. The feeder pillar shall be suitable for 440 volts 3 phase 4 wires, 50 cycles AC supply.

The cubicle should be fabricated out of heavy gauge sheet steel of thickness not less than 2 mm thick with suitable side frame and stiffeners. Hinged doors of not less than 1.6 mm thick should be provided at the front and rear of the cubicle to provide access for installation, operation, tests and inspection. The rear door is provided to facilitate cable termination and the front door for inspection of fuses, to switch 'ON' and 'OFF' the switch as and when required. All doors should be fitted with dust excluding neoprene gaskets. The doors should also be fitted with suitable locking arrangement with lock to prevent unauthorized opening. The cubicle should be designed for mounting over cement concrete plinths by the roadside, and should be of substantial construction capable of withstanding the vibrations normally experienced due to vehicular traffic. The top of the feeder pillar is of slanting construction in all directions to prevent any collection of water due to rain. A gland plate is provided at the bottom of the feeder pillar (removable) for mounting the cable glands. The feeder pillar shall be fitted on an angle iron pedestal at the bottom covered with sheet metal from all the four sides which facilitates cable bending etc specially with aluminium cables. Two lifting hooks shall be provided at the top. A door switch shall be provided in the feeder pillar so as to switch 'ON' and 'OFF' the lamp fixed in the brass batten holder below the top sheet of the pillar.

The sheet steel materials used in the construction of the cubicle should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulfuric acid solution and recognised phosphating process. After metal treatment, the interior of the cubicle should be painted with two coats of air-drying red lead primer followed by two coats of air drying anti-condensation paint. The exterior of the cubicle should be painted with two coats of staving red oxide primer followed by one coats of epoxy finishing paint. One final spray of epoxy paint shall be applied at the time of handing over the installation.

All the nuts, bolts shall be cadmium plated with spring washers. A minimum spacing from cable connection to the bottom of gland plate shall be 300mm.

The bus bars should be of electrical grade copper. They should be air insulated with adequate clearances between conductors and between conductors and earth. These should be colour coded to enable immediate identification of the phases and neutral. The current density for bus bars shall not be more than 1.0 amps per square mm. All bus bar joints and tapings should be of the clamped type as far as possible thereby avoiding drilling of holes on bus bars. The bus bars should be carried on supports made out of a suitable non-inflammable and non-hygroscopic material such as Hylam, Permali or Formics. Suitable insulating phase barriers should be provided to prevent accidental short-circuits during operation.

The fuse base contacts should be of copper comprising one top contact for bolting to the bus bar, one bottom contact for terminating the incoming or outgoing cable and a cable lug. The bottom contacts should be so designed that the cable tail from the cable gland to the cable lug is vertical and does not foul with any live parts in its run. The spacing between the respective fuse bases should not be less than 40mm.

The fuse carriers should be fitted as standard to all fuses to minimize accidental contact with live metal during inspection or maintenance. The carriers should be phenolic moulded, designed to accommodate HRC fuse-links and should incorporate a wedge action device for tightening the fuse-link to the base contact. This wedge action should be operated externally by insulated thumb screws giving uniformly high pressure contact ad ensuring cool running under full load conditions, with positive location of the fuse-link tags on the base contact. The fuse-link shall not work loose due to vibration occurring from vehicular traffic.

A viewing aperture should be provided on the carrier to facilitate location of a 'blown' fuse. The fuse carriers should also be easily withdrawable in service. The design of the carrier should be such that carrier components do not carry any current and the contact is decidedly between fuse-link tag and base contact.

When incoming links are called for it should be possible to fit the carriers with solid links in lieu of fuses.

The neutral bus bar shall be rated at 100 % of the phase bus bars. The design should allow for neutral cable sockets to be fitted directly to the bus bars. A GI earth bar of size 40x5mm together with two cable eyes shall be provided for connections to earth pits. All the cables shall be terminated at ELEMEX terminal block and therefrom wiring shall be done with PVC insulated aluminum conductor cable to fuse units. The wiring shall be neatly bunched and shall be secured to wiring cradles.

A circuit cardholder to be made inside the front door and the card duly engraved / painted on aluminum / hylam sheet, Identification ferrules shall be used for incoming and out going cables.

AUTOMATIC FIRE DETECTION & ALARM SYSTEM

1. SCOPE

This specification covers the supply, installation, testing and commissioning of the Fire Detection Systems and generally comprise

- Provision of Smoke and Heat Detectors
- Provision of Manual Call Points
- Provision of Response Indicator Units
- Provision of Audio Alarm units
- Local and Main Control Unit for the System
- Public Address System
- Wiring between Detectors and Control Units to make the complete System

2. STANDARDS AND CODES

Specification for Smoke Detectors	BS 5445 : 1984
Specification for Heat Sensitive Detectors for use in automatic fire alarm Systems	IS 2175 : 1977
Code of Practice for installation of automatic Fire Alarm System using Heat sensitive type Fire Detectors	IS 2189: 1976
Code of Practice for Electrical Wiring installations (System voltage not exceeding 660 volts)	IS 732 : 1963
Automatic Fire Alarm Systems in buildings Control and indicating equipment	BS 3116 Part I BS 3116 Part IV
British Code of practice for installation and servicing of Fire Alarm Systems	CP 1019 : 1972
Underwriters Laboratory Specification for Smoke Detectors	UL 268

All equipment and the installation shall be as per the relevant Indian Standards Specifications. Where these Standards do not exist, the relevant British Standards or any other internationally accepted Standard shall apply.

3. IONISATION TYPE SMOKE DETECTORS

3.1 GENERAL

The Ionisation type Smoke Detectors shall be capable of sensing fire in the smoldering or the incipient stage. Smoke Detectors shall be sensitive to products of combustion of all materials like wood, paper, rubber, natural and synthetic fibres, plastic and common liquid hydrocarbons in accordance with the sensitivity requirements of BS 5445 Part 7 : 1984.

3.2 CONSTRUCTIONAL FEATURES

DETECTOR HEAD

The Smoke Detector enclosure shall be of white plastic moulded with high impact self extinguishing polycarbonate and shall be fitted to the base by a twist and lock action. Correct alignment of the electrical contacts in the base with the terminal pins of the Detector shall be ensured. The twist and lock action shall ensure a good electrical contact with the wiping action. Apertures in the Detector housing shall allow the free ingress of smoke through a stainless steel gauze and into the smoke sensing ionisation chamber.

IONISATION CHAMBERS

The Detector head shall incorporate two ionization chambers and twin radio active sources namely Americium 241 having a radio activity of less than 1.0 micro curies. The radio active source shall be mounted on a stainless steel electrode and shall be electrically insulated from the gauze and the chamber cage. The second radio active source shall be mounted on the underside of the stainless steel electrode. Air within the chambers shall be ionized by the radio active sources with the second being the sealed reference chamber in electrical series with the first - smoke sensing chamber. The gauze and the chamber cage shall provide electrical screening to the smoke sensing chamber.

DETECTOR BASES

The Detector bases shall be suitable for mounting directly on a 75 mm recessed round box or as required at the site. The bases shall have terminals which shall be suitable for receiving 1.5 sq mm PVC copper conductor or 2.5 sq mm PVC aluminium conductor cables. Access to the terminals shall be available from the front of the base after removing the Detector. A plastic cover shall be provided with each base to be fixed to the rear to eliminate the ingress of dust, water and insect into the Detector

LED INDICATION LAMP

A LED lamp shall be incorporated which shall normally flicker at the rate of six flashes per minute indicating alertness and shall turn steady when a fire is sensed enabling immediate identification of the Detector.

ELECTRONICS

The Printed Circuit Board electro tinned copper tracks shall be protected from corrosion by a green epoxy solder resist coating. The tracks and solder joints shall be protected against fungus growth by an insulating varnish coating.

The sensitive electronic components shall be protected by a high resistivity silicone encapsulation compound. All electronic components shall be electrostatically screened.

The electronic design and circuit shall provide the following safety devices:

- protection against high voltage spikes on the supply line
- protection against polarity reversal
- protection of the ionization chamber monitoring circuits from high voltage static Discharges.
- protection against high frequency transients
- detection of alarm at the control unit even in the event of LED failure
- protection against transient spikes on long lead lines to the remote indicators

DETECTOR WIRING

The Smoke Detector shall be suitable for 2 wire monitored supply.

OPERATIONAL PARAMETERS

The Detectors shall be suitable for operation at a maximum ambient temperature of 60 deg C. and a minimum of 0 deg C with a maximum relative humidity of 90%.

The Detector sensitivity shall remain constant and not vary with change in the ambient temperature, humidity, pressure or voltage by more than +/- 10%.

The performance of the Detectors shall not be effected by continuous air flows upto 10 meters per second.

The Detectors shall be suitably protected against the accumulation of dust and insects.

The Smoke Detectors shall comply to the requirements of BS 5445 Part 7 : 1984 and EN 54 Part 7 : 1984 for Vibration, Impact and Shock parameters.

The Smoke Detectors shall be designed and constructed to meet the requirements of IP 43.

DETECTOR TESTING IN SITU

It shall be possible to functionally test the Detector as well as assess its actual sensitivity without having to remove the same.

DETECTOR CERTIFICATION

The Smoke Detector shall be UL Listed and tested and approved by independent Authorities for certified compliance and acceptance to the relevant Standards. The Detectors shall be approved by the Local Fire Authorities and relevant documentation shall be supplied with the tender.

4. HEAT SENSITIVE RATE OF RISE CUM FIXED TEMPERATURE TYPE DETECTORS

4.1 GENERAL

The Heat Sensitive Detectors shall be of the rate of rise cum fixed temperature detection type and shall comply to the requirements of IS 2175 : 1977 and NFPA Standard 721. The detectors shall respond to a rate of rise in temperature of 8 deg C per minute and a fixed temperature of 57 deg C.

4.2 CONSTRUCTIONAL FEATURES

The Heat Detectors shall be of the plug-in type and shall be attached to the mounting plate by a twist and lock motion. The Detector body shall be of moulded plastic, white in colour. The electrical contacts and other moving parts of the Detector shall be enclosed in such a manner that will afford protection against moisture, dust, insects and other foreign matter. All make and break contacts shall be of silver or any other metal or alloy of equivalent characteristics.

The body and other parts shall be made of material inherently resistant to corrosion.

Any adjustments made at the factory shall be sealed and all adjustment screws shall be provided with a reliable means of locking to avoid disturbance of the adjustments in transit. In addition, the means of adjustment shall be rendered inaccessible to prevent tampering when the Detector is being installed or during its operation.

4.3 MOUNTING PLATES

All Detectors shall be installed on mounting plates moulded from white self extinguishing thermoplastic. The Detector shall be attached to the mounting plate with a twist and lock motion. The mounting plate shall be suitable for installation on a 75 mm round recessed box.

4.4 DETECTOR OPERATION

The Detector head shall house a thermostat or a fusible alloy as a fixed temperature element. When activated the external heat collector shall drop to provide a visual confirmation that the fixed temperature element has operated.

A pneumatic element shall sense the rate of rise in temperature by expansion of air within a sealed chamber faster than it can escape through the calibrated vent. The resultant increase in pressure shall depress a diaphragm causing the electrical contacts to close a circuit and trigger an alarm. The rate of rise element shall be of the self restoring type.

4.5 DETECTORS APPROVALS

The Detectors shall meet the performance requirements as per Clause 5 of IS 2175 : 1977 and/or other International Standards. The Detectors shall be UL Listed and FM approved and shall meet the approval requirements of the Local Fire Authorities. Test certificates from independent authorities and the approvals for the Detectors shall be furnished with the tender.

5.0 HEAT SENSITIVE FIXED TEMPERATURE TYPE DETECTORS

5.1 GENERAL

The Heat Sensitive Detectors shall be of the fixed temperature detection type and shall comply to the requirements of IS 2175 : 1977 and NFPA Standard 721. The detectors shall respond to a fixed temperature of 57 deg C. or 94 deg C as specified.

5.2 CONSTRUCTIONAL FEATURES

The Heat Detectors shall be of the plug-in type and shall be attached to the mounting plate by a twist and lock motion. The Detector body shall be of moulded plastic, white in colour. The electrical contacts and other moving parts of the Detector shall be enclosed in such a manner that will afford protection against moisture, dust, insects and other foreign matter. All make and break contacts shall be of silver or any other metal or alloy of equivalent characteristics.

The body and other parts shall be made of material inherently resistant to corrosion.

Any adjustments made at the factory shall be sealed and all adjustment screws shall be provided with a reliable means of locking to avoid disturbance of the adjustments in transit. In addition, the means of adjustment shall be rendered inaccessible to prevent tampering when the Detector is being installed or during its operation.

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5.4 DETECTOR OPERATION

The Detector head shall house a thermostat or a fusible alloy as a fixed temperature element. When activated the external heat collector shall drop to provide a visual confirmation that the fixed temperature element has operated.

5.5 DETECTORS CERTIFICATION

The Detectors shall meet the performance requirements as per Clause 5 of IS 2175 : 1977 and/or other International Standards. The Detectors shall be UL Listed and FM approved and shall meet the approval requirements of the Local Fire Authorities. Test certificates from independent authorities and the approvals for the Detectors shall be furnished with the tender.

6. MANUAL CALL POINTS

Manual Call Points shall consist of a push button switch housed in a dust tight sheet steel enclosure of 1.5 mm thick sheet to manually initiate audio visual alarms. The front shall be sealed with a breakable glass cover fixed in such a way that the actuating push button is kept depressed as long as the glass is intact and released automatically when the glass is broken. The front face of the Manual Call Box shall have an area not less than 5000 sq mm and the element shall have an exposed area of not less than 1600 sq mm in the shape of a square or a rectangle.

A small steel hammer shall be attached to the assembly with a steel chain to facilitate breaking of the glass front. The Manual Call Box shall be suitable for surface or recessed mounting as required. The words "IN CASE OF FIRE BREAK GLASS" 5 mm high shall be painted in red on the front face.

7. RESPONSE INDICATOR

The Response Indicator shall consist of a red LED mounted in a sheet steel enclosure of 1.5 mm thick sheet suitable for surface or recessed mounting on walls or partitions as required. These shall be connected to the Detectors in the enclosed area to indicate the status of the Detector. In normal circumstances the lamp shall flicker but in the event of the Detector inside the enclosed area sensing a fire, the lamp shall glow steadily.

8. ILLUMINATED SIGNS

The Illuminated Signs shall have the letters "FIRE EXIT" or "NO FIRE EXIT" painted in red on a white perspex sheet as the front face of a sheet steel enclosure constructed with 1.5 mm thick sheet. The perspex sheet shall be back lit with an integral battery back up facility so as to operate independent of the mains supply in the event of a mains failure. The preferred dimensions of the Illuminated Signs shall be 450 mm length and 225 mm height with 100 mm high lettering. They shall be suitable for surface or recessed mounting as required.

9. ALARM SIRENS

Electronic audio alarm sirens shall be suitable for operation on the DC supply of the System and will be actuated from the Main Control Panel in the event of a fire. These shall have a two tone modulated alarm signal for continuous service with an output of 100 dB at a distance of 3 metres.

10. MAIN CONTROL PANEL

10.1 GENERAL

The Main Control Panel (MCP) shall be centrally located and shall form the nerve centre of the total System. The MCP shall continuously monitor the status of each Fire Zone.

10.2 CONSTRUCTIONAL FEATURES

The MCP shall be metal enclosed, sheet steel cubicle pattern, dead front, floor/wall mounting type as required and suitable for indoor mounting.

The MCP shall be dust and vermin proof. Synthetic rubber gaskets shall be provided on all covers and doors to render the joints dust and vermin proof. All doors shall be lockable.

The MCP shall be fabricated from 2.0 mm CRCA thick sheet steel and shall be folded and braced to provide a rigid support. Joints shall be seam welded.

10.3 MAIN CONTROL PANEL CONFIGURATION

The MCP shall monitor the status of each Fire Zone and shall be configured to include:

- a) **Microprocessor** based electronic panel complete with a fascia to provide the following indications and controls:
 - "FIRE" indication one per zone
 - "FAULT" indication one per zone
 - "FIRE TEST" push button one per zone
 - "ZONE ISOLATE" switch one per zone

- "DETECTOR FAILURE - OPEN CIRCUIT - SHORT CIRCUIT" indication
 - "DETECTOR REMOVED" indication
 - "BREAK IN WIRING" indication with initiation of alarm
- b) Mother Board to control and monitor the entire System with audio/visual alarms and with a fascia to provide the following controls and indications:
- "MAINS ON" switch with indicating lamp
 - "SYSTEM ON" switch with indicating lamp
 - "MAINS FAILURE" indication
 - "BATTERY LOW" indication
 - "LAMP TEST" push button
 - "STANDBY ON" indication
 - "SYSTEM RESET" push button
 - "ALARM CANCEL" push button
 - "TRICKLE BOOST" toggle switch
 - "AUDIO ALARM" selector switches for general and/or zone wise broadcast.
 - "AUTO/MANUAL" selector switch for the Illuminated Signs
- c) Power Supply for the System integral with the MCP. The power supply rating shall be adequate for the Detectors, Illuminated Signs and all other devices as required in the System.
- The power supply unit integral with the Control Panel shall consist of a 230/24 volt step down transformer. The 24 volt secondary of the transformer shall be rectified through a silicon diode bridge rectifier unit and the D C output filtered to minimise ripples. The unregulated 24 volt DC supply shall be regulated for the electronic circuits and the power to the entire System.
- d) Screw type terminal blocks and cable glands for termination of all control wiring.
- e) Required potential free spare contacts/ or as called for in Bill Of Quantities.
- f) End of Line resistors as required by the System design shall be provided as a part of the Control Panel.
- g) Audio visual alarm unit with a provision to sound an alarm throughout the building from the Main Control Panel either as a general broadcast or selectively as may be required.

10.4 ELECTRONICS

The Printed Circuit Board electro tinned copper tracks shall be protected from corrosion by a green epoxy solder resist coating. The tracks and solder joints shall be protected against fungus growth by an insulating varnish coating.

The sensitive electronic components shall be protected by a high resistivity silicone encapsulation compound. All electronic components shall be electrostatically screened.

The electronic design and circuit shall provide protection against high voltage spikes on the supply line

All Printed Circuit Boards shall be mounted in the MCP such that they can be pulled out from the front without the need for disconnecting any wires and shall therefore be mounted on rails and plugged directly into connectors.

10.5 DISPLAY

The Main Control Panel shall be complete with a display showing the layout of each floor of the Building/s and each Fire Zone marked clearly thereon for ready identification with the Zone indications and controls. The Display Panel shall be integral with the MCP and shall be etched in colour on a white perspex sheet as approved by the Engineer in charge.

10.6 INTERNAL WIRING

All internal wiring shall be with 1.5 sq mm PVC insulated copper conductor wires colour coded and labelled with ferrules for easy identification. The wiring shall be properly bunched and harnessed. The wiring shall be done in a manner such that it is readily accessible from the front for maintenance.

10.7 SHEET STEEL TREATMENT AND PAINTING

Sheet steel materials used in the construction of the Panels should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognized phosphating process. The steel work shall then receive two coats of filler oxide primer before final painting.

All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

10.8 NAME PLATES AND LABELS

Suitable engraved white on black name plates and identification labels shall be provided for identification of the Fire Zones as approved by the Engineer in charge.

11. REMOTE CONTROL PANELS

Remote Control Panels shall generally comply to the Specifications of the Main Control Panels as detailed in para 9 above. These shall be located remotely and will indicate the status of each Zone and the MCP but without any controls. The indications to be provided on the Remote Control Panel shall be :

- "FIRE" indication one per zone
- "FAULT" indication one per zone
- "DETECTOR FAILURE - OPEN CIRCUIT - SHORT CIRCUIT" indication one per Zone
- "DETECTOR REMOVED" indication one per Zone
- "BREAK IN WIRING" indication one per zone
- "MAINS ON" indicating lamp
- "SYSTEM ON" indicating lamp
- "MAINS FAILURE" indication
- "BATTERY LOW" indication
- "STANDBY ON" indication

12. BATTERY AND BATTERY CHARGER

Adequately rated 24 volt lead acid rechargeable DC battery with 12 hour autonomy shall be provided for the System. The capacity shall be such as to feed the full load of the Fire Detection System including the Illuminated Signs in the event of a mains failure. It shall be connected to the MCP via a mains failure relay.

The battery shall be complete with a Battery trickle charger set and shall be maintained in a charged condition with the constant trickle charge. It shall be possible to boost the charging of the battery by the manual operation of the trickle/boost toggle switch when 'Battery Low' indication is observed on the Main Control Panel.

The Battery capacity shall fully meet the requirements of Clause 5.2 of IS 2189.

13. WIRING

The wiring for the Fire Detection System shall in general comply with the requirements of IS 2189 : 1976 and IS 732 : 1963. The Detectors in each loop shall be wired upto the Main Control Panel with a 2 core 1.5 sq. mm. copper conductor or 2 core 2.5 sq mm aluminium conductor FRLS PVC insulated 660/1100 volt grade wires in concealed or surface conduit as required. Crimped terminations shall be used throughout the System.

14. TEST CERTIFICATES

Type test certificates from a recognized independent agency shall be furnished for all the equipment. The equipment shall comply to the requirements of the Indian, International Standards, Fire Insurance Authorities and all National and Local Regulations in force.

15. SENSITIVITY ADJUSTMENTS

The sensitivity of all Detectors shall be set/adjusted by the Supplier to suit the site conditions.

16. INSTALLATION, COMMISSIONING AND ACCEPTANCE TESTS

The following installation, commissioning and acceptance tests shall be conducted by the Contractor and shall be apart from the Standard/Routine tests prescribed and normally conducted by the Supplier. These tests shall be carried out as a part of the installation irrespective of whether or not these are covered by the Standard/Routine tests.

INSTALLATION TESTS

- After installation of the Detector Bases and prior to installation of the Detectors, the wiring shall be tested for continuity and insulation resistance. A high voltage insulation meter 500 to 1000 volts shall be used to measure the insulation resistance between each conductor and between each conductor and earth. The value of insulation resistance shall not be less than 1 Mega ohm.
- The insulation resistance of the wiring to the Response Indicators shall also be checked as above prior to the installation of the Indicators.

COMMISSIONING AND ACCEPTANCE TESTS

Each zone shall be tested by a test fire or by a heat source on all or any one or more of the Detector selected by the Engineer in charge. The time required for detection shall be noted and shall be within prescribed limits.

- Each alarm circuit shall be energised separately and the sound level reading taken to check for conformity with the minimum standards.
- Open circuit and removal of a Detector from a detection circuit shall be tested.
- Short circuit operation for each detection circuit will be tested
- Tests to prove satisfactory operation of the system shall be conducted simulating the conditions of
 - * Mains Failure
 - * Battery disconnection
 - * Open circuit and short circuit conditions of each alarm circuit

The results of all the tests conducted shall be so recorded and approved by the Engineer in charge prior to acceptance of the System.

17. AUTHORITIES AND APPROVALS

The work shall conform to the requirements and provisions of the relevant Government Acts, Regulations and Bye Laws of the Local Authorities. The Contractor shall give all notices as required under the said Acts, Regulations and Bye Laws.

The Contractor shall submit applications, drawings etc. as required and obtain approval, licenses

and sanctions thereof from Delhi Fire Services and any other Statutory Authorities. The Contractor shall obtain the final completion certificate from the concerned authorities to enable the Engineer in charge to commission the installation.

The Contractor shall be responsible for the payment of all fees etc. to be paid to the relevant Authorities and the Engineer in charge shall refund the same to the Contractor on submission of receipts in original.

The work shall not be deemed to be complete until the above approvals, licenses, sanctions etc. have been obtained by the Contractor.

SPECIFICATION FOR LT PANEL/ SWITCHGEAR

1. CONSTRUCTION:-

- i. Switchgear enclosure shall conform to the degree of protection IP4x minimum thickness of sheet metal used shall be 2 mm.
- ii. The switchgear shall comprise a continuous line up of single / Multi-tire cubicles. The installations of circuit breakers however shall be limited to the bottom two tires only.
- iii. The design shall be of fully compartmentalized execution with metal/ insulating portions. Working height shall be limited between 750 mm to 1800 mm from the floor level.
- iv. Each breaker shall be housed in a separate cubicle, complete with an individual front access door; each vertical section shall have a removable back cover. All doors & covers shall be gasketed.
- v. Switchgear cubicle shall be so sized as to permit closing of the front access door when the breaker is pulled out to ISOLATED position.
- vi. All switchgear, lamps & indicating instruments shall be flush mounted on the respective cubicle door whereas relays & other auxiliary devices of any may be mounted on a separate cubical.

2. BUS AND BUS TAPS

- i. The main buses & connections shall be of high conductivity aluminium alloy, as per IS : 5082 sized for specification current rating with maximum temperature limited to 85 degree C (i.e., 35 degree C rise over 50 degree C ambient). Bus bars shall be designed for a maximum current density of 0.8A/ sqmm.
- ii. All bus connections shall have adequate contact pressure which should be ensure by means of two bolt connections with plain & spring washers locknuts. Bimetallic connections between dissimilar metals.
- iii. Bus connections shall be fully insulated for working voltage with adequate phase / ground clearances.

Insulating sleeves for bus bars & surrounds for joints shall be provided.

Bus insulator shall be flame-retardant, track resistant type with high creep age surface.

- iv. All buses & connections shall be supported & braced to with stand the stresses due to maximum short circuit current & also to take care of any thermal expansion.
- v. Bus-bars shall be sleeved in colour coded manner for easy identification & so located that the sequence RYB shall be from left to right, top to bottom of front to rear, when viewed from the front of switchgear assembly.
- vi. Bolted disconnected links shall be provided from all incoming & outgoing feeders for isolation of neutral, if necessary.

3. CIRCUIT BREAKER

- i. Circuit breaker shall be three poles, single throw, air breaker type with stored energy, trip free mechanism & shunt trip. The circuit breaker of the outgoing feeder shall have an in built microprocessor base release, short circuit, over current & earth fault protection release.
- ii. Circuit breakers shall be draw out type, having SERVICE, TEST & ISOLATED position with positive indication for each position along with in built relay unit.

- iii. Circuit breaker of identical rating shall be physically & electrically interchangeable.
- iv. Circuit breaker shall be motor wound spring charged mechanism, motor voltage should be 240 V AC. For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open close-open operation of the circuit breaker shall be possible after failure of power supply to the motor. Power supply for this motor shall be taken from the output of auto changeover.
- v. Mechanical safety interlocking shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed.
- vi. Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.
- vii. Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operation counter & mechanism charge/ discharge indicator.
- viii. In addition to the auxiliary contacts required for normal breaker operation & indication, each breaker shall be provided with following for interlocking purpose:-
 - a) Position/ cell switch with 4 NO. + 4 NC contacts. These shall be available as spare for automation work.
Control Supply: - 230V AC for closing,
Tripping & indication lamps.
 - b) Auxiliary switch, with 6 NO+ NC contact, mounted on the stationary portion of the switchgear & operated mechanically by a sliding level from the breaker, in SERVICE position. These shall be available as spare for automation work.
- ix. Limit / auxiliary switches shall be convertible type, that is, suitable for changing NO contact to NC & Vice-Versa.

4. MOULDED CASE CIRCUIT BREAKERS

- i. Moulded case circuit breakers (MCCB) or fuse free breakers, incorporated in switchboards wherever required, shall conform to IS 13947 : 1993 in all respects. MCCBs shall be suitable either for single phase 240 Volts or 3 Phase 415 Volts AC 50 HZ supply.

MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIPPED indicators. Three phase MCCBs shall have a common handle for simultaneous operation and tripping of all the three phases. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of microprocessor based electronic type provided on each pole and connected by a common tripe bar such that tripping of any one pole causes three poles to open simultaneously. Electronic tripping device shall have IDMT characteristics for sustained over loads and short circuits.

Contact trips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances.

MCCBs shall be provided with following accessories, if specified in drawings/schedule of quantities :

- Shunt trip
- Alarm switch
- Auxiliary switch

MCCBs shall be provided with following interlocking devices for interlocking the door a switch board.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent door being opened when the breaker is in ON position

- Deinterlocking device to open the door even if the breaker is in ON position.

MCCBs shall have rupturing capacity as specified in drawings/schedule of quantities.

- ii. MCCB shall be triple pole air break.
- iii. The MCCB shall have a quick - make, quick - break mechanism operated by a suitable external rotary handle, complete with position indicator this handle shall have provision for pad locking in ON & OFF position.
- iv. MCCB should have microprocessor base electronic release with over current, earth fault & short circuit protection equivalent to L&T 'D' since with RC-10 release.

5. **CONTROL & INDICATION :-**

The circuit breaker shall be wired up for both local & remote operation. A local- remote selector switch shall be provided for this purpose. Each breaking cubicle shall be equipped with following:-

- i. One (1) Test- neutral - service selector switch stay put type with test/ service position pistol grip handle & key interlock for breaker marked 'E'.
- ii. Two (2) heavy duty, oil tight push buttons for TRIP & CLOSE.
- iii. Three (7) LED indicating lights on front of compartment :-
 - GREEN : breaker open & spring charged
 - RED : Breaker close
 - AMBER : Trip / circuit healthy condition
 - WHITE : Control supply failure
 - Phase indication : One Red, One Blue & One Yellow

O & 1 NC should be provided for status monitoring of the remote / local position.

- iv. Lamps shall be low watt, LED type lamp & lens shall be replaceable from the front.
- v. The general scheme of connections for control, interlock & protection shall got approved before fabrication of panel.

6. **FUSES :-**

- i. Fuses shall be HRC, preferably link type with a minimum interrupting capacity equal to the short circuit current.
- ii. Fuses shall be furnished complete with fuse base & fittings of such as to permit easy & safe replacement of fuse element. Visible indicated indication shall be provided on blowing of the fuse.

7. **CURRENT TRANSFORMER :-**

Current transformer shall be cast- resin type. All secondary connections shall be brought out to terminal blocks where or delta connection will be made.

- i. Ratings :
 - for incomers and buscoupler

1500-750/5+5 : 3 sets

- For out goings :
 - 800-400/5+5 : 4 sets
 - 600-300/5+5 : 4 sets
 - 400-200/ 5+5 : 2 sets

- ii. Accuracy class of the current transformers shall be :-
 - a.) Class 5P10 for other relaying (protection).
 - b.) Class 1.0, ISF < 5 for metering.

8. RELAYS :-

- i. Relays shall be of drawout design with built in testing facilities. Small auxiliary relays may be in non drawout execution.
- ii. Relay shall be rated for operation on 5 Amp secondary current & 110 / 220 V secondary voltage; number & rating of relay contacts shall suit the job requirements.
- iii. The contractor shall furnish, install & co-ordinate all relays to suit the requirements of protection & interlock & as broadly indicated in the annexure & drawings.

9. METERS (DIGITAL DISPLAY):-

- i. Indicating instruments shall be switch board type & accuracy class of 2% .
- ii. All Digital Watt-hour meter shall be provided, Alternatively, they may have test block to facilitate testing of meter without disturbing C.T. or V.T. secondary connections.
- iii. Each breaker shall be with volt meter, amp meter with selector switches & KWH meters. Only out going feeders will be relaxed from voltmeters.

10. SECONDARY WIRING :-

- i. The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, & interlocking schemes.
- ii. Fuses & links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches & other devices shall be wired upto terminal blocks.
- iii. Wiring shall be done with FRLS PVC flexible, 650V grade, PVC insulated switchboard wires with solid copper conductors of 2.5 sqmm for voltage circuits alongwith numbered ferrules.
- iv. Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per contractors wiring diagrams.
- v. Wire terminations shall be made with crimping type connectors with insulating sleeves. Wire shall not be spliced between terminals.

11. TERMINAL BLOCKS

- i. Terminal blocks shall be 660V grade box clamp type with marking strips, similar to ELMEX 10 sqmm of equal. Terminals for C.T. secondary leads shall have provision for shorting.
- ii. Not more than two wires shall be connected to any terminals equal in number to 20% active terminals shall be furnished.

iii. Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

12 CABLE TERMINATION :-

- i. Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for each of termination & connection.
- ii. All provision & accessories shall be furnished for termination & connection of cables, including removable gland plates, cable supports, crimp type tinned copper/ aluminium lugs, brass compression gland with tapered washer (power cable only) & terminal block.
- iii. Gland plate shall be minimum 4 mm thick.

13 BUS DUCT CONNECTION :-

- i. Bus duct connections, where specified shall be furnished along with transportation of panel. Bus duct connections shall be generally from the top.
- ii. All connecting bus work shall have the same continuous rating as associated switchgear bus & shall be fully braced for the listed short circuit current.
- iii. All provision such as matching flange & other accessories shall be furnished for connection to bus duct if any, being supplied by this purpose will be furnished by contractor.

14 GROUND BUS :-

- i. A ground bus, rated to carry maximum fault current, shall extend full length of the switchgear.
- ii. The ground bus shall be provided with two bolt drilling with GI bolts & nuts at each to receive 50 x 6mm GI flat.
- iii. Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker & drawout VT unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.
- iv. Whenever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus & connected thereto.
- v. C.T. & V.T. secondary neutrals shall be earthed through removable links so removed without disturbing others.

15 NAMEPLATES :-

- i. Nameplates of approved design shall be furnished at each cubicle & at each instrument & device mounted on or inside the cubicle.
- ii. The material shall be lamicaid or approved equal, 3mm thick with white letter on black background.
- iii. The name plate shall be held self-tapping screws. Nameplate size shall be minimum 20 x 75 mm for instrument device & 40 x 150mm for panels.
- iv. Caution notice suitable metal plate shall be affixed at the back of each vertical panel.

16. SPACE HEATERS PLUG SOCKETS :-

- i. Each vertical section shall be provided with thermostat controlled space heater & 5A, 3 pin plug socket.

ii. Cubical heater, plug-socket circuit shall have individual switch fuse units.

17. A.C. / D.C. POWER SUPPLY :-

i. The following power supplied will be made available to the switchgear :

240 A.C. Supply : Two Feeders

The DC supply required for control purposes is to be obtained in each module through a rectifier arrangement, which will convert the 250V AC supply to 110V DC. The equipment necessary for this rectification including protective relaying as per the approved drawing are also to be included.

ii. Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 2-pole, single throw for A.C. & 2-pole, double throw for D.C. Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch-fuse units shall be provided at each cubicle for AC/DC supplies.

iii. AC load shall be so distributed as to present a balance loading on three-phase supply system.

18. PAINTING :-

i. All surface shall be sand blasted, pickled & grounded as required to produce a smooth, clean surface free of scale, grease & rust.

ii. After cleaning, the surface shall be given a phosphate coating followed by 2 coats of high quality prime & stove after each coat.

iii. The switchgear shall be finished in light gray (IS shade # 631) with two coats of synthetic enamel paint.

iv. Sufficient quantity of touch- up paint shall be furnished for application at site.

19. SPECIAL TOOLS & TACKLES :-

i. A set of special tools & tackle (manual charging handle & operating handle trolley for lifting outside breaker for maintenance) which are necessary or convenient for erection, commissioning, maintenance & overhauling of the equipment shall be supplied.

ii. The tools shall be shipped in separate containers (Tool Box) clearly marked with the name of the equipment for which they are intended.

20 PARES :-

i. The bidder shall submit list of recommended spare parts for three (3) years satisfactory & trouble free operation indicating the itemized price of each item of the spares.

21 DRAWINGS, DATA & MANUALS :-

i. To be furnished for approval after award of work.

a. General arrangement drawing showing constructional features, space required in front for withdrawals, power & control cable entry points etc.

b. Details of materials with specifications.

c. Typical foundation plan & loading.

d. Typical breaker control schematic.

e. Matching flanges & terminals for the bus termination.

f. Type test reports on circuit breaker.

g. Technical leaflet on

h. Circuit breaker

i. Instrument transformers

- j. Relays, meters, switches etc.
 - k. Single line diagram
 - l. Control schematics
 - m. Wiring diagram
22. Instruction manuals of switchgear & individual equipment :-
The manual shall clearly indicate the installation method, checkup & tests to be carried out before commissioning of the equipment.
23. The bidder may note that the drawings, data & manuals listed here in are minimum requirements only the bidder shall ensure that the other necessary write-ups, curves & information required to fully describe the equipment are submitted with his bid.

CIRCUIT BREAKER

Make	- As per approved make.
Type	- Microprocessor release air circuit breaker
Rated voltage	- 415 Volts
Rated frequency	- 50 Hz
Rated current	- 1600/(Icu=Icf=1sec 50 kA) 800A(Icu=Icf=1sec 50 kA)
No. of pole	- 3
Aux. Voltage for trip/close coil	- 110 V DC
Motor for spring charging Voltage	- 240 V AC
Protection unit	- Equivalent to SR-18G with fault indication & thermal masonry.

Interlocking arrangement electrically & mechanically with bus coupler & incomer.

PROTECTION (FOR LT SUPPLY 415V PANEL)

The minimum protection to be provided for different type of circuit are listed below :-

INCOMING FEEDER :-

- i. 2 over current +E/F relay microprocessor based alongwith the element of instantaneous o/c & E/F protection.

BUS COUPLER :-

3 O/C relay microprocessor based

All inverse time O/C relay shall be 3 sec. Version.

All definite time O/C relay shall have adjustable time range of 0-6 Sec.

Apart from protection relays each breaker shall be provided with auxi. Contact multiplier relay, anti pumping relay, trip supervision relay, lockout relay test terminal block. These relay shall be hand reset.

SPECIFICATION FOR LT BUS DUCT

1. Design Criteria

- 1.1 The LT non phase segregated bus duct serve as a interconnection between the LT switchgear and outdoor LT transformer.
- 1.2 The LT bus ducts will be installed partially indoor and partially outdoor in a hot, humid and tropical atmosphere. All panels associated.
- 1.3 Bus duct associated equipment and wiring shall be provided with tropical finish to prevent fungus growth. All ventilation openings shall be screened and drains shall be filtered to prevent entrance of dust and insects.
- 1.4 For continuous operation at specified ratings, temperature rise of the bus duct and auxiliary equipment shall be limited to the site permissible values stipulated in relevant standards and / or this specification.
- 1.5 Bus duct and auxiliary equipment shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit currents listed in the annexure without any damage or deterioration of material.
- 1.6 The bus ducts shall be self cooled and shall not be equipped with blower or any other type of forced ventilation.
- 1.7 Bus duct enclosure shall be of sheet steel.

2. Specific Requirements.

2.1 General

- 2.1.1 The LT bus duct shall be non phase segregated enclosure type.
- 2.1.2 The layout of the bus ducts shall be generally in accordance with enclosed drawings. The details shown however are only typical. Bidder may propose changes to suit his particular design.
- 2.1.3 All parts and accessories shall have appropriate match mark and part numbers for easy identification and installation at site.

3. Enclosure

- 3.1 Phase shall be enclosed in weather proof, dust-tight, enclosure of sheet steel fabricated type conforming to degree of protection of IP 55.
- 3.2 Circumferential neoprene rubber gaskets shall be provided for dust tight joints with adjacent enclosure section.
- 3.3 The bus enclosure shall have extended bellows or equivalent means to allow for temperature changes and vibrations. Flexible joints shall be provided in enclosures at all points where the bus duct terminates at equipment to withstand vibration, expansion/ contraction and at suitable intervals in any straight run of the bus duct where expansion and contraction would otherwise result in stress in the supporting structures.

- 3.4 All outdoor bus enclosures shall be so designed & constructed as to prevent accumulation of rain water on top sheet. Similarly all gasketed flanged joints shall be suitably protected against direct splashing of rain water in case of outdoor runs.
- 3.5 Suitable inspection openings shall be provided for access to support insulators, bus joints, transformer terminals, switchgear terminals etc. All inspection openings shall have reliable sealing arrangement with neoprene gaskets.
- 3.6 Seal-off bushings complete with wall frame and support plates shall be provided where the bus duct penetrates the building wall. The seal is to prevent free exchange of air between indoor and outdoor portions of the bus duct.
- 3.7 Silica-gel breather shall be provided on both indoor and outdoor portions of the bus duct.
- 3.8 Filtered drains for drainage of condensate shall be provided at the lowest points and at such locations where accumulation of condensate can be expected.
- 3.8 Shipping length of the bus duct shall be not more than three (3) meters in length.

4. Bus Conductor

- 4.1 The bus conductor shall be of high conductivity, aluminium alloy, supported on wet process porcelain insulators.
- 4.2 The bus conductor shall be designed for bolted connections throughout the run.
- 4.3 Flexible connections shall be provided between bus sections to allow for expansion and contraction of the conductor. Flexible connections shall also be provide at all equipment terminations.
- 4.4 All contact surfaces shall be silver plated to ensure an efficient and trouble-free connection. All connection hardware shall be non-magnetic and shall have high corrosion resistance.

5. Disconnect Link

- 5.1 Removable bolted disconnect link shall be provided in the bus where shown on the drawing for the purpose of isolation.
- 5.2 Disconnect link shall consist of a removable section of conductor and shall be so constructed as to permit easy removal or reinsertion without alignment difficulties.
- 5.3 The bus on both sides of the link shall be rigidly supported so that the disconnect link is equal in mechanical strength to any other section of the bus.

A minimum clearance of 300mm (12") shall be provided between the disconnected bus sections with the link removed.

6. Insulators

- 6.1 Bus support insulators shall be interchangeable, high creep, high strength, wet process, fine glazed porcelain. Alternatively good quality cast resin insulators.
- 6.1 Insulator shall be mounted in such a way so as to permit easy removal or replacement without disassembly of the bus. The insulator mounting plate shall be designed for cantilever loading to withstand the short circuit.
- 6.2 The conductor shall be fastened on the insulator through fixed and slip joints so as to allow conductor expansion or contraction without straining the insulator.
- 6.3 Space heater shall be provided preferably located near to each insulator to avoid moisture condensation within bus-duct. No and wattage rating of space heater shall be decided by the tenderer.

7. Connections & Terminations

20. All matching flanges, seal off bushings, gaskets, fittings, hardware and supports required for termination of the bus duct at the switchgears, transformers shall be furnished.
21. In this connection the contractor is required to coordinate through the engineer with the suppliers of the switchgear, transformers with regard to connection details, mechanical and thermal stresses.
22. Flexible connections both for conductor and enclosure shall be furnished.
 - a) At all equipment termination to provide for misalignment upto 25mm (1") in all directions.
 - b) Between bus duct supported from building steel to prevent transmission of vibration.
23. The equipment terminal connections shall be readily accessible and shall provide sufficient air gap for safe isolation of equipment during testing.
24. If the material of bus conductor and that of the equipment terminal connectors are different then suitable bi-metallic connectors shall be furnished.

8. Grounding

- 8.1 A separately run 50x6mm GI flat suitably clamped along the enclosure shall be used as the ground bus. All parts of the bus enclosure supporting structures and equipment frames shall be bonded to above ground bus.
- 8.2 Ground pad shall be bolted type to accommodate 50x6mm galvanized steel flats. Complete with suitable tapped holes, bolts and washers.

9. Supporting Structures

- 9.1 All supporting structures required for hanging and/or supporting the complete bus duct shall be furnished. These include all members, indoor/outdoor posts, bolts, shims, base plate, beams, hangers, brackets, bracings and hardware.
- 9.2 All buses shall be adequately supported and braced to successfully withstand normal operation, vibration, thermal expansion, short circuit forces and all specified design loads.
- 9.3 Supports shall be designed to provide tolerance of $\pm 12\text{mm}$ (1/2") in the horizontal and vertical directions.
- 9.4 All steel members shall be hot dip galvanized after fabrication. All hardware shall be of high strength steel with weather resistant finish.
- 9.5 Concrete foundation, building steel, concrete, inserts/plates will be provided by the owner.

The contractor shall co-ordinate with the owner for this purpose giving well in advance the details of his requirements so as to enable the owner to arrange for the same in time.

10. Wiring

- 10.1 All wiring for space heaters shall be done with insulated stranded copper conductor of not less than 2.5 sqmm cross section. Each wire shall be identified at both ends with wire designation as per contractor's wiring diagram and shall be brought out to a terminal box outside the bus duct.
- 10.2 Terminal blocks shall be box-clamp type Elemex 10 sq.mm with marking strips or approved equal.
- 10.3 At least 20% spare terminals shall be furnished in the terminal block.

11. Name Plate

- 11.1 Suitable name plate shall be furnished with each piece of equipment.
- 11.2 Materials for name plate shall be plastic/lamicoid, 3mm thick, using white letters on black background.

12. Finish

- 12.1 Except for supporting steel structures which shall be galvanized, all equipment shall be finished with a undercoat of high quality primer followed by two coats of synthetic enamel paints.
- 12.2 The interior surface finish shall be as per manufacturer's standard. The shade of exterior surface finish will be battle ship gray shade 632 as per IS-5.
- 12.3 Pretreatment consisting of degreasing, derusting etc. shall be done on all fabricated parts before painting or galvanizing.
- 12.4 Paints shall be carefully selected to withstand heat and weather conditions. The paint shall not scale-off or crinkle or get removed by abrasion due to normal handling.
- 12.5 Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished.

Specification of LED fixtures:

- i. LED batten with reliable and robust CRCA housing structure, CRI>80, System Lumen Output of 4000 lm with a System wattage of 38 watts and a system efficacy of 105 lm/Watts, Lifetime of 40,000 burning hours @ L70, Wide operating voltage range of 140V-27V, Color Temperature Options of 6508K, Power Factor> 0.95, THD<10% with short circuit and over voltage cut off. LM 79 and LM 80 reports need to be submitted from NABL accredited lab to verify above parameters. BN 108C LED 40S PSU CDL WH with AC 108 C MB A (Ceiling/Surface mounting Accessory)
- ii. LED based Flood light, housing made up of pressure die cast aluminum alloy with effective thermal management, sturdiness and embossed brand name/logo name of manufacturer. The fixture should have a minimum system efficacy of >100 lumen/Watt and a minimum system lumen output of 25500 lumens and maximum system wattage of 245 Watts. The fixture shall have a CRI of minimum 70. The fixture shall be designed for a system life of 50,000 hours @ 70%lumen maintenance. Ingress Protection of IP66 (lamp and gear Compartment) and Mechanical Impact Resistance Rating of IK>=05. The fixture driver should have an operating voltage range of 140-270 V, surge protection of >=3 KV, PF>0.9 and THD<20%. The fixture should comply with the parameters as per IS10322. The LED driver should comply to IEC61000-3-2 ed. 3.2, 2009 for Harmonics, IEC61347-2-13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, IEC62384 ed. 1.1, 2011 for performance and IEC 61547 ed. 2.0, 2009, CISPR-15 for EMI. LM79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters.

Approved Make List

S.No.	Items	Makes
1	MS Conduit (ISI marked)	BEC/AKG/NIC/Steel craft/ M-Key, SK (E.R.W)
2	PVC Conduit and accessories	Polycab/AKG/Asian
3	PVC/XLPE insulated aluminium/Copper conductor armoured/Unarmoured MV Cable upto 1100 V	Havells/Finolex/KEI/Grandlay/ Gloster
4	FRLS PVC insulated copper conductor stranded flexible wire i/c control cables	Havells/Finolex/KEI/Grandlay/RR Kabel/ Gloster
5	Cable Raceway floor/wall mounted and accessories	Schenider/Legrand/Cooper
6	Modular Switch & Socket	Legrand (Myrus)/M.K. (Element)/Schneider (Zencelo India)/Havells/ ABB
7	Metal clad Industrial Socket	Legrand/Siemens/Schneider/C&S/ABB
8	Cat-6 Cable	Beldon/Siemon/Legrand/Penduit (Pannet)
9	Cable Glands	Dowells/Commet/Gripwell/Raychem
10	Crimp Patch Cord	Beldon/Siemon/Legrand/Penuit (Pannet)
11	Protection Device (MCB/RCCB/DB/ELCB)	Siemens (Betagard),/Hager/Schneider (Acti9)/ Legrand (DX 3)/ C&S / ABB
12	MCCBs	Siemens (3VA)/L&T (MNX)/Schneider(NSX)/ Legrand (DPX 3)/ C&S / ABB
13	Power contactor	Siemens (Sicop),/L&T (MNX) / Schneider (TesyS) / Legrand (CTX 3) / ABB (Ax) / C&S
14	Surge Protection Devices	Siemens/L&T/Schneider (Acti 9) / Legrand
15	Panel Accessories	Siemens /L&T/Schneider / Legrand/Tecnic / ABB/ C&S
16	Selector Switch	Salzer/Seimens /BCH/ Kacee
17	Auxiliary Relays	Siemens/L&T/Schneider/Legrand/ABB
18	LED/Metal Halide/Fluorescent Internal Lighting Fixture	Philips/ Vipro/Havells/Crompton/Decon
19	External Lighting Fixture	Philips/ Wipro/Havells/Crompton
20	Emergency Lighting/ Exit Sign boards	Philips/Havells/Lighting Technologies/Trilux/Prolite
21	Ceiling Fan (ISI marked & BEE rated 5 star)	Havells/Almonard/Orient/Usha/Bajaj
22	Paint	Nerolac/Asian/Berger
23	Advance Lighting Protection System (Early Streamer Emission Type)	LPI (Australia)-by allied power/SGI (Duval Messien/satellite (France)- by SGI/Bradlay (USA)- by JMV/Erico (USA)-by security shoppe/ABB
24	GI Pipe	Tata/Jindal/SAIL
25	IEC 61439 Part-I & II compliance Design verified assembly type Electrical Panels	Schneider (Blokset)/Legrand (XL 3) / Siemens (Sepan)/ L&T (Ti) /ABB (ArTu)/C&S The components used in the panel shall be of the same make which were used for getting the test certificate of IEC 61439, the same shall be provided for which no separate permission is required from the engineer in charge.
26	Non Design verified assembly type Electrical Paels	Tricolite, Delhi /Siemens / Schneider/ Milestone/ Neptune
27	Air Circuit Breaker	Siemens (3 WL-ETU 45B)/ Schneider (Master Pact NW- 7.0A)/L&T (U power omega- MTX 3.5)/Legrand(DMX 3 MP4 LSIQ)/ C&S/ABB

28	<i>Surge Voltage Protection</i>	<i>Siemens /Schneider/L&T/Legrand/ABB</i>
29	<i>Earth fault module</i>	<i>Siemens/Schneider/L&T/Legrand</i>
30	<i>Protection relays</i>	<i>Siemens/Areva/L&T/Legrand</i>
31	<i>C.Ts and PTs</i>	<i>Kappa/AE/Matrix</i>
32	<i>Digital Meters</i>	<i>Siemens (PAC)/ Schneider/ (conzerv) / Secure Enersol / L&T</i>
33	<i>Change Over Switch</i>	<i>L&T/Havells /Socomec/ABB/C&S</i>
34	<i>Indicating lamps</i>	<i>ESBEE/Schneider/Siemens/Vaishno</i>
35	<i>Power capacitors</i>	<i>Epcos/ Neptune / Legrand /ABB</i>
36	<i>Automatic Power factor correction relay/controller</i>	<i>Epcos/Siemens (PAC) /Schneider (Conzerv)/L&T/Neptune</i>
37	<i>Sealed Maintenance Free Batteries</i>	<i>Exide/Panasonic/Hitachi/Shinkobe</i>
38	<i>Battery charger</i>	<i>Caldyne/Chhabi Electricals/Statcon/Max Power</i>
39	<i>Cable Trays (Factory Fabricated/Overhead & Floor Raceways</i>	<i>Legrand/MEM/OBO</i>
40	<i>HDPE underground cable duct</i>	<i>Rex Polyextrusion/Tirpura/Plasomatics/Duraline</i>
41	<i>Insulation Mats</i>	<i>DL Miller & Co. Ltd.?Premier Polyfilm Ltd./RMG Polyvinyl India Ltd/Jyoti</i>
42	<i>Smoke/Heat detectors</i>	<i>Apollo/ System Sensor/ Agni</i>
43	<i>Manual Call point</i>	<i>PRD/System-Tek/ Simplex/ System Sensor/Agni</i>
44	<i>Response indicators</i>	<i>PRD/System-Tek/ Simplex/ System Sensor/Agni</i>
45	<i>Fire Exit Signs</i>	<i>System-Tek/ Simplex/ Agni</i>
46	<i>Fire Control Panel</i>	<i>System-Tek/ Morley /Agni</i>
47	<i>Speaker / Hooter</i>	<i>System-Tek/ Philips /Agni</i>
48	<i>Occupancy Sensors/ Movement Sensor</i>	<i>Legrand/ Philips/ Wipro</i>
49	<i>Flush type switch /socket</i>	<i>Anchor/ Kinjal/ SSK/ Havells Reo</i>
50	<i>Fuse switches unit / switch fuse unit /HRC fuse</i>	<i>L&T / Siemens/ Havells/ C&S</i>
51	<i>Exhaust fan</i>	<i>Almonard/ Alstom/ Crompton</i>
52	<i>XLPE insulated HT cables</i>	<i>/Gloster KEI/Havells</i>
53	<i>Cable lug</i>	<i>Ascon (Heavy gauge) Jainson Dowells</i>
54	<i>Lamp Holder (Brass)</i>	<i>Kay/SSK/Kinjal</i>
55	<i>Telephone wires/Telephone Cable / jelly filled telephone cables</i>	<i>Finolex /Delton/Havell's /R.R. Kabel</i>
56	<i>Telephone tag blocks</i>	<i>Krone/ Pouyet</i>
57	<i>Telephone outlet</i>	<i>MK Electric /Legrand (Mosaic)/Crabtree (Piccadilly)</i>
59	<i>GI raceways</i>	<i>Milestone Engineering /Legrand/MDS/Neptune Systems Pvt. Ltd./MK</i>
60	<i>PVC raceways</i>	<i>Legrand/ MK</i>
61	<i>Electronic ballast</i>	<i>Philips /Wipro/Bajaj/Decon/Crompton/Havells</i>
62	<i>DLP plastic trunking</i>	<i>Legrand/MK</i>
63	<i>Geysers</i>	<i>Recold /Venus /Usha Lexus /Sphere hot</i>
64	<i>Tower Light</i>	<i>Ligman/Simes/Bega</i>

65	<i>HT/LT transformers</i>	<i>ABB/Schneider /CGL (Crompton Greaves Ltd.)</i>
66	<i>HT SF-6 circuit breakers/VCB</i>	<i>Siemens /ABB/CGL</i>
67	<i>Programmable Logic Controller(PLC)</i>	<i>Siemens/Allen-Bradley/Schneider</i>
68	<i>Earthing (Chemical Earthing) Plate Earthing</i>	<i>JMV/As per CPWD Norms</i>
69	<i>Octagonal Pole</i>	<i>Bajaj/Crompton/Phillips</i>
70	<i>11 kV HT panel I/c relay</i>	<i>CGL/Schneider/ABB</i>
71	<i>Control Relay Panel</i>	<i>CGL/Schneider/ABB</i>
72	<i>Lightning Arrestor</i>	<i>ABB/Alltec/JMV</i>
73	<i>Temp. Gauge</i>	<i>Guru</i>
74	<i>Gate Valve</i>	<i>Leader/Sant</i>
75	<i>Electrical Backup</i>	<i>Spare hot/ Racold</i>
76	<i>PVC Tank</i>	<i>Syntex/ Polycon</i>
77	<i>Thermostat</i>	<i>ISI Marked</i>
78	<i>Flat Collector Plate</i>	<i>Solocrome/ Tata BP/ Racold</i>
79	<i>S.S Sheet</i>	<i>Jindal / National</i>
80	<i>HT/LT cable joints (Straight through/outdoor/indoor)</i>	<i>3M/ Denson/ GSeal</i>
81	<i>Alternator</i>	<i>STAMFORD</i>
82	<i>DG Set</i>	<i>Sterling & Wilson /Caterpillar/Commins Power / eneration</i>