TENDER DOCUMENT

FOR

SUPPLY, ERECTION, TESTING AND COMMISSIONING OF 11kV UNDERGROUND CABLE RING MAIN INCLUDING 2 NOS. COMPACT SUBSTATIONS AT CHEMICAL SCIENCE (1250kVA) AND E-TYPE QUARTERS (500kVA), EXTENSION OF EXISTING 11kV SWITCHGEAR PANEL AT 66kV MUSS BY ADDING 4 NOS. OF 11kV VCB PANELS, REPLACEMENT OF EXISTING 11kV LOAD BREAK SWITCH UNIT BY ADDING 1 NO. OF 11kV COMPACT RMU AT SS-14, ADDITION OF 1 NO. OF 11/0.415kV, 1.0MVA TRANSFORMER AND EXTENSION OF 415V PANEL BY ADDING 3 NOS. OF 415V PANEL AT PHYSICAL SCIENCE AND ASSOCIATED 11kV BUSDUCT, 11kV & 415V CABLING WORK INCLUDING ALL CIVIL WORKS AT IISC CAMPUS

INDIAN INSTITUTE OF SCIENCE
BANGALORE -560012

CONTENTS

TENDER NOTIFICATION

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Tender Notification No. **09/CCMD/2016-17** Date**d 28-10-2016**

Sealed item rate tenders in Two cover system (Technical & Financial Bids) accompanied by E.M.D. by way of Crossed Demand Draft drawn in favour of the Registrar, Indian Institute of Science are invited in duplicate from the eligible Registered under SUPER GRADE CLASS (ELECTRICAL), Karnataka/equivalent grade of other States/Manufacturer(License not required) ,Contractors of CPWD/KPWD/MES/Railways for the following work:

Tender documents may be downloaded from the website www.iisc.ac.in/opportunities/tenders/ from **18.11.2016 to 09.12.2016**, for a non-refundable fee (for two sets) as indicated in the Table below, in the form of Demand Draft on any Nationalized/ Scheduled bank payable at Bangalore in favour of "Registrar, Indian Institute of Science". Interested tenders may obtain further information at the same address.

The Technical Bid & Financial Bid shall be submitted in two separate sealed covers duly superscribed as TECHNICAL & FINANCIAL BID. These two covers shall be submitted in a single cover duly superscribing the name of the work with name and address of the tenderer addressed to the Project Engineer cum Estate Officer, CCMD on or before **16.12.2016** up to 3.00 p.m

Sl. No.	Name of the Work	Estimated Cost (Rs. in lakhs)	E.M.D. Rs.	Cost of Tender Documents Rs.	Time for completion of work
	SUPPLY, ERECTION, TESTING AND COMMISSIONING OF 11kV UNDERGROUND CABLE RING MAIN INCLUDING 2 NOS. COMPACT SUBSTATIONS AT CHEMICAL SCIENCE (1250kVA) AND E-TYPE QUARTERS (500kVA), EXTENSION OF EXISTING 11kV SWITCHGEAR PANEL AT 66kV MUSS BY ADDING 4 NOS. OF 11kV VCB PANELS, REPLACEMENT OF EXISTING 11kV LOAD BREAK SWITCH UNIT BY ADDING 1 NO. OF 11kV COMPACT RMU AT SS-14, ADDITION OF 1 NO. OF 11/0.415kV, 1.0MVA TRANSFORMER AND	**444.00**	6,66,000/-	10,000/-	8 (Eight Months)

	EXTENSION OF 415V PANEL BY ADDING 3 NOS. OF 415V PANEL AT PHYSICAL SCIENCE AND ASSOCIATED 11kV BUSDUCT, 11kV & 415V CABLING WORK INCLUDING ALL CIVIL WORKS AT IISC CAMPUS				

1. **Schedule of dates**

    a. Commencement of downloading the tender documents : **18/11/2016**
    b. A pre-bid meeting is arranged on 02.12.2016 at 4.00 p.m. at the office of Centre for Campus Management and Development. The agencies who are having queries on the tender will be clarified.
    c. Last date for downloading the tender document : **09/12/2016**
    d. Last date for Receipt of duly filled tenders along with cost of Tender documents and EMD to be enclosed in Technical Bid is up to **16.12.2016 3.00 P.M**

2. **Eligibility criteria** :
    a. The agency / Manufacturers should have executed a single work of similar nature work in Government/Semi-Government costing not less than 80% of the estimated cost of this tender work in any of the financial year during the preceding five years from 2011-12 to 2015-16
    b. The agencies who have executed similar nature of work are eligible to obtain the tender documents.
    c. The agency should have given a financial turnover with a minimum of Rs. 888 lakhs in any two consecutive years in the preceding five years from 2011-12 to 2015-16.

3. The eligible Contractors satisfying the above conditions can obtain the Tender forms and other related details including specification and schedule of quantities from the Project Engineer cum Estate Officer, CCMD, IISc after paying the prescribed fee in the form of Demand Draft.

4. The tenderer shall submit the cost of Tender documents and E.M.D in the form of Demand Draft separately drawn in favour of the Registrar, IISc along with the technical bid.

5. Conditional tenders ARE LIABLE TO BE REJECTED

6. The last date for submission of duly filled tender form along with the Tender document and EMD is **16.12.2016** up to 3.00 P.M. and the technical bid will be open on the same day at 3.30 P.M or otherwise the next convening working day during office hours.

7. Financial bid of technically qualified agencies only will be opened. The date and time of opening the financial bids of successful agencies will be intimated separately.

8. The firm seeking exemption of tender fees and EMD shall produce sufficient document proof for having registered with NSIC for claiming exemption.

9. The institute reserves the right to accept or reject any or all tenders without assigning any reasons therof.

REGISTRAR

CENTRE FOR CAMPUS MANAGEMENT AND DEVELOPMENT, INDIAN INSTITUTE OF SCIENCE

BANGALORE 560 012

PRE-QUALIFICATION DOCUMENT FOR TECHNICAL BID

NAME OF WORK : SUPPLY, ERECTION, TESTING AND COMMISSIONING OF 11kV UNDERGROUND CABLE RING MAIN INCLUDING 2 NOS. COMPACT SUBSTATIONS AT CHEMICAL SCIENCE (1250kVA) AND E-TYPE QUARTERS (500kVA), EXTENSION OF EXISTING 11kV SWITCHGEAR PANEL AT 66kV MUSS BY ADDING 4 NOS. OF 11kV VCB PANELS, REPLACEMENT OF EXISTING 11kV LOAD BREAK SWITCH UNIT BY ADDING 1 NO. OF 11kV COMPACT RMU AT SS-14, ADDITION OF 1 NO. OF 11/0.415kV, 1.0MVA TRANSFORMER AND EXTENSION OF 415V PANEL BY ADDING 3 NOS. OF 415V PANEL AT PHYSICAL SCIENCE AND ASSOCIATED 11kV BUSDUCT, 11kV & 415V CABLING WORK INCLUDING ALL CIVIL WORKS AT IISc CAMPUS

CENTRE FOR CAMPUS MANAGEMENT AND DEVELOPMENT

INDIAN INSTITUTE OF SCIENCE - Bangalore 560 012

PART - A

TECHNICAL BID (PRE-QUALIFICATION DOCUMENT)

NAME OF WORK	SUPPLY, ERECTION, TESTING AND COMMISSIONING OF 11kV UNDERGROUND CABLE RING MAIN INCLUDING 2 NOS. COMPACT SUBSTATIONS AT CHEMICAL SCIENCE (1250kVA) AND E-TYPE QUARTERS (500kVA), EXTENSION OF EXISTING 11kV SWITCHGEAR PANEL AT 66kV SWITCHYARD BY ADDING 4 NOS. OF 11kV VCB PANELS, REPLACEMENT OF EXISTING 11kV LOAD BREAK SWITCH UNIT BY ADDING 1 NO. OF 11kV COMPACT RMU AT SS-14, ADDITION OF 1 NO. OF 11/0.415kV, 1.0MVA TRANSFORMER AND EXTENSION OF 415V PANEL BY ADDING 3 NOS. OF 415V PANEL AT PHYSICAL SCIENCE AND ASSOCIATED 11kV BUSDUCT, 11kV & 415V CABLING WORK INCLUDING ALL CIVIL WORKS AT IISc CAMPUS
ISSUED TO	
DD / RECEIPT NO. & DATE	
LAST DATE FOR SUBMISSION OF TENDER DOCUMENTS ALONG WITH EMD	

FACE SHEET

(To be filled at the time of issue of Tender Document)

1.0	Name of the work	SUPPLY, ERECTION, TESTING AND COMMISSIONING OF 11kV UNDERGROUND CABLE RING MAIN INCLUDING 2 NOS. COMPACT SUBSTATIONS AT CHEMICAL SCIENCE (1250kVA) AND E-TYPE QUARTERS (500kVA), EXTENSION OF EXISTING 11kV SWITCHGEAR PANEL AT 66kV SWITCHYARD BY ADDING 4 NOS. OF 11kV VCB PANELS, REPLACEMENT OF EXISTING 11kV LOAD BREAK SWITCH UNIT BY ADDING 1 NO. OF 11kV COMPACT RMU AT SS-14, ADDITION OF 1 NO. OF 11/0.415kV, 1.0MVA TRANSFORMER AND EXTENSION OF 415V PANEL BY ADDING 3 NOS. OF 415V PANEL AT PHYSICAL SCIENCE AND ASSOCIATED 11kV BUSDUCT, 11kV & 415V CABLING WORK INCLUDING ALL CIVIL WORKS AT IISc CAMPUS
2.0	Tender Document sold to	
3.0	Date of issue of blank documents to the Contractor	
4.0	Last date of receipt of filled up Tender Documents along with EMD	
5.0	Opening of Technical Bids	
6.0	Opening of technically qualified financial bids	

PROJECT ENGINEER cum ESTATE OFFICER

CCMD

TO BE FILLED AT THE TIME OF OPENING OF ALL TENDERS

1.0	Whether the Contractor has remitted the EMD and how?	:	DD/Banker's Cheque
2.0	No. and Date of DD/Banker's Cheque	:	
3.0	Name of the Bank	:	
4.0	Whether the Contractor fulfills all the conditions of EMD	:	
5.0	Whether the Contractor fulfills all the conditions of Tender Notification and Conditions of Contract etc.	:	
6.0	Whether counter conditions, if any, are put by the Contractor?	:	

Opened by me on this day _____ at _____.

Total no. of corrections in the tender :

Place : Bangalore

Date :

PROJECT ENGINEER cum ESTATE OFFICER

CCMD

LETTER OF APPLICATION

(To be submitted on the letter head of the applicant)

To,

Project Engineer cum Estate Officer

Indian Institute of Science,

Bangalore - 560 012.

Karnataka.

Subject: Supply, Erection, Testing And Commissioning Of 11kV Underground Cable Ring Main Including 2 Nos. Compact Substations at Chemical Science (1250kVA) And E-TYPE Quarters (500kVA), Extension Of Existing 11kV Switchgear Panel at 66kV Switchyard by Adding 4 Nos. Of 11kV VCB Panels, Replacement Of Existing 11kV Load Break Switch Unit By Adding 1 Nos. Of 11kV Compact RMU At SS-14, Addition Of 1 Nos. Of 11/0.415kV, 1.0MVA Transformer And Extension Of 415V Panel By Adding 3 Nos. Of 415V Panel At Physical Science And Associated 11kV BUSDUCT, 11kV & 415V Cabling Work Including All Civil Works At IISc Campus

1.0 Being duly authorized to act on behalf of _____ (Name of the applicant) herein after referred to as the "Applicant" and having received and fully understood all the prequalification information provided, the undersigned hereby applies to be qualified by yourselves as a bidder for the following work.

2.0	Following are the copies of original documents shall be submitted along with the offer	:
2.1	Certification of incorporation	:
2.2	Class - I Electrical Contractors License	:
2.3	Audited balance sheets and profit & loss accounts for last 3 years	:
2.4	Sales Tax registration certificate and sales tax clearance certificate	:
2.5	Service Tax registration certificate	:
2.6	PF registration certificate	:
2.7	ESI registration certificate	:
2.8	Proof of having executed one project of similar nature not less than Rs.355 Lakhs	
	(Copies of purchase order & completion certificate)	:
2.9	Solvency certificate for 40% of the amount of tender	:

3.0 Your department and its authorized representatives are hereby authorized to conduct any enquiries or investigations to verify the statements, documents and information submitted in connection with this application and to seek clarification from our bankers and clients regarding any financial and technical aspects. This letter of application will also serve as authorization to any individual or authorized representatives of any institutions refer to in the supporting information, to provide such information deemed necessary and requested to yourselves to verify statements and information provided in this application or with regard to the resources, experience and competence of the applicant.

4.0 Bidder shall fulfill following general requirements:

4.1 Bidder shall have adequate experience in Design, Installation, Testing & Commissioning of RMU, Compact Substation, Transformers, HT UG Cabling and Associated Civil Works including Quality Control and shall have the entire infrastructure required to execute the works.

4.2 The bidder shall possess valid CLASS-I (ELECTRICAL) LICENSE in KPTCL / CPWD / KPWD / MES / RAILWAYS / EQUIVALENT GRADE OF OTHER STATES as applicable / reputed manufacturing companies.

4.3 For Manufacturer, CLASS-I (ELECTRICAL) LICENSE is not mandatory.

5.0 Bidder shall meet the following minimum financial requirements:

5.1 The annual turnover of the bidder during any two consecutive years in the last 5 years from 2011-2012 to 2015-2016 shall be not less than Rs.887 Lakhs.

5.2 Bidder shall be financially sound to execute this contract. Solvency required will be approximately 40% of the amount of Tender.

5.3 Bidder shall have valid Service Tax and Sales Tax, PF and ESI registrations.

6.0 Bidder shall meet the following minimum technical capabilities:

6.1 The firm should have executed a single work of Design, Installation, Testing and Commissioning of at least one (1) 11kV Underground Cable Ring Main including Two (2) Compact Substations, Extension of existing 11kV Switchgear Panel by adding Four (4) 11kV VCB Panels, Replacement of Existing LBS unit by adding One (1) 11kV Compact RMU, Addition of 11/0.415kV 1.0MVA Transformer and extension of 415V Panel by adding Three (3) 415V Panel and associated 11kV/415V Cabling work on total Turnkey basis complete all Civil works / similar nature in Government / Semi Government / Reputed Organizations costing not less than 80% of the estimated cost in any one of the financial years during the block period of previous five years. Agency shall submit copy of purchase order and completion for authentic verification of similar works carried out.

6.2 The agencies who have executed at least one work of similar nature at least in the last 5 years as on date of bid submission of Supply, Erection, Testing and Commissioning of 11kV Underground Ring Main Unit, Compact Substations, 11kV Switchgear Panel, 11kV Compact RMU, 11/0.415kV 1.0MVA Transformer including all Civil works will qualify for the opening of the Technical Bid. List of such jobs executed and on hand with value shall submit with the bid.

6.3 Bidder shall have full-fledged Engineering, Quality, Erection and Project Management departments in their projects division.

6.4 The bidder shall supply ISO: 9000 certified equipments.

7.0 Eligible Contractor satisfying the above conditions can obtain the Tender Forms and other related details including Specifications and Schedule of Quantities from the Project Engineer cum Estate Officer, CCMD, IISc Bangalore after paying the prescribed fee in the form of Demand Draft in favor of the Registrar, IISc. The Tenderer shall submit the EMD in the form of Demand Draft drawn in the favor of The Registrar, IISc to be submitted in the Technical Bid.

8.0 Bidder shall have full-fledged Engineering, Quality, Erection and Project Management departments in their projects division. Your agency or its authorized representatives may contact the following persons for further information.

Technical Enquiries :
Name :
Designation :
Address :
Telephone :
Fax :
Email address :

9.0 Conditional tenders shall not be accepted.

10.0 Bidder shall comply with latest safety codes and safety practices. IISc shall not be held responsible for any mischief during project execution.

11.0 This application is made in full understanding that:

11.1 The qualified Contractor will be subjected to verification of all information for prequalification at the time of submission of tender documents.

11.2 IISc reserves the right without assigning any reasons for its actions and decisions to amend the scope of any work under this project. In such event, bids will be invited from qualified bidders who meet the revised requirements.

11.3 IISc reserves the right, without assigning any reasons for its action & decisions to reject or accept any application and cancel the process & reject all applications.

11.4 IISc shall not be liable for any such actions and shall be under no obligation to inform the applicants for such actions and decisions.

12.0 The undersigned declare that the statements made and the information furnished in the tender document is true and correct.

SIGNATURE OF THE BIDDER

(With Seal & Date)

DETAILS OF SIMILAR NATURE FOR PAST FIVE YEARS FROM 2011-2012 TO 2015-2016

PROJECT NAME	NAME OF EMPLOYER	DESCRIPTION OF WORK	CONTRACT NO.	VALUE OF CONTRACT	DATE OF WORK ORDER	STIPULATED PERIOD OF COMPLETION	ACTUAL DATE OF COMPLETION		REMARKS EXPLAIN REASONS FOR DELAY

Enclose satisfactory certificate and date of completion from the concerned engineer-in-charge not below the rank of Executive Engineer or Competent Authority.

Certificate/Testimonials will be verified, if required.

SIGNATURE OF BIDER

(With date and seal)

A) EXISTING COMMITMENTS AND ON-GOING WORKS OF SIMILAR NATURE

DESCRIPTION OF WORK	PLACE AND STATE	CONTRACT NO. AND DATE	NAME AND ADDRESS OF EMPLOYER	VALUE OF CONTRACT (Rs. IN LAKHS)	STIPULATED PERIOD OF COMPLETION	VALUE OF WORKS REMAINING TO BE COMPLETED	ANTICIPATED DATE OF COMPLETION

1.0 Details to be furnished with necessary work order signed from concerned Engineer-in-charge not below the rank of Executive Engineer or Competent Authority.

2.0 Work Order/Testimonials will be verified if required.

SIGNATURE OF BIDDER
(With date and seal)

DETAILS OF SINGLE GOVERNMENT / SEMI GOVERNMENT / REPUTED ORGANIZATIONS SIMILAR NATURE OF WORK COSTING Rs.355 LAKHS (80% OF THE ESTIMATED COST) & ABOVE CARRIED OUT DURING PREVIOUS FIVE FINANCIAL YEARS 2011-2012 T0 2015-2016

PROJECT NAME	NAME OF EMPLOYER	DESCRIPTION OF WORK	CONTRACT NO.	VALUE OF CONTRACT	DATE OF WORK ORDER	STIPULATED PERIOD OF COMPLETION	ACTUAL DATE OF COMPLETION	REMARK EXPLAIN (REASONS FOR DELAY)

B) SIMILAR NATURE OF WORK FOR WHICH TENDERS SUBMITTED PENDING FINALIZATION

DESCRIPTION OF WORK	PLACE AND STATE	ESTIMATED VALUE OF WORKS (Rs IN LAKHS)	STIPULATED PERIOD OF COMPLETION	DATE WHEN DECISION IF EXPECTED	REMARKS IF ANY

1.0 Details to be furnished with necessary work order signed from concerned Engineer-in-charge not below the rank of Executive Engineer or Competent Authority

2.0 Work Order/Testimonials will be verified if required.

SIGNATURE OF BIDDER

(With date and seal)

DETAILS OF MACHINERIES AND EQUIPMENTS:

EQUIPMENT	QUANTITY IN NUMBERS	CAPACITY / SIZE	AGE & CONDITION	OWNED / HIRED

Note: The Agency should have their own machineries and equipments required for Installation, Testing and Commissioning of project. In case any of these machineries/equipments are proposed to be hired, ownership documents with necessary hire/lease agreement from the owner of the machineries/equipments shall be obtained and furnished.

SIGNATURE OF BIDDER

(With date and seal)

QUALIFICATION AND EXPERIENCE OF KEY PERSON PROPOSED FOR ADMINISTRATION AND EXECUTION OF THE PROJECT

(Attach biographical data along with support documents in the following Performa)

DESIGNATION	NAME	QUALIFICATION	YEAR OF EXPERIENCE (GENERAL)	YEAR OF EXPERIENCE IN THE PRESENT POSITION

SIGNATURE OF BIDDER

(With date and seal)

FINANCIAL REPORT FOR LAST FIVE YEARS ENDING WITH 2011-2012 TO 2015-2016

(Balance sheets, Profit and Loss Statements and Annual Turn Over)

Sl. No.	YEAR	TURN OVER AMOUNT	REMARKS
1.0	2011 - 2012		
2.0	2012 - 2013		
3.0	2013 - 2014		
4.0	2014 - 2015		
5.0	2015 - 2016		

Enclose Certificate from concerned Engineer-in-charge not below the rank of Chartered Accountant.

SIGNATURE OF BIDDER

(With date and seal)

FINANCIAL CAPABILITY

Name of the applicant	:	

Banker					
Address of the Banker:					
Telephone/Fax/Telex:			Contract name & Title		
Financial Information (Rs. in Lakhs)	Actual previous Five Financial Years				
	2011 - 2012	2012 - 2013	2013 - 2014	2014 - 2015	2015 - 2016
1.0 Total assets					
2.0 Total liabilities					
3.0 Net worth					
4.0 Working capital					

Note:

1.0 Attach audited financial statements for last three years signed by Competent Authority.

2.0 Income Tax clearance certificate to be enclosed duly signed by Competent Authority.

SIGNATURE OF BIDDER

(With date and seal)

INFORMATION OF LITIGATION HISTORY IN WHICH BIDDER IS INVOLVED

SL. NO	OTHER PARTY	CAUSE OF DISPUTE	AMOUNTS INVOLVED	PRESENT STATUS

Earnest Money Deposit (EMD) (DD No. _____, Dated _____)

Enclosed/Not Enclosed

SIGNATURE OF BIDDER

(With Date and Seal)

GENERAL CONDITIONS & AGREMENT CLAUSE

General Condition of the Contract

a) This "General rules and directions to contractors "shall also form part of the tender document.

b) The Tenders are valid for 3(three) months from date of opening.

c) Time is the essence of the contract. Time of completion allowed is EIGHT months from the date of work order.

d) The letter of intent shall be issued soon followed by the formal work order.

e) The contractor is expected to visit the site and study the probable routes of transportation of material to the site before quoting.

f) The successful tenderer is required to sign an agreement for the due fulfillment of the contract and start the work immediately on of the acceptance of his tender. A draft of the articles of the agreement is enclosed.

g) All the items of the work are to be executed as per relevant IS specifications.

h) Only first quality materials shall be allowed for the work. The samples of all materials shall be got approved by the Engineer-in-charge before supplying for the work. For all items prior approval will have to be taken from Engineer-in-charge.

i) It is entirely the responsibility of the contractor to arrange for and provide all materials required for successful completion of the work.

j) The rates quoted by the contractor shall include all taxes, conveyance, loading and unloading charges, labour supervision thereof, of all tools and implements, incidental charges and all that is required for the complete work.

k) All the routine tests for 11KV cables and panels etc., to be carried out at the factory in the presence of the IISc representative and test certificate produced along with the catalogue and maintenance manual and the agency at his cost shall arrange for such inspection. However, no separate payments shall be made in this regard.

l) Schedule of quantities (Bill of Quantities) along with technical specifications is attached herewith. It should however, be clearly understood that these quantities are liable to alterations by omission, addition or variation, at the discretion of the Engineer-in-charge.

m) The Contractor has to agree and strictly abide to all the conditions stipulated in the tender and any offers with deviation or request for deviation are liable to be rejected.

n) The Contractor shall obtain the Clearance certificate from Chief Electrical Inspectrate to Government(CEIG), Chennai after completion of work. Requisite fee for CEIG inspection and approval shall be paid by IISc. Final bill will be paid only after the clearance certificate from CEIG is received.

o) The debris arises during the progress of work should be cleared then and there to keep the surrounding clean and tidy, such debris shall, if not cleared, be cleared at Contractors risk and cost.

p) Right to recovery for Loss / Damage: Any cost incurred by the Institute in connection with any improper performance of this contract by the Contractor, his workmen, servants pr agents and any money which may become payable to Institute as aforesaid and by way of any omission and commission of work, all compensation for any losses or damages, shall be deemed to be money due under the terms of this contract and may be deducted by the Institute from any money due or accruing to the Contractor by the Institute or may be recovered by the Institute from the Contractor in any other manner as deemed fit.

q) The guarantee shall be 12 months from the date of handing over the installation duly energized.

r) The contractor has to prepare a time schedule for the complete work in detail and submit to Engineer-in-charge in triplicate within 10 days from the day of letter of intent. This shall be modified to suit the civil construction work.

s) Registrar / Director, IISc reserves the right for accepting or rejecting any or all the tenders without assigning any reason thereof.

Clause 1.: SECURITY DEPOSIT

(a) The person/persons whose tender may be accepted (hereinafter called the contractor which expression shall unless the context otherwise requires, include his heirs, executors, administrators and assigns) shall pay Earnest Money Deposit indicated in Column (ii) of the table given below and shall permit Institute (a) to deduct FSD at the percentage mentioned in Column (iii) of the table given below of all moneys payable for work done under the Contract, at the time of making such payments to him/them and (b) to hold such deductions as Further Security Deposit (FSD).

Estimated cost of the work	E.M.D Percentage	F.S.D Percentage
(i)	(ii)	(iii)
Upto Rs.20,00,000/-	2 ½%	5%
Rs.20,00,000/- upto Rs.1.00 Crore	2%	5 ½%
Rs.1.00 crore upto Rs.10 crores	1½%	6%
10 crores and above	1%	6 ½%

(b) Addition or Reduction in Security Deposit.

The EMD for the tendered work and additional amount of Security Deposit at the rates mentioned in Sub-clause 1(a) above should be, paid by the contractor. It a portion of the work is withdrawn from the Contractor under the provisions of Clause 12(a), the Project Engineer cum Estate Officer(CCMD), Indian Institute of Science(hereinafter referred to as the Project Engineer cum Estate Officer) may allow a proportionate reduction in the amount of the Security Deposit.

(c) Dues to Institute, to be set off against Security Deposit.

All compensation or other sums of money payable by the Contractor to Institute under the terms of this contract may be realized or deducted from any Security Deposit payable to him or from any sums which may be due or may become due by Institute to the Contractor on any account whatsoever and in the event of his security deposit being reduced by reason of any such realization or deduction as aforesaid, the Contractor shall, within ten days thereafter, make good in cash any sum or sums which have been deducted from, or raised by sale of his security deposit or any part thereof.

(d) Refund of Security Deposit (EMD & FSD):

The Security Deposit lodged/paid by a Contractor shall be refunded to him after the final bill is paid or after twelve months from the date of completion of the work, during which period the work should be maintained by the Contracor in good order, whichever is later.

Clause 2. : PENALTY FOR DELAY

(a) Written Order to Commence Work

After acceptance of the tender, The Project Engineer cum Estate Officer, CCMD shall issue a written order to the successful tenderer to commence the work. The Contractor shall enter upon or commence any portion of work only with the written authority and instructions of The Project Engineer cum Estate Officer, CCMD. Without such instructions the Contractor shall have no claim to demand for measurements of or payment for, work done by him.

(b) Program of work

The time allowed for carrying out the work as entered in the tender shall be strictly observed by the contractor. It shall be reckoned from the date of handing over the site to the Contractor not less than 75 percent of work site area comprising a continuous block. The work shall throughout the stipulated period of the contract be proceeded with, all due diligence (time being deemed to be the essence of the contract on the part of the Contractor). To ensure good progress during the execution of the work, the contractor shall be bound (in all cases in which the time allowed for any work exceeds one month) to comply with the time schedule according to the programme of execution of the work as agreed upon and enclosed to the agreement.

(c) Review of progress and responsibility for delay etc.,

The Project Engineer cum Estate Officer, CCMD shall review the progress of all works with the contractor during the first fortnight of every month. Such a review
shall take into account the programme fixed for the previous month,
obligations on the part of the Contractor.

(d) Apportioning of responsibility for delay between Contractor and Institute.

In case the progress achieved falls short by more than 25 percent of the cumulative programme, the reasons for such shortfall shall be examined and a record made thereof apportioning the responsibilities for the delay between the contractor and the Institute. This record should be signed in full and dated both by The Project Engineer cum Estate Officer, CCMD and the Contractor.

(e) Shortfall in progress made up subsequently.

To the extent the shortfall is assessed, as due to the delay on the part of the contractor, a notice shall be issued to him by The Project Engineer cum Estate Officer, CCMD to make up the shortfall . If the shortfall is not made up before the progress of the work is reviewed during the second month succeeding the month in which the shortfall was observed, the Contractor shall be liable to pay penalty as indicated in Clause 2(h) below.

(f) Grant of extension of time.

If the delay is attributable to reasons beyond the control of the Contractor, requisite extension of time shall be granted by The Project Engineer cum Estate Officer, CCMD in accordance with Clause 5 after obtaining the approval of his higher authorities, wherever necessary.

(g) Settlement of dispute regarding shortfall in progress.

In case of dispute between The Project Engineer cum Estate Officer,CCMD and Contractor regarding the responsibility for the shortfall in progress, the matter shall be referred to the Director, IISc., who shall thereupon give a decision within fifteen days from the date of receipt of reference. The decision of the Director shall be final and binding on the contractor and The Project Engineer cum Estate Officer,CCMD.

(h) Penalty for delay

In respect of the shortfall in progress, assessed as due to the delay on the part of contractor as per Clause 2(b) and 2 (c), the contractor shall be liable to pay as penalty an amount equal to one percent of the estimated value of the balance work assessed according to the programme, for every week that the due quantity of work remains incomplete; provided always that the total amount of penalty to be paid under the provisions of this clause shall not exceed 7 ½ percent of the estimated cost of the entire work as shown in the tender, provided further that in the event of the contractor making up the shortfall in progress within the stipulated or extended time of completion, the penalty so recovered may be refunded on an application in writing by the contractor.

Note: *If The Project Engineer cum Estate Officer,CCMD considers it necessary he shall be entitled to take action as indicated in Clause 3 (d) also.*

(i) Adjustment of excess/over payments.

Excess/over payments as soon as they are discovered should be adjusted in the next running account bill of the contractor and in case the final bill has already been paid, the excess/over payment made shall be recovered from the Security Deposit of the contractor together with interest at such percentages as Institute may decide from time to time, from the date of such excess or over payment to the date of recovery.

Clause 3.: ACTION WHEN WHOLE OF SECURITY DEPOSIT IS FORFEITED

In any case in which under any clause or clauses of this contract the contractor shall have rendered himself liable to pay compensation and/or penalty amounting to the whole of his security deposit including the amount deducted in installment from his bills as Further Security Deposit, The Project Engineer cum Estate Officer, CCMD on behalf of the Director, IISc., shall have power to adopt any of the following courses as he may deem best suited in the interest of Institute.

(a) Forfeiture of Security Deposit

Without prejudice to Institute's right to recover any loss from the Contractor under sub-clauses (b) and (c) of Clause 3 of the Contract, to rescind the contract (of which rescission notice in writing to the contractor under the hand of The Project Engineer cum Estate Officer, CCMD shall be conclusive evidence). And in that case, the security deposit of the contractor including whole or part of the lump sum deposited by him and also the amount deducted from his bills as Further Security Deposit, shall stand forfeited and be absolutely at the disposal of the Institute.

(b) Debiting cost of labour and materials supplied.

To employ labour paid by the Institute and to supply materials to carry out the work or any part of the work, debiting the contractor with the cost of the labour and the price of the materials (as to the correctness of which cost and price the certificate of the The Project Engineer cum Estate Officer, CCMD shall be final and conclusive against the contractor) and crediting him with the

value of the work done; in all respects in the same manner and at the same rates as if it had been carried out by the contractor under terms of this contract, and in that case the certificate of the The Project Engineer cum Estate Officer, CCMD as to the value of the work done shall be final and conclusive against the contractor.

(c) Recovery of extra cost on unexecuted work

To measure up the work of the contractor and to take such part thereof as is remaining unexecuted out of his hands and to give it to another contractor to complete it in which case any expenses which may be incurred in excess of the sum which would have been paid to the original contractor, if the whole work had been executed by him (as to the amount of which excess expenses the certificate in writing of the The Project Engineer cum Estate Officer, CCMD shall be final and conclusive) shall be borne and paid by the original contractor and shall be deducted from any money due to him by Institute under this contract.

(d) Action against unsatisfactory progress

If the contractor does not maintain the rate of progress as required under Clause 2 and if the progress of .any particular portion of work is unsatisfactory even after taking action under Clause 2(c) and 2(d), the The Project Engineer cum Estate Officer, CCMD shall be entitled to take action under Clause 3(b) or 3(c) at his discretion in order to maintain the rate of progress after giving the contractor 10 days notice in writing whereupon the contractor will have no claim for any loss sustained by him owing to such actions .

(e) No compensation for loss sustained on advance action

In the event of any of the above courses being adopted by the Project Engineer cum Estate Officer,CCMD, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased, or procured any materials, entered into any agreements or made any advances on account of, or with a view to the execution of the work or the performance of the contract. And in case the contract shall be rescinded under the provision aforesaid the contractor shall not be entitled to recover or be paid any sum for any work thereof actually performed by him under his contract, unless and until the Project Engineer cum Estate Officer,CCMD shall have certified in writing the performance of such work and the amount payable in respect thereof, and he shall only be entitled to be paid the amount so certified.

Clause 4.: CONTRACTOR TO REMAIN LIABLE TO PAY COMPENSATION IF ACTION IS NOT TAKEN UNDER CLAUSE-3.

(a) In any case in which any of the powers conferred upon the the Project Engineer cum Estate Officer, CCMD by Clause 3 thereof shall have become exercisable and the same shall not have been exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the contractor for which under any clause hereof he is declared liable to pay compensation or penalty amounting to the whole of his security deposit and the liability of the contractor for past and future compensation or penalty shall remain unaffected.

(b) Power to take possession of or require removal of or sell contractor's properties.

In the event of the The Project Engineer cum Estate Officer, CCMD taking action under sub-clause (a) or (c) of Clause 3, he may, if he so desires, take possession of all or any tools, plant, materials and stores, in or upon works or the site thereof or belonging to the contractor, or procured by him and intended to be used for the execution of the work or any part thereof, paying or allowing for the same in account at the contract rates; or in the case of contract rates not being applicable, at current market rates, to be certified by the The Project Engineer cum Estate Officer, CCMD whose certificate thereof shall be final. In the alternative, the Project Engineer cum Estate Officer, CCMD may after giving notice in writing to the contractor or his clerk of the works, foreman or other authorised agent, require him to remove such tools, plant, materials or stores from the premises within a time to be specified in such notice; and in the event of the contractor, failing to comply with any such requisition, the Project Engineer cum Estate Officer, CCMD may remove them at the contractor's expense or sell them by auction or private sale on account of the contractor and at his risk in all respect, and the certificate of the The Project Engineer cum Estate Officer, CCMD as to the expense of any such removal; and the amount of the proceeds and expense of any such sale shall be final and conclusive against the contractor.

Clause 5.: GRANT OF EXTENSION OF TIME

(a) If the contractor shall desire an extension of the time for completion of the work, on the ground of his having been unavoidably hindered in its execution or on any other ground, he shall apply in writing to the Project Engineer cum Estate Officer, CCMD before the expiry of the period stipulated in the tender or before the expiry of 30 days from the date on which he was hindered as aforesaid or on which the cause for asking for extension occurred, whichever is earlier and the Project Engineer cum Estate Officer, CCMD or other competent authority may if in his opinion, there are reasonable grounds for granting an extension, grant such extension as he thinks necessary or proper. The decision of such competent authority in this matter shall be final.

(b) The time limit for completion of the work shall be extended commensurate with its increase in cost occasioned by alterations or additions and the certificate of the Project Engineer cum Estate Officer,CCMD or other competent authority as to such proportion shall be conclusive.

Clause 6.: ISSUE OF FINAL CERTIFICATE – CONDITIONS REGARDING

(a)On completion of the work the contractor shall report in writing to the Project Engineer cum Estate Officer,CCMD the completion of the work. Then he shall be furnished with a certificate by the Project Engineer cum Estate Officer, CCMD of such completion, but no such certificate shall be given nor shall the work be considered to be complete until the contractor shall have removed from the premises on which the work shall have been executed, all scaffolding, surplus materials and rubbish, and shall have cleaned thoroughly all wood work, doors, windows, wall, floor or other parts of any building, in or upon which the work has been executed, or of which he may have had possession for the purpose of executing the work, nor until the works shall have been measured by the Project Engineer cum Estate Officer, CCMD or other competent authority, or where the measurements have been taken by his Engineer-in-charge until they have received the approval of the Project Engineer cum Estate Officer, CCMD or other competent authority, the said measurements being binding and conclusive against the contractor. If the contractor shall fail to comply with the requirements of this clause as to the removal of scaffolding, surplus materials and rubbish, and cleaning on or before the date fixed for the completion of the work the Project Engineer cum Estate Officer, CCMD or other competent authority may, at the expense of the contractor, remove such scaffolding, surplus materials and rubbish, and dispose of the same as he think fit and clean off such dirt etc., as aforesaid and

contractor shall be liable to pay the amount of all expenses incurred but shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

(b) CLOSURE OF CONTRACT PENDING COMPLETION OF MINOR ITEMS.

In cases where it is not desirable to keep the building contract open for minor items, such as flooring in the bath rooms, etc., which can be carried out only after installation of sanitary work the main contract may be finalized after getting a supplementary agreement executed in the prescribed form by the same contractor for doing the residual work.

Clause 7. : CONTRACTOR TO SUBMITBILLS MONTHLY IN PRINTED FORM

(a) A bill shall be submitted by the contractor on or before 15th of each month for all items of work executed in the previous month as required by IISc.

(b) All bills shall be prepared in the prescribed printed or electronic form in PDF format in quadruplicate and handed over to the Engineer-in-charge in charge of the work/ the Project Engineer cum Estate Officer, CCMD's Office and acknowledgment obtained.

(c) The charges to be made in the bills shall always be entered at the rates specified in the tender in full or in part as the case may be, in the case of any extra work ordered in pursuance of these conditions, and not mentioned or provided for in the tender, the charges in the bills shall be entered at the rates hereinafter provided for such work.

(d) Scrutiny of Bills and measurement of work

The details furnished by the Contractor in the bill will be completely scrutinized and the said work will be measured by the Engineer-in-charge in the presence of the Contractor or his duly authorized agent. The countersignature of the contractor or the said agent in the measurement book will be sufficient proof to the correctness of the measurements, which will be binding on the contractor in all respects. If the contractor does not submit the bills within the prescribed time, the Project Engineer cum Estate Officer,

CCMD may depute within seven days of the prescribed date, an Engineer-in-charge to measure up the said work. The countersignature of the contractor shall be obtained in the Measurement Book concerned with reference to which the Institute may prepare the bill.

(e) One copy of the passed bill will be given to the Contractor without any charge.

Clause 8.: PAYMENT PROPORTIONATE TO WORK APPROVED AND PASSED.

a) No payment shall be made for any work estimated to cost rupees five thousand or less until after the whole of the work shall have been completed and certificates of completion given. But in the case of works estimated to cost more than Rs. 5,000 the contractor shall on submitting the bill and after due verification by the Engineer-in-charge as per Clause 7(d) entitled to necessary payment proportionate to the part of the work then approved and passed by The Project Engineer cum Estate Officer, CCMD or other competent authority whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the contractor.

b) Payment at reduced rates

The rates for several items of works agreed to within shall be valid only when the items concerned are accepted as having been completed fully in accordance with the stipulated specifications. In cases where the items of work are not accepted as so completed, the Project Engineer cum Estate Officer, CCMD or other competent authority may make payment on account of such items at such reduced rates as he may consider reasonable in the preparation of final or on account bills.

c) Payment or intermediate certificates be regarded as advances:

All such intermediate payments shall be regarded as payments by way of advance against the final payments only and not as payments for work actually done and completed, and shall not preclude the Project Engineer cum Estate Officer, CCMD or other competent authority from requiring any bad, unsound imperfect or unskillful work to be removed or taken away and reconstructed or re-erected nor shall any such payment be considered as an

admission for the due performance of the Contract or any part thereof in any respect or the accruing of any claim, nor shall it conclude determine or affect in any other way the powers of the Project Engineer cum Estate Officer, CCMD or other competent authority as to the final settlement and adjustment of the accounts, or otherwise or in any other way vary or affect the contract.

d) Submission of Final bill and its settlement

The contractor shall submit the final bill within one month of the date of actual completion of the work in all respects. His claims shall be settled (except those under dispute) within five months after the final bill is submitted in acceptable form.

e) Disputed items

Note: The contractor shall submit a list of the disputed items within 30 days from the disallowance thereof and if he fails to do this, his claim shall be deemed to have been fully waived and absolutely extinguished.

Clause 9.: DEFINITION OF WORK

(a) The expression `Work' or 'Works' where used in these conditions, shall unless there be something in the subject or context repugnant to such construction, be construed to mean the work or works contracted to be executed under or in virtue of the contract, whether temporary or permanent and whether original, altered, substituted or additional.

(b) Work to be executed in accordance with specifications, drawings, orders etc.

The contractor shall execute the whole and every part of the work in the most sound and substantial and workmanlike manner, and in strict accordance with the specifications both as regards materials and workmanship. The contractor shall also conform exactly, fully and faithfully to the designs, drawings and instructions in writing relating to the work signed by the Project Engineer cum Estate Officer, CCMD or other competent authority and lodged in his office and to which the contractor shall be entitled to have access at such office, or on the site of the work for the purpose of inspection during office hours. The contractor shall also be responsible for the delivery of structure in sound conditions and the execution of the work strictly in accordance with the specifications of the work.

(c) Action where there is no specification

In the case of any class of work for which there is no such specification, then in such a case of the work shall be carried out in all respects in accordance with the instructions and requirements of the Project Engineer cum Estate Officer,CCMD or other competent authority.

(d) Work as per Specifications and IS Codes.

The detailed specification, which forms a part of contract, accompanies the tender document. In carrying out the various items of work as described in Schedule B of the tender documents and the additional, substituted, altered items of work these detailed specification shall be strictly adhered to, supplemented by relevant provisions of the Indian standard specifications, the code of practice; etc., The Indian standard specification and the code of practice to be followed shall be the latest versions of those listed in the detailed technical specifications. Any class of work, not covered by the detailed technical specifications, shall be executed in accordance with the instructions and requirements of the engineer and the relevant provisions of the Indian standard specifications.

Clause 10. : ALTERATION INQUNTITY OF WORK, SPECIFICATION AND DESIGN, ADDITIONAL WORK, DELETION OF WORK

(a) The Project Engineer cum Estate Officer, CCMD shall have power to make any alternations in, omissions from additions to or substitutions for the original specification, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work. For that purpose or if for any other reason it shall in his opinion be desirable, he shall have power to order the Contractor to do and the contractor shall do any or all the following -

(b) Increase or decrease the quantity of any work included in the contract.

(c) Omit any such work.

(d) Change the character or quality or kind of any such work,

(e) Change the levels, lines, positions and dimensions of any part of the work,

(f) Execute additional work of any kind necessary for the completion of the works and

(g) change in any specified sequence, methods or timing of construction of any part of the work.

10.a) Contractor bound by Project Engineer cum Estate Officer, CCMD's instructions

The Contractor shall be bound to carry out the work in accordance with any instructions in this connection which may be given to him in writing signed by the Project Engineer cum Estate Officer, CCMD or other competent authority and such alteration shall not in any way vitiate or invalidate the contract.

Orders for variations to be in writing

(i) No such variations shall be made by the Contractor without an order in writing of the Project Engineer cum Estate Officer provided that no order in writing shall be required for increase or decrease in the quantity of any work where such increase or decrease is the result of the quantities exceeding or being less than those stated in the 'Schedule B' provided also that if for any reason the Project Engineer cum Estate Officer, CCMD shall consider it desirable to give any such order verbally, the Contractor shall comply with such order without any confirmation in writing of such verbal order given by the Project Engineer cum Estate Officer, CCMD, whether before or after the carrying out of the order, shall be deemed to be an order in writing within the meaning of the clause; provided further that if the Contractor shall within seven days confirm in writing to the Project Engineer cum Estate Officer, CCMD and if such confirmation is not contradicted in writing within fourteen days by the Project Engineer cum Estate Officer, CCMD, it shall be deemed to be an order in writing by the Project Engineer cum Estate Officer, CCMD.

(ii) Any additional work which the contractor may be directed to do in the manner above specified as part of the work shall be carried out by the Contractor on same conditions in all respects on which he agreed to do the main work and same rates as are specified in the tender for the main work. However, change in the unit rates tendered and accepted shall be considered in respect of items under which the quantity of work performed exceeds tendered quantity by more than 25 percent and this actual change in rate will be restricted only to such excess quantity (i.e. beyond 125 percent of the tendered quantity).

(b) Rate for excess quantity beyond 125 percent of tendered quantity

The Additional quantity which exceeds 125 percent of the tendered quantity shall be paid at the rates entered in or derived from Schedule of Rates prevalent at the time of executing additions and alterations plus or minus the overall percentage of the original tendered rates over the current Schedule of

Rates (KPWD) of the year in which the tender is accepted (as per the comparative Statement prepared at the time of acceptance of the tender).

(c) Rates for additional, substituted, altered items of work

If the additional, substituted or altered work includes any class of work for which no rate is specified in the contract, then such work shall be carried out at the rates specified for or derived from similar item of work in the agreement. In the absence of similar items in agreement, rate shall be as specified for or derived from similar items in the schedule of rates of KPWD prevalent at the time of execution of such additional substituted or altered items of works, plus or minus the overall percentage of original tendered rates over the current schedule of rates of (KPWD) the year in which tender is accepted as mentioned in sub clause (b) above. With regard to the question whether the additional, substituted or altered item/items of work/works is / are similar or not, to that/those in the agreement / in the Schedule of Rates of KPWD and the decision of the Director shall be final and binding on the contractor.

(d) Determination of rates for items not found in Estimate or Schedule of Rates

If the rates for additional, substituted or altered work cannot be determined in the manner specified in sub clauses (b) and (c) above, then the contractor shall within 7 days of the date of receipt by him of the order to carry out the work, inform The Project Engineer cum Estate Officer,CCMD of the rates which it is his intention to charge for such class or work, supported by analysis of the rate or rates claimed. Thereupon the Project Engineer cum Estate Officer,CCMD shall determine the rate or rates on the basis of observed data and failing this, on the basis of prevailing market rates. Under no circumstances the contractor shall suspend the work on the plea of non-settlement of rates for items falling under this clause. In the event of any dispute regarding the rates for such items the decision of the Director, IISC shall be final.

Clause 11.: TIME LIMITS UNFORSEEN CLAIMS

Under no circumstances whatever shall the contractor be entitled to any compensation from Institute on any account unless the contractor shall have submitted claim in writing to the Project Engineer cum Estate Officer, CCMD or other competent authority within 30 days of the cause of such claim occurring.

Clause 12.: NO CLAIM TO ANY PAYMENT OR COMPENSATION FOR DELETION OF WHOLE OR PART OF WORK

a) If at any time after the execution of the contract documents, the Project Engineer cum
Estate Officer, CCMD or other competent authority shall, for any reason whatsoever, require the whole or any part of the work as specified in the tender, to be stopped for any period or require the whole or part of the work (i) not to be carried out at all or (ii) not to be carried out by the tendered contractor, he shall give notice in writing of the fact to the contractor who will thereupon suspend or stop the work totally or partially as the case may be. In any such case, except as provided hereunder, the contractor shall have no claim to any payment of compensation whatsoever on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not so derive in consequence of the full amount of the work not having been carried out, or on account of any loss that he may be put on account of materials purchased or agreed to be purchased, or for unemployment of labour recruited by him. He shall not also have any claim for compensation by reason of any alterations having been made in the original specifications, drawings, designs and instructions, which may involve any curtailment of the work, as originally contemplated.

(b) Payment for materials already purchased or ordered by contractor.

Where, however, materials have already been purchased or agreed to be purchased by the contractor before receipt by him the said notice the contractor shall be paid for such materials, at the rates determined by the Project Engineer cum Estate Officer, CCMD or other competent authority provided they are not in excess of requirements and are of approved quality, and/or shall be compensated for the loss, if any, that he may be put to, in respect of materials agreed to be purchased by him, the amount of such compensation to be determined by the Project Engineer cum Estate Officer, CCMD or other competent authority whose decision shall be final.

(c) Labour charges during stoppage of work

If the contractor suffers any loss on account of his having to pay labour charges during the period during which the stoppage of work has been

ordered under this clause, the contractor shall on application, be entitled to such compensation on account of labour charges as the Project Engineer cum Estate Officer,CCMD or other competent authority, whose decision shall be final, may consider reasonable. Provided that the contractor shall not be entitled to any compensation on account of labour charges if in the opinion of the Project Engineer cum Estate Officer,CCMD or other competent authority, the labour could have been employed in the same locality by the contractor for the whole or part of the period during which the stoppage of the work has been ordered as aforesaid.

(d) Time limit for stoppage of work

The period of stoppage ordered by the Project Engineer cum Estate Officer,CCMD or other competent authority should not ordinarily exceed six months. Thereafter the portion of works stopped may be treated as deleted from this agreement if a notice in writing to that effect is given to the Project Engineer cum Estate Officer, CCMD or other competent authority by the contractor within seven days after the expiry of the above period.

(e) Execution of work deleted

The portion of work thus deleted may be got executed from the same contractor on supplemental agreement on mutually agreed rates, which shall not exceed current Schedule of Rates(KPWD) plus or minus tender percentage,

Clause 13.: ACTION AND PENALTY IN CASE OF BAD WORK

If at any time before the security deposit is refunded to the contractor, it shall appear to the Project Engineer cum Estate Officer, CCMD or other competent authority that any work has been executed with unsound, imperfect or unskillful workmanship or with materials of inferior quality, or that any materials or articles provided by him for the execution of the work are unsound or of a quality inferior to that contracted for, or are otherwise not in accordance with the contract, it shall be lawful for the Project Engineer cum Estate Officer, CCMD or other competent authority to intimate this fact in writing to the contractor and then not withstanding the fact that the work, materials or articles complained of may have been paid for, the contractor shall be bound forthwith to rectify, or remove and reconstruct the work so specified on whole or in part as the case may require, or if, so required shall remove the materials or articles at his own charge and cost and in the event of his failing to do so within a period to be specified by the Project Engineer cum Estate Officer, CCMD or the competent authority in the written intimation aforesaid, the contractor shall be liable to pay a penalty not

exceeding one percent on the amount of the estimate for every day not exceeding ten days during which the failure, so continues and in the case of any such failure the Project Engineer cum Estate Officer, CCMD or other competent authority may rectify or remove, and re-execute the work or remove and replace the materia1s or articles complained of, as the case may be at the risk and expense in all respects of the contractor should the Project Engineer cum Estate Officer, CCMD or other competent authority for any valid reasons consider that any such inferior work or materials as described above is to be accepted or made use of, it shall be within his discretion to accept the same at such reduced rates he may fix thereof.

Clause 14.: WORK TO BE OPEN TO INSPECTION - CONTRACTOR OR RESPONSIBLE AGENT TO BE PRESENT

(a) All works under or in course of execution or executed in pursuance of the contract shall at all time be open to the inspection and supervision of the The Project Engineer cum Estate Officer, CCMD or other competent authority and his Engineer-in-charge, and the contractor shall at all times during the usual working hours, and at all other times at which reasonable notice of the intention of the Project Engineer cum Estate Officer, CCMD or other competent authority Engineer-in-charge to visit the work shall have been given to the contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing present for the purpose. Orders given to the contractor duly authorised agent shall be considered to have the same force and effect as if they had been given to the contractor himself.

(b) Employment of technical staff
The Contractor shall employ the following technical staff during execution of this work:

(i) One Graduate Engineer when the cost of the work to be executed is ‘Rs. 5 lakhs or more',

(ii) One qualified Engineering Diploma Holder when the cost of work to be executed is more than Rs. 2 lakhs but less than Rs. 5 lakhs;

(iii) In addition to (i) and (ii) above, the contractor shall employ different types of such technical personnel as may be required and sufficient for execution of work and directed by the Project Engineer cum Estate Officer,CCMD to ensure efficient execution of work.

The technical staff so employed, should be available at site whenever required by Engineer in-charge to take instructions.

(c) If the contractor fails to employ the technical staff as aforesaid, he shall be liable to pay a sum of Rs. 10000 (Rupees TEN thousand only) for each month of default in the case of Graduate Engineers and Rs. 5000 (Rupees Five thousand only) for each month of default in case of Diploma Holders.

(d) If the Contractor himself possesses the required qualification and is available at the site for receiving instructions from the The Project Engineer cum Estate Officer, CCMD and other competent authority vide sub-clause (a) above it will not be necessary for the technical staff to be available at site for receiving instructions.

Clause 15.: NOTICE TO BE GIVEN BEFORE WORK IS COVERED UP

The contractor shall give not less than five days notice in writing to the Project Engineer cum Estate Officer, CCMD or his Engineer-in-charge in charge of the work before covering up or otherwise placing beyond the reach of the measurement any work in order that the same may be measured; and correct dimensions thereof taken before the same is so covered up or placed beyond the reach of measurement, and shall not cover up or place beyond the reach of measurement, and work without the consent in writing of the Project Engineer cum Estate Officer, CCMD or other competent authority or his Engineer-in-charge in charge of work; and if any work shall be covered up or placed beyond the reach of measurement, without such notice having been given or consent obtained, the same shall be uncovered at the contractor's expense, and in default thereof no payment or allowance shall be made for such work or for the materials with which the same was executed.

Clause16.: CONTRACTOR LIABLE FOR DAMAGE DONE, AND FOR IMPERFECTIONS FOR TWELVE MONTHS AFTER CERTIFICATE OF COMPLETION

If the Contractor or his workmen or servants shall break, deface, injure or destroy any part of a building in which they may be working, or any building, road fence, enclosure or grassland or cultivated ground contiguous to the premises on which the work or any part thereof is being executed, or if any damage shall be done to the work, while it is in progress from any cause whatever or if any imperfections become apparent in it within Twelve months of the grant of a certificate of completion, final or otherwise, by the Project Engineer cum Estate Officer, CCMD or other competent authority the contractor shall make good the same at his own expenses, or in default the Project Engineer cum Estate Officer, CCMD or other competent authority

may cause the same to be made good by other workmen, and deduct the expenses (of which the certificate of the Project Engineer cum Estate Officer, CCMD or other competent authority shall be final) from any sums that may be due or may thereafter become due to the contractor, or from his Security Deposit or the proceeds of sale thereof, or of a sufficient portion thereof.

Clause 17.: **CONTRACTOR TO SUPPLY PLANT, LADDERS, CAFFOLDINGS, ETC., AND IS LIABLE FOR DAMAGES ARISING FROM NON-PROVISION OF LIGHT, FENCING ETC**

The contractor shall supply at his own cost all materials, plant, tools, appliance, implements, ladders, scaffolding, and temporary works required for the proper execution of the work whether in the original, altered or substituted form and whether included in the specification, or other documents forming part of the contract or referred to in these conditions or not, and which may be necessary for the purpose of satisfying or complying with the requirements of the Project Engineer cum Estate Officer, CCMD or other competent authority as to any matter as to which under these conditions he is entitled to be satisfied, or which he is entitled to require together with carriage therefore, to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials necessary for the purpose of setting out works, and counting, weighing and assisting in the measurement or examination at any time and from time to time of the work or the materials. Failing this, the same may be provided by the Project Engineer cum Estate Officer,CCMD or other competent authority at the expense of the contractor and expense may be deducted from any money due to the contractor under the contract or from his security deposit or the proceeds of sale thereof, or of a sufficient portion thereof. The contractor shall provide necessary fencing and lights required to protect the public from accident, and shall also be bound to bear the expense of defense of every suit, action or other legal proceedings, that maybe brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any suit, action or proceedings to any person, or which may with the consent of the contractor be paid for compromising any claim by any such person.

Clause 18.: MEASURES FOR PREVENTION OF FIRE

The contractor shall not set fire to any standing jungle, trees, brushwood or grass without a written permit from the Project Engineer cum Estate Officer,CCMD. When such permission is given, and also in all cases when destroying cut or dug up trees, brushwood grass, etc., by fire the contractor shall take necessary measures to prevent such fire spreading to or otherwise damaging surrounding property.

Clause 19.: LIABILITY OF CONTRACTOR FOR ANY DAMAGES DONE IN OR OUTSIDE WORK AREA

Compensation for all damages done by contractor or his men whether in or beyond the limits of Institute property including any damage caused by spreading of fire mentioned in Clause 18 shall be estimated by the Project Engineer cum Estate Officer, CCMD and the estimate of the Project Engineer cum Estate Officer, CCMD, subject to the decision of the Director, IISc on appeal shall be final and the contractor shall be bound to pay the amount of the assessed compensation on demand failing which the same will be recovered from the contractor as the damages in the manner prescribed in clause 1(c) or deducted by the Project Engineer cum Estate Officer, CCMD or other competent authority from any sums that may be due or become due from Institute to the contractor under this contract or otherwise.

The contractor shall bear the expenses of defending any action or other legal proceedings that may be brought by any person for injury sustained by him owing to neglect of precautions to prevent the spread of fire and shall pay any damages and cost that may be awarded by the court in consequence.

Clause 20.: EMPLOYMENT OF FEMALE LABOUR

The employment of female labourers on works in the neighbourhood of soldier barracks should be avoided as far as possible.

Clause 21.: WORK ON NOTIFIED HOLIDAYS

No work shall be done on any notified holiday without the sanction in writing of the Project Engineer cum Estate Officer, CCMD or other competent authority

Clause 22. : WORK NOT TO BE SUBLET

(a) The contract shall not be assigned or sublet by the contractor,. However, any specific portion of the work which is of a specialised nature and normally not executable by a general contractor could be got done by the specialised agencies which are executing such works, after obtaining the specific approval of the Project Engineer cum Estate Officer, CCMD in writing in each case. Such consent to sublet the work, if given, shall not relieve the contractor from any liability or obligation under the contract and he shall be responsible for the acts, defaults and neglects of any sub-contractor or his agents, servants or workmate as fully as if they were the acts, defaults or neglects of the contractor, his agents, servants or workmen.

(b) Consequences of subletting work without approval, becoming insolvent, bribing etc., by contractor and action against the contractor.

If the contractor shall assign or sublet his contract or any portion thereof without the specific approval of the Project Engineer cum Estate Officer, CCMD or attempts to do so or become insolvent or commence any proceedings to get himself adjudicated as insolvent or make any composition with his creditors or attempts so to do or if any bribe, gratuity, or indirectly be given, promised or offered by the contractor or any of his servants or agents to any officer or person in the employ of Institute in any way relating to his office or employment or if any such officer or person in the employment or if any such officer or person shall become in any way directly or indirectly interested in the contract, the Project Engineer cum Estate Officer, CCMD or other competent authority may thereupon by notice in writing rescind the contract and the security deposit of the contractor shall thereupon stand forfeited and be absolutely at the disposal of Institute and the same consequences shall ensure as if the contract had been rescinded under Clause 3 here of and in addition, the contractor shall not be entitled to recover or be paid for any work actually performed under contract.

(c) Recovery of excess payments based on excess measurements and action against contractor.

Whenever it is noticed that excess payments have been made to the contractor based on excess measurements recorded by the Engineer-in-charge in the measurement book and countersigned by the contractor or his duly authorised agent, action shall be taken to recover the excess payments together with interest immediately. Action may also be taken to remove the name of the contractor from the approved list of contractors and also to black-list him.

(d) Change in classification of excavations accepted not permitted.

Once the measurements mentioning the classification of the excavations are recorded in the measurement book and the same is signed by the contractor or his authorised agent in token of acceptance, no request for reclassification by the contractors shall be entrained.

(e) Criminal proceedings against IISc Officers and Contractor for the lapses.

Institute also reserve the right to initiate criminal proceedings against the concerned Institute Officers who are directly responsible for the lapse and the contractors who have colluded with the officers of the Institute in the lapse and fraudulently received amounts not due to them legitimately.

Clause 23.: SUM PAYABLE BY WAY OF COMPENSATION TO BE CONSIDERED AS REASONABLE COMPENSATION WITHOUT REFERENCE TO ACTUAL LOSS.

All sums payable by a contractor by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied for the use of Institute without reference to the actual loss or damage sustained and whether any damage has or has not been sustained.

Clause 24.: SETTLEMENT OF DISPUTES -TIME LIMIT FOR DECISION

(a) If any dispute or difference of any kind whatsoever were to arise between the Project Engineer cum Estate Officer, CCMD and the contractor regarding the following matters namely,

(i) The meaning of the specifications designs, drawing and instructions herein before mentioned,

(ii) The quality of workmanship or materials used on the work and

(iii) Any other question, claim right, matter, thing whatsoever, in any way arising out of or relating to the contract, designs, drawings, specification, estimates, instructions, or orders, or those conditions, or failure to execute the same whether arising during the progress of the work, or after the completion, termination or abandonment thereof, the dispute shall, in the first place, be referred to the Director, IISc. The Director, IISc shall within a period of fifteen days from the date of

being requested by the Contractor to do so give written notice of its decision to the Contractor.

(b) Director's decision final.

Subject to other form of settlement hereafter provided, the Director's decision in respect of every dispute or difference so referred shall be final binding upon the contractor. The said decision shall forthwith be given effect to and contractor shall proceed with the execution of the work with all due diligence.

(c) Remedy when Director's decision is not acceptable to contractor

In case the decision of the Director is not acceptable to the contractor, he may approach the Law Court at Bangalore for settlement of dispute after giving due written notice in this regard to the Director within a period of ninety days from the date of receipt of the written notice of the decision of the Director.

(d) Time limit for notice to approach Court of law by contractor

If the Director has given written notice of his decision to the contractor and no written notice to approach the law court has been communicated to him by the contractor within a period of ninety days from receipt of such notice, the said decision of Director shall be final and binding upon the contractor.

(e) Time limit for notice to approach law court by contractor when decision is not given by Director, IISc as at (b).

If the Director fails to give notice of his decision within a period of ninety days from the receipt of the contractor's request in writing for settlement of any dispute or difference as aforesaid, the Contractor may within ninety days after the expiry of the first named period of ninety days approach the Law Courts at Bangalore giving due notice to the Director.

(f) Contractor to execute and complete work pending settlement of dispute.

Whether the claim is referred to the Director or to the Law Courts, as the case may be, the contractor shall proceed to execute and complete the works with all due diligence pending settlement of the said dispute or differences.

(g) Obligations of The Project Engineer cum Estate Officer,CCMD and contractor shall remain unsettled during considerations of dispute.

The reference of any dispute or difference to the Director or the Law Court may proceed notwithstanding that the works shall then be or be alleged to be

complete, provided always that the obligations of the Project Engineer cum Estate Officer,CCMD and the contractor shall not be altered by reason of the said dispute or difference being referred to the Director or the Law Court during the progress of the works.

Clause 25.: CONTRACTOR TO PAY COMPENSATION UNDER WORKMEN'S COMPENSATION ACT.

(a) The contractor shall be responsible for and shall pay any compensation to his own workmen payable under the relevant Workmen's Compensation Act for injuries caused to the workmen. If Institute pays such compensation on behalf of the contractor it shall be recoverable by Institute from the contractor under as per relevant clauses.

(b) Contractor to pay expenses of providing medical aid to workmen.

The contractor shall be responsible for and shall pay the expenses of providing medical aid to any workman who may suffer a bodily injury as a result of an accident. If Institute incurs such expenses, the same shall be recoverable from the contractor forthwith and be deducted without prejudice to any other remedy of Institute, from any amount due or that may become due to the contractor.

Clause 26.: CONTRACTOR TO PROVIDE PERSONAL SAFETY EQUIPMENT FIRST AID APPARATUS, TREATMENT Etc

The contractor shall provide all necessary personal safety equipment and first aid apparatus for the use of the persons employed on the site and shall maintain the same in good condition suitable for immediate use, at any time and shall comply with the following regulations in connection therewith: -

(i) The worker will be required to use the equipment so provided by the contractor and the contractor shall take adequate steps to ensure proper use of the equipment by those concerned.
(ii) When work is carried on in proximity to any place where there is a risk of drowning; all necessary steps shall be taken for the prompt rescue of any person in danger.
(iii) Adequate provision shall be made for prompt first - aid treatment of all injuries likely to be sustained during he course of the work.

Clause 27.: MINIMUM AGE OF PERSONS EMPLOYED BY CONTRACTOR

(a): No contractor shall employ any person

(i) who is under age of 18 years.

(ii) Who does not produce a valid certificate of vaccination against smallpox in respect of himself/ herself as well as all the members of his/her family.

(b) The contractor shall provide potable water facilities to the workers. Similar amenities shall be provided to the workers engaged on large works in urban area.

(c) Removal of persons not satisfying conditions (a) (i) & (ii)

The Project Engineer cum Estate Officer,CCMD or other authority is authorised to direct the removal or to remove through - his own agency, from the work any person referred to in sub-clauses (a) above not satisfying these conditions and no responsibility shall be accepted by the Institute for any delay caused in the completion of the work by such directions for removal.

(d) Payment of fair and reasonable wages by contractor.

The contractor shall pay fair and reasonable wages, which shall not be less than the minimum wages fixed by Govt. of Karnataka from time to time to the workmen employed by him in the contract undertaken by him. In the event of any dispute arising between the contractor, and his workmen on the ground that the wages paid are not fair and reasonable the dispute shall be referred without delay to The Project Engineer cum Estate Officer,CCMD or other competent authority, who shall decide the same. The decision shall not in any way affect the conditions in the contract regarding the payment to be made by Institute at the agreed tender rates.

Clause 28.: CONTRACTOR NOT ENTITLED TO ANY CLAIM OR COMPENSATION FOR DELAY IN EXECUTION OF WORK IN BORROW PITS.

The contractor shall not be entitled to claim compensation if there is any delay in the execution of the work on account of water standing in borrow pits and compartments. The rates are inclusive for hard or cracked soil, excavation in mud, sub-soil water or water standing in borrow pits and no claim for extra rate shall be entertained, unless otherwise specified.

Clause 29: METHOD OF PAYMENT OF BILLS

Payment to contractors shall be made by cheques drawn by the Institute

Clause 30: SET OFF AGAINST ANY CLAIM OF INSTITUTE

Any sum of money due and payable to the contractor (including the security deposit refundable to him) under this contract may be appropriated by the Institute and set off against any claim of Institute in respect of a payment of a sum of money arising out of or under any other contract made by the contract with the Institute.

Clause 31 RATES INCLUSIVE OF ALL TAXES.

(a) The rates to be quoted by the contractor must be inclusive of all kinds of direct and indirect taxes, sales tax, Service Tax, labour cess, statutory levies etc., levied by the state government / Central Government or any local body or authority. No extra payment on this account will be made to the contractor.

(b) All quarry fees, octroi dues levied by the state or any local body or authority and ground rent, if any, charged by the The Project Engineer cum Estate Officer, CCMD for stacking materials should be paid by the contractor.

Advice to site personnel when working near underground Electricial cables

Important Note: Always assume that Electrical cables are present. Treat any cables found anywhere as LIVE.

During the course of the excavation, all site workers should exercise the following precautions:

a) Whenever possible, hand dig near underground services. Spades and shovels are safer than picks or forks.

b) Watch out for signs and the position of cables as work continues.

c) Do not use hand-held power tools directly over the marked alignment of an underground electricity cable identified by the competent person. Only use such tools if the work cannot feasibly be carried out by hand tools.

d) For hand- held power tools used for the purpose of breaking paved concrete surfaces, a horizontal clearance of 250 mm from any underground electricity cable must be maintained. Otherwise, a clearance of 500 mm around any underground electricity cable nearby must be maintained.

e) Keep a clear distance of 1 m between the side of any distribution cable and the bucket of a mechanical excavator, and for transmission cables , the distance is extended to 3 m.

f) Keep a clear distance between underground electricity cables and other utility plant (e.g. gas and water pipes, telecommunication cables, etc.). The distance should be at least 300 mm for cables of below 66 kV and at least 1 m for cables of 66 kV and above.

g) Do not build existing underground electricity cables into a manhole or other structure or encase them in concrete.

h) Always provide adequate support and anchoring of exposed underground electricity cables according to the electricity supplier's recommendations.

i) Report any electrical accident or damage to an underground electricity cable or its sheath, to Engineer-in-charge, CCMD. Even if there is no immediate danger, damage could lead to danger at a later date. Evacuate everyone from the immediate area of the damage but do not attempt to remove any objects or to touch injured persons, who are in contact with the damaged cable because the cable may still be LIVE.

j) Even if the underground electricity cable seems to be disconnected and abandoned, do not attempt to drill or cut into it, or to dismantle it until approval has been given by the Engineer-in-charge, CCMD.

k) All backfilling of excavations must be done carefully and warning tapes, tiles, protection plates or other protection must be replaced in their original position. The electricity supplier should be approached for make-up cable protection materials if they are missing or damaged before the backfilling. The same backfilling materials should be used unless otherwise agreed with the electricity supplier. If in doubt, the contractor must seek advice from CCMD on the specific requirements, etc.

l) Damaging underground electricity cables is dangerous and can often cause flashover, explosion or fire.

m) Damage can result from excavation or penetration of the ground.

n) Underground electricity cables may be found in roads, footpaths and on sites.

TECHNICAL SPECIFICATION

DOCUMENT No. PCPL-1414-4-402	CONTENTS

DOCUMENT No. PCPL-1414-4-402	CONTENTS

DRAWINGS			
DRAWING NO.	TITLE	REV. NO.	NO. OF SHEETS
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PCPL-1414-4-GA-101	General Arrangement- New Chemical Substation	P3	1
PCPL-1414-4-GA-102	General Arrangement- Physical Science Substation	P2	1
PCPL-1414-4-GA-103	General Arrangement- E Type Quarters	P2	1
PCPL-1414-4-GA-104	General Arrangement - MUSS Control Room	P1	1
PCPL-1414-4-GA-105	General Arrangement – SS-14	P0	1
PCPL-1414-4-GL-101	Earthing Layout- New Chemical Substation	P3	1
PCPL-1414-4-GL-102	Earthing Layout- Physical Science Substation	P2	1
PCPL-1414-4-GL-103	Earthing Layout- E Type Quarters	P2	1
PCPL-1414-4-GL-104	Earthing Layout - MUSS Control Room	P1	1
PCPL-1414-4-GL-105	Earthing Layout – SS-14	P0	1
PCPL-1414-4-CT-101	Composite Cabling layout	P4	1
PCPL-1414-4-CT-102	Cable Trench Layout- New Chemical Substation	P3	1
PCPL-1414-4-CT-103	Cable Trench Layout- Physical Science Substation	P3	1
PCPL-1414-4-CT-104	Cable Trench Layout- E Type Quarters	P1	1
PCPL-1414-4-CT-105	Cable Trench & Busway Layout - MUSS Control Room	P1	2
PCPL-1414-4-CT-106	Cable Trench Layout- SS-14	P0	1
PCPL-1414-2-ARC-101	Architectural Layout – MUSS Control Room	P1	1

1.0 This specification covers the design, engineering, procurement, manufacture, inspection and testing at the works of manufacturer and/or sub-vendor, packing for shipment, forwarding, including transit insurance, receipt at site, storage and handling at site, erection, testing, cleaning, start-up & commissioning and performance testing - all to the satisfaction of IISc and in accordance with these specifications and as per good engineering practices for the formation of new 11kV Underground Ring Main System including all civil works at IISc, Bangalore.

2.0 It is not the intent herein to specify completely all details of design and construction features of the equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous operation in a manner acceptable to IISc, who will interpret the meaning of drawings and specifications and shall have the power to reject any work which in his judgement is not in full accordance herewith.

1.0	Owner	Indian Institute of Science (IISc), Bangalore
2.0	Consultant	POET Consultants Pvt. Ltd., Bangalore
3.0	Project title	Electrical system up-gradation at IISc campus
4.0	Location	Bangalore, Karnataka
5.0	Elevation above mean sea level	908 meter
6.0	Nearest railway station	Bangalore City Railway Station / Yeshwanthpur Railway Station
7.0	Nearest national highway	NH No. 7
8.0	Nearest airport	Kempegowda International Airport, Bangalore
9.0	Annual average ambient temperature	
9.1	Maximum	37.5 ^{0}C
9.2	Minimum	12 ^{0}C
9.3	Ambient temperature (For Equipment Design)	45 ^{0}C
10.0	Annual rain fall	650-850 mm.
11.0	Humidity (for equipment design)	Not more than 85% at maximum temperature
12.0	Seismic zone	Zone -II as per IS 1893
13.0	Tropicalization	All equipment supplied against this specification shall be given tropical and fungicidal treatment in view of the climatic conditions prevailing at site. Tropical protection shall conform to IS-3202:1965, Protection of Electrical Power Equipment against climatic conditions.
14.0	Plant main earth grid	50x10 mm GS Flat
15.0	Auxiliary power supply	
15.1	MV ac power supply	415V, 3 Phase, 4-wire, 50Hz effectively earthed system
15.2	Lighting Fixtures, spring charging motors and Space Heaters	240V, 1 Phase, 2-wire, 50Hz, AC
15.3	Control Supply	110V AC / 110V DC as applicable
16.0	Auxiliary supply voltage variation	
16.1	AC Supply	Voltage Variation: +/- 10%
		Frequency Variation +/- 5%
		Combined Voltage and Frequency Variation: +/- 10%
16.2	DC Supply	Voltage Variation : + 10% to – 15%
		All devices and equipment shall be suitable for continuous operation over the entire range of voltage and frequency indicated above, without any change in their performance.

1.0 INTRODUCTION:

1.1 The Indian Institute of Science (IISc), Bangalore is a 105 years old establishment and is a premier institute for advanced scientific and technological research and education in India.

1.2 IISc, Bangalore has got a very old electrical system and has planned to upgrade the same and increase its capacity.

1.3 IISC, Bangalore presently draws electrical power at 66kV from Karnataka Power Transmission Corporation Limited (KPTCL), the local utility company.

1.4 At present, the power supply to the facility is fed by 2 Nos. of 5MVA, 66/11kV Transformers and 1 No. of 12.5MVA, 66/11kV Transformer.

1.5 Existing 11kV Switchgear has to be extended and existing electrical network has to be modified to form a new 11kV underground Ring Main System for reliable and continuous operation.

1.6 IISc, Bangalore has engaged M/s.POET Consultants Pvt. Ltd (PCPL) as their Consultant for the Electrical System Engineering.

2.0 SCOPE OF WORK:

2.1 The following is the scope of supply, unloading and storage at site, erection, testing and commissioning for the project:

SL. NO.	ITEM DESCRIPTION	QTY.
1.	11kV Switchgear (Extension Panel) at MUSS	
1.1	11kV, 18.14kA, 3-phase, Indoor switchboard with draw out vacuum circuit breaker for 2 No. 630A outgoing feeder on LHS and 2 Nos. 630A outgoing feeders on RHS.	1 Set
1.2	1250A, Phase Segregated Busduct	1 Lot
2	Chemical Science Substation	
2.1	Outdoor Compact Substation with following:	1 No.
a)	Non-Extendable Compact Ring Main Unit (VVVM) comprising 11kV, 630A, 20kA for 3 seconds Vacuum Circuit Breaker for incomers and outgoing feeder and metering module	
b)	1 No. of 11/0.433kV, 1250kVA, Oil Filled Hermetically sealed Distribution Transformer with vector group Dyn11 & impedance (Z) 6.25%	
c)	1 No. of 415V, 3 Phase, 4wire, 2500A, 50kA for 1 Sec. MV Switchgear comprising of 1No.2500A ACB Incomer 1 No. 1250A ACB Outgoing feeder 2 Nos. 630A MCCB Outgoing feeders 1 No. 400A MCCB Outgoing feeder 1 No. 200A MCCB Outgoing feeder	
3	Physical Substation	
3.1	Transformer	1 No.
a)	11/0.433kV, 1000kVA, Outdoor type, ONAN Cooled Distribution Transformer with vector group Dyn11,Off Load Tap Changer, & Impedance (Z) 5.00%	
3.2	415V, 3 Phase, 4wire, 1600A, LT panel (Extension panel) with:	1 Set

SL. NO.	ITEM DESCRIPTION	QTY.
a)	1 No. 1600A ACB Incomer	
b)	2 Nos. 630A MCCB Outgoing feeders	
4	E Type Quarters Substation	
4.1	Outdoor Compact Secondary Substation with following:	1 No.
a)	Non-Extendable Compact Ring Main Unit (VVVM) comprising 11kV, 630A, 20kA for 3 seconds Vacuum Circuit Breaker for incomers and outgoing feeder and metering module	
b)	1 No. of 11/0.433kV, 500kVA, Oil Filled Hermetically sealed Distribution Transformer with vector group Dyn11 & Impedance (Z) 4%	
c)	1 No. of 415V, 3 Phase, 4wire, 1000A, 25kA for 1 Sec. MV Switchgear comprising of 1No.1000A ACB Incomer 2 Nos. 400A MCCB Outgoing feeders 2 Nos. 250A MCCB Outgoing feeders 1 No. 63A MCCB Outgoing feeder	
5	SS-14 Substation	
5.1	11kV Compact Ring Main Unit (CRMU)	1 No.
a)	Extendable Compact Ring Main Unit (VVVM) comprising 11kV, 630A, 20kA for 3 seconds, Vacuum Circuit Breaker for incomers & outgoing feeder and metering module	
6	11kV Network	
6.1	HV Power cables	As per Price Schedule
a)	11kV Earthed Grade (E), stranded Aluminium conductor, XLPE insulated, multi core, strip armoured, extruded PVC inner and outer sheathed cables conforming to IS-7098: Part 2. The cable sizes shall be as specified.	
b)	11 kV Straight through joints and cable end terminations	
7	Power and Control Cables	
7.1	LV Power Cables	As per Price Schedule
a)	1.1kV Grade stranded Aluminium conductor XLPE insulated, armoured, PVC outer sheathed cables confirming to IS-7098: Part 1. The cable sizes shall be as specified. All cable terminations shall be provided.	
7.2	Control Cables	As per Price Schedule
a)	1.1kV Grade, stranded Copper conductor PVC insulated, steel wire armoured, overall FRLS PVC outer sheathed control cables conforming to IS 1554 (Part-1). The cable sizes shall be as specified. All cable terminations shall be provided.	
8	Electrical Works	
8.1	Cabling System	
a)	Cable installation complete with cable trays and accessories, rigid and flexible conduits, cable glands, lugs etc.	As per Price Schedule
8.2	Earthing System	
a)	Cast Iron pipe earth stations	As per Price Schedule

SL. NO.	ITEM DESCRIPTION	QTY.
b)	Electrical grade GS strip earthing conductors of various sizes	As per Price Schedule
c)	Electrical grade copper strip earthing conductor	As per Price Schedule

2.2 The work shall be carried out in accordance with drawings, specifications, installation notes, data sheets and price schedule enclosed with this document.

2.3 The contractor shall be responsible for obtaining statutory clearances from the concerned authorities including approval of drawings and documents from KPTCL/CEIG/CEA and to obtain the safety certificate for charging the network. Statutory fees and processing fees shall be reimbursed by IISc on production of original receipts.

2.4 Reference drawings enclosed as Bid document are as given below:

SL. NO.	DRAWING NO.	REV NO	TITLE
ELECTRICAL DRAWINGS			
1.	PCPL-1414-4-SLD-102	P4	Key Single Line Diagram
2.	PCPL-1414-4-GA-101	P3	General arrangement - New Chemical Substation
3.	PCPL-1414-4-GA-102	P2	General arrangement - Physical Science Substation
4.	PCPL-1414-4-GA-103	P2	General arrangement - E Type Quarters
5.	PCPL-1414-4-GA-104	P1	General Arrangement - MUSS Control Room
6.	PCPL-1414-4-GA-105	P0	General Arrangement – SS-14
7.	PCPL-1414-4-GL-101	P3	Earthing Layout - New Chemical Substation
8.	PCPL-1414-4-GL-102	P2	Earthing Layout - Physical Science Substation
9.	PCPL-1414-4-GL-103	P2	Earthing Layout - E Type Quarters
10.	PCPL-1414-4-GL-104	P1	Earthing Layout - MUSS Control Room
11.	PCPL-1414-4-GL-105	P0	Earthing Layout – SS-14
12.	PCPL-1414-4-CT-101	P4	Composite Cabling layout
13.	PCPL-1414-4-CT-102	P3	Cable Trench Layout - New Chemical Substation
14.	PCPL-1414-4-CT-103	P3	Cable Trench Layout - Physical Science Substation
15.	PCPL-1414-4-CT-104	P1	Cable Trench Layout - E Type Quarters
16.	PCPL-1414-4-CT-105	P1	Cable Trench and Busway Layout - MUSS Control Room
17.	PCPL-1414-4-CT-106	P0	Cable Trench Layout – SS-14
CIVIL DRAWINGS			
18.	PCPL-1414-2-ARC-101	P1	Architectural Layout – MUSS Control Room

3.0 GENERAL REQUIREMENT:

3.1 In the event of conflict in details for any equipment / item / sub-system, etc., between data sheets, drawings, Section-4, Section-5, the explanation furnished in this section i.e., Section-3 shall be final and to be considered for bidding purposes.

3.2 The design, manufacture, testing and performance of all equipment shall comply in all respects with the requirements of the latest edition of the applicable standards and codes.

4.0 DISMANTLING OF EXISTING SYSTEM:

4.1 Existing cables connected between the substations, SS-11 to SS-14, SS-4 to Nano- science and Compact RMU (near housing colony road) to NVH substation to be dismantled and to be handed over to the IISc.

4.2 Existing 11kV LBS switchgear located at SS-14 has to be dismantled and to be handed over to the IISc.

5.0 DISMANTLING AND RELOCATING:

5.1 Dismantling and Relocating of Battery in Existing Battery Room at MUSS control Building from Present Location Facing towards North to new location facing towards west and Associated cabling work, including removing the existing cables along termination and laying new cable from battery to battery charger with necessary clamps and hardware, cable tags, ferrule numbers, lugs etc. and related earthing works as per drawings.

6.0 SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF EQUIPMENT:

6.1 The following equipment and systems shall be supplied, Installed/Erected, Tested and commissioned as per enclosed specification and drawings.

6.2 HV SWITCHGEAR

6.2.1 The Switchgear shall conform to enclosed specification PCPL-4-S4-151 for HV Indoor Switchgear along with data sheets PCPL-1414-4-S4-151-01 and Single Line Diagram as listed below:

SL. NO.	DRAWING NO.	TITLE
1	PCPL-1414-4-SLD-102	Key Single Line Diagram

6.2.2 All the interconnecting cabling for various instruments mounted on the switchgear panel shall be included in the scope of BIDDER.

6.2.3 Bidders shall offer horizontal isolation and horizontal draw out indoor type breaker.

6.2.4 The offered switchgear shall be complete with suitably sized copper bus bars with HV insulated heat shrink sleeves of Raychem make throughout the length of the panels.

6.2.5 The bus bar chamber of each panel shall have a partition plate with seal off bushing to arrest arc and smoke travel to other panel in case of an insulation failure.

6.2.6 The panels shall be provided with 50x8 mm copper earth bus throughout the length of the switchboards for connecting to earth grid.

6.2.7 The main and earth busbar from the existing 11kV switchgear shall be extended to new 11kV switchgear (Outgoing feeders) via adapter panel (if required).

6.2.8 Cable sizes have been mentioned to size the cable termination chamber. Cable sealing kits will be supplied by BIDDER. Suitable cable clamping arrangement shall be provided in the cable chamber. The minimum height of cable termination points from Bottom of the panel shall be 750 mm.

6.2.9 If breaker transport trolley is required, BIDDER shall include the cost of one such trolley in their quoted price.

6.2.10 MCB's of suitable rating shall be used in the control circuits (AC/ DC).

6.2.11 One earthing truck each for cable side earthing and busbar earthing for specified breaker rating shall be quoted separately. The earthing truck shall consist of a voltage transformer, quick making earth

switch, a buzzer and indicating lamps to warn the operator before the earth switch is closed in the event of presence of potential on the cable/bus to be earthed.

6.2.12 The indicating lamps shall be cluster type LED of suitable colour depending on the functions.

6.2.13 All control wiring for CT and other circuits shall be of minimum size 2.5 Sq mm flexible multi-stranded copper wire, FRLS-PVC insulated preferably of LAPP Cables.

6.2.14 Each panel shall be provided with danger sign label as per IS 2551, both at front and rear.

6.2.15 Each panel shall have name plate on both front and rear side with the letter size of minimum 25mm. Cable size shall be painted on each cable box chamber.

6.2.16 The switchgear shall be SCADA compatible. The circuit breakers and meters shall have facility for communication / interfacing with SCADA. The interface equipment for SCADA shall be suitable for MODBUS / OPEN Protocol.

6.2.17 The status of equipments like Circuit Breaker, Local/ Remote switches, Circuit Breaker Alarm and Trip Indications, Circuit Breaker operation commands, Supply Fail Indications, Circuit Breaker healthiness etc shall be made available to/from SCADA by providing necessary RTUs and any other necessary hardware required in the HV Switchgear.

6.2.18 Contact multiplication for the auxiliary contacts shall be achieved only through bi-stable auxiliary relay type VAJC of Areva make or equivalent and not by means of air break contactors or mono-stable relays.

6.2.19 All secondary and auxiliary wiring terminals shall be of stud type.

6.2.20 20% spare terminal blocks shall be made available in each terminal block location for purchaser's use.

6.2.21 All unused terminals of all meters, instrumentation shall be wired out to the terminal blocks.

6.2.22 CT terminal blocks shall be of shorting link type.

6.2.23 Switchgear shall be extendable on both sides to add additional feeders later.

6.2.24 Front doors of all the panels shall be provided with padlocking facility.

6.2.25 No live parts shall be accessible on opening the panel door.

6.2.26 Necessary measurement shall be carried out by the successful bidder for existing panel dimensions.

6.3 COMPACT SUBSTATION (CSS)

6.3.1 Two (2) Nos. of Outdoor CSS shall be supplied for the Chemical Science Substation and E Type Quarters Substation in accordance with the enclosed drawing PCPL-1414-4-SLD-102.

6.3.2 The CSS shall be suitable for outdoor installation and Non Walk-in Type. The CSS housing shall be prefabricated using pre-formed sections with detachable modules of walls, doors and ceilings. Base frame shall be suitable for installing the CSS at ground level on pre-cast foundation. Suitable ventilation shall be provided for proper cooling of the electrical equipment housed inside the enclosure, so as to limit the temperature rise to limits specified in data sheet A. All doors shall be fitted with handles and latches for padlocking. The doors shall be closed by means of a two point device, which secures the door to the top and base frame. The doors shall be fitted with stainless steel hinges and with door stoppers. The enclosure shall be designed for the degree of protection to IP54.

6.3.3 Adequate space shall be provided inside the CSS for easy access, operation and maintenance of equipment.

6.3.4 CSS shall be provided with required illumination and small power sockets.

6.3.5 CSS shall be divided into three distinct compartments, Non-Extensible Compact Ring Main Unit (VVVM), Oil filled Hermitically Sealed Transformer and MV Switchgear. All power connections from one compartment to the other shall be through seal off bushings.

6.3.6 Document holders shall be provided in each compartment for housing the respective O&M manuals and drawings.

6.3.7 The external finish shade of the CSS shall be Light Grey / Dark Grey combination and the interiors shall be painted with glossy white finish shade.

6.3.8 CSS shall have its own earthing bar of min. 50 x 10mm GS conductor running all along and interconnected to RMU, Transformer and MV Switchgear enclosures minimum at two places. Also, all non conducting metal parts of the CSS enclosure, barriers, etc., shall be connected to this earthing conductor. Minimum two nos. of earthing terminations shall be provided for connection to the purchaser's earthing grid.

6.3.9 RING MAIN UNIT

6.3.9.1 One (1) No per CSS. Of 11kV, 630A, 20kA for 3 seconds, Outdoor, Non-Extendable Compact Ring Main Unit (VVVM Module) shall be supplied for Chemical Science Substation and E Type Quarters Substation in accordance with the enclosed drawing PCPL-1414-4-SLD-102.

6.3.9.2 The HV-RMU shall conform to enclosed specification PCPL-4-S4-160 along with the Data sheets PCPL-1414-4-S4-160-02.

6.3.9.3 Each RMU shall comprise the required numbers of the following type of modules as shown in the single line diagram:

a. Vacuum circuit breaker with three position disconnector and earth switch downstream of the breaker.

b. Metering Module.

6.3.9.4 Each module shall have a SF6 gas filled, robotically welded stainless steel inner enclosure (Main tank) for the switching devices and an outer enclosure.

6.3.9.5 The circuit breakers shall be suitable for motorised operation from remote panel/SCADA.

6.3.9.6 All control, status indication, monitoring and protection devices shall be provided as specified.

6.3.10 OIL FILLED HERMETICALLY SEALED TRANSFORMER

6.3.10.1 Power Transformer with off load tap changer shall conform to enclosed specification PCPL-4-S4-132 along with Data Sheets PCPL-1414-4-S4-132-02.

6.3.10.2 The finish shade for the transformer and its accessories shall be Interarch white. The type of paint shall be air-dried synthetic enamel. The interior of the marshalling box shall be painted with glossy white enamel paint.

6.3.10.3 Bidders are required to offer transformer with low losses. No load and Load losses shall not exceed 2kW and 12kW respectively for 1250kVA Power Transformer& 0.9kW and 5kW respectively for 500kVA Power Transformer. The losses mentioned are subject to IS tolerance.

6.3.10.4 The losses quoted by the bidders shall be evaluated for Power Transformers based on the following formula:

Capitalised cost of Transformer Losses = Quoted price of Transformer (INR) + (296471*W_i) + (199229*W_c)

Where

Wi = No Load Loss (Iron) in kW

Wc = Load Loss (Copper) in kW

6.3.10.5 IISc reserves the right to reject the Transformer, if the losses exceed the guaranteed values plus tolerance as per Table-7 of IS 2026 (Part-1).

6.3.10.6 However, the transformer can be accepted if the Vendor modifies the design and offers the transformer for retesting within a reasonable time. All costs towards this rework shall be to the vendor's account.

6.3.10.7 The transformer shall be provided with 50x8 mm Cu earth bus from the neutral bushing terminal to the transformer bottom, supported on insulators for connections to earth pits.

6.3.10.8 Transformer shall be supplied with the essential spares listed at Data Sheet – A under Section – 4.

6.3.10.9 The transformer shall be designed with IS tolerance on the impedance.

6.3.11 MV SWITCHGEAR

6.3.11.1 The MV switchgear shall conform to enclosed specification PCPL-4-S4-153 along with data sheets PCPL-1414-4-S4-153-02.

6.3.11.2 Suitable sleeving of busbars shall be done with phase identification marking.

6.3.11.3 The incomer shall be Four Pole, fixed type, manual operated; spring charged Air Circuit Breaker (ACB).

6.3.11.4 All outgoings shall be Four Pole, fixed type, manually operated Moulded Case Circuit Breaker (MCCB).

6.3.11.5 All the interconnecting cabling for various instruments mounted on the switchgear shall be included in the scope of Bidder.

6.3.11.6 All CT terminals shall be wired through shorting type terminal blocks.

6.3.11.7 Metering: Incomer feeder shall be provided with digital multi function display meter type EM 6400 of conserve or equivalent.

6.3.11.8 The finish shade for the switchgear and its accessories shall be RAL 7032. The type of paint shall be powder coated.

6.3.11.9 The current ratings indicated for all the ACB's and MCCB's shall be in-panel rating and NOT FREE AIR RATING. Successful Bidder shall furnish type test certificates for all these equipment in support of rating selection.

6.3.11.10 Safety: All ACB and MCCB handles shall be pad lockable in OFF position.

6.3.11.11 Protection: The ACB / MCCBs shall be provided with short circuit, overload and earth fault protections with independently adjustable current and time settings. The ACB / MCCBs shall have microprocessor based releases.

6.3.11.12 The MV panel shall be provided with 50 x 10 mm GS earth bus throughout the length of the panel for connections to Purchaser's earth grid.

6.4 RING MAIN UNIT (RMU)

6.4.1 One (1) No. of 11kV, 630A, 20kA for 3 seconds, Outdoor Ring Main Unit (Extensible VVVM module) shall be supplied for SS-14 Substation in accordance with the enclosed drawing PCPL-1414-4-SLD-102.

6.4.2 The HV-RMU shall conform to enclosed specification PCPL-4-S4-160 along with the Data sheets PCPL-1414-4-S4-160-01.

6.4.3 RMU shall comprise the required numbers of the following type of modules as shown in the single line diagram:

a. VCB with three position disconnector and earth switch downstream of the breaker.

b. Metering Module.

6.4.4 Each Module shall have SF6 gas filled, robotically welded stainless steel inner enclosure (Main tank) for the switching devices and an outer enclosure.

6.4.5 The vacuum circuit breaker shall be suitable for motorised operation from remote panel/SCADA.

6.4.6 All control, status indication, monitoring and protection devices shall be provided as specified.

6.5 POWER TRANSFORMER

6.5.1 Power Transformer with off load tap changer shall conform to enclosed specification PCPL-4-S4-132 along with Data SheetsPCPL-1414-4-S4-132-01.

6.5.2 The finish shade for the transformer and its accessories shall be 632 of IS 5. The type of paint shall be epoxy coated.

6.5.3 Bidders are required to offer transformer with low losses. No load and Load losses shall not exceed 1.4kW and 10.4kW respectively for 1000kVA Power Transformer. The losses mentioned are subject to IS tolerance.

6.5.4 The losses quoted by the bidders shall be evaluated for Power Transformers based on the following formula:

Capitalised cost of Transformer Losses = Quoted price of Transformer (INR) + (296471*W_i) + (199229*W_c)

Where

Wi = No Load Loss (Iron) in kW

Wc = Load Loss (Copper) in kW

6.5.5 Institute reserves the right to reject the Transformer, if the losses exceed the guaranteed values plus tolerance as per Table-7 of IS 2026 (Part-1).

6.5.6 However, the transformer can be accepted if the Vendor modifies the design and offers the transformer for retesting within a reasonable time. All costs towards this rework shall be to the vendor's account.

6.5.7 The transformer shall be provided with 50 x 8 mm Cu earth bus from the neutral bushing terminal to the transformer bottom, supported on insulators for connections to earth pits.

6.5.8 Transformer shall be supplied with the essential spares listed at Data Sheet – A under section – 4.

6.5.9 The transformer shall be designed with IS tolerance on the impedance.

6.5.10 In the event of conflict between the contents of section-3 and other sections of the specification (except Data Sheet-A of section-4), the former shall govern. In the event of conflict between Data sheet-A of section-4 and the contents of section-3, the former shall govern.

6.5.11 Vendor shall submit quality assurance plan, which would form part of purchase order, to enable the Institute to assure the quality of components at various stages of manufacture.

Negotiation of technical parameters by Bidder after the bids are opened will not be entertained.

6.6 MV SWITCHGEAR

6.6.1 MODIFICATION TO EXISTING PHYSICAL SUBSTATION LT PANEL

6.6.2 Existing LT Panel is 1600A, 3Φ, 4W, 50Hz, with aluminium busbars.

6.6.3 One No. Of 1600A, FP, EDO ACB incomer and two (2) Nos. of 630A, 4P, MCCB shall be added to RHS of the panel as shown in SLD.

6.6.4 LT Panel shall be 3 Phase, 415V, 50Hz, 4W, single front floor mounted type. The panels shall be of compartmentalised design conforming to Form 3b of IEC60439-1.

6.6.5 Panel shall be with aluminium bus bars.

6.6.6 Panel shall have cable entry from bottom side.

6.6.7 ACB shall be electrically operated, motor assisted spring charged and electrically closing type.

6.6.8 ACB shall be provided with micro processor based over current, short circuit and earth fault protection (LSING) with independently adjustable current and time settings and also shall have communication ports.

6.6.9 MCCBs shall be electrically operated, motor assisted spring charged and electrically closing type.

6.6.10 MCCBs shall be provided with microprocessor based releases for overload, short circuit and earth fault protection with independently adjustable current and time settings and also shall have communication ports.

6.6.11 Electrical interlocking shall be provided as indicated in the single line diagram to prevent parallel operation.

6.6.12 Current Transformers, Local / Remote selector switch, TNC switch and lockable type Emergency Push Buttons shall be provided on the incoming / outgoing feeders as indicated in SLD.

6.6.13 All incoming and outgoing feeders shall be provided with a digital multi function meter model EM 6400 of CONZERVE make or equivalent as indicated in the single line diagram.

6.6.14 ON, OFF, Auto Trip and R Y B indications shall be provided on the incoming / outgoing feeders as indicated in SLD. Other indicating lamps as indicated in SLD shall also be provided.

6.6.15 Panel shall be provided with 50 x 10 mm GS earth bus throughout the length of the switchboard for connection to purchaser's earth grid.

6.6.16 Panel shall be provided with 10mm wide MIMIC diagram of colour violet (IS-5) on the front side of the panel.

6.6.17 Switchgear shall be extendable on RHS to add additional feeders later.

6.6.18 The current ratings indicated for all the breakers shall be IN-PANEL rating and NOT FREE AIR rating. Successful Bidder shall furnish FREE AIR rating and IN-PANEL rating with type test certificates for all these equipment in support of rating selection.

6.6.19 ACB's and MCCB's shall be complete with integral phase barriers and terminal covers (supplied by switchgear manufacturer) for shrouding the live parts. No FRP sheets should be used for ACB/MCCB live part shrouding inside the switchgear compartment.

6.6.20 In the event of non-availability of sufficient numbers of auxiliary contacts for MCCB / ACB, to meet the requirements of control & interlocking schemes, bidder shall use VAJC type relay of Areva make or equivalent for multiplication of contacts.

6.6.21 All the meters shall be provided with communication port.

6.6.22 Communication Cables for all meters as applicable shall be looped inside the panel and terminated at one place.

6.6.23 All the interconnecting cabling to various instruments mounted on the switchgear panel shall be included in the scope of Bidder.

6.6.24 Panel mounted indicating lamps shall be of cluster LED type.

6.6.25 The entire control & power network have to be designed as a fuse less system. Hence, no control fuses shall be used in control circuits. MCBs / RCBOs of suitable rating are to be used for control circuits and PT secondary circuits in place of fuses.

6.6.26 All control wiring shall be of minimum 2.5 Sq.mm FRLS PVC insulated stranded copper wire.

6.6.27 All exposed live parts shall be provided with proper shrouding.

6.6.28 All incoming and outgoing terminations shall be finger touch proof of suitable rating.

6.6.29 All control terminal blocks shall be of push on cage type with a minimum size of 6sq.mm. CT terminal blocks shall be of shorting link type. Minimum 15% spare terminal blocks shall be provided.

6.6.30 Inter panel barriers shall be provided in the bus-bar chamber.

6.6.31 Suitable sleeving of busbars shall be done with phase identification marking.

6.6.32 Control and instrument cables shall run in separate raceways.

6.6.33 Suitable type and size of lugs shall be provided for end termination of wires depending upon the type of terminal ends.

6.6.34 Terminal rubber boots of suitable size shall be provided for power cable terminations.

6.6.35 All ACB and MCCB handles shall be pad lockable in OFF position. In addition to this, respective module door shall be interlocked with switch handle.

6.6.36 The panel door shall be provided with single cylindrical key operated door locks.

6.6.37 The panel rear cover shall be bolted type with module identification labels.

6.6.38 All busbar and cable alley shall be identified with respective label at the front and rear side of the panel.

6.6.39 "LIVE BUSBAR" sticker shall be provided on front and rear side of Busbar Alley.

6.6.40 All components of the Panel shall have identification tags.

6.6.41 All panel doors shall be earthed using 6 sq.mm flexible copper braid / 6 sq. mm flexible copper wire (green with yellow strip) to the panel frame.

6.6.42 Each section of the Panel shall be provided with 16A, 3-pin Switched Socket Outlet in Cable Alley.

6.6.43 Each cable alley shall be provided with Panel illumination lamp controlled by door limit switch.

6.6.44 The panel shall have external and internal finish as specified in Data Sheet A.

6.6.45 Panel shall be provided with danger plate on the front side as per relevant IS and complete with warning and voltage level in 3 languages (English, Hindi and Kannada). Details shall be furnished by the successful bidder.

6.6.46 The switchboard shall be supplied with the essential spares required for trouble free operation for 3 years.

6.6.47 Milli Volt Drop Test on all busbar joints shall be carried out for this panel.

6.7 11kV SEGREGATED PHASE BUS DUCT

6.7.1 11kV Segregated Phase bus ducts shall be supplied with all required straight runs, 90 degree bends, adaptor boxes, other accessories and support structures for connecting the 11kV indoor switchboards in accordance with enclosed drawing PCPL-1414-4-CT-105.

6.7.2 The bus duct shall be installed indoor.

6.7.3 The bus duct shall be 11kV, 1250A, 18.14kA for 3 seconds, 3-phase, segregated phase, naturally cooled with Aluminium conductors (include Raychem sleeves) enclosed in painted MS sheet steel enclosure.

6.7.4 The bus support insulators shall be either epoxy or porcelain.

6.7.5 The bus duct shall conform to enclosed specification PCPL-4-S4-162 along with the Data Sheets PCPL-1414-4-162-01.

6.7.6 Bidders shall quote for busduct system based on the quantity indicated in price schedule (Section-5).

6.8 SUPPLY AND INSTALLATION OF CABLES

6.8.1 HV POWER CABLES

a. The cables shall be 11kV, Earthed grade, XLPE insulated, screened, armoured, PVC sheathed and shall conform to enclosed specification PCPL-4-S4-203 and associated data sheets.

b. The cable sizes and quantities shall be as furnished in Section-5.

c. Heat shrinkable type straight through joints shall be supplied wherever mentioned in Section-5.

d. Heat shrinkable type cable termination kits shall be supplied as furnished in Section-5.

6.8.2 MV POWER CABLES

a. The Cables shall be 1100 Volt grade, XLPE insulated, FRLS-PVC sheathed and shall conform to enclosed specification PCPL-4-S4-201 and associated data sheets.

b. The cable sizes and quantities shall be as furnished in Section-5.

c. The cable termination shall be as furnished in Section-5.

6.8.3 MV CONTROL CABLES

a. The Cable shall be 1100 Volt grade, stranded copper conductor, PVC insulated, armoured and shall conform to enclosed specification PCPL-4-S4-201 and associated Data sheets.

b. The cable sizes and quantities shall be as specified in Section-5.

c. The cable termination shall be as specified in secton-5.

6.8.4 Cabling System

The scope of work shall include supply, installation, testing and commissioning of the following:

a. All the power and control cables required for completion of work and proper functioning of the system.

b. Complete cable carrier system which shall include:

i) Galvanised bolted type Cable trays, tray covers and all accessories such as coupler plates, elbows, tees, bends, reducers, stiffeners etc and all hardware.

ii) All rigid and flexible conduits and pipes with accessories.

c. All Cable Glands, Lugs, termination kits etc., for cable terminations.

6.8.5 Cable size and cable number shall be marked near cable termination.

6.8.6 Bidders shall quote for cable carrier system, power and control cables and their terminations based on the quantity indicated in price schedule (Section-5).

6.8.7 Cable carrier system sizing shall be carried out considering 20% empty space for addition of future cables.

6.8.8 The installation of the cabling system shall be in accordance with the following specifications:

a. PCPL-4-S4-223: Cabling system.

b. PCPL-4-S4-224: Cable Installation Notes.

6.8.9 All cable schedules and interconnection schedules shall be submitted for approval.

6.8.10 The following formats will be furnished by Institute during detailed engineering for Contractor to fill in and submit for Institute's reference and records:

a. Cable schedule.

b. Interconnection schedule.

Further, cable numbering and cable tray numbering shall be done based on the procedure that would be given by the Institute during detailed engineering.

6.9 EARTHING SYSTEM

6.9.1 All the materials required for the system earthing shall be supplied installed and commissioned. The supply and installation work shall be carried out in accordance with the following specification:

a. PCPL-4-S4-230: Earthing and Lightning protection.

b. PCPL-4-S4-231: Earthing and Lightning protection system installation notes.

6.9.2 Earthing shall be carried out in accordance with drawings listed below:

SL. NO	DRAWING NO.	TITLE
1.	PCPL-1414-4-GL-101	Earthing Layout- New Chemical Substation
2.	PCPL-1414-4-GL-102	Earthing Layout- Physical Science Substation
3.	PCPL-1414-4-GL-103	Earthing Layout- E Type Quarters
4.	PCPL-1414-4-GL-104	Earthing Layout - MUSS Control Room
5.	PCPL-1414-4-GL-105	Earthing Layout – SS-14

6.9.3 Equipment manufacturer's drawings, instruction manuals also need to be referred for installation and commissioning works.

6.9.4 Bidder shall also co-ordinate with the equipment manufacturer's commissioning engineers/ representative for successful installation and commissioning of the equipment/ system.

7.0 APPROVED MAKES:

7.1 The following makes of components are acceptable. Any other make as approved by KPTCL shall be offered. If any of KPTCL approved makes are considered, evidence such approvals by providing documentary proof along with the technical bid.

SL. NO.	EQUIPMENT	PREFERRED MAKES
1.	11KV HT panel with VCBs	Schneider / Siemens / Abb
2.	Ring Main Unit	Schneider / Siemens / Abb
3.	Compact Secondary Substation	Schneider / Siemens / Abb
4.	Power Transformer	ALSTOM / ABB / Schneider / GE / ANDREW YULE
5.	Segregated Phase Busduct	BUSBAR SYSTEMS PVT. LTD. / CONTROL AND SWITCHGEAR, NEW DELHI / ENPRO ENGINEERING, CHENNAI
6.	MV Switchgear	Schneider / Siemens / Abb
7.	Load break Switches	Schneider / Siemens / Abb
8.	Air Circuit Breakers	Schneider / Siemens / Abb
9.	Moulded Case Circuit Breakers	Schneider / Siemens / Abb
10.	Relays	Siemens / Alstom / Easun / Abb
11.	Interposing Transformers, Auxiliary Instrument Transformers & Control transformers	Instrans / Kappa / Prayog / Kalpa
12.	Switches, Push buttons, actuators Ind. Lamps	Kaycee / Areva / Siemens / Schneider
13.	Meters & Instruments	Siemens / Schneider / AE

SL. NO.	EQUIPMENT	PREFERRED MAKES
14.	Annunciation Facia type	Procon / Digicont / Aplab / Larsen & Toubro
15.	Terminals	Phoenix / Wago
16.	MCB, RCBO, ELCB, Contactors	Siemens / Abb / Schneider / MDS Legrand
17.	Enclosure	Rittal / Schneider / Siemens / Abb / EL Steel / Hensel (for outdoor)
18.	Cable Trays	Profab / MDS Legrand
19.	Switches & sockets	MDS Legrand / MK Germany / Clipsal
20.	Panel space heaters	Rittal
21.	Humidistat	Rittal
22.	11kV UG Cable	Asian / KEC RPG / Universal / Polycab
23.	11kV Class termination and jointing kits	Raychem RPG / Compaq International
24.	Power and Control Cables	UNIVERSAL / Polycab / Asian / KEC RPG
25.	Cable Glands	Baliga / Comet
26.	Cable lugs	Dowell/ AMP
27.	Lighting	Philiphs / CGL / Wipro
28.	Steel	SAIL / VSP

8.0 INSPECTION AND TESTING:

8.1 GENERAL

8.1.1 All the equipment, apparatus, materials and supplies provided by the contractor under this contract shall be subjected to tests in the shop and at the field in the presence of Project Engineer cum Estate officer for conformity with the requirements of the specifications. The details of the test procedures and test equipment to be used shall be intimated to the Institute.

8.1.2 The Contractor shall submit a detailed Quality Assurance Plan within 30 days after the purchase order.

8.2 TEST REPORTS

8.2.1 Within 15 days of completion of each and every specified test, including commissioning tests, the Contractor shall submit SIX signed copies of the test reports to the Institute.

8.2.2 The test report shall include, but not necessarily be limited to the following.

a. A description of the test equipment with diagram showing arrangement of the test instruments and devices.

b. Sample computations, wherever necessary to show the test values employed in the equations.

c. Curves showing relation of tested quantities.

d. Data in tabulated form.

e. The comparison of the test results with the guaranteed requirements of the specification and explanation of deviations, if any.

8.3 SHOP TESTS

The shop tests shall include type, routine and acceptance tests as applicable as well as any other tests as required

8.4 RE-TESTING

The Contractor shall, at its own expense, promptly make good all defects evident by testing or made apparent in any other ways. After defects in the equipment have been rectified, the equipment will be subjected to such retesting as may be necessary until the equipment is proved to be in satisfactory operation/condition.

8.5 QUALITY ASSURANCE PLAN (QAP)

The contractor shall furnish Quality Assurance Plan (QAP) for each equipment/system which shall include the following details:

a. List of areas in manufacturing process where stage inspection by Project Engineer cum Estate officer shall be carried out.

b. Hold points in the manufacturing process for Project Engineer cum Estate officer inspection.

c. Shop test schedules for the Project Engineer cum Estate officer to witness the tests.

d. The hold points and shop test schedule shall be discussed with the Project Engineer cum Estate officer before the QAP is finalised.

8.6 INSPECTION BY PROJECT ENGINEER CUM ESTATE OFFICER

a. The Project Engineer cum Estate officer will do inspection at the hold points during manufacture as per approved QAP.

b. The Project Engineer cum Estate officer will witness the type and routine tests as well as other shop tests as per approved QAP.

c. The Project Engineer cum Estate officer will witness any re-testing that may be required as specified in Para 8.4.

d. The costs of travel, food and lodging and other incidental expenses for Project Engineer cum Estate officer for the inspection and witnessing of tests shall be borne by the Contractor.

9.0 DOCUMENTATION:

9.1 Bidder shall submit the following documents for all equipment in THREE SETS with the bid:

a. All drawings as mentioned in respective specification

b. Catalogue of all Equipment along with the filled in data sheet-B.

c. Bill of material with type, ratings and makes of all components.

d. Copies of valid type test certificates (not older than 5 years from the date of bidding) carried out on offered equipment for short circuit, impulse, temperature rise and IP class.

9.2 Whether explicitly mentioned or not in the various sections of this specification, Vendor's documentation shall include hard copies of all drawings related to this package, operating and instruction manuals, training manuals, etc., in SIX sets after delivery of equipments to site. The GA and schematic diagrams shall be in AutoCAD software compatible and shall preferably be carried out in Promise or equivalent software. Vendor shall submit the following documents, in THREE sets each to

IISc and PCPL for their review and/or approval after award of contract and before start of manufacture for.

a. Overall general arrangement drawings giving plan, section, foundation loading data (both static and dynamic), side view, etc.

b. Internal component layout drawings.

c. Sizing calculation for busbar selection and earthing conductor selection.

d. Catalogue of the Equipment along with the filled in data sheet-B.

e. Bill of material with type, ratings and makes of all components.

f. Control and schematic diagrams for circuit breakers, isolators and CRP with ferrule and terminal numbers.

g. Testing and calibration certificate of all meters.

h. Interconnection schedule.

i. Cable schedule.

j. Copies of valid type test certificates (not older than 5 years from the date of bidding) carried out on offered equipment for short circuit, impulse, temperature rise and IP class shall be submitted in THREE SETS along with the drawing for review and approval.

9.3 This clause is applicable across all sections for all equipments. However, any additional instruction mentioned in individual sections shall be strictly complied.

10.0 COMPLETION SCHEDULE:

All equipments to be procured under this specification shall be supplied to site and erected within the period as specified in the forwarding letter. BIDDER shall submit a bar chart for various activities of manufacturing, testing, inspection, delivery, erection, testing and commissioning.

11.0 QUANTITY VARIATION:

11.1 The quantities for supply and installation are furnished at Section-5. The bidder shall quote unit rates for all items. The unit rate schedule shall be binding for any quantity variation.

11.2 For cabling, earthing and lighting the estimated quantities are given at Section-5. However; the bidder shall estimate the quantities from the drawings and quote accordingly.

11.3 In addition to the Bill of material specified at Section-5, the Bidder shall study the tender drawings and shall highlight any item/equipment that is required for completion of the job.

11.4 The quantities and unit rates for such non- tendered items shall be quoted separately. Prior approval for unit rates for non-tendered items shall be taken before carrying out the work.

12.0 PERFORMANCE GUARANTEE:

12.1 The workmanship for the equipment, accessories and erection shall have warranty of 18 months from the date of supply or 12 months from the date of commissioning, whichever is earlier.

12.2 The temperature rise of the bus bars and at the cable termination end shall not exceed 40ºC above ambient temperature.

1.0 SCOPE OF ENQUIRY:

1.1 The scope of this enquiry is to briefly describe the various civil and structural works required as a part of Electrical System up-gradation works at the IISc. Campus at Bangalore. As part of the up-gradation works it is proposed to extend the existing 11 KV switchgear and modify existing electrical network to form a new 11 KV underground Ring Main System. Broadly this will involve;

a. Installation of Compact Sub Stations in Chemical Science area and E .Type Quarters area along with associated cable trenches.

b. New Cable Trench in Physical Science Area

c. Modification to existing MUSS Control Room.

d. Providing cables in HDPE pipes to be buried underground.

The proposed layout covering the above works is indicated in the Drawing Nos. PCPL-1414-2-ARC-101, PCPL-1414-4-GA-101 to 104 and PCPL-1414-4-CT-101 to 105.

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

1.2.1 Design of civil foundation drawings along with necessary calculations for all foundations,

1.2.2 Preparation of construction drawings for all foundations under this project,

1.2.3 Construction of RCC foundations including foundations for Compact Substation Units and Transformers,

1.2.4 Some modification in the interior on the ground floor of the MUSS building involving works indicated in 1.2.6.

1.2.5 Construction of Cable trenches along with their precast covers.

1.2.6 Construction of Chain Link fencing and gates.

1.2.7 Excavating trenches, installing HDPE pipes and cables in the excavated trenches, backfilling and providing pathways on the top of trenches.

1.2.8 Dismantling of wall inside the control room building (Battery room wall) and constructing new wall along with its foundation of RR masonry and other associated works.

1.2.9 Underground horizontal drilling below the roads and inserting HDPE pipes in the drilled holes.

1.2.10 Provide gravel filling in the transformer yard and compact substation area.

1.2.11 Any other minor civil works required for the completion of the entire work.

2.0 EARTHWORK SPECIFICATION :

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

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

2.2.1 IS-1200 - Method of measurement of Building Works.

2.2.2 IS-3764 - Safety code for excavation works.

2.2.3 IS-3385 - Code of practice for measurement of Civil Engineering works.

2.2.4 IS-2720 - Part – II - Determination of moisture Content

2.2.5 Part –VII - Determination of Moisture Content-Dry Density Relation Using Light Compaction.

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

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

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

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

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

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

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

2.7 The rates quoted shall also include dumping of excavated materials in regular heaps, bunds, riprap with regular slopes as directed by Project Engineer cum Estate Officer, within the lead specified and levelling the same so as to provide natural drainage. Soil excavated shall be stacked properly as directed by Project Engineer cum Estate Officer. As a rule all softer material shall be laid along the centre of the heaps, the harder and more weather resistant materials forming the casing on the sides and the top.

2.8 The area to be excavated / filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall also be removed. The material so removed shall be burnt or disposed off as directed by Project Engineer cum Estate Officer. Where earth fill is intended, the area shall be stripped of all loose/soft patches, topsoil containing objectionable matter/materials before fill commences. All materials to be excavated are classified into one of the following classes and shall be paid for the rate tendered for that particular class of material. No distinction shall be made whether the material is dry, moist or wet. The decision of Institute / Project Engineer cum Estate Officer regarding the classification of material shall be final and binding on Contractor.

2.9 Earthwork is classified under any of the following categories:

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

2.9.2 Soft and decomposed rock:- This shall include rock, boulder, slag, chalk, slate, hard mica schist, laterite and all other rock materials, that do not need blasting and could be removed with picks, hammer, crow bars, wedges, and pneumatic breaking equipment. Rock boulders not longer than 3 feet in any direction and not more than 20 inches in any one of the other two directions are included in this category.

2.9.3 Hard rock: - This shall include all rock occurring in large continuous masses, which cannot be removed except by blasting for loosening it. Harder varieties of rock with or without veins and secondary minerals which, in the opinion of Institute / Project Engineer cum Estate Officer require blasting shall be considered hard rock. Boulders of rock not classified above shall also be classified as hard rock.

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

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

2.12 All excavations shall be done to the minimum dimensions as required for safety and working facility. Prior approval by the Institute / Project Engineer cum Estate Officer shall be obtained by Contractor for the method he proposes to adopt for excavation, Including dimensions, side slopes, dewatering, disposal, etc. This approval, however, shall not in any way relieve Contractor of his responsibility for any consequent loss or damage. Side slopes shall be as step that will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slopes dressed to a modified stable slope. Removal of the slipped earth will not be paid for if the slips are due to the negligence of Contractor.

2.13 All loose boulders, semi detached rocks (along with earthy stuff which might move therewith) not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of the Project Engineer cum Estate Officer, to fall or otherwise endanger the workmen, equipment, or work, etc., shall be removed away from the area of the excavation. The method used shall be such as not to shatter or render unstable or unsafe, the portion which was originally sound and safe.

2.14 Any material not requiring removal as contemplated in the work, but which in the opinion of the Institute / Project Engineer cum Estate Officer, is likely to become loose or unstable later, shall also be removed as directed by the Institute / Project Engineer cum Estate Officer. The cost of such stripping will be paid for at the unit rates accepted for the class of material in question.

2.15 All fill material will be subject to Institute / Project Engineer cum Estate Officer's approval. If any material is rejected by Institute / Project Engineer cum Estate Officer, Contractor shall remove the same forthwith from the site at no extra cost to the Institute. Surplus fill material shall be deposited / disposed off as directed by Project Engineer cum Estate Officer after the fill work is completed. No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with.

2.16 To the extent available, selected surplus spoils from excavated material shall be used as backfill. Fill material shall be free from clods, salts, sulphates, organic or other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, boulders shall be broken into pieces not longer than 6 inches size, mixed with properly graded fine material consisting of murrum or earth to fill up the voids and the mixture used for filling.

2.17 If any selected fill material is required to be borrowed. Contractor shall make arrangements for bringing such material from outside borrow pits. The material and source shall be subject to prior approval of Institute / Project Engineer cum Estate Officer. The approved borrow pit area shall be cleared of all bushes, roots of trees, plants, rubbish etc. Top soil containing salts/sulphate and other foreign material shall be removed. The material so removed shall be burnt or disposed off. Contractor shall make necessary access roads to borrow areas and maintain the same, if such access road does not exist, at his cost.

2.18 As soon as the work in foundation has been accepted and measured, the spaces around the foundations, structures, pits, trenches etc. shall be cleared of all debris and filled with earth layers not exceeding 200 mm when finished, each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to 90% Modified Proctor Density and to the satisfaction of Institute / Project Engineer cum Estate Officer. Earth shall be rammed with approved mechanical compaction machines. The final backfill surface shall be trimmed and levelled to proper profile as indicated on the drawings.

2.19 Plinth filling shall be carried out with approved material in layer not exceeding 200 mm finished, watered and compacted with mechanical compaction machines, when filling reach final level, the surface shall be flooded with water, unless otherwise directed, for at least 24 hours, allowed to dry and

then the surface again compacted as specified above to avoid settlements at a later stage. The finished level of the filling shall be trimmed to the level/slope specified.

2.20 Where specified in the schedule of works, compaction of the plinth fill shall be carried out by means of 12 tonne rollers smooth wheeled, sheep-foot or wobbly wheeled rollers. As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill. The finished thickness of each unconsolidated fill layer can in this case be up to a maximum of 300 mm. rolling shall commence from the outer edge and progress towards the centre and continue until the compaction is to the satisfaction of Project Engineer cum Estate Officer. But in no case less than 10 passes of roller will be accepted for each layer. The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated and filled and consolidated.

2.21 For filling with local sand, sand shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded condition shall be included in Contractor's rate for sand filling. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until Institute / Project Engineer cum Estate Officer has inspected and approved the fill.

2.22 Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipe and drains have been tested and passed. The backfilling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes.

2.23 Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centreline of the pipes shall be done by hand compaction with selected approved earth in layers not exceeding 8 inches. Backfilling above the level of the centreline of the pipe shall be done with selected earth by hand compaction or other approved means in layers not exceeding 6 inches.

2.24 Filling of the trenches shall be carried simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

2.25 Site grading shall be carried out as indicated in the drawings and as directed by Project Engineer cum Estate Officer. Filling and compaction shall be carried out as specified herein.

2.26 If no compaction is called for, the fill may be deposited to the full height in one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and levelled uniformly and compacted before the next layer is deposited.

2.27 To ensure the fill has been compacted as specified, field and laboratory tests shall be carried out by Contractor at his cost. Contractor's quoted rates for all earth/sand filling items are deemed to include such all tests for compaction.

2.28 Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed.

2.29 The fill shall be carried out to such dimensions and levels as indicated on the drawings. The fill shall be considered as incomplete if the desired compaction has not been obtained.

2.30 The compaction, shall comply with the specified (proctor/ modified proctor) density at moisture content differing not more than 4 percent from the optimum moisture content. Contractor shall demonstrate adequately at his cost, by field and laboratory tests that the specified density has been obtained.

2.31 Lead for deposition/disposal of excavated material, shall be as specified in the respective item of work. For the purpose of measurement of lead the are to be excavated or filled or area on which excavated material is to be deposited/disposed off shall be divided into suitable blocks and for each of the blocks, the distance between centre lines shall be taken as the lead which shall be measured by the shortest straight line route on the plan and not the actual route taken by Contractor.

2.32 All excavation shall be measured net, as per drawings. Dimensions for purpose of payment shall be reckoned on the horizontal area of the excavation at the base of foundation of the walls, columns,

footings, tanks, rafts, or other foundations/structures to be built, multiplied by the average depth from the surface of the ground in accordance with the drawings. Excavation in side slopes will not be paid for. Contractor may make such allowance in his rates to provide for excavation in side slopes keeping in mind the nature of the soil and safety of excavation.

2.33 Unless otherwise specified, the unit rates quoted for excavation in different types of materials shall also account for a basic lead of 130 m for disposal as specified or as directed. Only leads beyond the basic 130 m will be considered as extra lead and paid for at the rates quoted in the schedules.

2.34 Backfilling as per specification the sides of the foundations of columns, footings, structures, walls, tanks, rafts, trenches etc. with excavated material will not be paid separately, if item rate calls specifically for excavation and backfilling. Excavation and backfilling shall include excavation, stacking of excavated materials as directed, excavation/packing of stacked selected material, conveying it to the place of final backfill, compaction etc. as specified. As a rule, material to be backfilled will be stacked temporarily within the basic lead of 130 m unless otherwise directed by Project Engineer cum Estate Officer. If Project Engineer cum Estate Officer directs/permits a lead over 130 m for such material, the conveyance of the material for the extra distance over the basic lead of 130 m for backfilling will be paid for.

2.35 Payment for plinth/trench filling work will be made based on measurement of plinth/trench dimensions filled. The plinth ground level shall be surveyed before hand for this purpose.

2.36 Backfilling, plinth filling etc. with borrowed earth will be paid for at rates quoted. The quoted rate shall include all operations such as clearing, excavation, lead and transport, fill, compaction etc. as specified. Actual quantity of consolidated filling shall be measured and paid for. The lead, lift etc. shall be as indicated in the schedule of quantities.

2.37 Actual quantity of consolidated sand filling shall be measured and paid.

3.0 DEWATERING SPECIFICATIONS:

3.1 Excavations shall be kept absolutely free of water. Areas around the excavation pits shall be graded such as to prevent surface water from entering excavated areas. Contractor shall remove any water including rain water and subsoil water accumulated in the pits, by pumping or other adequate means approved by Institute / Project Engineer cum Estate Officer, and keep excavations dry until foundation work is completed and the pits backfilled. Sumps shall be made for dewatering at locations clear of excavations to be done further. Approval of Institute / Project Engineer cum Estate Officer shall be obtained for the method of pumping the Contractor wishes to adopt. The pumping arrangement shall be such as not to cause any subsoil movement or blowing in due to differential head of water during pumping. Adequate pumping arrangement shall be made to ensure timely completion of scheduled work.

3.2 If the inflow of ground water is considerable, well-point system – single stage or multistage shall be adopted. Contractor shall submit his scheme for the well-point system indicating the stages, the spacing, number and diameter of well-points, headers etc., and the number, capacity and location of pumps for approval of Institute / Project Engineer cum Estate Officer. The cost of dewatering shall be included in the item rate for excavation unless separately provided for.

4.0 SPECIFICATIONS FOR STRUCTURAL CONCRETE WORKS

4.1 This specification covers the general requirements for concrete to be used using on-site production facilities including requirements relating to the quality, handling, storage of ingredients, proportioning, batching, mixing and testing of concrete and also requirements relating to the quality, storage, bending and fixing of reinforcement. This also covers the transportation of concrete from the mixer to the place of final deposit and the placing, curing, protecting, repairing and finishing of concrete.

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

amendments and revisions. In case of discrepancy between this specification and those referred to herein, this specification shall govern.

4.2.1 I.S. 269 Specification for ordinary, rapid hardening and low heat Portland cement

4.2.2 IS 650 Specification for standard sand for testing of cement

4.2.3 IS 383 Specification for coarse and fine aggregates from natural sources for concrete

4.2.4 IS 2386 (Part I to VIII) Methods of test for aggregates for concrete.

4.2.5 IS 516 Methods of test for strength of concrete

4.2.6 IS 1199 Methods of sampling and analysis of concrete

4.2.7 IS 3025 Methods of sampling and testing (physical and chemical) water used in industry

4.2.8 IS 432 (Part I & II) Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.

4.2.9 IS 1139 Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement

4.2.10 IS 1566 Specification for plain hard drawn steel wire fabric for concrete reinforcement

4.2.11 IS 1785 Specification for plain hard drawn steel wire for pre-stressed concrete

4.2.12 IS 1786 Specification for cold twisted steel bars used in pre-stressed concrete

4.2.13 IS 2090 Specification for high tensile steel bars used in pre-stressed concrete

4.2.14 IS 4990 Specification for plywood for concrete Shuttering work

4.2.15 IS 2645 Specification for integral cement water Proofing compounds

4.2.16 IS 1791 Specification for batch type of concrete Mixers

4.2.17 IS 2438 Specification for roller pan mixer

4.2.18 IS 2505 Specification for concrete vibrators immersion type

4.2.19 IS 2506 Specification for creed board concrete Vibrators

4.2.20 IS 2514 Specification for concrete vibrating tables

4.2.21 IS 3366 Specification for pan vibrators

4.2.22 IS 4656 Specification for form vibrators of concrete

4.2.23 IS 2722 Specification for portable swing, weigh-batchers for concrete (single and double bucket type)

4.2.24 IS 2750 Specification for steel scaffoldings

4.2.25 IS 456 Code of practice for plain and reinforced concrete.

4.2.26 IS 1343 Code of practice for pre-stressed concrete

4.2.27 IS 3370 (Parts I to V) Code of practice for concrete structures for storage of liquids

4.2.28 IS 3935 Code of practice for composite construction

4.2.29 IS 34201 Criteria for design & construction of precast concrete trusses

4.2.30 IS 2204 Code of practice for construction of reinforced shell roof

4.2.31 IS 2210 Criteria for design of R.C. Shell structures and folded plates

4.2.32 IS 2751 Code of practice for welding of mild steel bars used for reinforced concrete construction

4.2.33 IS 2502 Code of practice for bending and fixing of bars for concrete reinforcement

4.2.34 IS 3558 Code of practice for use of immersion vibrators for consolidating concrete

4.2.35 IS 3414 Code practice for design and installation of joints in buildings.

4.2.36 IS 4014 (Parts I & II) Code of practice for steel tubular scaffolding.

4.2.37 IS 2571 Code of practice for laying in-situ cement concrete flooring

4.2.38 IS 3696 (Parts I & II) Safety code for scaffolds and ladders

4.2.39 IS 1200 Method of measurement of building work

4.2.40 IS 3385 Code of practice for measurement of Civil engineering works

4.3 In the event that the local statutory or pollution control board requirements are more stringent than those set forth in this specification, such requirements shall be considered part of this specification and shall supersede this specification where applicable.

4.4 Project Engineer cum Estate Officer shall inspect the source/s of material, the operation of procurement and the layout for storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Institute / Project Engineer cum Estate Officer's approval obtained, prior to starting of concrete work.

4.5 The materials to be used in manufacture of standard concrete shall consist solely of a standard type portland cement, clean sand, natural coarse aggregate, clean water, admixtures, if specially called for on drawings or specifications.

4.6 Unless otherwise specified in the drawings or called for by Institute / Project Engineer cum Estate Officer, cement shall be ordinary Portland cement in 50 kg. Bags. Changing of brands or type of cement within the same structure will not be permitted.

4.7 A certified report attesting to the conformance of the cement to I.S specifications by cement manufacturer's chemist shall be furnished, for each consignment received at site to Institute / Project Engineer cum Estate Officer.

4.8 Contractor will have to make his own arrangement for the storage of adequate quantity of cement. If supplies are arranged by Institute / Project Engineer cum Estate Officer, cement will be issued in quantities to cover work requirements for one month or more, as deemed fit by Institute / Project Engineer cum Estate Officer and it is the responsibility of the Contractor to ensure adequate and proper storage. Cement bags shall be stored in a dry closed shed (Storage under tarpaulins is not permitted), well away from the outer walls and elevated from the floor to avoid contact with moisture from ground and so arranged as to provide ready access. Damaged or reclaimed or partly set cement is not permitted to be used and shall be removed from the site. The storage arrangements shall be such that there is no dead storage. Not more than 12 bags shall be stacked in any tier. The storage arrangement shall be approved by Institute / Project Engineer cum Estate Officer. Consignments of cement shall be stored as received and shall be consumed in the order of their delivery.

4.9 Cement held in storage for a period of ninety (90) days or longer shall be tested. Should at any time Institute / Project Engineer cum Estate Officer has reasons to consider that any cement is defective, then irrespective of its origin and/or manufacturer's test certificate, such cement shall be tested immediately at Contractor's cost at an approved laboratory, and until the results of such tests are found satisfactory, it shall not be used in any work. Contractor is not entitled to any claim of any nature on this account.

4.10 Definition of different aggregates:

4.10.1 "AGGREGATE" in general designates both fine and coarse inert materials used in making concrete.

4.10.2 "FINE AGGREGATE" is aggregate most of which passes through 4.75 mm IS sieve

4.10.3 "COARSE AGGREGATE" is aggregate most of which is retained on 4.75 mm sieve.

4.11 All fine and coarse aggregate proposed for use in the work shall be subject to Institute / Project Engineer cum Estate Officer's approval and after specific materials have been accepted, the source of

supply of such materials shall not be changed without prior approval of Institute / Project Engineer cum Estate Officer.

4.12 Aggregate shall, consist of natural sands, crushed stone and gravel from source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, durable against weathering, of limited porosity and free from deleterious material that may cause corrosion of the reinforcement or may impair the strength and/or durability of concrete. The grading of aggregate shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the "mix design" and preliminary tests on the concrete specified later.

4.13 Samples of aggregate for mix design and determination of suitability shall be taken under the supervision of Project Engineer cum Estate Officer and delivered to the laboratory, and records of test results on aggregates and concrete submitted to Project Engineer cum Estate Officer in advance of the scheduled placing of concrete.

4.14 All fine and coarse aggregate shall be stacked separately in stockpiles in the material yard near the work site in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign materials and earth during storage and while heaping the materials shall be prevented. The aggregate must be of specified quality not only at the time of receiving at the site but also at the time of loading it into mixer. Rakers shall be used for lifting the coarse aggregate from bins or stock piles, coarse aggregate shall be piled in layers not exceeding 1.20 meters in height to prevent coning or segregation. Each layer shall cover the entire area of the stock pile before succeeding layers are started. Aggregates that have become segregated shall be rejected.

4.15 Aggregates having a specific gravity below 2.6 (saturated surface dry basis) shall not be used.

4.16 Fine aggregate shall consist of natural or crushed sand to I.S. 383. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, and adherent coating. Clay, loam, alkali, organic matter, mica, salt, or other deleterious substances, which can be injurious to the setting qualities / strength/durability of concrete.

4.17 Sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter.

4.18 The percentage of deleterious substances in sand delivered to the mixer shall not exceed the following:

4.18.1 Percent by weight

	Uncrushed	Crushed
1) Material finer than 75 micron I.S. sieve	3.00	15.00
2) Shale	1.00	-
3) Coal lignite	1.00	1.00
4) Clay lumps	1.00	1.00
Total of all above substances including Items 1) to 4) for un-crushed sand and crushed sand	5.00	2.00

4.18.2 Unless otherwise directed or approved, the grading of sand shall be within the limits indicated below:

Percentage passing for:

I.S. Sieve Designation	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100

2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8.30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

4.19 Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron I.S. sieve, by total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron I.S. sieve or to percentage passing any other sieve size on the coarser limit of Grading Zone I or the finer limit of Grading Zone IV. Fine aggregates conforming to Grading Zone IV shall not be used.

4.20 The sand shall have a fineness modulus of not less than 2.6 or more than 3.2. The fineness modulus is determined by adding the cumulative percentage retained on the I.S. sieve sizes 4.75 mm 0.36 mm, 1.18 mm, 600 micron, 300 micron, 150 micron and dividing the sum by 100.

4.21 Coarse aggregate for concrete shall conform to I.S. 383. This shall consist of natural or crushed stone and gravel, and shall be clean, free from elongated, flaky or laminated pieces adhering coatings, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter.

4.22 Natural gravel and crushed rock shall be screened and/or washed for the removal of dirt, or dust coating.

4.23 Coarse aggregate shall be graded in and the grading shall be within limits.

4.24 The pieces shall be angular in shape and shall have granular or crystalline surfaces friable, flaky and laminated pieces. The Maximum size of coarse aggregate shall be the maximum size specified. The amount of fine particles occurring in their free state or as loose adherent shall not exceed 1 % when determined by laboratory sedimentation tests as per IS 2386. After 24 hours immersion in water, a previously dried sample shall not have gained more than 10 % of its oven dry weight in air, as determined by IS 2386.

4.25 Water used for both mixing and curing shall be free from injurious amounts of deleterious materials. Potable water is generally satisfactory for mixing and curing concrete.

4.26 In case of doubt, the suitability of water for mixing concrete shall be ascertained by the compressive strength and initial setting time test specified in I.S. 456. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account taken of seasonal variations. The sample shall be stored in clean container previously rinsed out with similar water.

4.27 Average 28 days' compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90 % of the average strength of three similar concrete cubes with distilled water.

4.28 In initial setting time of test block made with appropriate test cement and the water proposed to be used shall not be less than 30 minutes and shall not differ more than 30 minutes from the initial setting time of control test block prepared with the appropriate test cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of I.S. 4031.

4.29 Where water can be shown to contain an excess of acid, alkali sugar or salt, Institute / Project Engineer cum Estate Officer may refuse to permit its use. Percentage of solids in water when tested in accordance with the method indicated below, shall not exceed the following:

4.29.1 Percent Method of Test (ref. To IS 3025)

Organic	0.20	10 and 11 (organic solids = total solids minusignited residue)
Inorganic	0.30	11 (Ignited residue)

Sulphates (as So4)	0.50	20
Alkali, Chlorides (as Cl)	0.01	24

4.30 Reinforcement bars, if supplied by Contractor, shall be either plain round mild steel bars grade I as per I.S. 432. (Part I) or medium tensile steel bars as per I.S. 432 (Part I) or hot rolled mild steel and medium tensile steel deformed bars as per I.S. 1139 or cold twisted steel bars as per I.S.1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with I.S. 1566. Substitution of reinforcement will not be permitted except upon written approval from Institute / Project Engineer cum Estate Officer.

4.31 The reinforcement shall not be kept in direct contact with the ground but stacked on top of an arrangement of timber sleepers or the like. Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.

4.32 All steel shall be of Grade I quality. No re-rolled material will be accepted. If demanded by Institute / Project Engineer cum Estate Officer, Contractor shall submit the manufacturer's certificate for steel. Random tests on steel supplied by Contractor may be performed by Project Engineer cum Estate Officer as per relevant I.S. All costs incidental to such tests shall be at Contractor's expense. Steel not conforming to specifications shall be rejected.

4.33 All reinforcement shall be clean, free from grease, oil, paint dirt, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used. All bars shall be rigidly held in position before concreting. No welding of rods to obtain continuity shall be allowed unless approved by Institute / Project Engineer cum Estate Officer. If welding is approved, the work shall be carried out as per I.S. 2751, according to latest modern practices and as directed by Project Engineer cum Estate Officer. In all cases of important connections, tests shall be made to prove that the joints are of the full strength of bars welded. Special precautions, as specified by Institute / Project Engineer cum Estate Officer, shall be taken in the welding of cold worked reinforcing bars and bars other than mild steel.

4.34 Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be staggered and the locations of all splices, except those specified on the drawings, shall be approved by Institute / Project Engineer cum Estate Officer. The bars shall not be lapped unless the length required exceeds maximum available lengths of bars at site.

4.35 All bars shall accurately bent according to the sizes and shapes shown on the detailed working drawings/ bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and re-bent in a manner that will injure the material. Bars containing cracks or splits shall be rejected. They shall be bent cold. No reinforcement shall be bent when in position in the work without approval, whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

4.36 Reinforcement shall be accurately fixed by any approved means and maintained in the correct positions shown in the drawings by the use of blocks, spacers and chairs as per IS 2502, to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be securely bound together at all such points with no. 16 gauge annealed soft iron wire. The vertical distance required between successive layers of bars in beams or similar members shall be maintained by the provision of mild steel spacer bars at such intervals that the main bars do not sag between adjacent spacer bars.

4.37 Erected and secured reinforcement shall be inspected and approved by Institute / Project Engineer cum Estate Officer prior to placement of concrete.

4.38 For payment of work done under this item, the actual quantity of steel as required by and as calculated from the drawings and approved by Institute / Project Engineer cum Estate Officer, irrespective of the level or the height at which the work is done, shall be taken. The unit rate for reinforcement shall

include all wastage, binding wire, etc., for which no separate payment shall be made. Laps as shown in drawings and as per required at site and approved by Institute / Project Engineer cum Estate Officer, shall be measured and paid for.

4.39 All concrete in the work shall be "Controlled Concrete" as defined in I.S. 45, unless it is a nominal mix concrete such as 1:3:6, 1:4:8 or 1:5:10. Whether reinforced or otherwise, all controlled concrete works to be carried out under this specification shall be divided into the following.

4.40 Minimum compressive strength of 15 cm. cubes at 7 and 28 days after mixing, conducted in accordance with IS. 545

Class	Preliminary Test kg/cm2		Works test kg/cm2		Maximum size of aggregate mm		
	At 7 days	at 28 days	at 7 days	at 28 days			
M40	335	500	270	400			20
M35	300	440	235	350			20
M30	250	380	200	300	40	or	20
M25	220	320	170	250	40	or	20
M20	175	260	135	200	40	or	20
M15	135	200	100	150	40	or	20

Note: It shall be understood that whenever the class of concrete such as M20 is specified it shall be Contractor's responsibility to ensure that maximum crushing strength stipulated for the respective class of concrete is obtained.

4.41 Contractor shall carry out concrete mix design to investigate the grading of aggregates, water to cement ratio workability and the quality of cement required to obtain the maximum strength specified of preliminary and work cubes. The proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made.

4.42 Whenever there is a change either in required strength of concrete or water/cement ratio or workability or the source of the aggregates and/or cement, preliminary tests shall be repeated to determine the revised proportion of mix to suit the altered conditions.

4.43 Test specimens shall be prepared with at least two different water/cement ratios for each class of concrete, consistent with workability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in all respects to those to be actually employed in the works. It is Contractor's duty to carry out these tests and he shall furnish to Institute / Project Engineer cum Estate Officer a statement of proportions proposed to be used for the various concrete mixes. For preliminary tests, the following procedure shall be followed.

4.44 Materials shall be brought to room temperature and all materials shall be in dry condition. The quantities of water, cement and aggregate for each batch shall be determined by weight to an accuracy of I part in 1000 parts.

4.45 It shall be done in a small batch mixer as per I.S.516 in such a manner as to avoid loss of water. The whole batch is mixed thoroughly for a period of not less than 2 minutes until the resulting concrete is uniform in appearance.

4.46 The consistency of each batch of concrete shall be measured immediately after mixing, by the slump test in accordance with I.S.1199.

4.47 Concrete test cubes shall be moulded by placing fresh concrete in the mould and compacted as specified in I.S.516.

4.48 Curing shall be as specified in I.S.516. The cubes shall be kept in moist air of at least 90% humidity at a temperature of 27^0C. For 24 hours from time of adding water to the dry ingredients. They shall be removed from the moulds and kept immersed in clean, fresh water kept at 27 ◦C temperature until required for test. Curing water shall be renewed every seven days. A record of maximum and minimum temperatures at the place of storage shall be maintained during the period they are in storage.

4.49 The strength shall be determined based on not less than three cube test specimens for each age and each water-cement ratio. All these laboratory test results shall be tabulated and furnished to Institute / Project Engineer cum Estate Officer. The test result shall be accepted by Institute / Project Engineer cum Estate Officer if the average compressive strengths of the specimens tested is not less than the compressive strength specified for the age at which specimens are tested, subject to the condition that only one out of the three consecutive tests may give a value less than the specified strength for that age, but in no case none of the test values shall fall below 90% of the specified strength. If the results are not satisfactory Project Engineer cum Estate Officer may direct the Contractor to make such changes, as he considers necessary to meet the requirements. All these preliminary tests shall be conducted by the Contractor at his own cost in an approved laboratory and his rates for concrete items are deemed to include the cost of these operations and tests.

4.50 The proportions that shall be decided by preliminary tests shall be by weight. These proportions of cement, fine and coarse aggregate shall be maintained during subsequent concrete batching. The grading of fine and coarse aggregate shall be checked as frequently as possible, to ensure maintaining of grading in accordance with the samples used in preliminary mix design. The material shall be stock piled well in advance of use.

4.51 Only such quality of water shall be added to cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete. The water added to the mix shall be such as not to cause segregation of materials or the collection of excessive water on the surface of the concrete.

4.52 The water cement (W/C) ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix.

4.53 The actual water cement ratio to be adopted shall be determined in each instance by Contractor and approved by Institute / Project Engineer cum Estate Officer.

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

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

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

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

4.56 The materials and proportions of concrete materials as established by the preliminary tests for the concrete mix design shall be rightly followed for all concrete on the project and shall not be changed except when specifically permitted by Institute / Project Engineer cum Estate Officer.

4.57 Concrete shall be of strength stipulated in the respective items. All concrete shall be mixed in mechanically operated batch mixers complying with IS 1791, and of approved make with suitable provision for correctly controlling the water delivered to the drum. The quantity of water actually entering the drum shall be checked with reading of the gauge or valve setting, when starting a job. The test should be made while the mixer is running. The volume of the mixed materials shall not exceed the manufacturer's rated mixer capacity. The batch shall be charged into the mixer so that some water will enter the drum in advance of cement and aggregates. All water shall be in the drum by the end of the first 15 seconds of the specified mixing time. Each batch shall be mixed until the concrete is uniform in colour, for a minimum period of two minutes after all the materials and water are in the drum. The entire contents of the drum shall be discharged in one operation before the raw materials for the succeeding batches are fed into the drum.

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

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

4.60 At least 6 test cubes of each class of concrete shall be made for every 2000 cft. Concrete or part thereof. Such samples shall be drawn on each day for each type of concrete. Of each set of 6 cubes, three shall be tested at 7 days age and three at 28 days of age. The laboratory test results shall be tabulated and furnished to Institute / Project Engineer cum Estate Officer. Project Engineer cum Estate Officer will pass the concrete if the average strength of specimens tested is not less than the strength specified, subject to the condition that only one out of three consecutive tests may give a value less than the specified strength but this shall not be less than 90% of the specified strength.

4.61 Slump tests shall be carried out immediately after sampling.

4.62 Admixtures may be used in concrete only with the approval of Institute / Project Engineer cum Estate Officer after ensuring that, with the passage of time neither the compressive strength nor its durability is reduced. Calcium chloride shall not be used for accelerating the set of cement for any concrete containing reinforcement, or embedded steel parts. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instructions.

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

4.64 Where specified and approved by Institute / Project Engineer cum Estate Officer, water reducing admixtures shall be added in quantities specified by owner. The admixtures shall be added in the form of a solution.

4.65 Where specified and approved by Institute / Project Engineer cum Estate Officer, retarding agents shall be added to concrete mix in quantities specified by Project Engineer cum Estate Officer.

4.66 Where specified and approved by Institute / Project Engineer cum Estate Officer, water proofing agent conforming to IS.2645, shall be added in quantities specified by Project Engineer cum Estate Officer.

4.67 Project Engineer cum Estate Officer may at his discretion instruct the Contractor to use any other admixture in the concrete.

4.68 Tests shall be carried out on cement, sand, coarse aggregate in accordance with the relevant Indian Standards, at regular intervals, whenever any new batch of material is received at site. Tests on cement shall include:

a) Fineness test

b) Test for normal consistency

c) Test for setting time

d) Test for soundness

e) Test for tensile strength

f) Test for compressive strength

g) Test for heat of hydration (by experiment and by calculations) in accordance with IS 269.

4.69 Tests on sand shall include:

a) Sieve test

b) Test for organic impurities

c) Decantation test for determining clay and silt content

d) Specific gravity test

e) Test for unit weight and bulkage

f) Test for sieve analysis and fineness modulus.

4.70 Tests on coarse aggregate shall include

a) Sieve analysis

b) Specific gravity and unit weight of dry, loose and rodded aggregate

c) Soundness and alkali aggregate reactivity

d) Petro-organic examination

e) Deleterious materials and organic impurities

f) Test for aggregate crushing value.

4.71 The above test shall be carried out by Contractor, even if the materials are supplied by Project Engineer cum Estate Officer. No separate payment shall be made for these tests & Contractor shall include the cost of these in his unit rates of concrete works.

4.72 If the work cubes do not give stipulated strength, Contractor shall dismantle portions of the work, which are un-acceptable and re-do the work to the standard stipulated at Contractor's cost. The unit rate for concrete shall be all inclusive, including making preliminary mix design and test cubes, works cubes, testing them as per specification, slump test, optional tests etc., complete.

4.73 In the event of any work being suspected of faulty material or workmanship or both, Project Engineer cum Estate Officer before requiring its removal and reconstruction, may order that it should be load tested in accordance with the following provisions

4.74 The test load shall be 125% of the maximum superimposed load for which the structure was designed. Such test load shall not be applied before 56 days after the effective hardening of concrete. During the test, struts strong enough to take whole load shall be placed in position leaving a gap under the members. The test load shall be maintained for 24 hours before removal.

4.75 If within 24 hours of the removal of the load, the structure does not show a recovery of at least 75 percent of the maximum deflection shown during the 24 hours under the load, the test loading shall be repeated after a lapse of at least 72 hours, the structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 75 percent of the maximum shown during the second test. The cost of the load test shall be borne by the Contractor.

4.76 Any other tests, e.g. taking out in an approved manner concrete cores, examination and tests on such cores removed from such parts of the structure as directed by Project Engineer cum Estate Officer, sonic testing etc., shall be carried out by Contractor if so directed.

4.77 Should the result of any test prove unsatisfactory, or the structures show signs of weakness, undue deflection or faulty construction, Contractor shall remove and rebuild the member or members involved or carry out such other remedial methods as may be required by Project Engineer cum Estate Officer. Contractor shall bear the cost of doing so.

4.78 Before the concrete is actually placed in position, the insides of the formwork shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottom of columns and wall forms, to permit removal of saw dust, wood shavings, binding wires, rubbish dirt etc., Openings shall be placed or holes drilled so that these materials and water can be removed easily. Such openings/ holes shall be later suitably plugged.

4.79 The various trades shall be permitted ample time to install drainage and plumbing lines, floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedment's to be cast in concrete as indicated on the drawings or as is necessary for the proper execution of the work. All such embedment's shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.

4.80 Slots, openings, holes, pockets etc., shall be provided in the concrete work in the positions indicated in the drawings or as directed by Project Engineer cum Estate Officer.

4.81 Reinforcement and other items to be cast in concrete shall have clean surfaces that will not impair bond.

4.82 Prior to concrete placement all work shall be inspected and approved by Institute / Project Engineer cum Estate Officer and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected at Contractor's cost.

4.83 Approval by Institute / Project Engineer cum Estate Officer of any and all materials and work as required herein shall not relieve Contractor from his obligation to produce finished concrete in accordance with the drawings and specifications.

4.84 No concrete shall be placed in wet weather or on a water covered surface. Any concrete that has been washed by heavy rain shall be entirely removed, if there is any sign of cement and sand having been washed away from the concrete mixture. To guard against damage which may be caused by rains, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted before leaving the work unattended. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water above / around freshly placed concrete, suitable drains & sumps shall be provided.

4.85 Immediately before concrete placement begins, prepared surfaces, except formwork, which will come in contact with the concrete to be placed, shall be covered with a bonding mortar as specified later in this document.

4.86 All buckets, containers and conveyors used for transporting concrete shall be mortar-tight. All means of conveyors shall be suitable to deliver concrete of the required consistency and plasticity without segregation or loss of slump whatever method of transportation is employed. Chutes shall not be used for transport of concrete without the written permission of Institute / Project Engineer cum Estate Officer and concrete shall not be re-handled before placing.

4.87 Concrete must be placed in its final position before it becomes too stiff to work. On no account water shall be added after the initial mixing. Concrete which has become stiff or has been contaminated with foreign materials shall be rejected and disposed off as directed by Project Engineer cum Estate Officer.

4.88 All equipment used for mixing, transporting and placing of concrete shall be maintained in clean condition. All pans, buckets, hoppers, chutes, pipelines and other equipment shall be thoroughly cleaned after each batch of placement.

4.89 Before any concrete is placed, the entire placing programme consisting of equipment, layout, proposed procedures and methods shall be submitted to Institute / Project Engineer cum Estate Officer for approval and no concrete shall be placed until Institute / Project Engineer cum Estate Officer's approval has been received. Equipment for conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete during depositing without segregation of materials, considering the size of the job and placement location.

4.90 Concrete shall be placed in its final position before cement reaches its initial set and concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer, and once compacted it shall not be disturbed.

4.91 Concrete shall, in all cases, be deposited as near as practicable directly to its final position, and shall not be re-handled or caused to flow in a manner which will cause segregation, loss of materials, displacement of reinforcement, shuttering or embedded inserts or impair its strength. For locations where direct placement is not possible, and in narrow forms, Contractor shall provide suitable drop and "Elephant Trunks" to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height, especially if reinforcement is in the way, particularly in columns and thin walls.

4.92 Except when otherwise approved by Institute / Project Engineer cum Estate Officer, concrete shall be placed in the shuttering by shovels or other approved implements and shall not be dropped from a height more than 1.2 metres or handled in a manner which will cause segregation.

4.93 The control of placing shall begin at the mixer discharge. Concrete shall be discharged by a vertical drop into the middle of the bucket or hopper and this principal of a vertical discharge of concrete shall be adhered to throughout all stages of delivery until the concrete comes to rest in its final position.

4.94 Central-bottom-dump buckets of a type that provides for positive regulation of amount and rate of deposition of concrete in all dumping position shall be employed.

4.95 In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1.2 metres. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any other manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.

4.96 Concrete placed in restricted forms by barrows, buggies, cars, short chutes or hand shovelling shall be subjected to the requirement of vertical delivery of limited height to avoid segregation and shall be deposited as near as practicable to its final position.

4.97 Where it is necessary to use transfer chutes, specific approval of the Institute / Project Engineer cum Estate Officer must be obtained to type, length, slopes, baffles, vertical terminals and timing of operations. These shall be so arranged that an almost continuous flow of concrete shall be obtained at the discharge and without segregation. To allow for the loss of mortar against the ides of chutes, the first mixes shall have less coarse aggregate. During cleaning of chutes, the waste water shall be kept clear of the forms. Concrete shall not be permitted to fall from the end of the chutes by more than 1.2M. Chutes, when approved for use, shall have slopes not flatter than 1 vertical: 3 horizontal and not steeper than 1 vertcal:2 horizontal. Chutes shall be of metal or metal lined and of rounded cross section. The slopes of all chute sections shall be approximately the same. The discharge end of the chutes shall be maintained above the surface of the concrete in the forms.

4.98 Concreting, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness as directed by the Project Engineer cum Estate Officer. These shall be placed as rapidly as practicable to prevent the formation of cold joints or planes of weakness between each succeeding layer within the pour. The thickness of each layer shall be such

that it can be deposited before the previous layer has stiffened. Any tendency to segregation shall be corrected by redesign of mix or other means, as directed by Project Engineer cum Estate Officer.

4.99 The top surface of each pour and bedding planes shall be horizontal unless otherwise instructed.

4.100 Concrete shall be compacted during placing, with approved vibrating equipment until the concrete has been consolidated to the maximum practicable density, is free of pockets of coarse aggregates and fits tightly against all form surfaces reinforcement and embedded fixtures. Particular cars shall be taken to ensure that all the concrete placed against the form faces and into corners of forms or against hardened concrete at joints is free from voids or cavities. The use of vibrators shall be consistent with the concrete mix and caution exercised not to over vibrate the concrete to the point that segregation results.

4.101 Vibrators shall conform to IS specification. Type of vibrator to be used shall depend on the structure where concrete is to be placed. Shutter vibrators, to be effective, shall be firmly secured to the formwork which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Immersion vibrator shall have “no load” frequency, amplitude and acceleration as per IS 2505 depending on the size of the vibrator. Immersion vibrators in sufficient numbers and of adequate size shall be used to proper consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted. Thin walled elements shall be compacted using 25 mm dia immersion vibrators.

4.102 Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to move concrete inside the forms. Particular attention shall be paid to vibration at the top of a lift, e.g. in a column or wall.

4.103 When placing concrete in layers, which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, mixing and joining of concrete between the succeeding layers.

4.104 The immersion vibrators shall penetrate the layer being placed and also penetrate the layer below while under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

4.105 Care shall be taken to prevent the contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.

4.106 Form attached vibrators shall be used only with specific permission of Institute / Project Engineer cum Estate Officer.

4.107 The use of surface vibrators will not be permitted under normal conditions. However for thin slabs, surface vibration by specially designed vibrators may be permitted, on approval by Institute / Project Engineer cum Estate Officer.

4.108 The formation of stone pockets or mortar pondages in corners and against faces of forms shall not be permitted. If these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for thorough bonding, as directed by Project Engineer cum Estate Officer.

4.109 Except when placing with slip forms, each placement of concrete in multiple lift work shall be allowed to set for at least 24 hours after final set of concrete and before the start of a subsequent placement.

4.110 When placing concrete in walls with openings, in floors of integral slab and beam construction and other similar conditions, the placing shall stop, when the concrete reaches the top of the openings in the walls or bottom horizontal surface of the slab, as the case may be placing shall be resumed before the concrete in place reaches initial set, but not until it has had time to settle as determined by Project Engineer cum Estate Officer.

4.111 When placing concrete through reinforcing steel, care should be taken to prevent segregation of the coarse aggregate.

4.112 If bleeding or free water on top surface of concrete being deposited into the forms occurs, the concrete pour shall be stopped and the conditions causing this defect corrected before any further concreting resumed.

4.113 Concrete shall be placed without interruption until completion of the work between predetermined construction joints, as specified hereinafter.

4.114 If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made where the work is stopped. Joints shall be either vertical or horizontal, unless shown otherwise on drawings. In case of an inclined or curved member, the joint shall be at right angles to the axis of the member. Vertical joints in the walls shall be kept to a minimum. Vertical joints shall be formed against a stop board; horizontal joints shall be level and wherever possible, arranged so that the joint lines coincide with the architectural features of the finished works. Battens shall be nailed to the formwork to ensure a horizontal line and, if directed shall also be used to form a grooved joint. For tank walls and similar work joints shall be formed as per I.S. 3370. Concrete that is in the process of setting shall not be disturbed or shaken by traffic either on the concrete itself or upon the shuttering. Horizontal and vertical construction joints and shear keys shall be located and shall conform in detail to the requirements of the plans unless otherwise directed by Project Engineer cum Estate Officer. Where not described, the joint shall be in accordance with the following.

4.115 In a column, the joint shall be formed 75 mm below lowest soffit of the beam including haunches, if any. In flat slab construction the joint shall be 75 mm below the soffit of column capital. At least two hours shall elapse after depositing concrete in columns, piers or walls, before depositing in beams, girders or slabs supported thereon.

4.116 Concrete in a beam shall be placed throughout without a joint but if the provision of a joint is unavoidable the joint shall be vertical and at the center or within the middle third of the span unless otherwise shown on the drawings. Where a beam intersects a girder, the joint in the girder shall be offset a distance equal to twice the width of the beam and additional reinforcement provided for shear. The joints shall be vertical throughout the full thickness of the concrete member. A joint in a slab shall be vertical and parallel to the principal reinforcement. Where it is unavoidably at right angles to the principal reinforcement, the joint shall be vertical and at the middle of the span.

4.117 Vertical construction joints in watertight construction shall not be permitted unless indicated on the drawings. Where a horizontal construction joint is required to resist water pressure, special care shall be taken in all phases of the construction to ensure maximum water-tightness.

4.118 Dowels for construction work not likely to be taken up in the near future, shall be wrapped in tar paper & burlap.

4.119 Mass foundations shall be poured in lifts not exceeding 0.5 M in height unless otherwise indicated on drawings or approved by Institute / Project Engineer cum Estate Officer.

4.120 A driver mix shall be used for the top lift of horizontal pour to avoid laitance. All laitance and loose stones shall be thoroughly and carefully removed by wire brushing / hacking and surface washed.

4.121 Just before concreting is resumed, the roughened joint surface shall be thoroughly cleaned and loose matter removed, and then treated with a thin layer of cement grout of proportion specified by Owner worked well into the surface. The new concrete shall be well worked against the prepared face before the gout/mortar sets. Special care shall be taken to obtain thorough compaction and to avoid segregation of the concrete along the plane of the joint.

4.122 Keeping it continuously damp for the time of period required for complete hydration and hardening to take place shall cure all concrete. Preference shall be given to the use of continuous sprays, or ponded water, continuously saturated coverings of sacking, canvas, hessian or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth even-textured coat. Extra precautions shall be exercised in curing concrete during hot and cold weather as outlined herein after. The quality of curing water shall be the same as that used for mixing concrete.

4.123 Certain types of finish or preparation for overlaying concrete must be done at certain stages of curing process and special treatment required for specific concrete surface finish.

4.124 Curing of concrete made of high alumina cement and super sulphated cement shall be carried out as directed by Project Engineer cum Estate Officer.

4.125 Fresh concrete shall be kept continuously wet for a minimum period of 10 days from the date of placing of concrete. After 12 to 24 hours have elapsed after laying concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied to the unformed concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of vertical side forms. Quantity of water shall be controlled so as to prevent erosion of freshly placed concrete.

4.126 Ample water supply should be assured under pressure in pipes if required, with all necessary appliances of hose, spraying devices.

4.127 Whenever a covering such as wet gunny bags which will prevent loss of moisture from concrete is used, the covering shall be kept continuously wet during the curing period.

4.128 All equipment, men, materials required for curing shall be on hand and ready for use before concrete is placed.

4.129 Fresh concrete shall be protected from damage due to construction operations by leaving forms in place for ample period specified later in this specification. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps shall be taken to protect immature concrete from damage by debris, excessive loading, vibration, aberration or contact with other materials etc. that may impair the strength and/or durability of the concrete. Workmen shall be warned so as to prevent from disturbing green concrete during its setting period. If it is necessary that workmen enter the area of freshly placed concrete, bridges shall be placed over the area

4.130 Initially after the shuttering is removed, the surface of the concrete shall be very carefully gone over and all defective areas shall be brought to the attention of the Institute / Project Engineer cum Estate Officer who may permit the patching of the defective areas or else reject the concrete unit partially or in its entirely. Rejected concrete shall be removed and replaced by Contractor at no additional expenses to Institute. Holes left by form bolts etc. shall be filled up and made good with mortar composed of one part of cement to one and a half parts of sand after removing any loose stones adhering to the concrete. Mortar filling shall be struck off flush at the face of concrete. Concrete surfaces shall be finished as required by Institute / Project Engineer cum Estate Officer. No patching work shall be done without prior inspection of the defective area and without prior permission of Project Engineer cum Estate Officer.

4.131 Superficial honeycombed surfaces and rough patches shall be similarly made good immediately after the removal of shuttering, in the presence of Project Engineer cum Estate Officer and superficial water and air holes shall be filled in. The mortar shall be well packed into the surface with a wooden float. Excess water shall be avoided. The surface of the exposed concrete placed against the shuttering shall be rubbed down immediately on removal of shuttering to remove fins or other irregularities, care being taken not to damage the surface. Surface irregularities shall be removed by grinding.

4.132 If reinforcement is exposed or honey combing occurs at vulnerable positions e.g. ends of beams or columns it may be necessary to cut out the member completely or in part and reconstruct. If only the patching is necessary, the defective concrete shall be cut out till solid concrete is reached. An area extending 6 inches beyond the edge and the surface of the prepared voids shall be wetted with water for 24 hours immediately before patching material is placed.

4.133 The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Institute / Project Engineer cum Estate Officer. Epoxies shall be applied strictly in accordance with the instructions of the manufacturer.

4.134 Small size holes such as holes left after removal of form bolts, grout insert holes and slots cut for repair of cracks shall be repaired as follows. The hole to be patched shall be roughened and thoroughly

wetted with clean water until absorption stops. A 5 mm thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched, followed immediately by patching concrete, which shall be consolidated with a wooden float. The concrete patch shall be built up in 10 mm thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and a smooth finish obtained by wiping with hessian, a steel trowel shall not be used for this purpose. The mix for patching shall be of the same materials and in the same proportions as that of the concrete being repaired. Smaller size of the coarse aggregate may be used and the mix shall be kept as dry as possible.

4.135 Mortar filling by air pressure (guniting) shall be used for repair of areas too large and/or shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and the texture of the surrounding concrete. White cement shall be substituted for ordinary cement, if so directed by Project Engineer cum Estate Officer, to match the shade of the patch with the original concrete.

4.136 Two hours after the repair works, the area patched shall be covered with an approved non-staining, water saturated material such as gunny bags which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by a fine spray or sprinkling for not less than 6 days.

4.137 All materials, procedures and operations used in the repair of concrete and also the finished repair work shall be subject to the approval of Institute / Project Engineer cum Estate Officer. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and dried.

4.138 The type of finish for the formed surface of concrete shall be as follows, unless otherwise specified by Project Engineer cum Estate Officer. For surfaces against which backfill or concrete is to be placed, no treatment is required except repairs of defective areas.

4.139 For surfaces below grade which will receive water proofing treatment the concrete shall be free of surface irregularities which would interfere with proper application of the waterproofing materials.

4.140 Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repair of damaged or defective concrete, removal of fins and abrupt irregularities, filling of holes left by form ties and rods and clean up of loose or adhering debris.

4.141 Surfaces which will be exposed to weather and which would normally be level shall be sloped for drainage. Unless the drawings specify a horizontal surface or shows the slope required, the tops of narrow surfaces such as stairs, treads, walls, curbs and parapets shall be sloped across the width as required by the Project Engineer cum Estate Officer. Surfaces that will be covered by backfill or concrete, sub-floors to be covered with concrete topping, terrazzo or quarry tile, and similar surfaces shall be screened and levelled to produce even surfaces. Surface irregularities shall not exceed 6 mm Surface which will not be covered by backfill, concrete or tile toppings such as outside decks, floors and galleries and sumps, parapets, gutters, sidewalks, floors & slabs, shall be removed before final finishing. Floating may be done with hand or power tools and started as soon as the screened surface has attained a stiffness to permit finishing operations and these shall be the minimum required to produce a surface uniform in texture and free from screed marks or other imperfections. Joints and edges shall be tooled as called for on the drawings or as directed by the Project Engineer cum Estate Officer.

4.142 Exposed concrete shall mean any concrete, other than floors or slabs, exposed to view upon completion of the job. Unless otherwise specified on the drawings, the standard finish for exposed concrete shall be a smooth finish. A smooth finish shall be obtained with the use of lined or plywood forms having a smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed off and all blemishes, projections etc., removed leaving the surface reasonably smooth.

4.143 Where specified on the drawings integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified on the drawings as per I.S.2571. The surface shall be compacted and then floated with a wooden float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

4.144 All concrete shall be protected against damage until final acceptance by Institute / Project Engineer cum Estate Officer.

4.145 The formwork shall consist of shores, bracings, sides of beams and columns, bottom of slabs etc, including ties, anchors, hangers, inserts etc, complete which shall be properly designed and planned for the work. False work shall be so constructed that vertical adjustments can be made at compensate for camber and settlements. Wedges may be used at the top or bottom of timber shores, but not at both ends, to facilitate vertical adjustments or dismantling of formwork.

4.146 The design and the engineering of formwork as well as its construction shall be the responsibility of the Contractor. The drawings and/or calculations for the design of the formwork shall be submitted to the Institute / Project Engineer cum Estate Officer for approval before proceeding with the work, with no extra cost to the Institute. Institute / Project Engineer cum Estate Officer's approval however shall not relieve the Contractor of the full responsibility for the design and construction of the formwork. The design shall take into account all the loads vertical as well as lateral that the forms will be carrying including live and vibration loads.

4.147 Tolerance is a specified permissible variation from lines, grade or dimension given in the drawings. Unless otherwise specified, the following tolerance will be permitted

a. Variation from the plumb - In the lines and surfaces of columns, piers, walls and in arises 6 mm per 2.5 m. but not more than 25 mm

b. For exposed columns and other conspicuous lines

In any bay or 5 m maximum	-6 mm
In 10 m or more	-10 mm

c. Variation from the level or from the grades indicated on the drawings.

i. In slab soffits, ceilings, beam soffits and in arises

In 2.5 m	-6 mm
In any bay or 5 m. Maximum	-8 mm
In 10 or more	-16 mm

ii. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.

In any bay of 5 m. maximum	-6 mm
In 10 m. or more	-10 mm

d. Variation of the linear building lines from established position in plan and related position of columns, wall and partitions.

In any bay or 5 m. maximum	-16 mm
In 10 m. or more	-20 mm

e. Variation in the sizes and location of sleeves, openings in wall and floors, except in the case of anchor bolts : 6 mm

f. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls: minus 6 mm Plus 10mm

g. Variation in dimension in plan: minus 6 mm Plus 50mm

h. Misplacement of eccentricity minus 2% of footing width in the direction of misplacement but not more than minus 2

i. Reduction in thickness -6 mm

j. Variation in steps

In a flight of stairs Rise – minus 3 mm, Tread – minus 6 mm

k. In consecutive steps – Rise - Minus 3 mm, Tread – minus 3 mm

4.148 Form work may be of timber, plywood, metal, plastic or concrete. For special finishes the formwork may be lined with plywood, steel sheets, oil tempered hard board etc. Sliding forms and slip forms may be used with the approval of Institute / Project Engineer cum Estate Officer.

4.149 Form shall conform to the shapes, lines grades and dimensions including camber of the concrete as called for on the drawings. Ample studs, walers, braces, ties, straps shores, etc. shall be used to hold the forms in proper position without any distortion whatsoever to permit the use of immersion vibrators and until the concrete has sufficiently set. The shuttering shall be close boarded. Timber shall be well seasoned free from sap, shakes, loose knots, worm holes, warps or other surface defects. Faces coming in contact with the concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent loss of water and fine material from concrete.

4.150 Plywood shall be used for exposed concrete surfaces. Sawn and wrought timber may be used for unexposed surfaces. Inside faces for concrete surfaces which are to be rubbed finished shall be planned to remove irregularities or unevenness in the face.

4.151 All new and used form lumber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness, cleanliness of surfaces. Form lumber unsatisfactory in any respect shall not be used and if rejected by Institute / Project Engineer cum Estate Officer shall be removed from the site.

4.152 Shores supporting successive storeys shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed support shall be provided for shores that cannot be secured on adequate foundations.

4.153 Formwork, during any stage of construction, showing signs of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by faulty formwork, shall be removed completely and the formwork corrected prior to placing new concrete.

4.154 Excessive construction camber to compensate for shrinkage, settlement, etc, which may impair the structural strength of members, will not be permitted.

4.155 Forms shall be so designed and constructed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints conform to the architectural features of the structure as to locations of joints and be as directed by Project Engineer cum Estate Officer.

4.156 Where exposed concrete finishes are required, the forms shall be constructed with special care so that the resulting concrete surfaces require a minimum finish.

4.157 Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bearers.

4.158 The shuttering for slabs and beams shall be so erected that the shuttering on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Repropping of beams shall not be done. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the shuttering.

4.159 If the shuttering for the column is erected for the full height of the column, one side shall be left open and built up in sections as placing of concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.2 M maximum.

4.160 Care shall be taken to see that the faces of form work coming in contact with concrete are perfectly cleaned and proper mould oil applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Use of engine oil is not permitted to be used as mould oil. Concrete shall not be placed until coating of the forms is complete. Adjoining concrete surfaces shall also be protected against contamination from the coating material.

4.161 All corners and angles exposed in the finished structure shall be formed with mouldings to form chamfers or filets on the finished concrete. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as then forms to which it is attached.

4.162 Vertical construction joints or faces which will be exposed after the completion of the work shall be chamfered except where not permitted by Project Engineer cum Estate Officer.

4.163 Wire ties passing through the walls are not allowed. In their place bolts passing through sleeves may be used.

4.164 Before reuse, all forms shall be thoroughly scrapped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Institute / Project Engineer cum Estate Officer. Warped lumber shall be resized.

4.165 Contractor shall record on the drawing or a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from.

4.166 In no circumstances shall forms be struck until the concrete reaches strength of at least twice the stress due to self weight and any construction/erection loading to which the concrete may be subjected at the time of striking formwork.

4.167 In normal circumstances (generally where temperatures are above 20 ◦C) forms may be struck after expiry of the following period. :

4.167.1 Walls. Columns and vertical sides of beams, 24 to 48 hours footings, pile caps etc.

4.167.2 Sides of walls which are cast against earth

Beam soffits	18 days
Slabs	10 days

4.168 Striking shall be done slowly with utmost care to avoid damage to arises and projections and without shock or vibrations, by gently easing the wedges. If after removing the formwork, it is found that timber has been embedded in the concrete, it shall be removed and the concrete made good as specified earlier.

4.169 Reinforced temporary openings shall be provided, as directed by Project Engineer cum Estate Officer, to facilitate removal of formwork which otherwise may be inaccessible.

4.170 The rods, clamps, form bolts, etc, which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours and not later than 40 hours after the concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time. Ties, withdrawn from walls and beams shall be pulled toward the inside face.

4.171 Soft or spongy areas shall be cleaned out and backfilled with either a soil-cement mixture, lean concrete or clean sand fill compacted to a minimum density of 90% Modified Proctor.

4.172 Prior to construction of formwork for any item where soil will act as bottom form, approval shall be obtained from Institute / Project Engineer cum Estate Officer as to the suitability of the soil.

4.173 Where concrete has to rest on rock, just the rock surface shall be cleaned with high pressure water and air jet.

4.174 Prior to placing concrete, the rock surface shall be kept wet for a period of 2 to 4 hours unless otherwise directed by the Project Engineer cum Estate Officer.

4.175 All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft, yielding soil shall be removed and replaced with suitable earth and well compacted. Where specified, lean concrete shall be provided on the earth stratum for receiving concrete. The surface of absorptive soils against which concrete is to be placed shall be moistened thoroughly so that no moisture will be drawn from the freshly placed concrete and later shall help to cure the concrete.

4.176 The preparation of concrete surfaces on which additional concrete is to be placed later, shall preferably be done by cleaning. All laitance shall be removed and the surface roughened. The surface should not contain any unsound concrete and glazed mortar.

4.177 After rock or concrete surfaces upon which new concrete is to be placed have been roughened, cleaned and wetted, a coat of cement-sand mortar shall be placed on the surface. The mortar shall have the same cement-sand proportions as the concrete which shall be placed on it. The Water-cement ratio shall be determined by prevailing conditions of placing and as approved by Institute / Project Engineer cum Estate Officer.

4.178 The mortar shall be placed in sufficient quantity to cover completely the surface about 10 mm thick for rock surfaces and about 5 mm thick for concrete surfaces. It shall be brushed or broomed over the surface and worked thoroughly into cracks, crevices and depressions. Accumulations or puddles of mortar shall not be allowed to settle in depressions and shall be brushed out to satisfactory degree, as determined by Project Engineer cum Estate Officer.

4.179 Vertical construction joints shall be cleaned as specified above. In placing concrete against formed construction joints, the surfaces of the joints, where accessible shall be coated thoroughly with the bonding mortar immediately before they are covered with concrete or by scrubbing with wire brooms dipped into the fresh concrete. Where it is impracticable to apply such mortar coating, special precautions shall be taken to ensure that the new concrete is brought into adequate contact with the surface of the joint by careful puddling and spading with aid of vibrators and suitable tools.

4.180 Provision shall be made for expansion and contraction in concrete by use of special type of joints located as shown on the drawing. Contraction joint surfaces shall be treated as directed by the specifications or the drawings or as directed by the Project Engineer cum Estate Officer.

4.181 Under all ordinary conditions all foundations shall be dewatered and concrete placed in the dry.

4.182 Side shutters shall not be struck in less than 24 hours after depositing concrete and no pre-cast unit shall be lifted until the concrete reaches strength of at least twice the stress to which the concrete may be subjected to at the time of lifting.

4.183 The lifting and removal of pre-cast units shall be undertaken without causing shock, vibration or undue bending stresses to or in the units. Before lifting and removal takes place Contractor shall satisfy Institute / Project Engineer cum Estate Officer that the methods he proposes to adopt for these operations will not over- stress or otherwise affect seriously the strength of the precast units. The reinforced side of the units shall be clearly marked.

4.184 All pre-cast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each unit shall be kept constantly watered or preferably be completely immersed in water if the size of the unit so permits.

4.185 Slots, openings or holes, pockets etc., shall be provided in the concrete work in the positions indicated in the drawings or as directed by Project Engineer cum Estate Officer. Any deviation from the approved drawings shall be made good by Contractor at his own expense, without damaging any other work. Sleeves, bolts, inserts, etc. shall also be provided in concrete work where so specified.

4.186 All materials, workmanship and finished construction shall be subject to the continuous inspection and approval of Institute / Project Engineer cum Estate Officer.

4.187 All material supplied by Contractor and all work or construction performed by Contractor rejected as not in conformance with the specifications and drawings, shall be immediately replaced at no additional expense to the Institute.

4.188 Approvals of any preliminary materials or phase of work shall in no way relieve the Contractor from the responsibility of supplying concrete and or producing finished concrete in accordance with the specifications and drawings.

4.189 Upon the completion of the concrete work, all forms, equipment, construction tools, protective coverings and any debris resulting from the work shall be removed from the premises.

4.190 All debris, i.e. empty containers, scrap, wood, etc. shall be removed to "dump" daily.

4.191 The finished concrete surfaces shall be left in a clean condition satisfactory to Institute / Project Engineer cum Estate Officer.

4.192 The unit rate for concrete work under various categories shall be all inclusive and no claims for extra payment of account of such items as leaving holes, pockets, embedding inserts, etc. shall be entertained unless separately provided for in the schedule of quantities. No extra claim shall be entertained due to change in the number, position and/or dimensions of holes, slots or openings, sleeves, inserts or on account of any increased lift or scaffolding etc. All these factors should be taken into consideration while quoting the unit rates. Unless provided for in the schedule of quantities the rates shall also include fixing inserts in all concrete work, whenever required.

4.193 Payments of concrete will be made on the basis of unit rates quoted for the respective items in the schedule of quantities. No deduction in the concrete quantity will be made for reinforcements, inserts, etc. and openings less than 0.5 Sq.ft. in area where concrete is measured in Sq.ft. and 1/3 cft. Where concrete is measured in cu. feet. Similarly the unit rate for concrete work shall be inclusive or exclusive of shuttering is paid for separately, it shall be very clearly understood that the payment for formwork is inclusive of form work, shuttering, shoring, propping, scaffolding, etc. complete.

4.194 Payment for beams will be made for the quantity based on the depth measured from the undersides of the slabs and length measured as the actual length without deducting for supports. Height reckoned upto the undersides of beams.

5.0 GENERAL BUILDING WORKS SPECIFICATIONS:

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

5.2 Applicable codes and specifications

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

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

- IS: 1077 Common burnt clay building bricks.
- IS: 3102 Classification of burnt clay bricks
- IS: 2180 Burnt clay building bricks, heavy duty.
- IS: 3495 Methods of sampling and testing clay building bricks.

- IS: 2691 Burnt clay facing bricks.
- IS: 2212 Code of practice for brick work.
- IS: 2185 Load bearing hollow concrete blocks
- IS: 5498 Lime-Cement-Cinder hollow concrete blocks.
- IS: 3115 Lime-Cement Cinder solid blocks.
- IS: 1597 Code of practice for construction of stone masonry (Part I)
- IS: 2394 Code of practice for application of lime plaster finish.
- IS: 2645 Integral cement water proofing compounds.
- IS: 1443 Code of Practice for laying and finishing of cement concrete flooring tiles.
- IS: 2114 Code of practice for laying in sity terrazzo floor finish.
- IS: 777 -Glazed Earthenware tiles.
- IS: 4021 Timber door, window and ventilator frames.
- IS: 2202 Wooden flush door shutters (Solid core type) Part I.
- IS: 1003 Timber panelled and glazed shutters. (Parts I & II)
- IS: 4020 Methods of tests for wooden flush doors: Type tests
- IS: 1761 Transparent sheet glass for glazing and framing purposes.
- IS: 4351 Steel door frames.
- IS: 1038 Steel doors, windows and ventilators,
- IS: 1081 Code of practice e for fixing and glazing of metal(Steel and aluminium) doors, windows and ventilators
- IS: 5807 Methods of test clear finishes for wooden furniture (Parts I & III)
- IS: 1477 Code of practice for painting of ferrous metals in buildings and allied finished (Parts I & II)
- IS: 2338 Code of practice for finishing of wood and wood-based materials (Part I)
- IS: 427 Code of practice for painting of ferrous metals in buildings and allied finished (Parts I & II).
- IS: 428 Distemper, oil emulsion, colour as required.
- IS: 2395 Code of practice for painting concrete, masonry and plaster surfaces.
- IS: 3384 Bitumen primer for use in water proofing and damp-proofing.
- IS: 1580 Bituminous compounds for water proofing and caulking purposes.
- IS: 1322 Code of practice for water proofing of roof with bitumen felts.

5.3 Brick work: Bricks used in works shall conform to the relevant Indian Standard. They shall be sound, hard, homogenous in texture, well burnt in kiln without being vitrified, table moulded, deep red; cherry or copper coloured, of regular shape and size and shall have sharp and square edges and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing ungrounded particles and/ or which absorb water more than 1/6th of their weight when soaked in water for twenty four hours shall b rejected. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 35 kg/sq.cm unless otherwise noted in drawings.

5.3.1 The size of the brick shall be 23.0 x 11.5 x 7.5cm unless otherwise specified; but tolerance upto ± 3 mm in each direction shall be permitted. However, bricks conforming in size to IS-1077 could be used. Bricks shall be provided with frogs. Only full size bricks shall be used for masonry work. Bricks bats shall be used only with the permission of the Institute / Project Engineer cum Estate Officer to make up required wall length or for bonding. Sample bricks shall be submitted to the Institute / Project Engineer cum Estate Officer for approval and bricks supplied shall conform to approved samples. If demanded by Project Engineer cum Estate Officer, brick sample shall be got tested as per IS 3495 by CONTRACTOR at no extra cost the Institute. Bricks rejected by Project Engineer cum Estate Officer shall be removed from the site of works within 24 hours.

5.3.2 Mortar: Mortar for brick masonry shall be prepared as per IS 2250. Mix for cement mortar shall be as specified in the respective items of work. Gauge boxes for sand shall be of such dimensions that one completed bag of cement containing 50 kgs. Of cement forms one unit. The sand shall be free from clay, shale, loam, alkali and organic matter shall be of sound, hard, clean and durable particles. Sand shall be approved by the Institute / Project Engineer cum Estate Officer. If so directed by the Project Engineer cum Estate Officer, sand shall be thoroughly washed till it is free of any contamination.

5.3.3 For preparing cement mortar, the ingredients shall first by mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall preferably be machine mixed, though hand mixing in a thorough manner may be allowed. The mortal sq mixed shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected.

5.3.4 The CONTRACTOR shall arrange for test on mortar samples if so directed by the Project Engineer cum Estate Officer.

5.3.5 Workmanship: All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work. Brick work 230 mm thick and over shall be laid in English Bond unless otherwise specified. 115 mm thick work shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Bricks shall be laid with frogs uppermost.

5.3.6 All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 230 mm both faces shall be kept in vertical planes. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform distribution of pressures on the supporting structures) and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 450. But in no case the level difference between adjoining walls shall exceed 1.25 M. Workmanship shall conform to IS 2212.

5.3.7 Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plaster of pointing to be done. When plastering or pointing is not required to be done. The joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If the mortar in the lower course has begun to set, the joints shall be raked out to a depth of 12 mm before another course is laid.

5.3.8 All brickwork shall be built tightly against columns, floor slabs or other structural members.

5.3.9 Where drawings indicate that structural steel columns are to be fireproofed with brickwork, the brick shall be built closely against all flanges and webs with all spaces between the steel and brickwork filled solid with mortar. Steel members partly embedded in brickwork and not indicated to be fireproofed with

concrete, shall be covered with not less than 12 mm thick mortar unless directed otherwise by Project Engineer cum Estate Officer.

5.3.10 Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors, conduits, structural steel, steel lintels etc. shall be installed by the CONTRACTOR at no extra cost to the Institute. Furnishing of any of these inserts by the CONTRACTOR will be paid for separately. Openings, arches, etc. shall be provided as shown on the drawings. Chases, pockets, etc. shall be provided as shown on the drawings to receive windows, louvers, door frames etc. Wall ties and flashings shall be built into the brickwork in accordance with the drawings and specifications. It shall be clearly understood that the rates quoted by the CONTRACTOR include for fixing of inserts, leaving openings, cutting chases in brickwork for various trades etc.

5.3.11 Facing brickwork: Facing bricks of the type specified shall be laid in the positions indicated on the drawings and all facing brickwork shall be well bonded to the backing bricks. No facing brickwork shall at any time be more than 600 mm above the backing brickwork.

5.3.12 All facing brickwork shall be pointed as the work proceeds and internal faces of the brickwork shall be pointed with neat flush joint to give a fair face.

5.3.13 Faced work shall be kept clean and free from damage, discolouration etc. at all times. The CONTRACTOR shall fill carefully all holes with bricks similar to the surrounding brickwork, point brick work as required.

5.3.14 For facing brickwork, double scaffolding shall be used. No holes in brickwork for scaffolding shall be permitted.

5.3.15 The green work shall be protected from rain by suitable covering. Bricks shall be kept constantly moist on all faces for a minimum period of ten days. Brick work shall not be raised more than one metre per day.

5.3.16 The rates quoted by the CONTRACTOR are exclusive of transoms and mullions. CONTRACTOR shall provide the same as shown or indicated on the drawings. These shall be generally provided only in half and full brick walls. Dimensions of the transoms and mullions shall conform to the thickness of the wall. Concrete work for transoms and mullions shall conform to the specifications for concrete and shall be of grade M 20.

5.3.17 Where shown on the structural drawings, bricks for partition walls shall be stacked adjacent to the structural member to pre-deflect the structural member before the wall is built.

5.3.18 Measurement: Brick work of thickness one brick i.e. 230 mm and above shall, unless otherwise stated in the Schedule of Quantities, be paid in units of cu.m or part thereof. Brickwork of thickness less one brick i.e. less than 230 mm thick shall be measured and paid on the basis of rates quoted per sq.m or thereof. In all cases, the quantities measured and paid for, shall be those actually executed after making necessary deductions for openings etc. Brick masonry for steps and such other mass works and encasement shall be paid on the basis of rates quoted per cu.m or part thereof.

5.4 Concrete block masonry: Concrete blocks (hollow or solid) shall generally conform to IS: 2185. Blocks shall be regular in size and shape and shall be of specified strength. Blocks shall be properly cured before they are brought to sit. Half or three quarter size blocks are to be used wherever required to make up length of wall and broken blocks shall not be used. The texture of the blocks shall be such that plaster will adhere to it. The CONTRACTOR shall supply samples for approval. Blocks supplied shall conform to approved samples.

5.4.1 Mortar: Mortar shall be similar to mortar in brickwork as given above.

5.4.2 All blockwork shall be plumb, square and properly bonded. The joints shall be broken. The thickness of the courses shall be uniform with courses horizontal. All connected work shall be carried out at nearly one level and no portion of the work shall be left more than one course lower than the adjacent work.

5.4.3 Blocks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 8 mm. The face joints shall be raked to a minimum depth of 10 mm by

raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plaster or pointing. When plastering or pointing is not required, the joints shall be struck flush. For pointed masonry or for masonry without plaster, smooth textured concrete blocks shall be used. The face of block work shall be kept clean at all times.

5.4.4 Where blocks are to be used for load bearing wells, the uppermost layer of blocks supporting slab or other structural members, shall be solid or treated as directed by the Project Engineer cum Estate Officer.

5.4.5 Pre-cast concrete screen blocks or 'jali' work may be used for decorative purposes. The CONTRACTOR shall furnish samples for approval.

5.4.6 Measurement: Blockwork of specified thickness shall be paid in units of sq.m. or parts thereof. If reinforcing bars are specified in horizontal courses, it shall be measured and paid for separately at quoted rate for reinforcement. In all cases, the quantities measured and paid for, shall be those actually executed after making necessary deductions for openings etc.

5.4.7 Miscellaneous inserts e.g. sleeves, ties, anchors, conduits etc., in block masonry shall be installed by Contractor, at no extra cost to Institute. Furnishing of any of these inserts by Contractor will be paid for separately.

5.5 Random rubble masonry, un-coursed in foundation, plinth and superstructure.

5.5.1 Stones for this work shall be hard, durable rock, clean or fine grained and uniform in colour, free from veins, flaws and other defects and shall conform to IS 1597 (Part I) . The stones shall be laid in mortar proportions specified for the particular item of work. Stones shall be got approved, if desired by Institute / Project Engineer cum Estate Officer.

5.5.2 For all work below ground level the masonry shall be random rubble un-coursed with ordinary quarry dressed stones for hearting and faced with selected quarry dressed stones.

5.5.3 For all work above ground level and I superstructure the masonry shall be random rubble, well bonded, faced with hammer dressed stones with square quoins at joints and corners.

5.5.4 No stones shall tall into the wall, either with a point or to length less than 1 ½ times its height. The thickness of the joints shall not exceed 12 mm.

5.5.5 Spalls and pinnings shall not be allowed to show on the face of the wall. Two bond stones each of minimum area of 500 cm2 for every 1.0 sq.m. of each wall face shall be provided. These shall be through stones in walls 600 mm thick and under. In walls thicker than 600 mm, the length of bond stones shall be 2/3 times the thickness of walls. The stones for hearting of the wall shall not be less than 150 mm in any direction. Chips and spalls shall be wedged in to avoid thick mortar beds and joints. The well faces, corners and joints of openings shall be truly vertical. The quoins shall be of selected stones, neatly dressed with chisel to form the required angle and laid header - stretcher alternately.

5.5.6 The exposed face of the work shall be carefully and neatly point with mortar in all joints. On the other side, the joints shall be neatly struck with trowel while the mortar is fresh.

5.5.7 Mortar: The mortar for the work shall be as specified in the respective items of work and shall be prepared as per Clause 3.3.

5.5.8 Curing of masonry shall continue for a minimum of ten days.

5.5.9 Measurement: The unit of measurement shall be cu.m. or part thereof. Actual quantity of masonry shall be calculated from dimensions shown on the drawings less openings and shall be paid for.

5.6 Coursed rubble masonry (first sort) for superstructure : The stones used shall be hard, durable, rock free from veins flaws and other defects and shall conform to IS 1597 (Part I). Height of each course in the masonry shall not be less than 150 mm. The stones in each course shall be of equal height. All courses shall be of the same height unless otherwise specified. All stones shall be set in full cement

mortar of proportion specified for the respective item of work. Stones shall be got approved, if desired by Institute / Project Engineer cum Estate Officer.

5.6.1 The face stones shall be squared on all joints and beds. The beds being hammer or chisel dressed true and square for at least 75 mm from the face and the joints for at least 40 mm. The face of the stone shall be hammer dressed so that bushings shall not project more than 40 mm.

5.6.2 No spalls or pinning shall be allowed on the face. All bed joints shall be horizontal and side joints vertical and no joints shall be more than 10 mm in thickness.

5.6.3 No face stone shall be less in breadth than in height or shall tail into the work to a length less than the height and at least 1/3rd the number of stones shall tail into the work to at least twice their height or in walls over 600 mm in thickness 3 times their height.

5.6.4 Through stones shall be inserted every 1.5 metres to 1.8 meters apart in every course and shall run right through when the wall is not more than 600 mm thick. When the wall is more than 600 mm thick a line of two or more headers shall be laid from the face to face which shall overlap each other by at least 150 mm. A header shall have a length of at least thrice its height.

5.6.5 Stones shall break joint at least half the height of the course. Quoins shall be formed of stones at least 45 cm long, laid stretcher end header alternately. They shall be laid square in their beds, which shall be fair dressed to a depth of at least 100 mm. The corner shall be chisel dressed for a width of 25 mm.

5.6.6 The work on the interior face shall be precisely the same as on the exterior face unless the work is to be plastered in which case the side joints need not be truly vertical.

5.6.7 Hearting shall consist of flat bedded stones carefully laid on their proper beds and solidly bedded in mortar, chips and sqauls of stone being wedged in wherever necessary so as to avoid thick beds or joints of mortar. Care shall be taken so that no dry work or hollow spaces shall be left anywhere in the masonry. The face and backing shall be brought up evenly but the backing should not be levelled up to at each course by the use of chips.

5.6.8 Mortar :The mortar for the work shall be as specified in the respective items of work and shall be prepared as of Clause 3.3

5.6.9 Curing of masonry shall continue for a minimum of ten days.

5.6.10 Measurement: The unit of measurement shall be cu.m. or part thereof. Actual quantity of masonry shall be calculated from dimensions shown on drawings less openings and shall be paid for.

5.6.11 Inserts, bolts, etc.: Inserts, bolts, etc. shall be provided in masonry and concrete works as indicated on the drawings. It is imperative that all inserts, bolts, fixtures and fittings shall be provided in their position very accurately. If the Project Engineer cum Estate Officer directs that such inserts and bolts be fixed by use of templates, the CONTRACTOR shall make arrangements for providing such templates. If as a consequence of negligence on the part of the CONTRACTOR, the inserts, bolts, fixtures, fittings, etc. are out of alignment, the CONTRACTOR shall make arrangements to have the inserts and bolts removed and re-fixed in their proper position as directed by the Project Engineer cum Estate Officer, at no cost to the Institute.

5.6.12 Measurement Inserts, bolts etc. shall be measured and paid for as indicated in Schedule of Quantities.

5.7 Rubble packing: Rubble used for packing under floors, foundations etc. shall be hard, durable rock free from veins, flaws and other defects. The quality and size of the rubble shall be subject to the approval of the Institute / Project Engineer cum Estate Officer.

5.7.1 Rubble shall be hand packed as directed by Project Engineer cum Estate Officer. This shall be laid closely in position on the sub-grade. All interstices between the stones shall be wedged-in with smaller stones of suitable size well driven to ensure tight packing and complete filling of interstices. Such filling shall be carried out simultaneously with the placing in position of rubble stones and shall not lag behind.

5.7.2 Small interstices shall be filled with hard clean sand and well watered and rammed.

5.7.3 Measurement: The unit of measurement shall be sq.m. for the specified thickness of rubble packing.

5.8 Cement pointing: The joints of masonry shall be raked at least 12 mm deep, 3 or 4 days after the courses are laid. The dust shall then be brushed out of the joints and the wall, washed with water if not done earlier. The mortar shall consist of one part of cement to one part of fine sand. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be touched again after it has once begun to set.

5.8.1 The joints of the points work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk or 'V' as may be directed. No false joints shall be allowed.

5.8.2 The work shall be kept wet for a week after the pointing is complete.

5.8.3 Whenever coloured pointing has to be done, the colouring pigment of the colour required shall be added to cement in such proportion as recommended by the manufacture and as approved by the Institute / Project Engineer cum Estate Officer.

5.8.4 Measurement: The area pointed shall be calculated in sq.m. from dimensions shown on drawings less openings and shall be paid for.

5.9 Cement plaster work: All joints in masonry shall be raked to a depth of 12 mm with a hooked tool made for the purpose when the mortar is still green and in any case within 48 hours of its laying. The surface to be rendered shall be washed with fresh clean water free from all dirt, loose material, grease etc. and thoroughly wetted for 6 hours before plastering work is commenced. Concrete surfaces to be rendered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall.

5.9.1 The proportion of the mortar shall be as specified under the respective items of work. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as per I.S. Standards. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to stand for more than 25 minutes after mixing with water.

5.9.2 Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. The decision as to when the plaster has hardened will be given by the Project Engineer cum Estate Officer. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

5.9.3 Whenever the specification or the item of work calls for water proofing, the CONTRACTOR shall provide the percentage of water proofing compound as specified in the items of work.

5.9.4 Where lath plaster is specified, it shall be paid for at the same rate as for plaster work without metal lath except that separate payment for metal lath will be made.

5.9.5 Ceiling plaster shall be done before wall plaster and wall plaster shall commence at top and work downwards.

5.9.6 Interior plaster: This plaster shall be laid in a single coat of 13 mm thickness. The mortar shall be dashed on the prepared surface with a trowel and finished smooth by trowelling on the surface with neeru II i,e cream). Neeru shall be properly slaked fat lime. The standard of finish expected is high and shall conform IS 2394. Interior plaster shall be carried out on jambs, lintel and sill faces, top and undersides, etc. as shown in the drawings or as directed by the Project Engineer cum Estate Officer. Rate quoted for plaster work shall be deemed to include plastering of all these surfaces. However, if the item of work includes plaster finish, no separate payment would be made under 'plastering work'.

5.9.7 Exterior Plaster Exterior plaster work shall be carried out in 2 layers, the first layer being 14 mm thick and the second layer being 6 mm thick. The first layer shall be dashed against the prepared surface with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving an even and uniform surface, trowel finished unless otherwise directed by the Project Engineer cum Estate Officer.

5.9.8 Exterior Sand Faced Plaster: The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 14 mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows, etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item of work. The scratch coat shall be cured for at least 7 days and then allowed to dry.

5.9.9 The second coat shall be 6 mm thick and it shall be applied until at least 10 days have elapsed after the application of the scratch coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation and without joints, finish shall be straight, true and even. The mortar proportions of this coat shall be as specified under the respective item of work.. Only approved white sand shall be used for the second coat and for finishing work. Sand for finish shall be of even coarse size and shall be dashed on the surface and sponged.

5.9.10 Wherever 32 mm thick plaster has been specified, this is intended for purposes of providing beading, bands etc. This work should be carried out in two or three layers and as directed by the Project Engineer cum Estate Officer.

5.9.11 In the case of pebble face finished plaster, pebbles of approved size and quality all be dashed against the final surface to obtain as far as possible uniform pattern. In cases, workmanship shall all conform to IS 1601.

5.9.12 Measurement: The quantity of work to be paid for under this item shall be calculated by taking the projected surface of the area plastered after making necessary deductions for openings, doors, windows, fan openings etc. The actual plaster work carried out on jambs of doors, windows, openings etc. shall be measured and added. However, for purposes of payment under this item, plaster work carried on surface of items of work , which include plaster finishes, shall not be taken into account.

5.10 Waterproofing admixtures : If directed by the Institute / Project Engineer cum Estate Officer, the CONTRACTOR shall use approved waterproofing admixture made by reputed manufacturer in the mortar for plaster work. The quantity to be used etc. shall be in accordance with the manufacturer's instructions subject however to the approval of the Institute / Project Engineer cum Estate Officer. These admixtures shall not contain calcium chlorides unless specifically allowed by Project Engineer cum Estate Officer and shall conform to IS:2645. Payment shall be made for actual quantity of such admixture used unless it is already covered in the rates for the work concerned.

5.11 Mosaic terrazzo and plain cement tiling work flooring.

5.11.1 The type, quality, size, thickness, colour etc. of the tiles for flooring and skirting work shall be of best quality approved by the Institute / Project Engineer cum Estate Officer. For this purpose, the CONTRACTOR shall provide the Project Engineer cum Estate Officer with necessary samples for his selection.

5.11.2 Before the tiling work is commenced, the sub-surface shall be thoroughly cleaned and washed of all loose materials, dirt, and scum or laitance and then well wetted without forming water pools on the surface.

5.11.3 The tiles shall be laid on lime concrete mortar bedding of about 25 to 30 mm thick.. The proportion of mortar shall be one part of cement, 2 parts of lime and 6 parts of sand. The mortar shall be evenly spread on the sub-floor. Over this mortar bed, 5 kg. Of cement per sq.m. of floor area shall be spread. The tiles shall be fixed on this bed one after another, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be perfectly straight and uniform in thickness. The tiles shall be laid perfectly in level unless otherwise specified or required or desired by the Project Engineer cum Estate Officer. After laying the tiles the joints shall be finished with white cement or cement of approved colour.

5.11.4 For lime mortar, lime from burnt stone shall be used. It shall be free from ash and impurities and be in the form of lumps and not power when brought to site. Lime which is damaged due to rain, soaking, moisture or air soaking will be rejected.

5.11.5 Floor tiles laid adjoining the wall shall project 12 mm under the plaster, skirting or dado as may be required by the Project Engineer cum Estate Officer. Half tiles and pieces shall be avoided as far as possible. After laying, the flooring shall be allowed to cure undisturbed for seven days. Design traffic shall not be allowed on the floor for at least 14 days after laying the tiles.

5.11.6 About a week after laying the tiles, each and every tile shall be lightly tapped with a small wooden mallet to find out if it gives a hollow sound; if it does, such tiles along with any other cracked or broken tiles shall be removed and replaced with a new tile to proper line and level. The same procedure shall be followed again after the tiles are finally polished. For the purpose of ensuring that such replaced tiles match with those earlier laid, it is necessary that the CONTRACTOR order enough extra tiles from the factory to meet this contingency. The tiles shall finally be cleaned and polished by using dilute oxalic acid or any other method recommended by the manufacturer and approved by the Institute / Project Engineer cum Estate Officer.

5.11.7 After the joints have developed sufficient strength, the floors shall be machine polished to the desired finish as approved by the Institute / Project Engineer cum Estate Officer. Sufficient quantity of water shall always be used during polishing to prevent scratching.

5.11.8 For dado and skirting work, the vertical surface shall be thoroughly cleaned and wetted. Thereafter it shall be evenly and uniformly covered with about 12 mm thick 1:2 cement mortar. For this work the tiles as obtained from the factory shall be of the size required and practically fully polished. The back of each tile to be fixed shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall with a wooden mallet. This shall be done from the bottom of the surface upwards. The joints shall be as close as possible and the work shall be truly vertical and flush.

5.11.9 After the work has set, hand polishing with carborundum stones shall be done so that the surface attains a high gloss and shine. Corners and junctions shall be finished true. The workmanship shall conform to IS 1443. The work is subject to the approval of the Institute / Project Engineer cum Estate Officer. If any portion of the work is rejected by the Institute / Project Engineer cum Estate Officer, the same shall be removed and redone by the CONTRACTOR to the satisfaction of the Project Engineer cum Estate Officer at no extra cost to the Institute.

5.11.10 The procedure for laying and finishing cement tiles in floor and dado shall be as for mosaic tiles except that in this case the tiles shall be cement tiles instead of mosaic/terrazzo tiles.

5.11.11 Measurement: Unit of measurement for floor tiling, and dado shall be sq.meter or part thereof of the superficial area. Actual quantity of tiling work carried out will be measured and paid for after making deductions for openings etc. For skirting, unit of measurement shall be linear meter for the specified width.

5.12 In-situ terrazzo/mosaic flooring: The marble chips shall be of approved size, colour and shade. The cement used may be white coloured cement or cement mixed with colouring pigments as directed by the Project Engineer cum Estate Officer. The proportion or marble chips to cement shall be as directed by the Project Engineer cum Estate Officer but in no case it shall be less than 21/2:1.

5.12.1 Samples of terrazzo/mosaic work shall be prepared for approval of the Institute / Project Engineer cum Estate Officer. The entire work shall conform to the approved samples. For in-situ mosaic on stair treads, floors at building entrances etc. the CONTRACTOR shall provide a chequered non- slippery finish at no extra cost.

5.12.2 The terrazzo chips shall be laid after placing the base. The base shall consist of a layer of lime mortar as per Cl.12.3 15 mm thick spread and levelled. Chips shall be thoroughly mixed dry and then white cement or cement of approved colour shall be added in specified proportion. Chips and cement shall be thoroughly mixed and evenly spread on the platform and not heaped. Water shall then be added to obtain a plastic mix of suitable consistency as directed by the Project Engineer cum Estate Officer.

5.12.3 Terrazzo layer shall be placed as soon as the screed coat has set sufficiently but in no case then the day thereafter. The thickness of terrazzo topping shall not be less than 10 mm. The surface shall be rammed to obtain the consolidation and a Additional chips shall be sprinkled on the surface and rammed in until surplus cement is worked out and chips forced together so that the finished floor will show not less than 70% aggregate. The surface is finally trowelled lightly.

5.12.4 The CONTRACTOR shall keep the floor moist not less than six days. The surface shall then be machine polished. Voids shall be filled with neat grouting of same kind and colour as matrix; this grouting shall remain at least 72 hours before being removed for final cleaning. The floor shall be refinished wherever necessary to leave the work in first close condition. The workmanship shall conform to SI.2114.

5.12.5 While the under bed is still plastic, metal dividing strips of brass or aluminium, about 35 mm wide and 1.25 mm thick, shall be inserted in the mortar bed according to the design of the floor, care being taken to see that no section exceeds. I.S. sq.m. in area. The top of strips shall be 10 mm above the surface of the under bed and shall conform to the finished level of the floor.

5.12.6 Measurement : Measurement and payment shall be as per Clause 4.11.11

5.13 Glazed tile work: The glazed tiles in paving and dado shall be of the best available first class quality approved by the Institute / Project Engineer cum Estate Officer and they should be laid on a base of 12 mm thick lime mortar. The tiles shall be of standard size without warp and with straight edges true and even in shape and size and of uniform colour. They shall be laid truly vertical on walls and truly horizontal on floors or to slopes as directed. The joint shall be very thin, uniform and perfectly straight. The joint shall be floated with white cement as approved by the Institute / Project Engineer cum Estate Officer. At the top of dado work, a coloured glazed tile border 75 mm deep shall be provided as approved by the Institute / Project Engineer cum Estate Officer. The rate quoted for paving and dado work shall be inclusive of angles, corner pieces, and approved colour border on top. Glazed tiles shall conform to IS.777.

5.14 Shahbad / tandur / kota stone flooring: Stones should be of approved quality, hard, sound, durable and uniform thickness. Edges shall be chisel dressed and the top surface shall be machine polished with joints running true and parallel from side to side. Stones should be laid on a bed of lime mortar. Thickness of mortar bedding should not be less than 12 mm and not more than 25 mm. Before laying, the stone slabs should be thoroughly wetted with clean water. Quantity of mortar mixed shall be just adequate to prepare a mortar bed over as much area as could be covered with the slabs within half an hour. The slabs are then laid and gently tapped with wooden mallet till it is firmly and properly bedded. There should be no hollows left. The joints should not be more than 2 mm thick. The joints should be struck smooth. The floor should be kept covered with damp sand or water for a week. Slabs should be of standard sized and shapes. Slabs supplied should meet all the required properties and test requirements as stipulated in IS Code 11224.

5.15 Integral cement finish on concrete floor : In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screeded off to proper level and tamped with tamper having conical projections so that the aggregate shall be forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener as approved by the Institute / Project Engineer cum Estate Officer shall be supplied and used as recommended by the manufacturer.

5.16 Woodwork in doors, windows, partitions, louvers, railing etc.

5.16.1 Wood used for all work shall be the best of the respective class specified, and properly seasoned by at least 6 months air drying suitable for joiner's work, should be of natural growth, uniform in texture, straight grained, free from sapwood, dead knots, open shakes, boreholes, rot, decay and any and all other defects and blemishes.

5.16.2 The thickness specified for joiner's wrought timbers is, unless otherwise specified, prior to planning and 3 mm will be allowed from the thickness stated for each wrought face.

5.16.3 All joining shall be wrought on all faces and finished off by hand with sandpaper, with slightly rounded arises.

5.16.4 The joints shall be pinned with hard wood pins and put together with white lead. Jointing shall be by means of mortice and tennon or dovetailed joints as approved.

5.16.5 Any joiner's work which shall spilt, fracture, shrink, or show flaws or other defects due to unsoundness, inadequate seasoning or bad workmanship shall be removed and replaced with sound material at the CONTRACTOR'S expense.

5.16.6 Doors, windows, and ventilator frames, transoms and mullions shall be rebated. All dimensions shall be as per drawings. The top framing member of doors and top and bottom framing of windows and ventilators shall project about 150 mm in brickwork. The verticals of doorframes shall project about 50 mm below finished floor. Surface coming in contact with brickwork shall be painted with bitumen as directed by the Project Engineer cum Estate Officer. Each of the door and window frames shall be provided with 3 Nos. MS 225x25x6 flat split holdfasts on each side. These holdfasts shall be embedded in masonry or concrete work. The work shall conform to IS: 4021.

5.16.7 The doors shall be panelled or solid flush doors as described in the item of work. All flush doors shall be supplied with approved fittings such as hinges, mortise lock of approved make with handles on both sides, oxidized brass tower bolts and latch arrangements, door stops etc. and as shows in drawings but exclusive of door closers. Door closers, where separately specified shall be of heavy-duty hydraulic type to be approved by Institute / Project Engineer cum Estate Officer. Panelled doors shall have the same fittings except in place of union lock, an aldrop shall be provided. Each door leaf shall have two 250 mm tower bolts, two handles of aluminium or oxidized brass and one door stopper mounted near the bottom of door. External flush doors shall be made of weatherproof plywood. Flush doors shall conform to IS 2202 (Part I).

5.16.8 Doors will generally have no sills but if a few have to be provided; the CONTRACTOR shall do so at no extra cost to the Institute.

5.16.9 The type of window shall be as specified. Each shutter shall have one pair of hinges, two tower bolts one 225 mm long and another 150 mm long), one handle and one hook with eye and peg stay. Ventilators shall have two MS hold fasts and hinges, one handle and one hook and eye at each and one small tower bolt in the centre. Where so directed by the Project Engineer cum Estate Officer, the doors and windows shall be provided with parliamentary type hinges at no extra cost.

5.16.10 The workmanship of all door and window shutters shall conform to the requirements of IS: 1003 (Parts I & II) and IS 2202 (Part I). If required, flush door panels shall be got tested as per IS 4020.

5.16.11 Cupboards, almirahs, and shelves shall be provided as shown in drawings. The doors could be of either hinged type or sliding type as approved by the Institute / Project Engineer cum Estate Officer. All dimensions as furnished in the drawings shall be followed. Fixtures and fittings as shown on drawings or as directed by Project Engineer cum Estate Officer shall be used.

5.16.12 Railings and architrave shall conform to the shape shown on drawings or as approved and fixed by means of screws (counter sunk or otherwise) or bolts.

5.16.13 The finish expected is of a very high order and the work shall be all-inclusive whether or not all detailed specifications have been spelt out and the work shall be free from blemish.

5.16.14 No iron bars or grills are proposed to be provided in the windows or ventilators. Glass louvered ventilators where specified shall be provided.

5.16.15 Glazed windows, louvers, ventilators and doors shall be provided with either clear or pinheaded glass 5.5. mm thick which shall be free from all blemishes and shall conform to IS:1761. It should be clearly understood that glass which does not have uniform refractive index or which is wavy, will be rejected.

5.16.16 Woodwork shall not be painted, oiled or otherwise treated before it has been approved by the Institute / Project Engineer cum Estate Officer.

5.16.17 Measurement: All doors, windows, ventilators, louvers, will be measured in sq.m. The measurement will be taken to the outside of framework exclusive of horns, projections, etc. The rate quoted shall be all inclusive such as nails, screws, glazing, fixtures, fittings, providing peep holes, locking device, handles, door steps etc. The rate shall also be inclusive of polishing/painting with 3 coats of approved paint over primer coat.

5.17 Steel doors, windows and fittings: The steel doors, windows, ventilators shall conform to IS: 4351. All steel doors, windows, ventilators, and louvers etc. shall be of sizes as specified and conform to the description in the respective items of work. Whether or not specifically mentioned, all fixtures and fittings necessary for the satisfactory operation of the doors and windows shall be provided. Doors, windows and ventilators shall be obtained from an approved manufacturer. Specific approval for such purchase shall be obtained beforehand. Samples shall also be got approved before further manufacture starts, unless this is waived in writing by the Institute / Project Engineer cum Estate Officer. All steel doors shall be of pressed steel (18 gauge) flush type with or without removable transom. All doors shall be provided with a three way bolting device and locking arrangement with duplicate keys and handles on either side. The CONTRACTOR shall obtain windows with friction hinges in place of windows with peg stays if so directed by the Project Engineer cum Estate Officer. For centre hung and top hung ventilators suitable spring catch/pulley and chord arrangement shall be provided for facility of opening. Whenever fly mesh over windows is called for, they shall be fixed on the window and suitable lever type or rototype arrangement shall be provided for opening or closing of the glazed panels from inside. Prior approval of Institute / Project Engineer cum Estate Officer shall be taken before order is placed with the manufacturer.

5.17.1 Where specified, steel doors supplied shall be airtight. For this purpose, the CONTRACTOR shall provide necessary padding materials such as rubber, felt or any other approved material.

5.17.2 Measurement: Doors, windows shall be measured in sq.m of the actual size measured to the outside of the steel framework.

5.17.3 The rate quoted shall be inclusive of glazing with 5 mm thick glass free from all blemishes. The workmanship shall conform to IS 1081. The rate quoted shall also be inclusive of fixing the doors, windows, ventilators, louvers etc. in brick work, steel framing etc., by making holes/drilling holes in steel work where required..

5.17.4 The rate shall also include cost of painting two coats of approved enamel paint over one coat of approved zinc rich primer.

5.18 Rolling shutters: The rolling shutters shall conform to the size indicated in drawings and shall be of quality specified in the Schedule of Quantities. The rolling slats shall be in one piece and be made of heavy gauge steel sheets minimum 18 SWG in thickness. A cylindrical hood shall be provided on the top to enclose the shutter when it is open. The rolling shutters shall be provided with suitable looking arrangements and deep channel guides. In case galvanized rolling shutters are specified, the rolling shutter shall be made of hot dip galvanized slats, hood, deep channel guides all preferably in one piece.

5.18.1 In case of hand operated pull and push type, rolling shutters of sizes larger than 10 sq.m in area or in case of very large gear operated rolling shutters or as directed by the Project Engineer cum Estate Officer, rolling shutters shall be provided with ball bearings for smooth and efficient operation. In addition, in case of large rolling shutters and depending upon local wind conditions, the rolling shutters should also be provided with special wider channel guides or it shall be provided with central movable channel supports to take up the design wind pressures in the area.

5.18.2 The rates quoted shall be inclusive of providing three coats of approved paint over 2 coats of approved primer coat (One shop coat and one coat after erection) where not galvanized. Rates quoted shall also include cost of lever lock and erection. Fixing lugs to be provided to guide channel to suit actual site conditions or as directed by the Project Engineer cum Estate Officer at no extra cost.

Painting/polishing for wood work & iron work

a. Paint/Polish to be used for various items of work shall be of best quality and shall be obtained ready mixed in sealed containers from approved manufacturer. The CONTRACTOR shall obtain the Institute / Project Engineer cum Estate Officer's approval for the make and colour of the paint he proposes to use. If required, Polish for woodwork shall be tested as per IS 5807 (Parts I & III).

b. All surfaces shall be thoroughly cleaned of all dirt, loose particles and rust and approved prior to application of paint. For wood surface, a priming coat without colouring matter shall be first applied after which all holes, cracks, etc. shall be stopped with putty and all knots properly killed with quick-lime,. Workmanship shall conform to IS:1477 (Parts I &II) and 2338 (Part I)

c. Specified number of coats shall be applied and at least 24 hours shall elapse between the applications of successive coats. No painting shall be carried out on exterior work in wet weather or no surfaces which are not entirely dry.

5.19 Painting/polishing rate shall include all necessary scaffolding, cradles and plant. Measurements will be on the basis of sq.m. for doors and windows, only the projected area will be measured, if such painting/polishing is not already a part of the item, without deducting for the glazed portions though not painted. The CONTRACTOR'S rate should take this into account.

5.20 Distempering, white/colour washing and painting of walls

5.20.1 Distempering: The Surface to be treated shall be thoroughly cleaned of all dirt and loose particles etc. Inequalities and holes shall be filled with gypsum which should be allowed to set hard before distemper is applied.

5.20.2 Distemper shall be of well-known brands of approved make. It shall be applied by a broad stiff brush in two coats over a coat of primer. The first and second coat shall be applied only after the primer coat has thoroughly dried. The first coat shall be of a lighter tint. The shade of the distemper shall be got approved by the Institute / Project Engineer cum Estate Officer. Water bound and oil bound distemper shall conform to the requirements of IS 428 respectively.

5.20.3 White wash: Walls to be thoroughly cleaned before application of white wash. White wash shall be of ordinary fat lime and of good quality. It shall be slaked with an excess of water to the consistency of a cream and allowed to remain under water for 2 days. It shall then be strained through a cloth and 2 kg of clean gum added for every cubic meter of lime ready for white washing.

i. Each coat is to be applied with a brush. It shall be laid with a stroke of the brush from the top downwards, another from bottom upwards over the first stone, and similarly, one stroke from the right and another from the left over the first brush before it dries. Three such coats shall be applied.

5.20.4 Colour wash: Colour wash shall be applied the same way as white wash. Necessary and approved colouring matter shall be added to the white wash which has been strained. Only wash sufficient for the day's work shall be prepared each morning. If the finished surface is powdery and comes off easily or the general appearance is streaky, the work shall be rejected.

5.20.5 Painting: Paint to be used for the various items of work should be of approved make and colour. It is imperative that the CONTRACTOR should obtain Institute / Project Engineer cum Estate Officer's permission in regard to the make and colour of paint that he proposes to use for the various items of work. The painting work shall be carried out as directed by the Project Engineer cum Estate Officer, keeping, however, in view the recommendations of the manufacturer.

5.20.6 Where painting with plastic emulsion is specified, all uneven surfaces shall be made up by use of putty of appropriate quality, after the surface has been thoroughly cleaned of all dust, dirt and sand papered. One primer coat and 2 coats of emulsion paint shall be applied. Workmanship shall conform to the requirements of IS 2395.

5.20.7 Measurement: The actual quantity of work carried out will be measured in sq. meter after making deductions for openings etc. and shall be paid for.

5.21 Expansion joints, water stops, pre-moulded joint filters, flashings

5.21.1 Expansion joints: Expansion joints shall be provided with 20 gauge copper strips/MS hot dip galvanized strips of 250 mm width at locations shown on drawings or as approved by the Institute / Project Engineer cum Estate Officer. The strips shall be bent to the shape indicated on drawings and embedded properly in masonry. The joint width shall be uniform throughout and special care shall be taken to ensure proper bonding at expansion joints. Expansion joints shall be continuous and where two or more strips meet, they shall be lapped to the extent of 75 mm and joints properly soldered. The expansion joints shall be filled with pre-moulded joint fillers and sealed with mastic compound. For purposes of measurement, the laps provided will be neglected. Wherever an expansion joint between the existing part and new part is proposed the rate quoted shall be inclusive of making necessary connections with existing parts.

5.21.2 Water stops: Water stops shall be of rubber or PVC Bars of approved make. These shall be provided at locations indicated on drawings. Water stops shall be lapped 100 mm and heat sealed to obtain continuity. Water stops shall be clean and free from grease etc. Projected portion of water stops shall be cleaned thoroughly of all concrete and mortar coating as directed before resuming concrete work. Water stops shall be in long lengths to avoid joints as far as possible.

5.21.3 Joint filler: Pre-moulded joint fillers shall be of a non-deteriorating and resilient type. A sample of material shall be approved by the Institute / Project Engineer cum Estate Officer before being brought on site. Installation shall be carried out properly and as directed.

5.21.4 Flashings: Metal or tar felt flashing shall be fixed as directed by the Project Engineer cum Estate Officer. Metal flashing where provided shall be welded / soldered to obtain continuity. Tar felt flashing shall be lapped for a minimum length of 150 mm.

5.21.5 Flashing shall be measured and paid for in linear meters for the specified width disregarding laps or joints.

5.21.6 Water proofing work: All surfaces to be water proofed shall be dry, clean, smooth and free from dust and loose particles.

5.21.7 Tar felt type: For a five-layer treatment, bitumen primer conforming to IS 3384 shall be applied. Over this primer coat, hot bitumen conforming to IS 1580 shall be applied at the rate of 1.2 kg/m2. Hessian based felt type 3 Grade 2 conforming to IS 1322 shall be spread and embedded in the previously laid bitumen while hot. Hot bitumen will again be applied over the felt at the rate of 1.2.kg/m2. Pea size gravel or grit shall be uniformly spread at the rate of 0.008 cum./sq.m. The end and side laps of each sheet shall not be less than 100 and 175 mm respectively and shall be firmly bonded with bitumen. The extreme ends shall be taken up about 100-150 mm along parapet wall and embedded in chases made in the wall and brick masonry and made good in plaster. The standard of water proofing shall comply with IS 1346. For seven layer treatment, one additional layer of felt and one layer of bitumen shall be laid before gravel layer in a manner described above for five layer treatment.

5.21.8 Brick bat coba china mosaic type: In case of works where brick bat coba and china mosaic are specified, brick bat coba of average thickness specified in the item of work shall be laid to the required slopes as shown on the drawings. Proportion of brickbat shall be 2 parts of brickbat to one part of lime mortar (one part o lime to 2 parts of sand). The brick bats shall be hard, well burnt and of size varying from 12 mm to 25 mm. Lime shall be of best quality of hydraulic lime double ground. While preparing brick bat concrete, jaggery in proportion indicated by the Project Engineer cum Estate Officer shall be added. The brick bat coba shall then be laid to slopes, providing necessary wattas, and beaten at least for 48 hours after laying. Over the brick bat coba a bedding of 1:2 lime mortar 20 mm to 25 mm thick, shall be provided. A layer of neat cement grout, about 10 mm thick shall then be laid. Immediately on application of cement grout, assorted pieces of coloured china, previously soaked in water shall be set closely on the fresh surface and properly tamped to the required grade. The cement grout freshly laid shall work its way to the top surface. The surface after completion of work shall be finally cleaned with sawdust and waste and it so directed by the Project Engineer cum Estate Officer with dilute acid. China mosaic shall be cured for at least 10 days. If so directed by the Project Engineer cum Estate Officer, border of colour or white mosaic shall be provided.

5.21.9 Brickbat coba and china mosaic shall be taken up the parapet walls to a height of 125 mm to 150 mm Necessary wattas shall be provided towards drain pipes as shown on drawings or as directed by the Project Engineer cum Estate Officer.

5.21.10 On prior approval from the Institute / Project Engineer cum Estate Officer, cement based proprietary type of waterproofing may be allowed to be done by a specialist CONTRACTOR,

5.21.11 The CONTRACTOR shall give a guarantee for any/all types of waterproofing for a minimum period of 7 years against bad or faulty material and construction and shall rectify the work at his own cost during the guarantee period.

5.21.12 Measurement: Payment for work executed would be made for projected area only between the inside of plastered walls. No payment would be made for rounding off at corners or for work carried on vertical faces of walls, slabs, parapet or column projections.

6.0 STRUCTURAL STEEL SPECIFICATIONS:

6.1 Scope: This specification covers the supply, fabrication, and erection of the roof trusses as per drawings and attached technical specifications and the bill of quantities.

6.1.1 A detailed work schedule has to be submitted and Architect's approval for the same obtained prior to commencement of any work. This schedule shall be submitted within 7 days of issue of work order.

6.1.2 TENDERER shall plan material supply schedule and site work to optimize period of construction.

6.2 Technical specifications

6.2.1 This specification covers general requirements for supply, fabrication, delivery and erection at site, design of connections, and preparation of fabrication drawings, inspection and testing, and painting of steel structures.

6.2.2 Unless otherwise specified all materials and workmanship shall conform to relevant Indian standard codes and specifications. Some of the codes are listed for the reference of contractor.

a.	IS: 226/ 2062	Structural steel, standard and fusion welding quality
b.	IS: 4923	Structural steel, rolled hollow square/rectangular sections.
c.	IS: 808	Rolled steel beam, channel and angle sections
d.	IS: 1977	Structural steel -ordinary quality
e.	IS: 1363	Black hexagon bolts, nuts and lock nuts, and black hexagon screws
f.	IS: 1364	Precision and semi-precision hexagon bolts, nuts, lock nuts and screws
g.	IS: 1367	Technical supply conditions for threaded fasteners
h.	IS: 2016	Plain washers
i.	IS:1852	Specification for rolling bad cutting tolerances for hot rolled steel products
j.	IS: 2074	Ready mixed paint, red oxide, zinc chrome, and priming
k.	IS: 800	Code of practice for use of structural steel in general building construction
l.	IS: 91	Recommendation for limits and fits for engineering
m.	IS: 4000	Code of practice for liquid penetrant flaw detection
n.	IS: 816	Code of practice for use of metal arc welding for general construction
o.	15. IS: 823	Code of practice for manual metal arc welding of mild steel
p.	IS: 1182	Recommended practice for radiographic examination of Fusion welded butt joints in steel

q. IS: 3658 Code of practice for liquid penetrant flaw detection

r. IS: 5334 Code of practice for magnetic particle flaw detection of welds

s. IS: 102 Ready mixed paint, brushing, red lead, non-setting, priming

6.2.3 When steel is supplied by Institute, it will be supplied at Owner's store, in such condition and lengths/sizes as are available in stock. Contractor shall acknowledge receipt of steel in writing indicating the sizes and lengths, quantities and date & time. Any bad condition of steel received shall be brought to the notice of the Project Engineer cum Estate Officer at the time of receipt of steel.

6.2.4 When steel is supplied by contractor, contractor shall furnish bills, test certificates as to conforming to specifications and proper weight records and get the same verified by Project Engineer cum Estate Officer.

6.2.5 Contractor shall use steel supplied by Institute carefully and economically, to ensure neither unnecessary damage nor wastage occurs.

6.2.6 Contractor shall submit his bill of materials indicating cutting lengths of each size and their nos. for Institute / Project Engineer cum Estate Officer's approval. All steel materials left over after completion of work, shall be returned to Owner's store at contractor's cost, giving account of size and length of each size returned.

6.2.7 An unaccountable wastage of up to a maximum of 1% of the weight of fabricated steel will be allowed.

6.2.8 Architect will issue design drawings to contractor and they shall form part of this specification. Architect reserves the right to make changes in the drawings. All such revisions shall be incorporated in the fabrication drawings to be prepared by the contractor at his cost. All work shall be carried out as per these drawings and this specification.

6.2.9 Contractor shall submit fabrication drawings based on the design drawings for approval of Architect. No fabrication shall commence prior to approval of fabrication drawings by the Architect.

6.2.10 Contractor shall also prepare drawings for erection scheme of the fabricated steel, indicating the method of erection, no. of units into which he would split the entire structure, location of supports to be taken, type of support and erection equipment etc.

6.2.11 All connections shall be detailed for ease of assembly and erection.

6.2.12 Drawings prepared by the contractor shall be at contractor's cost and his quoted rates shall include for all such costs.

6.2.13 Bolted connections shall be provided only where shown on design drawings and for temporary connections for erection purposes. All temporary bolted connections shall be removed after final erection and bolt holes plug welded and ground smooth.

6.2.14 Riveted connections are not permitted.

6.2.15 Rolled steel before working shall be straightened. Straightening/flattening shall be done so as not to damage the material. Heating or forging for this purpose shall not be permitted.

6.2.16 Cutting may be by shearing, cropping, sawing. All cut edges shall be dressed to a neat finish. Machine flame cutting may be carried out with prior permission of Architect, but hand flame cutting is not permitted.

6.2.17 All drilling shall be carried out by machine. Gas cutting to make holes is strictly prohibited.

6.2.18 Inspection of bolts after tightening shall be carried out as stipulated in the relevant Indian standards depending upon the method of tightening and the type of bolt used.

6.2.19 All electrodes to be used in the project shall be got approved by Architect.

6.2.20 All welders to be employed in the project shall be qualified and sample welds made by each of them shall be submitted for Architect's approval. Rejected welders shall not be employed for the project. Failure to adhere to this will entail severe penalty, including suspension of contractor's work.

6.2.21 No fillet weld shall be thicker than the parent metal. Parent metals shall be prepared properly and contractor shall ensure that the gap between members to be welded shall be not more than 1.5 mm.

6.2.22 Electrode flux shall be sound and unbroken.

6.2.23 Welding equipment and accessories shall have adequate capacity for welding. All welding equipment shall be adequately earthed and provision shall be made for measuring the current at any time.

6.2.24 All welds shall be free from defects like blowholes, slag inclusions, insufficient penetration, cracks, undercutting etc.

6.2.25 Voltage and current shall be set according to the manufacturer's recommendations.

6.2.26 All complete penetration butt welds shall be made by manual metal arc welding.

6.2.27 Sample welds shall be inspected for flaws by radiographic testing in accordance with relevant Indian standards.

6.2.28 All defective welds, including those detected by visual inspection of Architect shall be rectified as directed by Architect.

6.2.29 Cost of all necessary tests shall be borne by the contractor. His quoted rates are deemed to have included the same.

6.2.30 No rolled or fabricated member shall deviate from straightness by more than $1/1000^{th}$ of the axial length or 10 mm whichever is less.

6.2.31 The length of members with both ends finished shall have a maximum tolerance of +/- 1 mm. Members without ends finished for contact bearing shall have a maximum tolerance of +/- 1.5 mm for members up to 10 meters long and a tolerance of +/- 3 mm for members over 10 meters in length.

6.2.32 Lateral deviation between centerlines of web plate and flange plate at contact surface, in the case of built up sections shall not exceed 3 mm.

6.2.33 Column ends bearing on each other or resting on base plates and compression joints designed for bearing shall be milled true and square to ensure proper bearing and alignment. Base plates shall have their surfaces milled true and square.

6.2.34 Contractor shall give sufficient notice to Architect in advance of the materials or workmanship getting ready for inspection. All rejected material shall be removed forthwith from site or from fabrication shop.

6.2.35 Material not rejected in fabrication shop is liable or rejection at site at the time of final inspection.

6.2.36 No material/fabricated item shall be dispatched to site or painted without prior inspection and approval of Architect.

6.2.37 Architect reserves the right to specify additional tests, if he deems it necessary and the contractor shall carry out the same at no extra cost to Institute.

6.2.38 Contractor shall maintain records of all inspection and test reports and shall be made available to Architect whenever demanded.

6.2.39 After checking and inspection, all members shall be marked for identification during erection. These markings shall match those in the fabrication drawings. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depths to be clearly visible, even after a member is galvanized.

6.2.40 All erection marks shall be located clear of the bolt holes and on the outer surface and near one end. Members longer than 6.5 meters shall be marked at both ends.

6.2.41 All fabricated steel work shall receive one shop coat of Zinc chromate primer, one coat at site of zinc chromate primer and two coats of synthetic enamel paint of approved make.

6.2.42 Prior to first coat of primer painting, the surfaces shall be brushed, sand papered and cleaned of all rust and any adhering.

6.2.43 For the purpose of payment, the actual weight of completed and erected structure shall be calculated from approved fabrication drawings.

6.2.44 Full weight of rivets and bolts shall be measured, but no allowance shall be made for galvanizing, painting or welding, nor for rolling margins.

6.2.45 Weight of standard sections shall be based on IS standards and manufacturer's catalogue for SAIL steel products.

6.2.46 Contractor shall furnish a preliminary erection scheme at the time of tendering. On successful bid, a detailed erection as specified elsewhere in this specification shall be furnished within ten days of award of contract.

6.2.47 The erection scheme shall cover method oh unloading, transportation within site/shop, assembling, hoisting and erection, and also the type and quantity of equipment he proposes to use for all the above operations.

6.2.48 The erection scheme shall also include a layout plan to show the areas proposed for unloading, main storage, storage of partly fabricated items, passageways, transport ways and the work areas.

6.2.49 Erection scheme shall clearly indicate how the equipment and any guy rope, anchors etc. are placed/fixed, sequence of erection activity by activity etc.

6.2.50 The scheme also shall indicate the site staff organization chart, wherein the number of supervisory staff, number and composition of different erection gangs etc. are indicated.

6.2.51 Any modification to the erection scheme required by the Architect for safety of men and material, and structures, requiring additional equipment, bracings, guy wires, anchors etc. shall be provided by the contractor at no extra cost.

6.2.52 All equipment, labour, tools and tackles, anchors, guys etc. shall be provided by contractor at no extra cost and his quoted rates are deemed to include the same.

6.2.53 An experienced and qualified full time supervisor shall be posted at site by the contractor.

6.2.54 Contractor shall complete all preliminary works at site, such as a site office, unloading gantry, labor quarters, if any, winches, hoists, compressors, cranes, water and electrical connections, and all tools and tackles, prior to arrival of steel.

6.2.55 Contractor shall furnish at his expense, necessary passageways, fences, safety belts, and safety helmets, lights and all safety precautions as per statutory regulations. A licensed electrician shall be kept at site for the entire contract period.

6.2.56 Contractor shall take care not to damage existing structures, amenities etc. during his work.

6.2.57 No dragging of steel shall be permitted. All materials shall be stored at least 300 mm above ground.

1.0 SCOPE:

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

2.0 CODES AND STANDARDS:

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

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

3.0 MAJOR PARAMETERS

3.1 The major parameters of the switchgear and associated equipment are specified in enclosed Data sheet A1. The Bidder shall confirm compliance of these data in full. Deviations, if any, shall be specifically brought out in the schedule of Technical Deviations.

3.2 The bill of material for each type of cubicle is given in enclosed single line diagram/module drawings/ Bill of material. The scope of supply shall include all these items.

4.0 CONSTRUCTIONAL FEATURES:

4.1 Metal-clad switchgear shall comprise metal-enclosed switchgear and control gear in which components are arranged in separate compartments with metal-enclosure intended to be earthed.

The metal-clad switchgear and control gear shall have separate compartments for the following components:

a. Each set of busbars

b. Switching device (Circuit Breaker/Contactor/Load Break switch/Fuses)

c. Power Cable Terminations

d. Metering, control & auxiliary switching devices and relaying devices

4.2 The switchgear shall be totally dust, moisture and vermin-proof. The degree of protection shall be as specified in Data sheet A1.

4.3 The current transformers shall be fitted on the fixed portion of the switchgear and not on the Breaker truck.

4.4 The Cable compartment shall fully house all power cable connections along with associated cable terminations. Wherever zero sequence current transformers are provided for earth fault protection, these shall also be located inside the cable compartment.

4.5 All doors of panels, removable covers shall be gasketted all around with neoprene gaskets of proper size. All louvers shall have screen and filter. Vent openings shall be covered with grills so arranged that hot gases or other material cannot be discharged through them in a manner that can injure the operating personnel. The screens and grills shall be made of either brass or galvanised iron wire mesh.

4.6 Metal-clad unit shall comprise of rigid welded structural frame enclosed completely by metal sheets smoothly finished, levelled and free from dents and uneven surfaces. The thickness of sheet steel shall be as specified in Data Sheet A1.

4.7 Painting

4.7.1 All sheet steelwork shall be phosphated in accordance with the following procedure and in accordance with relevant standards for phosphating iron and steel.

a. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.

b. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with slightly alkaline hot water and drying.

c. After phosphating, thorough rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and oven drying.

4.7.2 After phosphating, the sheet metal shall be subjected to powder coating process. The powder coating shall be carried out by spraying Polyester Epoxy powder (60/ 40) or equivalent using electrostatic or corona gun. After uniform deposition of the powder to the required thickness on to the object, it shall be transferred to a curing oven.

4.7.3 The final finished thickness of paint film on steel shall not be less than 100 microns, and shall not be more than 150 microns.

4.7.4 Finished painted equipment shall present an aesthetically pleasing appearance, free from dents and uneven surfaces with unique colour shade.

4.8 Switchgear design shall comprise fully compartmental execution having separate vertical sections for each circuit. Compartments with doors for access to operating mechanism shall be so arranged as not to expose high voltage circuits. Switchgear cubicles shall be provided with hinged doors on the front with facility for padlocking door handles.

4.9 Structures, busbars and control wiring troughs shall be so designed and arranged to make future extensions readily feasible on either side.

4.10 Instruments, relays and control devices shall be mounted flush on hinged door of the metering compartment located in the front portion of cubicle. Panel door shall be supported by strong hinges and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.

4.11 Switchgear cubicles shall be provided with bottom sheet metal plates of 3 mm thick (minimum). Cubicles shall be fitted with removable gland plates in the cable termination chamber at bottom for entry of cables. The gland plates shall be of non-magnetic material, if single core cable terminations are specified.

4.12 Mounting sills in the form of mild steel channels properly drilled shall be supplied along with anchor bolts for mounting the switchgear cubicles. These shall be despatched in advance so that they may be installed and levelled when concrete foundations are poured.

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

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

5.0 TYPES OF PANELS:

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

a. Circuit Breaker Panel

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

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

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

6.0 SAFETY INTERLOCKS & FEATURES:

Switchgear shall be provided with following inter locks:

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

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

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

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

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

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

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

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

7.0 MAIN BUS BARS:

7.1 Main busbars shall be of electrolytic grade copper (tough pitched-99% purity) or Aluminium Alloy, E91E grade as specified in Data Sheet-A, conforming to relevant standards specified there in.

7.2 Bus-bars shall be located in air insulated enclosures and segregated from all other compartments of the cubicle. Direct access or accidental contact with busbars and primary connections shall not be possible. To provide a seal between adjacent cubicles, busbars shall be taken through seal-off bushings or insulating pads.

7.3 Bus-bars shall either be air insulated or encapsulated in epoxy and phase segregated by means of insulated phase barriers as specified in Data Sheet-A. The insulating material for phase barriers shall be made of non-hygroscopic material such as glass reinforced plastic or epoxy, which shall provide adequate insulation for the specified voltage class.

7.4 All busbar joints and bus tap joints shall be silver faced. Plain and spring washers shall be provided to ensure good surface contacts at the joints and taps. Wherever copper to dissimilar materials connections are required, suitable bimetallic connectors or clamps shall be used at joints & taps.

7.5 Bus-bars shall be rated in accordance with the service conditions and the rated continuous and short time current ratings specified in Data Sheet – A. Calculations shall be submitted for the busbar sizing taking into account ambient, enclosure and proximity de-ratings.

7.6 Bus-bars shall be adequately supported on insulators to withstand dynamic stresses due to short circuit current specified in Data Sheet-A. Busbar support insulators shall conform to relevant standards specified in Data Sheet –A.

7.7 The busbar clearances in air shall be as specified in Data Sheet-A.

7.8 Busbars shall not be painted and all performance characteristics specified shall be obtained with unpainted busbars.

8.0 CIRCUIT BREAKERS:

8.1 Circuit breakers shall be of Vacuum or SF6 type as specified in Data Sheet-A. These shall conform to relevant standards specified in Data Sheet-A and shall be of the horizontal draw-out type. Circuit breakers shall comprise three separate identical single pole units operated through a common shaft by the operating mechanism.

8.2 Circuit breakers shall be suitable for switching duty of transformers whose maximum capacity is furnished in Data Sheet-A and other devices specified in Data Sheet-A.

8.3 Circuit breaker along with its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow smooth movements. Isolating plugs and sockets for auxiliary power as well as control circuits shall be of robust design and fully self-aligning. Plugs and sockets for auxiliary power circuits shall be silver faced and shall be insulated with FRLS PVC or similar insulating material shrouds.

8.4 There shall be 'Service', 'Test' and 'Fully withdrawn' distinct positions for the breakers in it's housing. In the 'Test' position, the circuit breaker shall be capable of being tested for operation without energising the power circuits, i.e. the control circuits shall remain undisturbed while the power contacts shall be disconnected. Separate limit switches each having a minimum of 3 NO + 1 NC contacts shall be provided for both 'Service' and 'Test' positions of the circuit breakers as spares. These contacts shall be rated for 10A, 240V AC and 0.5A (inductive breaking) at 220V DC.

8.5 Connection of the control circuit between the fixed portion of the cubicle and the breaker carriage shall be by means of a 24-pin plug and socket arrangement. If a 24-pin arrangement is inadequate for the control and interlock scheme offered by the VENDOR, the VENDOR shall provide plug and socket having adequate number of pins. The plug and socket shall be so designed that, it shall be possible to engage or disengage the plug into the socket in 'test' position only, thereby eliminating the possibility of faulty insertion and wiring connections. The plug, after insertion, shall remain secured in position by spring clamps, which need considerable force to operate. The length of the plug chord shall be such that plug can be inserted into the socket only when the breaker is in 'test' and move further to 'Service' position. But it shall be necessary to with draw the plug from the socket before the breaker truck can be pulled out into the "Fully Withdrawn" position. It shall not be possible to move the circuit breaker into service or fully in position unless plug and socket be inserted in position.

8.6 Vacuum breakers shall have completely sealed interrupting units for interruption of arc inside the vacuum chamber. The breakers shall be provided with "contact wear indicator" visible from the front of the equipment, without requiring opening of the cubicle door, allowing the operator to access the conditions of the interrupters whilst the unit is in service. It shall be possible to isolate easily the vacuum interrupter unit from the breaker operating mechanism when in drawn out position for mechanical testing of the interrupter to check loss of vacuum.

8.7 The vacuum breakers shall be complete with integral surge arrestors to provide protection to the equipment controlled by the breaker, against switching surges.

8.8 SF6 circuit breakers shall operate on puffer or rotating arc principle. The breaker shall have, SF6 gas pressure 'low' and 'very low' alarm and trip contacts.

9.0 OPERATING MECHANISM:

9.1 Circuit breaker shall be power operated, either by pneumatic or by a motor charged spring operated mechanism. Main poles of the breakers shall be such that unless otherwise specified, the maximum difference between instants of contacts touching during closing shall not exceed quarter a cycle of the rated frequency.

9.2 Operating mechanism shall be non-pumping electrically and either mechanically or pneumatically under every method of closing (except during manual closing of a breaker for maintenance). Electrical anti-pumping feature shall be obtained by means of an auxiliary relay only and use of a contactor to achieve this feature shall not be acceptable.

9.3 Main poles of the breakers shall operate simultaneously.

9.4 Closing and Trip Circuits

9.4.1 Closing and trip coils shall be rated for satisfactory operation on the control supply voltage specified in Data Sheet A1.

9.4.2 Close and trip coils shall operate satisfactorily under the following conditions of supply voltage variations:-

a. Closing Coils - 85% to 110% of rated voltage

b. Trip Coils - 50% to 110% of rated voltage.

9.4.3 Electrical anti-pumping feature shall be provided.

9.4.4 Trip circuit supervision relay shall be provided to indicate 'trip circuit healthy' in the switchgear and remote panel and to provide alarm for 'trip circuit faulty'.

9.5 Spring Operating Mechanism

9.5.1 Spring charging motor shall be universal type suitable for operation on AC and DC control voltages specified in Data Sheet A1 with voltage variation of 80% to 110% of rated voltage.

9.5.2 Spring operated mechanism, shall be complete with spring charging motor, opening spring, closing spring with limit switch for automatic charging and all necessary accessories to make the mechanism a complete operating unit.

9.5.3 As long as power is available to the spring charging motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply to the motor, at least one open-close-open operation of the circuit breaker shall be possible.

9.5.4 Breaker operation shall be independent of the spring charging motor, which shall be used solely for compressing the closing spring.

9.5.5 Closing action of the circuit breaker shall compress the opening spring ready for tripping. When closing springs are discharged, after closing a breaker, closing springs shall automatically be charged for the next operation.

9.5.6 Motor shall be such that it requires a maximum of about 30 sec for fully charging the closing spring.

9.6 Operating Mechanism Control

9.6.1 Operating Mechanism shall normally be operated by remote electrical control when the breaker is in "Service" position. Electrical tripping shall be performed by shunt trip coils. Provision shall be made for local electrical control when the breaker is in "Test" position by a control switch on the switchgear cubicle door. Also, "Local/ Remote" selector switch lockable in "Local" position shall be provided on the cubicle door.

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

a. 'Red', 'Green', and 'Amber' lamps for breaker 'on', 'off' and 'auto trip' indication.

b. 'Red' lamps for test and service position.

c. 'White' lamp for trip circuit healthy

d. 'Blue' lamp for spring charged.

9.7 Breaker Accessories

The following accessories shall be provided with each breaker.

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

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

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

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

9.7.5 Mechanical position indicator for closing spring charged.

9.7.6 Manual spring charging facility.

9.7.7 Operation Counter

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

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

10.0 CONTACTORS:

10.1 The contactor shall be triple pole, vacuum type.

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

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

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

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

11.0 SWITCH FUSE UNIT:

11.1 The switch isolator shall be load break type capable of breaking the load current specified in Data Sheet A1.

11.2 The switch shall be manually operated or motor operated as specified in Data Sheet A1.

11.3 The switch shall be able to make and carry for specified duration the fault currents specified in Data Sheet A1.

11.4 The switch shall provide 4 'NO' and 4 'NC' auxiliary contacts for purchasers use.

11.5 The fuses shall be single pole, HRC type suitable for the fault duty specified.

11.6 The high voltage fuses shall be ofstriker pin type. On blowing of fuse in any phase, the switch unit shall open outto prevent single phase operation.

11.7 The switch fuse unit shall be draw out type.

12.0 CURRENT TRANSFORMERS"

12.1 Each panel shall be provided with metering and protection current transformers (CTs) as shown in the single line diagrams.

12.2 The CT parameters are given in the single line diagrams and Data Sheets. The BIDDER shall ensure that the specified ratings are adequate for the relays and meters furnished by him. If specified ratings are not adequate, the BIDDER shall offer CTs of required rating.

12.3 The CTs shall be of cast resin type and completely encapsulated.

12.4 The CTs shall withstand the momentary and short time fault current rating specified for the switchgear.

12.5 The core balance CTs shall be suitable for the respective outgoing feeder and suitably supported.

12.6 Test links shall be provided in the secondary leads of CTs to carry out current and phase angle measurement tests.

12.7 All CTs shall be earthed through a separate earth link on the terminal block to permit measurement of CT insulation resistance.

12.8 The CT shall have polarity indelibly marked on each CT and associated terminal block.

13.0 VOLTAGE TRANSFORMERS:

13.1 Each panel shall be provided with metering and protection voltage transformers (VTs) as shown in the single line diagrams.

13.2 The VT parameters are given in the single line diagrams and Data Sheets. The bidder shall ensure that the specified ratings are adequate for the relays and meters furnished by him. If specified ratings are not adequate, the BIDDER shall offer VTs of required rating.

13.3 The VTs shall be of cast resin type and completely encapsulated.

13.4 The VTs shall be single phase, draw out type.

13.5 Each single pole VT shall be housed in a separate sheet metal compartment.

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

a. 1.5 for 30 seconds in case of effectively earthed system.

b. 1.9 for 8 hours in case of non-effectively earthed system.

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

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

14.0 INDICATING INSTRUMENTS & METERS:

14.1 Instruments and meters shall be supplied as shown in single line diagram/data sheets.

14.2 Electrical indicating instruments shall be of minimum 96mm square size, 240 degree scale deflection with a class of accuracy of 0.5/ 1.0 as applicable, suitable for flush mounting.

14.3 Indicating instruments shall have provision for zero adjustment outside the cover.

14.4 Instrument dials shall be parallax free with black numerals on a white dial.

14.5 Watt-hour metes shall be of the direct reading electrodynamometer type complete with cyclometer type dials and reverse running stops.

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

15.0 INDICATING LAMPS:

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

15.2 Bulbs and lenses shall be easily replaceable from the front.

16.0 CONTROL & SELECTOR SWITCHES:

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

16.2 Control switches shall be: of the spring return to normal type and provided with pistol grip type handles Control switches for circuit breaker control shall be provided with: contact development as specified in bill of material of enclosed drawings.

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

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

17.0 PUSH BUTTONS:

17.1 Push buttons shall be: Of the momentary contact, push to actuate type rated to carry 10A at 240V AC & 1A (inductive breaking) at 220V DC Fitted with self reset, 2 NO and 2 NC contacts provided with integral escutcheon plates marked with its function.

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

17.3 'Stop' push buttons shall be red in colour.

17.4 All other push buttons shall be black in colour.

18.0 PROTECTION RELAYS:

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

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

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

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

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

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

18.7 Auxiliary relays for multiplying equipment status/ position contacts shall be of Areva make type VAJC or equivalent bi stable relay and shall not be either contactor type or mono stable relay.

19.0 EARTHING:

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

19.2 The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current for the duration as specified in Data Sheet-A, without exceeding maximum allowable temperature rise.

19.3 Suitable clamp type terminals at each end of the earth bus shall be provided to suit the size of the PURCHASER's earthing conductor.

19.4 All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus.

19.5 Bolted joints, splices, taps etc. to the earth bus shall be made with at least two bolts.

19.6 Hinged doors shall be earthed through flexible earthing tinned Cu braid of suitable size.

19.7 Positive earthing of circuit breaker frame shall be maintained when it is in the connected position and in all other positions whilst the auxiliary circuits are not totally disconnected.

19.8 The circuit breaker frame contacts/ control circuit contacts are plugged in the associated stationary contacts.

19.9 Circuit/ Busbar Earthing Facility

19.9.1 It shall be possible to connect each circuit or set of 3 phase busbars of the switchgear to earth either through earthing switches or through truck mounted earthing devices (in the Incomer/ Bus PT panel with suitable arrangement to earth only the dead bus).

19.9.2 Integral earthing switches shall be mechanically interlocked with the associated breaker / isolator to prevent earthing of live circuit of busbars.

20.0 CUBICLE ACCESSORIES AND WIRING:

Cubicle accessories and wiring shall include following:

20.1 Inter-cubicle wiring between cubicles of same switchgear shall be carried out by the VENDOR. Separate schematics, internal and inter-cubicle wiring diagrams and external cable connection diagrams for each cubicle shall be furnished by the VENDOR. The external connection drawings shall indicate all external connections to be made by the PURCHASER to the respective cubicles from the PURCHASER'S remote equipment. Necessary data for remote connections will be furnished by the PURCHASER to the VENDOR.

20.2 It shall be the responsibility of the VENDOR to select motor protection relays whose characteristics shall match with motor characteristics for the motor feeders.

20.3 One common two pole miniature circuit breaker of adequate rating for controlling DC supplies to tripping and closing circuits of breaker.

20.4 10% spare terminals of each size in each Terminal blocks in addition to those used to complete internal wiring and inter-cubicle wiring shall be made available for purchaser's use.

20.5 All accessories such as Local / Remote selector switch, breaker control switch with indicating lamps, 'Tests' and 'Services' position limit switches with position indicating lamps etc. as per attached specifications and drawings shall be included in the VENDOR'S scope of supply.

20.6 Inter-cubicle looping of control and cubicle space heating supplies for all the panels of switchgear shall be carried out by the VENDOR.

20.7 Terminals suitable to receive cables for motor space heater shall be provided in each cubicle by the VENDOR for the motor feeders.

20.8 Segregation of auxiliary and control terminals for AC & DC shall be followed in all locations.

20.9 Wiring inside the switchgear shall be carried out with 1100/650 V grade, FRLS PVC insulated, stranded conductor wires. Control circuits shall be wired with copper conductor of at least 2.5 Sq.mm for CT circuits and 1.5 sq.mm for VT and other circuits, the number and size of strands shall be 7 of 0.67 mm and 0.5 mm diameter respectively.

21.0 CABLE BOXES & GLANDS:

21.1 Cables boxes/ pot heads and glands shall be provided in the switchgear.

21.2 Cable boxes/ pot heads for power cables shall be suitable for stranded aluminium conductor, cross linked polyethylene insulated cables, as specified in Section-C and / or Data Sheet-A.

21.3 Cable terminating boxes shall be supplied complete with all accessories (excluding heat shrinkable sleeves and kits) required for terminating PURCHASER's cables should be furnished by the VENDOR.

21.4 The accessories shall include but not be limited to armour clamps, brass glands, pig tails etc.

21.5 Connecting leads of adequate size with terminal clamps for connecting cable box terminal to switchgear equipment terminals shall be included.

21.6 Cable box shall withstand the short circuit rating of the switchgear.

21.7 Necessary number of cable glands shall be provided for terminating auxiliary power and control supply cables.

21.8 Glands shall be of heavy-duty brass castings, machine finished and complete with check nut, washers, neoprene compression ring etc.

22.0 MISCELLANEOUS ACCESSORIES:

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

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

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

a. One complete pole of the breaker.
b. Closing coil.
c. Tripping coil.
d. Spring charging motors along with closing and tripping springs.
e. Set of gaskets.
f. Busbar support insulators.
g. Auxiliary switch assemblies.
h. Operating mechanism rods.
i. Limit position switches.
j. Local/remote selector switches
k. Breaker control switches.
l. Bus seal –off bushings.
m. Various types of relays.

n. Indicating lamps.

o. Cable boxes/ pot heads of different types.

p. Fixed and moving plug contact assemblies.

q. Different types of CTs & PTs.

r. Main Fixed and moving contact assemblies for breakers.

23.0 TESTS AND TEST REPORTS:

23.1 The VENDOR shall completely assemble, with all the associated equipment including bought out items mounted and wired and test each cubicle as per relevant standards specified in Data Sheet-A. All type and routine tests shall be carried out as per this standard. Type test reports for short circuit and temperature rise shall be submitted along with the bid.

23.2 Type tests and routine tests shall be carried out on all associated equipment as per relevant standards specified in Data Sheet-A.

23.3 Copies of the test certificates shall be submitted for the PURCHASER'S approval before despatch of the switchgear. The switchgear shall not be despatched unless the test certificates are approved. Bound copies of complete test results as specified in the distribution schedule shall be furnished with the switchgear. These shall include complete reports and results of the routine tests as also certified copies of type tests carried out on equipment of identical design.

23.4 Oscillographic test records for closing and tripping timings of the breakers shall also be furnished.

24.0 DRAWINGS AND DATA:

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

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

b. Typical and recommended schematic diagrams for control and supervision of circuit breakers.

c. Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for all cables entry etc.

d. Type test certificates along with oscillograms for breakers of identical ratings.

DATA SHEET - A1									
Sl. No.		Description				Unit	Data		
1.0 SWITCHGEAR CUBICLES AND BUS BARS RATING	1.1	Rated Voltage/ Phases/ Frequency				kV/ No./ Hz	11kV / 3Ph / 50Hz		
	1.2	System Neutral Earthing	Effectively earthed				Yes		
			Non-Effectively Earthed.				NA		
	1.3	Maximum System Voltage.				kV	12		
	1.4	One minute power frequency withstand voltage				kV (rms)	28		
	1.5	1.2/50 µSec impulse withstand voltage				kVp	75		
	1.6	Short circuit withstand at rated voltage	Current			kA	18.14		
			Time			s	3		
	1.7	Dynamic rating				kAp	45.35		
	1.8	Reference ambient temperature.				^{O}C	45		
	1.9	Continuous current rating of busbars under site reference ambient temp.				A	1250		
	1.1	Maximum temperature of (final) busbars, droppers, connectors & contacts at continuous current rating under site reference ambient temperature.				^{O}C	85		
	1.11	Maximum temperature final of Cable termination Point				^{O}C	85		
	1.12	Applicable standards					As per Data Sheet A2		
2.0 SWITCHGEAR PARTICULARS		Designation	Busbars		Cable/Busduct Entry Top / Bottom (T/B)		Total no. of CB~~/ SFU~~ cubicles on Switch board	No of Bus PT	No of Line PT
			A	Cu / Al	Power	Control			
	2.1	11kV Switchgear (Extension Panel-LHS)	1250	Cu (To be extended from existing 11kV switchgear)	B (Cable)	B	2/0 (AERO Science +SS-14)	NA	NA
	2.2	11kV Switchgear (Extension Panel-RHS)	1250	Cu (To be extended from existing 11kV switchgear)	T (Bus--duct)	B	2/0 (NVH + NANO Science)	NA	NA
					B (Cable)				

DATA SHEET - A1				
Sl. No.		Description	Unit	Data
3.0 BILL OF QUANTITIES		By Bidder as per enclosed Single Line Diagram		
4.0 CONSTRUCTIONAL REQUIREMENT	4.1	Thickness of sheet steel enclosure, doors & covers	Cold Rolled / Hot Rolled	Cold Rolled
			Thickness	2.5mm
	4.2	Degree of enclosure protection		IP 4X
	4.3	Form of internal Separation		Form 4b
	4.4	Colour finish shade.	Interior	Glossy White
			Exterior	RAL 7032
	4.5	Earth bus.	Material	Cu
			Size	50 x 6 (To be extended from existing 11kV switchgear)
	4.6	Purchaser's Earthing conductor	Material	GS
			Size	50 x 10
	4.7	Bus duct/ bus trunking connections required	Yes/No	Yes
	4.8	Clearances in air of live part	Phase to phase	120
			Phase to Earth	120
	4.9	Bus bar insulation		Fully Insulated
5.0 BREAKER PARTICULARS	5.1	Circuit breaker type		VCB
	5.2	Voltage frequency & no of phase.		11kV / 50Hz / 3 Ph
	5.3	Rated operating duty.		0-0.3sec-CO-3min-CO
	5.4	Rated current at site reference ambient temperature	A	630
	5.5	Rated breaking capacity	MVA	-
			kA (rms)	18.14
	5.6	Rated making current	kA (Peak)	45.35
	5.7	Short time current withstand	kA (rms)	18.14
			Sec	3
	5.8	Asymmetrical breaking current	AC Component kA (rms)	18.14
			DC Component %	≥ 40

DATA SHEET - A1				
Sl. No.		Description	Unit	Data
5.0 BREAKER PARTICULARS	5.9	Total break time	ms	3 cycles (60 ms)
	5.10	Total make time	ms	4 cycles (80 ms)
	5.11	Trip free operating mechanism.		Yes
	5.12	Minimum no of auxiliary contacts		6 NO + 6NC
	5.13	Minimum No. of contacts in each position switch		Test Position: 3NO + 1 NC
				Service Posn. 3 NO + 1 NC
	5.14	Withstand test voltage		
	a)	One minute power frequency	kV (rms)	28
	b)	Impulse (1-2/50µSec wave)	kV(peak)	75
	5.15	Auxiliary control voltage		
	a)	For closing/ tripping coil	V AC/DC	110V DC
	b)	For spring charging motor	V AC/DC	240V AC
	c)	For space heaters and lighting	V AC	240V AC
	5.15	Breaker application		
	a)	Transformer control	Yes/ No	Yes
	b)	Motor control	Yes/ No	No
	c)	Capacitor control	Yes/ No	No
	5.16	Breaker Auxiliaries required		
	a)	Operation counter	Yes/ No	Yes
	b)	Mechanical position indicator	Yes/ No	Yes
	c)	Mechanical close & trip push button	Yes/ No	Yes
	5.17	Breaker Classification for electrical endurance as per IEC 62271-100	E1 / E2	E2
	5.18	Breaker classification - mechanical operations as per IEC 62271-100	M1/ M2	M2
	5.19	Breaker classification for Capacitor Switching as per IEC 62271-100	C1/ C2	NA
6.0 SWITCH FUSE UNITS	6.1	Switch Type		NA
	6.2	Motor operated	Yes/ No	
	6.3	Voltage Frequency & No of phases		
	6.4	Rated Current at site reference Ambient temperature	A	
TCH FUSE	6.5	Rated Breaking Current	kA (rms)	NA

DATA SHEET - A1				
Sl. No.		Description	Unit	Data
	6.6	Rated Making Current	kA (Peak)	
	6.7	Short Time withstand Current/Duration	kA (rms)	
		Duration	S	
	6.8	Trip free operating mechanism	Yes/ No	
	6.9	Minimum No of Auxiliary contacts		
	6.1	One Minute power frequency with stand voltage	kV	
	6.11	1.2/50μs Impulse withstand Voltage	kVp	
	6.12	Auxiliary Control Voltage		
	a)	Switch operating Motor	V AC/ DC	
	b)	Indicating Lamps	VAC/DC	
	6.13	Switch Application		
	a)	Transformer Control	Yes/ No	
	b)	Motor Control	Yes/ No	
	c)	Capacitor Control	Yes/ No	
	6.14	Type of HV Protection		
	6.15	Type of HRC Fuse		
	6.16	HRC Fuse Rating		
	6.17	Tripping Details		
	a)	Type		
	b)	Shunt Trip	Yes/ No	
	c)	Voltage of Shunt Trip	V DC	
7.0 HV CONTACTORS	7.1	Type		NA
	7.2	Rated Voltage, No of phases & frequency		
	7.3	Contractor Application		
	a)	Motor Control	Yes/ No	
	b)	Capacitor Control	Yes/ No	
	7.4	Rated Current at site reference Ambient Temperature	A	
	7.5	Rated Operating Duty		
	7.6	On/ Off Operation	Auto/ Manual	

DATA SHEET - A1				
Sl. No.		Description	Unit	Data
	7.7	Control Voltage		
	a)	Coil Voltage	V AC/DC	
	7.8	No of Auxiliary Contacts		
8.0 CTs	8.1	Type		Cast Epoxy Resin
	8.2	System voltage & frequency		11kV & 50Hz
	8.3	Class of insulation		Class B or better
	8.4	Rated primary current & ratio ref. Dwg. Nos.		Refer Corresponding SLD
	8.5	Accuracy class & burden		Refer Corresponding SLD
	8.6	Short time 1s Current rating & dynamic rating		18.14kA and 45.35kA
9.0 VOLTAGE TRANSFORMERS	9.1	Type		NA
	9.2	Rated Voltage		
	9.3	Method of connection		
	9.4	Rated voltage factor		
	9.5	Class of insulation		
	9.6	Accuracy class & burden		
10.0 H.V. FUSES	10.1	Rated current		NA
	10.2	Voltage class		
	10.3	Symmetrical interrupting Current		
11.0 METER	11.1	Accuracy class		Refer SLD
	a)	Indicating meters		
	b)	Energy meters		
	c)	Multifunction meters		
12.0 MIMIC DIAGRAM	12.1	Mimic Diagram required	Yes/ No	Yes
	12.2	Colour of mimic	kV	As per IS
13.0 WIRING DETAILS	13.1	Material of conductor	Stranded Cu/Al	Stranded Cu
	13.2	Size of wires		
	a)	CT circuits	Sq. mm	2.5
	b)	PT circuits	Sq. mm	NA
	c)	Auxiliary circuits	Sq. mm	2.5

DATA SHEET - A1				
Sl. No.		Description	Unit	Data
	13.3	Voltage grade		1100 Volts
	13.4	Type of insulation		FRLS PVC
	13.5	Terminal block details		Screw Type Finger Touch Proof
14.NOTES		14.1 All indicating instruments and meters shall be supplied as shown in single line diagram. 14.2 Protection relays shall be microprocessor based numerical relays as shown in single line diagram		

DATA SHEET–A2			
APPLICABLE STANDARDS			
Sl. No.	Description	Standards	
1.	Circuit breakers	IS 13188	IEC 62271-100
2.	Switches & switch Isolators	IS 9920	IEC 60265
3.	HV Fuses	IS 9385	
4.	Degree of Protection	IS 3427	IEC 60144
5.	Insulators	IS 2514	IEC 168
6.	Bushings	IS 2099 IS 10314, 5621	IEC 60137
7.	Current transformers	IS 2705	IEC 44
8.	Potential transformers	IS 3156	IEC 60186
9.	Meters	IS 722, IS 13010 IS 13779, IS 11448 IS 8530	
10.	Clamps & connectors	IS 5561	IEC 305
11.	Hot dip galvanising	IS 2629 IS 2633	
12.	High Voltage Switchgear and Control gear Assemblies.		IEC 62271-202

NOTES:

1. Equipment, associated accessories, component/parts raw material and tests shall in general conform to IS & IEC

DATA SHEET - B
(to be filled by the BIDDER and enclosed with the BID)

Sl. No.		Description		Unit	Bidder's Data
1.0. SWITCHGEAR CUBICLES AND BUS BARS RATING	1.1	Rated Voltage , Phase & Frequency		kV & Hz	
	1.2	System Neutral Earthing	Effectively earthed		
			Non Effectively Earthed.		
	1.3	Maximum System Voltage.		Kv	
	1.4	One minute power frequency withstand voltage		kV (rms)	
	1.5	1.2/50μ Sec impulse withstand voltage		kVp	
	1.6	Short circuit withstand at rated voltage	Current	kA	
			Time	Sec	
	1.7	Dynamic rating		kAp	
	1.8	Reference ambient temperature.		^{o}C	
	1.9	Continuous current rating of busbars under site reference ambient temp.			
	1.10	Maximum temperature of (final) busbars, droppers, connectors & contacts at continuous current rating under site reference ambient temperature.		^{o}C	
	1.11	Maximum temperature final of Cable termination Point		^{o}C	
	1.12	Applicable standards			

2.0 SWITCHGEAR PARTICULARS		Designation	Bus Bars		Cable Entry Top / Bottom (T/B)		Total no. of CB cubicles per Switch board	No of Bus PT	No of Line PT
			Amps	CU/ AL	Power	Control			
	2.1								
	2.2								
	2.3								
	2.4								
	2.5								
	2.6								
	2.7								
	2.8								
	2.9								
	2.10								

DATA SHEET - B
(to be filled by the BIDDER and enclosed with the BID)

Sl. No.		Description	Unit	Bidder's Data
3.0 BILL OF QUANTITIES		Bill of Quantities enclosed with the bid	YES/NO	
4.0 CONSTRUCTIONAL REQUIREMENT	4.1	Thickness of sheet steel enclosure, doors & covers	Cold Rolled/ Hot Rolled	
			Thickness	
	4.2	Degree of protection		
	4.3	Form of internal Separation		
	4.4	Colour finish shade.	Interior	
			Exterior	
	4.5	Earthing bus.	Material	
			Size	
	4.6	Purchaser's Earthing conductor	Material	
			Size	
	4.7	Bus duct/bus trunking connections provided	Yes/No	
	4.8	Clearances in air of live part	Phase to phase	
			Phase to Earth	
	4.9	Bus bar insulation		
5.0 BREAKER PARTICULARS	5.1	Circuit breaker type		
	5.2	Voltage frequency & no of phase.		
	5.3	Rated operating duty.		
	5.4	Rated current at site reference ambient temperature	AMPS	
	5.5	Rated breaking capacity	MVA	
			kA (rms)	
	5.6	Rated making current	kA (Peak)	
	5.7	Short time current withstand	kA (rms)	
			Sec	
	5.8	Asymmetrical breaking current	AC Component kA (rms)	
			DC Component %	
	5.9	Total break time	Milli second	
	5.10	Total make time	Milli second	

DATA SHEET - B
(to be filled by the BIDDER and enclosed with the BID)

Sl. No.		Description	Unit	Bidder's Data
5.0 BREAKER PARTICULARS	5.11	Switching over voltages	Per unit (peak)	
	a)	Maximum switching over voltage when switching off the breaker under any load condition	YES/NO	
	b)	Surge arresters provided to limit switching over voltages		
	5.12	Trip free operating mechanism.		
	5.13	Minimum no of auxiliary contacts		
	5.14	Withstand test voltage		
	a)	One minute power frequency	kV (rms)	
	b)	Impusle (1.2 x 50µs wave)	kV (peak)	
	5.15	Auxiliary control voltage	VOLTS AC/DC	
	a)	For closing / tripping coil		
	b)	For sprig charging motor		
	c)	For space heaters and lighting		
	5.16	Breaker application		
	a)	Transformer control		
	b)	Motor control		
	c)	Capacitor control		
	5.17	Breaker Auxiliaries provided		
	a)	Operation counter	YES/NO	
	b)	Mechanical position indicator	YES/NO	
	c)	Mechanical close & trip push button	YES/NO	
	5.18	Breaker Classification for electrical endurance as per IEC 62271-100		
	5.19	Number of mechanical operations as per IEC 62271-100		
	5.20	Rated Capacitor Switching Duty as per IEC 62271-100		
6.0 SWITCH FUSES	6.1	Switch Type		
	6.2	Motor operated	YES/NO	
	6.3	Voltage Frequency & No of phases		
	6.4	Rated Current at site reference Ambient temperature	Amps	

DATA SHEET - B
(to be filled by the BIDDER and enclosed with the BID)

Sl. No.		Description	Unit	Bidder's Data
6.0 SWITCH FUSES	6.5	Rated Breaking Capacity	kA	
	6.6	Rated Making Current	kA (Peak)	
	6.7	Short Time Current withstand	kA	
			Sec	
	6.8	Trip free operating mechanism	YES/NO	
	6.9	Minimum No of Auxiliary contacts		
	6.10	One Minute power frequency with stand voltage	kV	
	6.11	1.2/50μs Impulse withstand Voltage	kVp	
	6.12	Auxiliary Control Voltage		
	a)	Switch operating Motor	V(dc)	
	b)	Indicating Lamps	V(dc)	
	6.13	Switch Application		
	a)	Transformer Control		
	b)	Motor Control		
	c)	Capacitor Control		
	6.14	Type of HV Protection		
	6.15	Type of HRC Fuse		
	6.16	HRC Fuse Rating		
	6.17	Tripping Details		
	a)	Type		
	b)	Shunt Trip		
	c)	Voltage of Shunt Trip	V (dc)	
7.0 HV CONTACTORS	7.1	Type		
	7.2	Rated Voltage, No of phases & frequency		
	7.3	Contactor Application		
	a)	Motor Control		
	b)	Capacitor Control		
	7.4	Rated Current at site reference Ambient Temperature	A	
	7.5	Rated Operating Duty		
	7.6	On/ Off Operation	Auto	
			Manual	
	7.7	Control Voltage		
	a)	Coil Voltage	V (AC/DC)	

DATA SHEET - B
(to be filled by the BIDDER and enclosed with the BID)

Sl. No.		Description	Unit	Bidder's Data
	7.8	No of Auxiliary Contacts		
8.0 CURRENT TRANSFORMERS	8.1	Type		
	8.2	System voltage & frequency		
	8.3	Class of insulation		
	8.4	Rated primary current & ration ref. Dwg. Nos.		
	8.5	Accuracy class & burden		
	8.6	Short time 1 sec. Current rating & dynamic rating		
9.0 VOLTAGE TRANSFORMERS	9.1	TYPE		
	9.2	Rated Voltage		
	9.3	Method of connection		
	9.4	Rated voltage factor		
	9.5	Class of insulation		
	9.6	PF Withstand test voltage		
	9.7	Accuracy class & burden		
10.0 H.V. FUSES	10.1	Rated current		
	10.2	Voltage class		
	10.3	Symmetrical interrupting rating		
11.0 METER	11.1	Accuracy class		
	a)	Indicating meters		
	b)	Energy meters		
	c)	Multifunction meters		
12.0 MIMIC DIAGRAM	12.1	Mimic Diagram required	YES/NO	
	12.2	Colour of mimic	kV	
			kV	
13.0 WIRING DETAILS	13.1	Material of conductor		
	13.2	Size of wires		
	a)	CT circuits	Sq. mm	
	b)	PT circuits	Sq. mm	
	c)	Auxiliary circuits	Sq. mm	

DATA SHEET - B
(to be filled by the BIDDER and enclosed with the BID)

Sl. No.		Description	Unit	Bidder's Data
	7.8	No of Auxiliary Contacts		
8.0 CURRENT TRANSFORMERS	8.1	Type		
	8.2	System voltage & frequency		
	8.3	Class of insulation		
	8.4	Rated primary current & ration ref. Dwg. Nos.		
	8.5	Accuracy class & burden		
	8.6	Short time 1 sec. Current rating & dynamic rating		
9.0 VOLTAGE TRANSFORMERS	9.1	TYPE		
	9.2	Rated Voltage		
	9.3	Method of connection		
	9.4	Rated voltage factor		
	9.5	Class of insulation		
	9.6	PF Withstand test voltage		
	9.7	Accuracy class & burden		
10.0 H.V. FUSES	10.1	Rated current		
	10.2	Voltage class		
	10.3	Symmetrical interrupting rating		
11.0 METER	11.1	Accuracy class		
	a)	Indicating meters		
	b)	Energy meters		
	c)	Multifunction meters		
12.0 MIMIC DIAGRAM	12.1	Mimic Diagram required	YES/NO	
	12.2	Colour of mimic	kV	
			kV	
13.0 WIRING DETAILS	13.1	Material of conductor		
	13.2	Size of wires		
	a)	CT circuits	Sq. mm	
	b)	PT circuits	Sq. mm	
	c)	Auxiliary circuits	Sq. mm	

DATA SHEET - C

(to be filled in by the BIDDER and Submitted after award of contract)

Sl. No.		Description	Unit	Bidder's Data
1.0 CIRCUIT BREAKER DESIGN	1.1	Type		
	1.2	Live tank / dead tank design		
	1.3	Number of breaks per phase		
	1.4	Minimum clearances	mm	
	a)	Between poles	mm	
	b)	In air between live parts and earth	mm	
	c)	In vacuum between live parts	mm	
	1.5	Switching over voltages generated by the circuit breaker		
	a)	Switching off to running at no load	P.U. (Peak line to earth)	
	b)	Switching off motor with its rotor locked	P.U. (Peak line to earth)	
	c)	Switching off unloaded transformer (Ratings of motors and transformers as per "Auxiliary One Line Diagram"	P.U. (Peak line to earth)	
	1.6	Main contact		
		Type		
	a)	Material		
	b)	Silver facing provided	Yes/No	
	c)	Thickness of the facing	mm	
	d)	Design contact pressure	Kg/mm2	
	1.7	Arcing contacts		
	a)	Type		
	b)	Material		
	c)	Silver pacing provided	Yes /no	
	d)	Thickness of the facing	Micron	
	e)	Design contact pressure	Kg/mm2	
	1.8 a)	Length of contact travel	mm	
	b)	Total length of break per pole	mm	
	c)	Rate of contact travel at tripping	Mts/sec	
	d)	Rate of contact travel at closing	Mts/sec	
	1.9	Method of closing during power supply failure		

DATA SHEET - C
(to be filled in by the BIDDER and Submitted after award of contract)

Sl. No.		Description	Unit	Bidder's Data
	1.10	Closing coil consumption at rated voltage	Watts	
	1.11	Trip coil consumption at rated voltage	Watts	
2.0 VACUUM BOTTLES	2.1	Pressure inside the interrupter	mm Hg	
	2.2	Contact wear indication provided	Yes/No	
	2.3	Max gap between the contacts in vacuum in open condition	mm	
	2.4	Area of contact	mm^2	
	2.5	Adequate shielding against X-ray radiation provided	Yes/No	
	2.6	Type designation & Make of the Vacuum bottle used		
3.0 SF6 BREAKERS	3.1	Pressure of SF6 gas	Bar	
	3.2	Type of operating mechanism pneumatic/spring/hydraulic charged		
	3.3	If pneumatic, air pressure		
	3.4	Capacity of the local air receiver	Bar	
	3.5	Whether monitor for SF6 gas provided		
	3.6	Leakage of SF6 gas	m^3	
4.0 CLOSING MECHANISM	4.1	Type of closing mechanism		
	4.2	Spring charging motor		
	a)	Rated voltage	Volts	
	b)	Rating	Watts	
	c)	Speed	RPM	
	d)	Class of insulation		
	4.3	Satisfactory operation of spring charging motor between 80 to 100% of rated voltage		
	4.4	Time required to charge the spring from fully discharged condition	Sec	
	4.5	Overload and short circuit protection details		
	4.6	Is provision made for immediate charging of closing spring after a closure	Yes/No	
	4.7	Adequate spring reserve for one O-C-O operation without intentional time delay	Yes/No	
	4.8	Mechanical indication for spring charged/discharged condition provided	Yes/No	

DATA SHEET - C (to be filled in by the BIDDER and Submitted after award of contract)				
Sl. No.		Description	Unit	Bidder's Data
	4.9	Whether slow closing/opening is feasible for maintenance/testing	Yes/No	

DATA SHEET-A1				
COMPACT SUBSTATION				
SL #		Technical Particulars	UNIT	VALUE
1.0 CSS-SYSTEM DATA	1.1	Scope		
		a) Number of Compact Substation	Nos.	2 (Chemical Science CSS & E Type Quarters CSS)
		b) Configurattion of CSS		Compact Ring Main Unit, Oil filled Hermitically Sealed Transformer and MV Switchgear
		c) Details of CSS		As per enclosed SLD
2.0 CSS CONSTRUCTION	2.1	Type		Non Walk-in Type Compact Substation
	2.2	Service location	Indoor / outdoor	Outdoor
	2.3	Enclosure Protection		IP 54
	2.4	Doors		Each compartment shall be provided with the door and pad locking arrangement.
	2.5	Sheet metal		3.0 mm thick CRCA
	2.6	Lifting lugs		Four members
	2.7	Cable entry	Top / Bottom	Bottom
	2.8	Earth bus bar	Material	GS
			size	50 x 10mm
	2.9	Earth bus external connection	Material	GS
			size	50x 10mm
	2.10	Painting external finish		Light Grey /Dark Grey combination
	2.11	Painting internal finish		Glossy white finish shade
3.0 EARTHI NG	3.1	Earth pit		
		a) Type		Pipe electrode as per IS 3043
		b) Number		As required to achieve less than one ohm earth

DATA SHEET-A1				
COMPACT SUBSTATION				
SL #		Technical Particulars	UNIT	VALUE
				resistance for CSS
	3.2	Earth grid		
		a) Requirement		To interconnect earth pits
		b) Earthing conductor Layout		Buried 600mm below finished grade level
		c) Conductor material		GS flat strip
		d) Conductor size		Suitable to carry the specified fault current for one second calculated as per IS 3043

DATA SHEET - B				
COMPACT SUBSTATION				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		Technical Particulars	UNIT	VALUE
1.0. CSS-SYSTEM DATA	1.1	Make		
	1.2	Scope		
		a) Number of Compact Substation	Nos.	
		b) Configurattion of CSS		
		c) Details of CSS		
2.0 CSS CONSTRUCTION	2.1	Type		
	2.2	Service location	Indoor / outdoor	
	2.3	Enclosure Protection		
	2.4	Doors		
	2.5	Sheet metal		
	2.6	Lifting lugs		
	2.7	Cable entry	Top / Bottom	
	2.8	Earth bus bar	Material	
			size	
	2.9	Earth bus external connection	Material	
			size	
	2.10	Painting external finish		
	2.11	Painting internal finish		
3.0 EARTHING	3.1	Earth pit		
		a) Type		
		b) Number		
	3.2	Earth grid		
		a) Requirement		
		b) Earthing conductor Layout		
		c) Conductor material		
		d) Conductor size		

DATA SHEET-A1					
HV RING MAIN UNIT					
SL #		Technical Particulars		UNIT	VALUE
1.0 RING MAIN UNIT-SYSTEM DATA	1.1	Scope			
		a) Number of RMU station		Nos.	2 (Chemical Science CSS & E Type Quarters CSS)
		b) Number of ways (modules) in each RMU			VVVM (V- Vaccum Circuit Breaker, M- Metering Module)
		c) Details of RMU stations			As per enclosed SLD
	1.2	Rated System Voltage & Phases		kV (rms)	11kV, 3 Ph
	1.3	Highest System Voltage		kV (rms)	12
	1.4	Rated Frequency		Hz	50
	1.5	System Neutral			Effectively Earthed
	1.6	Rated power frequency withstand voltage (1 min)		kV (rms)	28
	1.7	Impulse withstand BIL (1.2/50/μ sec) Line to earth		kVp	±75
	1.8	Short circuit withstand capacity		Current (kA) rms	20
				Duration (sec)	3
	1.9	Short circuit making capacity		kAp	50
	1.10	Short circuit breaking capacity		kA (rms)	20
	1.11	Reference ambient temperature		°C	45
	1.12	Maximum temperature at continuous current rating and under site referance ambient a) Bus bar connectors and contacts b) Cable termination point		 °C °C	 85 85
2.0 RMU CONSTRUCTION	2.1	Type			Metal enclosed, compartmentalized, free standing construction
	2.2	Service location		Indoor / outdoor	Outdoor
2.0 RMU CONSTRUCTION	2.3	Enclosure Protection	Main Tank		IP 67
			Outer enclosure		IP 54
	2.4	Doors			--

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
	2.5	Covers		--
	2.6	Sheet metal		3.0 mm thick CRCA
	2.7	Base frame		Frame shall be covered from all four sides by MS plate/sheet. Painting should match with RMU shade.
	2.8	Lifting lugs		Four members
	2.9	Cable entry	Top / Bottom	Bottom
	2.10	Cable type and Size		Aluminium conductor XLPE insulated, armoured & PVC outer sheath. The size of cable shall be as shown in SLD.
	2.11	Cable termination		
	2.11.1	Terminals for cable terminations		Suitable for ring type Bimetalic lug
	2.11.2	Termination type		Heat shrinkable type
	2.11.3	Terminations height		Min height from gland plate shall be 900mm
	2.12	Bus bars		Tinned copper
	a) Continous rated current		Amps	630
	b) Short time current withstand capacity		KA(rms}	20
			sec	3
	c) Bus bar insulation			Fully insulated
	d) Maximum temperature rise above ambient			As per table no. 3 of IEC 60694
2.0 RMU CONSTRUCTION	2.13	Earth bus bar	Material	GS
			size	50 x 10mm
	2.14	Earth bus external connection	Material	GS
			size	50x 10mm
	2.15	Earth bus internal connection to all non current carrying metal parts		By 2.5 sq mm copper flexible wire
	2.16	Cooling arrangement		By natural air without fan
	2.17	Clearance in air of live parts		
		a) Phase to phase	mm	120
		b) Phase to earth	mm	120

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
	2.18	Mimic diagram		On panel front with colour code as per IS 11954
	2.19	Control Wiring details		
		a) Material of conductor		Stranded copper
		b) Size of wires		Minimum 2.5 sq mm
		c) Voltage Grade	V	1100
		d) Type of insulation		FRLS PVC
	2.20	Labels for meters & indicators		Anodized aluminium with white character on black background
	2.21	Danger plate on front & rear side		Anodized aluminium with white letters on red background
	2.22	Painting surface preparation		Shot blasting or chemical 7 tank process
	2.23	Painting external finish		Powder coated, shade – RAL 7032, uniform thickness 60 micron minimum
	2.24	Painting internal finish		Powder coated, shade – white, uniform thickness 60 micron
3.0 LBS MODULE	3.1	Type		NA
	3.2	Arc interruption medium		
	3.3	Operating mechanism for close and open		
	3.4	Rated current at specified site ambient temperature		
	3.5	a)Rated breaking capacity b)Rated making capacity		
	3.6	Short time current withstand		
	3.7	Auxiliary power supply for motor, local control, local indication		
	3.8	Accessories required		
3.0 LBS MODULE		a) Loacal / remote selector switch with 2 NO +2NC contact in each position		
		b) Control switch / push button for local operation		
		c) Local position indicators for disconnectors and earth switch		
		d) Mano meter for SF6 tank		
		e) Operation counter		
	3.9	Auxiliary switches and signal contacts required for remote indication and alarm wired to terminal block		NA
		a) Disconnector position		
		b) Earth switch position		
		c) SF6 low pressure		

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
4.0 CIRCUIT BREAKER MODULE	4.1	Type		Three pole operated simultaneously with three position disconnector and earth switch down stream of circuit breaker
	4.2	Arc interruption medium		Vaccum
	4.3	Rated operating duty		0-0.3sec-CO-3min-CO
	4.4	Operating mechanism		Motor & manual spring charged stored energy type
	4.5	Rated current at specified site ambient temperature	Amps	630
	4.6	Rated breaking capacity	kA (rms)	20
	4.7	Rated making capacity	kA (peak)	50
4.0 CIRCUIT BREAKER MODULE	4.8	Short time current withstand	kA(rms)	20
			Sec	3
	4.9	DC Component	%	40
	4.10	Total break time	ms	<80
	4.11	Total make time	ms	<80
	4.12	Auxiliary control voltage		
		a) Operating motor		Internal Power Pack
		b) Close and shunt trip coil		
		c) Space heater and lighting		
	4.13	Breaker classification as per IEC 62271-100		
		a) Electrical endurance	E1/E2	E2
		b) Mechanical endurance	M1/M2	M2
	4.14	Accessories required		
		a) Operation counter	Yes/No	Yes with minimum four digits & non resettable
		b) Local / remote selector switch with 2NO+2NC contacts	Yes/No	Yes
		c) Local position indicators for circuit breakers, disconnector and earth switch	Yes/No	Yes
		d) Spring charged indication	Yes/No	Yes
		e) Manometer for SF6 tank pressure	Yes/No	Yes
		f) Emergency trip push button	Yes/No	Yes
	4.15	Auxiliary switches and signal contacts for remote indication and alarm wired to terminal block		

DATA SHEET-A1					
HV RING MAIN UNIT					
SL #		Technical Particulars	UNIT	VALUE	
		a) Circuit breaker position	Nos.	4NO+4NC	
		b) Disconnector position	Nos.	4NO+4NC	
		c) Earth switch position		2NO+2NC	
		d) Circuit breaker tripped		2NO	
		e) SF6 low pressure		2NC	
5.0 EARTH SWITCH	5.1	Type		Three pole, operated simultaneously by a common shaft, for each circuit breaker	
	5.2	Switching in dielectric medium		SF6 gas	
	5.3	Operating mechanism		Manual	
	5.4	Fault making capacity	kAp	50	
	5.5	Auxiliary contacts		2NO+2NC	
	5.6	Minimum number of operations at no load (as per IEC 62271-102)		Mechanical endurance – class MI (1000 operations)	
	5.7	Making capacity endurance of earth switch (as per IEC 62271-102)		Class E2	
6.0 ACCESSORY EQUIPMENT	6.1	Capacitor voltage indicating system			
		a) Application		In CB modules as shown in Single line diagram (SLD)	
		b) Complete with integrated indicating lamps for R,Y,B phases		Required	
	6.2	Protection and metering current transformer			
		a) Application		As shown in SLD	
		b) Parameters		Protection CT	Metering CT
		i. Ratio		As shown in SLD	As shown in SLD
		ii. Accuracy class		5P10	0.5
		iii. VA burden	VA	By bidder Min 5	5
	6.3	Voltage transformer			
		a) Application		As shown in SLD	
		b) Parameters			
		i. Ratio		11kV/√3 / 110/√3/ 110/3 Volt	
		ii. Methods of connection		Star / Star/ Open Delta	
		iii. Accuracy class		As shown in SLD	
	6.4	Protection relay			

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
		a) Type		Self powered or conventional type, numerical relays as shown in SLD
		b) Relay elements required		As shown in SLD
		c) RS 485 port connection	Yes / No	Yes
	6.5	Fault passage indicator (short circuit & earth fault indicator)		
		a) Application		As shown in SLD
		b) Features required		
		i. Local and remote indication for FPI operated	Yes / No	Yes
		ii. Reset of FPI local and remote	Yes / No	Yes
	6.6	Surge arrester		
		a) Application		As shown in SLD
		b) Type		Gapless, metal oxide
		c) Rated voltage	kV (rms)	11
		d) Nominal discharge current	kA peak	10
7.0. AUXILIARY POWER SUPPLY	7.1	AC power supply		Internal Power Pack
	7.2	DC power supply		
	7.3	Battery		
		a) Type		
		b) capacity	Ah	
	7.4	Battery charger		
8.0 INTERLOCKS	8.1	Load break switch & respective earth switch		NA
	8.2	Circuit breaker & respective earth switch		Mechanical. Only one in close condition at a time.
	8.3	Prevent the removal of respective cable covers if circuit breaker is 'ON'		Electrical / Mechanical
	8.4	Prevent the closure of circuit breaker if respective cable cover is open		Electrical / Mechanical
	8.5	Cable test plug for CB accessible only if earth switch connected to earth		Mechanical
	8.6	For motorized RMUs prevent motorized operation of CB during manual operation		Electrical / Mechanical. Electrical signal shall be cut off during manual operation.
9.0 CO	9.1	Connection for SCADA		All connections for SCADA shall be wired to a seperate

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
				terminal board
	9.2	Potential free contacts for status indication in SCADA from each module as applicable		
		a) Local / remote selector switch		1 NO contact in each position
		b) Load Break switch (LBS)close/open		NA
		c) Circuit breaker (CB) close / open		2NO+2NC
		d) Earth switch close / open		1NO+1NC
	9.3	Potential free contacts for alarm signal to SCADA from each module as applicable		
		a) Circuit breaker tripped		1 NO
		b) Protection relay operated		1 NO
		c) SF6 gas pressure low		1 NO
		d) Fault passage indicator operated		1 NO
		e) Pressure relief device operated		1 NO / NC
		f) Battery charger fail		1 NO
		g) Any other signal recommended by vendor		
	9.4	Commands for operation from SCADA from each module as applicable		
		a) LBS close and open		NA
		b) CB close and open		Yes
		c) Fault passage indicatior reset		Yes
	9.5	RS 485 port connection from		
		a) Protection relay		Wherever applicable
		b) Multifunction relay		Wherever applicable
10.0 EARTHING	10.1	Earth pit		
		a) Type		--
		b) Number		--
	10.2	Earth grid		
		a) Requirement		--
		b) Earthing conductor Layout		--
		c) Conductor material		--
		d) Conductor size		--

DATA SHEET A2 HV RING MAIN UNIT APPLICABLE STANDARDS			
SL NO.	DESCRIPTION	STANDARDS	
1.	Circuit breakers	IS 13188	IEC 62271-100
2.	High voltage switches	IS 9920	IEC 60265
3.	Isolators	IS 9921	IEC 60129 IEC 62271-102
4.	SF6 Gas for use in electrical equipment		IEC 60376
5.	Degree of protection provided by enclosure	IS 13947	IEC 60947
6.	High voltage switchgear and control gear		IEC 60694
7.	Current transformers	IS 2705	IEC 60185
8.	Voltage transformers	IS 3156	IEC 60186
9.	Surge arresters	IS 3070	IEC 60099
10.	Relays	IS 3231	IEC 60255
11.	Insulators	IS 2544	IEC 60168
12.	Bushings	IS 2099	IEC 60137
13.	Clamps & connectors	IS 5561	IEC 60305
14.	Hot dip galvanising	IS 2629 IS 2633	

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
1.0 RING MAIN UNIT-SYSTEM DATA	1.1	Scope		
		a) Number of RMU stations	Nos.	
		b) Number of ways (modules) in each RMU stations	Nos.	
		c) Deatils of RMU stations	Nos.	
	1.2	Manufacturers Name		
	1.3	Country of manufacturer		
	1.4	Vendor's type designation		
	1.5	Rated system voltage and phases	kV (rms)	
	1.6	Highest System Voltage	kV (rms)	
	1.7	Rated Frequency	Hz	
	1.8	System Neutral		
	1.9	Rated power frequency withstand voltage (1 min)	kV (rms)	
	1.10	Impulse withstand BIL (1.2/50/μ sec) Line to earth	kVp	
	1.11	Short circuit withstand capacity	Current (kA)rms	
			Duration(sec)	
	1.12	Short circuit making capacity	kAp	
	1.13	Short circuit breaking capacity	kA (rms)	
	1.14	Reference ambient temperature	°C	
	1.15	Maximum temperature at continous current rating and under site referance ambient a) Bus bar connectors and contacts b) Cable termination point	 °C °C	
2.0 R M U	2.1	Type		

DATA SHEET-B					
HV RING MAIN UNIT					
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
SL #		TECHNICAL PARTICULARS		UNIT	VALUE
	2.2	Service location		Indoor / outdoor	
	2.3	Enclosure Protection	Main tank		
			Outer Enclosure		
	2.4	Doors			
	2.5	Covers			
	2.6	Sheet metal			
	2.7	Base frame			
	2.8	Lifting lugs			
	2.9	Cable entry		Top / Bottom	
	2.10	Cable type and Size			
	2.11	Cable termination			
	2.11.1	Terminals for cable terminations			
	2.11.2	Termination type			
	2.11.3	Terminations height			
	2.12	Bus bars			
		a) Continous rated current		Amps	
		b) Short time withstand capacity		Current	
				sec	
		c) Bus bar insulation			
		d) Maximum temperature rise above ambient			
	2.13	Earth bus bar		Material	
				size	
	2.14	Earth bus external connection		Material	
				size	
	2.15	Earth bus internal connection to all non current carrying metal parts			
	2.16	Cooling arrangement			
	2.17	Clearance in air of live parts			
		a) Phase to phase		mm	
		b) Phase to earth		mm	
	2.18	Mimic diagram			
	2.19	Wiring details			

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
		a) Material of conductor		
		b) Size of wires		
		c) Voltage Grade	V	
		d) Type of insulation		
	2.20	Labels for meters & indicators		
	2.21	Danger plate on front & rear side		
	2.22	Painting surface preparation		
	2.23	Painting external finish		
	2.24	Painting internal finish		
	2.25	Overall dimension of Each RMU		
		a) Length	mm	
		b) Depth	mm	
		c) Height	mm	
	2.26	Weight of each RMU	Kg	
3.0 LOAD BREAK SWITCH (LBS) MODULE	3.1	Make		
	3.2	Type		
	3.3	Arc interruption medium		
	3.4	Operating mechanism for close and open		
	3.5	Rated current at specified site ambient temperature	A	
	3.6	Rated breaking current	kA (rms)	
	3.7	Rated making capacity	kAp	
	3.8	Short time current withstand	kA (rms}	
			Sec	
	3.9	Auxiliary power supply for motor, local control, local indication		
	3.10	Accessories provided		
		a) Loacal / remote selector switch with 2 NO +2NC contact in each position	Yes / No	
		b) Control switch / push button for local operation	Yes / No	
		c) Local position indicators for disconnectors and earth switch	Yes / No	
		d) Mano meter for SF6 tank	Yes / No	
		e) Operation counter	Yes / No	

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
	3.11	Auxiliary switches and signal contacts provided for remote indication and alarm wired to terminal block		
		a) Disconnector position	Nos.	
		b) Earth switch position	Nos.	
		c) SF6 low pressure	Nos.	
	3.12	Total opening time at rated current	ms	
	3.13	No. of breaks per pole	Nos.	
	3.14	Total length of contact travel	mm	
	3.15	No. of LBS close & open operation cycles guaranteed at		
		a) 25% of rated current		
		b) 50% of rated current		
		c) 75% of rated current		
		d) 100% of rated current		
	3.16	No. of LBS making operations guaranteed at rated fault current electrical endurance class		
	3.17	No. of close & open operations guaranteed at zero current, Mechanical endurance class		
4.0 CIRCUIT BREAKER MODULE	4.1	Make		
	4.2	Vendor's type designation		
	4.3	Type		
	4.4	Arc interruption medium		
	4.5	Rated operating duty		
	4.6	Operating mechanism		
	4.7	Rated current at specified site ambient temperature	Amps	
	4.8	Rated breaking capacity	kA (rms)	
	4.9	Rated making capacity	kA (peak)	
	4.10	Short time current withstand	kA(rms)	
			Sec	
	4.11	DC Component	%	
	4.12	Total break time	ms	
	4.13	Total make time	ms	

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
	4.14	Auxiliary control voltage		
		a) Operating motor		
		b) Close and shunt trip coil		
		c) Space heater and lighting		
	4.15	Breaker classified as per IEC 62271-100		
		a) Electrical endurance	E1/E2	
		b) Mechanical endurance	M1/M2	
	4.16	Accessories provided		
		a) Operation counter	Yes/No	
		b) Local / remote selector switch with 2NO+2NC contacts	Yes/No	
		c) Local position indicators for circuit breakers, disconnector and earth switch	Yes/No	
		d) Spring charged indication	Yes/No	
		e) Manometer for SF6 tank pressure	Yes/No	
4.0 CIRCUIT BREAKER MODULE		f) Emergency trip push button	Yes/No	
	4.17	Auxiliary switches and signal contacts for remote indication and alarm wired to terminal block		
		a) Circuit breaker position	Nos.	
		b) Disconnector position	Nos.	
		c) Earth switch position		
		d) Circuit breaker tripped		
		e) SF6 low pressure		
	4.18	Number of breaks per pole		
	4.19	Total length of contact travel	mm	
	4.20	Nos. of circuit breaker close and open operations guaranteed at:		
		a) 25% of rated current	Nos.	
		b) 50% of rated current	Nos.	
		c) 75% of rated current	Nos.	
		d) 100% of rated current	Nos.	
5.0	5.1	Type		

DATA SHEET-B					
HV RING MAIN UNIT					
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
SL #		TECHNICAL PARTICULARS	UNIT	VALUE	
	5.2	Switching in dielectric medium			
	5.3	Operating mechanism			
	5.4	Fault making capacity	kA		
	5.5	Auxiliary contacts			
	5.6	Minimum number of operations at no load (as per IEC 62271-102)			
	5.7	Making capacity endurance of earth switch (as per IEC 62271-102)			
6.0 ACCESSORY EQUIPMENT	6.1	Capacitor voltage indicating system			
		a) Application			
		b) Complete with integrated indicating lamps for R,Y,B phases			
6.0 ACCESSORY EQUIPMENT	6.2	Protection and metering current transformer			
		a) Application			
		b) Parameters		Protection	Metering CT
		i. Ratio			
		ii. Accuracy class			
		iii. VA burden	VA		
	6.3	Voltage transformer			
		a) Application			
		b) Parameters			
		i. Ratio			
		ii. Methods of connection			
		iii. Accuracy class			
	6.4	Protection relay			
		a) Type			
		b) Relay elements provided			
		c) RS 485 port connection	Yes / No		
	6.5	Fault passage indicator (short circuit & earth fault indicator)			
		a) Application			
		b) Features provided			
		i. Local and remote indication for FPI operated	Yes / No		
		ii. Reset of FPI local and remote	Yes / No		

DATA SHEET-B					
HV RING MAIN UNIT					
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
SL #		TECHNICAL PARTICULARS		UNIT	VALUE
	6.6	Surge arrester			
		a) Application			
		b) Type			
		c) Rated voltage		kV (rms)	
		d) Nominal discharge current		kA peak	
7.0 AUXILIARY POWER SUPPLY	7.1	AC power supply			
	7.2	DC power supply			
	7.3	Battery			
		a) Type			
		b) Make			
		c) Vendor's type designation			
		d) Ampere hour capacity		Ah	
		e) No. of cells in series		Nos.	
		f) Cell voltage	Initial	Volts	
			Final		
	7.4	Battery charger			
		a) Make			
		b) Type			
		c) Dual redundant type		Yes/No	
		d) Input voltage		Volts ac	
		e) Output voltage		Volts dc	
		f) Rated DC current		Amps	
		g) Float charging current			
		h) Boost charging current			
		i) Natural cooling provided for charger		Yes / No	
		j) Rectifier type			
8.0 INTERLOCKS	8.1	Load break switch & respective earth switch			
	8.2	Circuit breaker & respective earth switch			

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
	8.3	Prevent the removal of respective cable covers if load break switch or circuit breaker is 'ON'		
	8.4	Prevent the closure of laod break switch or circuit breaker if respective cable cover is open		
	8.5	Cable test plug for LBS / CB accessible only if earth switch connected to earth		
	8.6	For motorized RMUs prevent motorized operation of LBS / CB during manual operation		
9.0 CONNECTIONS FOR SCADA	9.1	Connection for SCADA wired to separate terminal board		
	9.2	Potential free contacts provided for status indication in SCADA		
		a) Local / remote selector switch		
		b)		
		c) Load Break switch (LBS)close/open		
		d) Circuit breaker (CB) close / open		
		e) Earth switch close / open		
	9.3	Potential free contacts for alarm signal to SCADA		
		a) Circuit breaker tripped		
		b) Protection relay operated		
		c) SF6 gas pressure low		
		d) Fault passage indicator operated		
		e) Battery charger fail		
		f) Any other signal recommended by vendor		
	9.4	Commands for operation from SCADA		
		a) LBS close and open		
		b) CB close and open		
		c) Fault passage indication reset		
	9.5	RS 485 poer connection		
		a) Protection relay		
		b) Multifunction relay		

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
10.0 EARTHING	10.1	Earth pit		
		a) Type		
		b) Number provided for each RMU	Nos.	
	10.2	Earth grid		
		a) Conductor material		
		b) Conductor size		
	10.3	Earth resistance of RMU	Ohm	
11.0 DRAWINGS / DATA FURNISHED WITH BID	11.1	Drawings and catalogues		
		a) Plan and section drawings of each RMU	Yes / No	
		b) Single line diagram of each RMU	Yes / No	
		c) Catalogues of major equipment	Yes / No	
	11.2	Type test reports	Yes / No	Furnish list of type test reports
	11.3	Experience list	Yes / No	
	11.4	Recommended spares with unit rates	Yes / No	
	11.5	Recommended special tools and instruments with unit rates	Yes / No	

DATASHEET-A1					
OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER					
SL.NO		DESCRIPTION		UNIT	DATA
1.0 GENERAL	1.1	Application/ designation			Distribution Transformer
	1.2	Quantity required		Nos.	1250kVA - 1 No. 500kVA - 1No.
	1.3	Installation		Indoor/ Outdoor	Outdoor
	1.4	Degree of protection as per IS 2147			IP 23
2.0 RATINGS	2.1	Rating		kVA	1250/500
	2.2	Number of phases & frequency			Three phase,50Hz
	2.3	Number of windings			Two (2)
	2.4	Type of cooling			ONAN
	2.5	No load voltage	HV	kV	11
			LV	kV	0.433
			TV	kV	NA
	2.6	Winding Connection	HV		Delta
			LV		Star
			TV		NA
	2.7	Vector group			Dyn11
	2.8	Percentage impedance (HV to LV)		%	6.25%(1250kVA) 4% (500kVA)
	2.9	Direction of Power Flow		HV to LV/ LV to HV/ Bi directional	HV to LV
	2.10	Winding Insulation Category	HV	Uniformly/ Non uniformly Insulated	Uniformly
			LV ~~& TV~~		Uniformly
3.0 SYSTEM VOLTAGE	3.1	Nominal system voltage	HV	kV	11
			LV	kV	0.415
			TV	kV	NA
	3.2	Highest system voltage	HV	kV	12
			LV	kV	0.457
			TV	kV	NA
	3.3	System fault level	HV/ LV	kA	25 / 50 (1250kVA) 25 / 25 (500kVA)
4.0 NEUTRAL EARTHING	4.1	System neutral			
		HV			Effectively Earthed
		LV			Effectively Earthed
	4.2	Transformer neutral			
		HV			NA
		LV			Effectively Earthed

DATASHEET-A1					
OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER					
SL.NO		DESCRIPTION		UNIT	DATA
5.0 INSULATION WITHSTAND	5.1	Impulse (1.2/50 μ sec wave)	HV	kV_p	75
			LV ~~& TV~~	kV_p	NA
	5.2	Power frequency withstand voltage DRY	HV	kV	28
			LV ~~& TV~~	kV	3
		Power frequency withstand voltage WET	HV	kV	28
			LV ~~& TV~~	kV	3
	5.3	Transformer Neutral power frequency withstand voltage	HV	kV	NA
			LV	kV	3
6.0 TEMPERATURE RISE	6.1	Reference ambient temperature		˚C	45
	6.2	Oil by thermometer over the ambient		K	45˚C
	6.3	Winding by resistance over the ambient		K	50˚C
7.0 TAP CHANGING	7.1	Taps required: On load / off circuit			Off Circuit
	7.2	Tapping on windings			HV
	7.3	Total tapping range		%	+5 to -10
	7.4	Tapping Steps		%	2.5
	7.5	Control	Manual / automatic		Manual
			Local / remote		Local
	7.6	Control cubicle by			NA
	7.7	Voltage class of OLTC		kV	NA
	7.8	Current rating of OLTC		A	NA
	7.9	Type of OLTC installation In tank/ Separately mounted			NA

DATASHEET-A1					
OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER					
SL.NO		DESCRIPTION		UNIT	DATA
8 .0 DETAILS OF TRAFO. FOR PARALLEL OPERATION	8.1	Manufacturer's name			NA
	8.2	Rating		kVA	
	8.3	Exact turns ratio			
	8.4	Tapping range			
	8.5	Full load loss corrected to 75^{O}C		kW	
	8.6	% impedance at principal tapping			
	8.7	Vector group			
9.0 BUSHINGS	9.1	Voltage class	HV Line end	kV	12
			LV Line end	kV	3
			TV Line end	kV	NA
			HV neutral	kV	NA
			LV neutral	kV	3
	9.2	Impulse wave withstand (1.2/50 μ sec wave)	HV	kV_p	75
			LV ~~& TV~~	kV_p	NA
	9.3	Power frequency withstand for 1 Min.	HV Line end	kV	28
			LV Line end	kV	3
			HV neutral	kV	NA
			LV neutral	kV	3
	9.4	Minimum clearance	HV ph to ph	mm	As per CBIP
			LV ph to ph	mm	25
			HV ph to earth	mm	As per CBIP
			LV ph to earth	mm	25
	9.5	Minimum creepage distance (total protected)	HV Line end	mm	300
			LV Line end	mm	25
			HV neutral	mm	NA
			LV neutral	mm	25
	9.6	Bushing CT details	HV phase Bushings	Nos	NA
				Parameters	NA
			HV Neutral bushing.	Nos	NA
				Parameters	NA
			LV Phase Bushings	Nos	NA
				Parameters	NA
			LV Neutral bushing		
				Parameters	<u>NCT-1</u> 2000/5A, CL:PS,15VA <u>NCT-2</u> 1000/5A, CL: 5P10, 15VA (Vk, Rct and Im shall be decided during detail engg.)
RMI NA L CO NN	10.1	HV line end bushing/ cable box/ Cable box with disconnecting chamber.			Cable box with disconnecting chamber

DATASHEET-A1					
OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER					
SL.NO		DESCRIPTION		UNIT	DATA
	10.2	LV line end bushing/ cable box/ cable box with disconnecting chamber/ Bus duct.			Busduct
	10.3	HV neutral bushing/ Cable box/ Cable box with disconnecting chamber			NA
	10.4	LV neutral bushing/ Cable box/ Cable box with disconnecting chamber/ Bus duct.			Separate neutral bushing for earth connection
	10.5	Bushing terminals	Required	Yes/No	NA
			Size of take off conductor	HV	NA
				LV	NA
	10.6	Cable box, lugs and glands	Required	Yes/No	Yes
			Size of cable	HV	3C x 400 Sq.mm., 11kV (E) grade, Al, XLPE, Armoured power cable
				LV	Al. Busduct
11.0 EARTHING TERMINAL	11.1	Material of conductor	Body		GS
			Neutral		Cu
	11.2	Size of conductor	Body	mm	50 x 10
			Neutral	mm	50 x 8
12.0 MISCELLANEOUS	12.1	Wheels	Plain/ flanged		Plain
			Unidirectional/ bi-directional		Bi-Directional
	12.2	Vacuum withstand capability of Main tank with bushings, ~~radiators~~, fittings & accessories			Hermetically sealed with corrugated tank
	12.3	Transformer to be transported	Filled with oil	Yes/No	Yes
			Without oil with inert gas, Gas Cylinder and accessories, pressure gauge	Yes/No	NA

DATASHEET-A1				
OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER				
SL.NO		DESCRIPTION	UNIT	DATA
13.0 OPTIONAL FITTINGS REQUIRED	13.1	Magnetic oil level gauge with low oil level alarm contacts as per clause 19.10	Yes/No	No
	13.2	Pressure relief device as per clause 19.15	Yes/No	Yes
	13.3	Dial type thermometer with two contacts for oil temp. as per clause 19.16	Yes/No	No
	13.4	Gas and oil actuated i.e., Bucholz relay as per clause 19.17	Yes/No	No
	13.5	Winding temperature indicator with two contacts with two contacts as per clause 19.20	Yes/No	Yes
	13.6	On load tap changer as per specification PCPL-4-S4-133	Yes/No	No
	13.7	Oil surge relay with alarm and trip contacts for OLTC	Yes/No	No
	13.8	Valves as per clause 9.0	Yes/No	Yes
	13.9	Four plain rollers in place of fixing channels	Yes/No	Yes
14.0 EVALUATION & PENALTY	14.1	Formula for evaluation of bids (W_i = No Load loss, W_c = Load loss & W_p = Auxiliary Loss)		Refer Section-3 (Specific technical req.)
	14.2	Rates of penalty for exceeding the guaranteed losses per kW	W_i W_c W_p	Refer Section-3 (Specific technical req.)
15.0 ESSENTIAL SPARES	15.1	Complete set of gaskets	Set	Vendor to indicate requirement
	15.2	Bushing of each type	Nos	
	15.3	Dial type thermometer	Nos	
	15.4	Complete WTI equipment	Nos	
	15.5	Pressure relief valve/ Explosion vent diaphragras	Nos	
	15.6	Silica gel breather	Nos	
	15.7	Buchholz relay	Nos	
	15.8	One valve of each type	Nos	
	15.9	Cooler fan & Fan motor of each type		
	15.10	Oil pump & Pump motor of each type		
	15.11	OLTC motor	Nos	
	15.12	Oil Level gauge	Nos	
	15.13	Bushing CT of each type		
	15.14	Miscellaneous spare (contactors, control switches, MCBs, indication lamps etc)	10% of quantity used	
16.0 NOTES				

DATA SHEET A2 OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER APPLICABLE STANDARDS			
SL.NO.	ITEM	STANDARD	
1.0	Power transformer	IS 2026	IEC 60076
2.0	Fitting & Accessories for Power transformers	IS 3639	IEC
3.0	Guide for Loading of oil immersed transformers	IS 6600	IEC 60354
4.0	Insulating Oil	IS 335	IEC 60296
5.0	Bushings	IS 2099	IEC 60137
6.0	Degree of protection	IS 2147	IEC 60144
7.0	Buchholz relay	IS 3637	IEC
8.0	On load tap changer	IS 8468	IEC 60214
9.0	Application Guide for OLTC	IS 8478	IEC 60542
10.0	Code of Practices for selection, Installation and maintenance of Transformer	IS 10028	IEC

DATA SHEET B OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER (TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
SL. NO.		DESCRIPTION		UNIT	BIDDER'S DATA
1.0 GENERAL	1.1	Make			
	1.2	Quantity required		Nos.	
	1.3	Installation		Indoor/ Outdoor	
	1.4	Degree of protection as per IS 2147			
2.0 RATINGS	2.1	Rating		kVA	
	2.2	Number of phases & frequency			
	2.3	Number of windings			
	2.4	Type of cooling			
	2.5	No load voltage	HV	kV	
			LV / TV	kV / kV	
	2.6	Winding Connection	HV		
			LV / TV		
	2.7	Vector group			
	2.8	Percentage impedance		%	
	2.9	Direction of Power Flow		HV to LV	
				LV to HV	
				Bi directional	
	2.1	Winding Insulation Category	HV	Uniformly/ non uniformly Insulated	
			LV / TV		
	2.11	Winding Conductor Material			
	2.12	Highest System Voltage for which transformer windings are suitable	HV	kV	
			LV / TV	kV / kV	
	2.13	Transformer Neutral Earthing	HV		
			LV		

DATA SHEET B					
OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER					
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
3.0 INSULATION WITHSTAND	3.1	Impulse (1.2/50 µ-sec wave)	HV	kV_p	
			LV / TV	kV_p / kV_p	
	3.2	Power frequency withstand voltage DRY	HV	kV	
			LV / TV	kV / kV	
		Power frequency withstand voltage WET	HV	kV / kV	
			LV	kV	
		Transformer Neutral-power frequency withstand voltage	HV	kV	
			LV	kV	
4.0 TEMPERATURE RISE	4.1	Reference ambient temperature		^oC	
	4.2	Oil by thermometer over the ambient		^oC	
	4.3	Winding by resistance over the ambient		^oC	
5.0 TAP CHANGING	5.1	Taps provided On load / off load			
	5.2	Tapping on windings			
	5.3	Total tapping range		%	
	5.4	Tapping Steps		%	
	5.5	Control	Manual / automatic		
			Local / remote		
	5.6	Control cubicle by			
	5.7	Voltage class of OLTC		kV	
	5.8	Current rating of OLTC		A	
	5.9	Type of OLTC installation			
		In tank/ Separately mounted			

DATA SHEET B OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER (TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
6.0DETAILS OF TRANSFORMER FOR PARALLEL OPERATION	6.1	Manufacturer's Name			
	6.2	Rating		kVA	
	6.3	Exact turns ratio			
	6.4	Tapping range			
	6.5	full load loss corrected to 75°C		kW	
	6.6	% impedance at principle tapping			
	6.7	Vector Group			
7.0 BUSHINGS	7.1	Voltage Class	HV Line end	kV	
			LV Line end / TV	kV / kV	
			HV Neutral	kV	
			LV Neutral	kV	
	7.2	Impulse wave withstand (1.2/50 µ Sec wave)	HV	kVp	
			LV / TV	kVp	
	7.3	Power frequency withstand for 1 min	HV Line end	kV	
			LV & TV Line end	kV	
			HV Neutral	kV	
			LV Neutral	kV	
	7.4	Minimum clearance	HV Ph to Ph	mm	
			LV & TV Ph to Ph	mm	
			HV Ph to earth	mm	
			LV & TV Ph to earth	mm	
	7.5	Minimum creepage distance (total protected)	HV Line end	mm	
			LV & TV Line end	mm	
			HV neutral	mm	
			LV neutral	mm	
	7.6	Bushing CT details	LV Phase Bushings	Nos.	
				Parameters	
			LV Neutral bushing		
MINAL CON	8.1	HV line end bushing/ cable box/ Cable box with disconnecting chamber.			

DATA SHEET B					
OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER					
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
	8.2	LV line end bushing/ cable box/ cable box with disconnecting chamber/ Bus duct.			
	8.3	HV neutral bushing/ Cable box/ Cable box with disconnecting chamber			
	8.4	LV neutral bushing/ Cable box/ Cable box with disconnecting chamber/ Bus duct.			
	8.5	Bushing terminals	Required	Yes/No	
			Size of take off conductor	HV	
				LV	
	8.6	Cable box, lugs and glands	Required	Yes/No	
			Size of cable	HV	
				LV	
9.0 EARTHING TERMINAL	9.1	Material of conductor			
	9.2	Size of conductor		mm	
10.0 MISCELLANEOUS	10.1	Wheels	Plain / flanged		
			Unidirectional / bi-directional		
	10.2	Vacuum withstand capability of Main tank with bushings, radiators, fittings & accessories			
	10.3	Transformer to be transported	Filled with oil	Yes/No	
			Without oil with inertgas, Gas Cylinder and accessories, pressure gauge	Yes/No	
11.0 FITTINGS PROVIDED	11.1	Magnetic oil level gauge with low oil level alarm contacts as per clause 19.10		Yes/No	
	11.2	Pressure relief device as per clause 19.15		Yes/No	
	11.3	Dial type thermometer with two contacts for oil temp. as per clause 19.16		Yes/No	
	11.4	Gas and oil actuated i.e., Bucholz relay as per clause 19.17		Yes/No	
	11.5	Winding temperature indicator with two contacts with two contacts as per clause 19.20		Yes/No	
	11.6	On load tap changer as per specification PCPL-4-S4-133		Yes/No	
	11.7	Valves as per clause 9.0		Yes/No	
	11.8	Four plain rollers in place of fixing channels		Yes/No	
	11.9	Online dissolved gas analyser with all fillings as per specification		Yes/No	

DATA SHEET B				
OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
	11.10	All fittings and fixtures for nitrogen injected fire protection system as per specification.	Yes/No	
12.0 GUARANTEED LOSSES	12.1	No load looses (core loss and dielectric loss) at 100% voltage and frequency	kW	
	12.2	Load loss at rated current as 75°C winding temperature	kW	
	12.3	Auxiliary load losses at rated output	kW	
13.0 GUARANTEED PERFORMANCE DATA	13.1	Regulation at full load, 0.85 pf at 75°C winding temperature		
	13.2	External short circuit withstand capacity	KA	
			Sec	
			%	
	13.3	Magnetising current as rated voltage and frequency in percent of full load current		
	13.4	No Load current	A	
	A	At 100% of rated voltage	A	
	B	At 110% of rated voltage		
	13.5	Efficiency at 75°C	%	
	A	Full load, unity power factor	%	
	B	Full load, 0.85pf		
	13.6	Maximum flux density	Wb/m^2	
	A	At rated voltage	Wb/m^2	
	B	At 110% rated voltage		
	13.7	Over fluxing capability	Yes/No	
14.0		OLTC Control scheme conforms to specification	Yes/No	
15.0		Remote OLTC control panel conforms to specification	Yes/No	
16.0		Transformer marshalling Box and cooler control cabinet conforms to specification	Furnish list	
17.0 TESTS	17.1	List of Routine Test to be carried out	Furnish list	
	17.2	List of type carried out / to be performed	Furnish list	
	17.3	List of other tests to be carried out against extra price, quoted else where	Furnish list	
18.0		Total weight — Without oil	Kg	
19.0		Over all oil Dimension (L x W x H)	mm	
20.0		Total Quantity of Oil		
21.0		General arrangement drawing of the transformer attached with the bid	Yes/No	
			DRG No	

DATA SHEET B				
OIL FILLED (HERMETICALLY SEALED) POWER TRANSFORMER				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
22.0 ESSENTIAL SPARES	22.1	Complete set of gaskets	No	
	22.2	Bushing of each type	No	
	22.3	Dial type thermometer	No	
	22.4	Complete WTI equipment	No	
	22.5	Pressure relief valve/ Explosion vend diaphragras	No	
	22.6	Silica gel breather	No	
	22.7	Buchholz relay	No	
	22.8	One valve of each type	No	
	22.9	Cooler fan & Fan motor of each type	No	
	22.1	Oil pump & Pump motor of each type	No	
	22.1	OLTC motor	No	
	22.1	Oil Level gauge	No	
	22.1	Bushing CT of each type	No	
	22.1	Miscellaneous spare (contractors control switches, MCBs, indication lamps in cooler control Cabinet)		

DATA SHEET – A1								
MV SWITHGEAR								
Sl. No.		Description				Unit	Data	
1.0 SWITCHGEAR & BUSBAR RATING	1.1	Rated Voltage, Phases & Frequency					415V, 3Ph & 50Hz	
	1.2	System Neutral Earthing : Effectively / Non effectively					Effectively earthed	
	1.3	Maximum System Voltage				Volts	456.5	
	1.4	One minute Power Frequency Voltage						
	a)	Power Circuits				Volts	2500	
	b)	Control Circuits				Volts	1500	
	c)	Aux. Circuits connected to sec. Of CTs				Volts	2000	
	1.5	Continuous Current Rating of Bus bars under Site reference Ambient Temperature					See Bus bar details	
	1.6	Reference Ambient Temperature				^{o}C	45 ^{o}C	
	1.7	Maximum Temperature of Busbars, droppers & contacts at continuous current rating under site reference ambient Temp.				^{o}C	85 ^{o}C	
	1.8	Short circuit withstand for Busbars & Droppers						
	a)	Short Time (1 s) at 415V				kA (rms)	50 / 25 (As indicated in SLD)	
	b)	Dynamic Rating				kA (Peak)	110 / 52.5	
	1.9	Standard Applicable					As per Data sheet A6	
2.0 SWITCHGEAR PARTICULARS	Designation		Busbar Details			Single Front (SF) Double Front (DF)	Fully draw out (FD) Fixed (F)	Cable Entry Top (T) Bottom (B)
			Amps	Cu/ Al	TP/ TPN	SF/ DF	FD/ F	T/B
	1.	LV Cubicle (Chemical Science CSS)	2500	Cu	TPN	SF	F	B
	2.	LV Cubicle (E Type Quarters CSS)	1000	Cu	TPN	SF	F	B
3.0 SWITCHGEAR CONSTRUCTIONAL REQUIREMENTS	3.1	Panel internal form of separation as per IEC 60439-1					Form 3b	
	3.2	Sheet Steel	Type			Cold rolled/ Hot rolled	Cold rolled	
			Thickness	Frame		mm	2	
				Doors		mm	1.6	
				Covers		mm	1.6	
	3.3	Degree of protection as per IS:13947					IP54	

DATA SHEET – A1					
MV SWITHGEAR					
Sl. No.		Description		Unit	Data
	3.4	Colour finish shade as per IS:5		Interior	Glossy white
				Exterior	RAL:7032
	3.5	Earthing Bus		Material	GS
				Size	50 x 10
	3.6	Purchaser's Earthing Conductor		Material	GS
				Size	50 x 10
	3.7	Clearances in air of live parts (Min.)		Phase to Phase	25.4mm
				Phase to Earth	25.4mm
	3.8	Metal enclosed Bus duct/Bus trunking / Cable entry to cubicles if required		a) Top/ Bottom	Top
				b) Indoor/ Outdoor	Indoor
	3.9	Busbar Insulation	Air insulated with phase barriers	Yes/ No	No
			Fully insulated	Yes/ No	Yes
	3.10	Safety Interlocks,			
	a)	Door Interlock		Yes/ No	Yes
	b)	Shrouding of live parts		Yes/ No	Yes
	c)	Finger touch proof connection		Yes/ No	Yes
4.0 AIR CIRCUIT BREAKER	4.1	Circuit Breaker utilisation category		A/ B	B
	4.2	Voltage frequency & No. Of Phases			415V, 50Hz & 3Ph
	4.3	Rated operating duty			0-0.3sec-CO-3min-CO
	4.4	Rated breaking capacity			
	a)	MVA			36 / 18
	b)	Service breaking current at, 0.25 P.F.(I_{CS})		kA (rms)	50 /25
	4.5	Short circuit withstand capacity	Current	kA (rms)	50 / 25
			Duration	second	1
	4.6	Rated making current		kA (peak)	110 / 52.5
	4.7	Rated current at site reference ambient temperature (in panel rating)			To suit circuit rating (Refer SLD)
	4.8	Type of operating mechanism	Manual, spring assisted	Yes/ No	No
			Manual, spring charged	Yes/ No	Yes
			Motor operated spring assisted	Yes/ No	No
			Mechanical Spring Charged Indicator	Yes/ No	Yes
	4.9	Key Interlocking required		Yes/ No	Yes
	4.10	Shunt Trip required		Yes/ No	Yes
	4.11	Protection required			

DATA SHEET – A1					
MV SWITHGEAR					
Sl. No.		Description		Unit	Data
	a)	Relays / series releases			Microprocessor based overload, short circuit and earth fault releases with adjustable current and time delay settings with self diagnostic & provision for addition of a communication feature (SCADA)
	b)	Relay Type & Settings			Both current & time variable.
	c)	Under voltage release required		Yes/ No	Yes
				Setting	Both Voltage & time variable.
	4.12	Minimum No. Of Auxiliary contacts (Spare after meeting all the scheme requirements)			2NO + 2NC
	4.13	Control Voltage	For spring charging motor	Volts AC/ DC	NA
			For closing & tripping	Volts AC/ DC	NA
			For Indications	Volts AC/ DC	NA
4.0 AIR CIRCUIT BREAKER	4.14	Accessories required			
	a)	Mechanical position indicator for On/Off status		Yes/ No	Yes
	b)	Mechanical position indicator for Test & Service position		Yes/ No	Yes
	c)	Breaker operation counter		Yes/ No	Yes
	4.15	Manual operation required in addition to electrical operating devices			
	a)	For spring charging & closing		Yes/ No	Yes
	b)	For tripping		Yes/ No	Yes
	4.16	Annunciator required		Yes/ No	No
	4.17	Standards application			As per Data sheet A6
5.0 MOULDED CASE CIRCUIT BREAKER (MCCB)	5.1	Moulded case circuit breakers to be provided			
	a)	For Motor Control Circuits		Yes/ No	No
	b)	For other circuits		Yes/ No	Yes
	5.2	Voltage, frequency & No. Phases			415V, 50Hz & 3Ph
	5.3	Utilisation category		A/B	B
	5.4	Rated Operating duty			0-0.3sec-CO-3min-CO
	5.5	Rated service breaking capacity at, 0.25PF (I_{CS})		kA (rms)	50 / 25 (Refer SLD)
	5.6	Short circuit withstand	Current	kA (rms)	50 / 25 (Refer SLD)

DATA SHEET – A1					
MV SWITHGEAR					
Sl. No.		Description		Unit	Data
		capacity	Duration	s	1
	5.7	Rated making current		kA (peak)	110 / 52.5
	5.8	Rated current at site ref. Ambient temperature (in panel rating)		A	To suit circuit rating (Refer SLD)
	5.9	On/Off Operation			
	a)	Manual		Yes/ No	Yes
	b)	Power closing device for remote operation		Yes/ No	No
	c)	Shunt trip		Yes/ No	Yes
	5.10	Releases required			
	a)	Over load inverse time		Yes/ No	Microprocessor based overload, short circuit and earth fault releases with adjustable current and time delay settings with self diagnostic & provision for addition of a communication feature (SCADA)
	b)	Short circuit		Yes/ No	
	c)	Earth fault		Yes/ No	
5.0 MOULDED CASE CIRCUIT BREAKER (MCCB)	5.11	Accessories required			
	a)	Breaker Auxiliary contacts			Yes
	b)	Fault signalling contact for breaker auto trip through releases		Yes/No	Yes
	5.12	Termination arrangement			Terminal Spreaders shall be provided with phase barriers.
	5.13	Control Voltages			
	a)	For operating motor		Volts (AC/ DC)	NA
	b)	For closing/tripping		Volts (AC/ DC)	NA
	c)	For Indication		Volts (AC/ DC)	NA
	5.14	Standards applicable			As per Data Sheet A6
6.0 MOTOR PROTECTION CIRCUIT BREAKER (MPCB)	6.1	Motor Protection Circuit Breakers to be provided			NA
	a)	For Motor Control Circuits		Yes/ No	
	b)	For other circuits		Yes/ No	
	6.2	Voltage frequency & No. Of Phases			
	6.3	Utilisation category		A/B	
	6.4	Rated Operating duty			
	6.5	Short circuit withstand capacity	Current	kA (rms)	
			Duration	s	
	6.6	Rated service breaking capacity at, 0.25PF (I_{CS})		kA (rms)	
	6.7	Rated making current		kA (rms)	

DATA SHEET – A1					
MV SWITHGEAR					
Sl. No.		Description		Unit	Data
	6.8	Rated current at site ref. Ambient temperature (in-panel rating)		A	
	6.9	On/Off Operation			
	a)	Manual		Yes/ No	
	b)	Power closing device for remote operation		Yes/ No	
	c)	Shunt trip		Yes/ No	
	6.10	Releases required			
	a)	Over load inverse time			
	b)	Short circuit			
	c)	Earth fault		Yes/ No	
6.0 MOTOR PROTECTION CIRCUIT BREAKER (MPCB)	6.11	Accessories required			NA
	a)	Breaker Auxiliary contact			
	b)	Fault contact for breaker Auto trip			
	c)	Manual Hand RESET feature without opening door of MCC			
	6.12	Termination arrangement			
	6.13	Control Voltages			
	a)	For operating motor		Volts (AC/DC)	
	b)	For closing/tripping		Volts (AC/DC)	
	c)	For Indication & Control		Volts (AC/DC)	
	6.14	Standards applicable			
7.0 MINIATURE CIRCUIT BREAKER	7.1	Miniature circuit breakers to be provided			NA
	a)	For Motor Control Circuit		Yes/No	
	b)	For Other circuit		Yes/No	
	7.2	Voltage frequency & No. Of Phases			
	7.3	Rated operating duty			
	7.4	Rated service breaking capacity (at, 0.25PF) (I_{CS})		kA (rms)	
	7.5	Short circuit withstand capacity	Current	kA (rms)	
			Duration	s	
	7.6	Rated current at site ref. Ambient temperature		A	
	7.7	Tripping characteristic curve for			
	a)	For Lighting & small power application			
	b)	For UPS Power application			
	c)	For DC application			
	7.8	Positive Switch Operated Indication			
	7.9	Switching C-O cycles (minimum)			
	7.10	Standards applicable			

DATA SHEET – A1				
MV SWITHGEAR				
Sl. No.		Description	Unit	Data
8.0 CONTACTOR	8.1	Contractor to be provided		NA
	a)	For Motor Control Circuits	Yes/ No	
	b)	For other circuits	Yes/ No	
	8.2	Voltage frequency & No. Of phases		
	8.3	Rated Operating duty		
	8.4	Rated current at site ref. Ambient temperature	A	
8.0 CONTACTOR	8.5	On/ Off Operation		NA
	a)	Auto	Yes/ No	
	b)	Manual	Yes/ No	
	c)	Remote power operated	Yes/ No	
	8.6	Control Voltage	Volts	
	a)	For coil Voltage	AC/ DC	
	8.7	Standards applicable		
9.0 EARTH FAULT RELAY	9.1	Make	Prok Dv's or equivalent	As per SLD
	9.2	Setting		
	a)	Range	Current range 10-80%	
	b)	Time Setting	0.5 to 3sec	
	9.3	Location		
10.0 EARTH LEAKAGE CIRCUIT BREAKER (RCCB/RCBO)	10.1	Type	RCCB/ RCBO	NA
	10.2	Application		
	a)	For Motor circuits	Yes/ No	
	b)	For Lighting circuits	Yes/ No	
	c)	For other circuits	Yes/ No	
	10.3	Enhanced immunity to unwanted tripping (type 'i') required	Yes/ No	
	10.4	Voltage, frequency & No. Of Phases		
	10.5	Rated operating duty		
	10.6	Rated service breaking capacity at 0.5 PF(Ics)	kA (rms)	
	10.7	Rated current at site ambient temperature	Amps	
	10.8	Leakage current setting for protection		
	a)	For human safety	mA	
	b)	For Fire safety	mA	
	10.9	Positive switch operated indication		
	10.10	Switching C-O cycles		
	10.11	Applicable standard		
RE AR RE	11.1	Application		NA
	11.2	Type		

DATA SHEET – A1					
MV SWITHGEAR					
Sl. No.		Description		Unit	Data
	11.3	Maximum continuous operating voltage			
	11.4	Voltage protection level			
	11.5	Rated discharge current for 8/20μs wave			
	11.6	Maximum peak value of 8/20μs wave			
	11.7	Applicable standard			
12.0 CURRENT TRANSFORMER	12.1	Type			Cast epoxy resin
	12.2	Class of insulation			B
	12.3	CT parameters			
	a)	Rated primary current and ratio			As per SLD
	b)	Accuracy class and burden			As per SLD
	c)	Knee point voltage and excitation current			As per SLD
	12.4	Short circuit withstand current and time kA/1sec		kA(rms)	50 / 25
	12.5	Dynamic current withstand		kAp	110 / 52.5
	12.6	Applicable insulation			As per Data sheet – A6
13.0 VOLTAGE TRANSFORMER	13.1	Type			NA
	13.2	Class of insulation			
	13.3	VT parameters			
	a)	Number of windings			
	b)	Voltage ratio			
	c)	Method of connections			
	d)	Accuracy class and burden			
	13.4	Rated voltage factor			
	13.5	Applicable standards			
14.0 MODULE DRAWINGS	Module Type		Description		Drawing No
15.0 TESTS	15.1	Fully Type Tested Assembly (TTA) to be provided as per IEC-60439-1		Yes/No	No – Partially Type Tested (PTA)
	15.2	Type Tests shall include:-			
	a)	Temperature rise test		Yes/No	Valid type test reports shall be submitted for all Breakers
	b)	Dielectric Tests		Yes/No	
	c)	Short circuit withstand test		Yes/No	
	d)	Clearance and creepage distances		Yes/No	
	e)	Mechanical operations		Yes/No	
	f)	Degree of Protection		Yes/No	
	15.3	Routine Tests			As per applicable

DATA SHEET – A1				
MV SWITHGEAR				
Sl. No.		Description	Unit	Data
				standard
16.0 ESSENTIAL SPARES TO BE SUPPLIED	16.1	COMPLETE Air Circuit breaker with operating mechanism and releases where specified of the following ratings		By Bidder
	a)			
	b)			
	c)			
	d)			
	16.2	Complete MCCB/MPCB with operating mechanism and releases of the following ratings		By Bidder
	a)			
	b)			
	c)			
	d)			
	16.3	Complete MCB with releases of the following rating		By Bidder
	a)			
	b)			
	c)			
	d)			
	16.4	Complete RCBO with releases		By Bidder
	16.5	Closing & tripping coils		
	16.6	Operating motors		
	16.7	Auxiliary contact blocks		
	16.8	Moving auxiliary contact blocks		
	16.9	Breaker control switches		
	16.10	Service selector switches		
	16.11	Indicating Lamps with series Resistors		
	a)	Red		
	b)	Green		
	c)	Amber		
	d)	Blue		
	f)	White		
	16.12	Voltage Transformer of each rating		
	16.13	Control Transformer of each rating		
	16.14	Surge Arrester		
17.0 NOTES				

DATA SHEET – A2				
APPLICABLE STANDARDS				
Sl. No.	Description	STANDARDS		
01	Specification for low voltage switchgear and control gear		IS:13947	
02	AC circuit breakers		IS:13947, Part 2	IEC 60947-2
03	Factory built assemblies of Switchgear and control gear for voltages up to and including 1000V AC & 1200V DC.		IS:8623	
04	Air break switches		IS:13947 Part 3	
05	Miniature circuit breakers		IS:13032	IEC-60898
06	Contactors & Starters		IS:13947 Part 4	
07	Control switches/push buttons		IS:13947 Part 5	
08	Current transformers		IS:2705	
09	Voltage transformers		IS:3156	
10	Relays		IS:3231	
11	Indicating instruments		IS:1248	
12	Arrangement for busbars main connections and accessories		IS:5578 IS:11353	
13	AC electricity meters		IS:8530,722,13010,13779,11448	
14	Degree of protection		IS:2147	
15	The performance of AC control gear equipment rated up to 600V for use on high prospective fault current system			
16	Code of practice for installation and maintenance of switchgear		IS:10118	
17	Climate proofing of electrical		--	
18	Code of practice for phosphating iron & steel		IS:6005 BS:3189	
19	Wrought aluminium & aluminium alloys for electrical purposes		IS:5082	

DATA SHEET – B								
MV SWITCHGEAR								
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)								
Sl. No.		Description				Unit	BIDDER'S DATA	
1.0 SWITCHGEAR & BUSBAR RATING	1.1	Rated Voltage, Phases & Frequency						
	1.2	System Neutral Earthing : Effectively / Non effectively						
	1.3	Maximum System Voltage				Volts		
	1.4	One minute Power Frequency Voltage				Volts		
	a)	Power Circuits						
	b)	Control Circuits						
	c)	Aux. Circuits connected to sec. Of CTs						
	1.5	Continuous Current Rating of Bus bars under Site reference Ambient Temperature						
	1.6	Reference Ambient Temperature				°C		
	1.7	Maximum Temperature of Busbars, droppers & contacts at continuous current rating under site reference ambient Temp.				°C		
	1.8	Short circuit withstand for Busbars & Droppers						
	a)	Short /Time (1sec) at 415V				kA (rms)		
	b)	Dynamic Rating				kA (Peak)		
	1.9	Standard Applicable					As per Data sheet A2	
2.0 SWITCHGEAR PARTICULARS		Designation	Busbar Details			Single Front (SF) Double Front (DF)	Fully draw out (FD) Fixed (F)	Cable Entry Top (T) Bottom (B)
			Amps	Cu/AL	TP/TPN	SF/DF	FD/F	T/B
	1.							
	2.							
	3.							
	4.							
	5.							
	6.							
	7.							
	8.							
	9.							
	10.							
	11.							
	12.							

DATA SHEET – B MV SWITCHGEAR (To be filled in by the BIDDER and submitted with the BID)			
Sl. No.	Description	Unit	BIDDER'S DATA

3.0 SWITCHGEAR CONSTRUCTIONAL REQUIREMENTS	3.1	Panel internal form of separation as per IEC 60439-1					
	3.2	Sheet Steal	Type	Cold rolled/ Hot rolled			
			Thickness	Frame	mm		
				Doors	mm		
				Covers	mm		
				Partitions	mm		
	3.3	Degree of protection as per IS:13947					
	3.4	Colour finish shade as per IS:5		Interior			
				Exterior			
	3.5	Earthing Bus		Material			
				Size			
	3.6	Purchaser's Earthing Conductor		Material			
				Size			
	3.7	Clearances in air of live parts (Min.)		Phase to Phase			
				Phase to Earth			
	3.8	Metal enclosed Bus duct/Bus truning/ Cable entry to cubicles if required		a) Top/ Bottom			
				b) Indoor/ Outdoor			
	3.9	Busbar Insulation	Air insulated with phase barriers	YES/NO			
			Fully insulated	YES/NO			
	3.10	Safety Interlocks		Yes			
	a)	Door Interlock		Yes			
	b)	Shrounding of live parts		Yes			
	c)	Finger touch proof connection		Yes			
4.0 ACB	4.1	Circuit Breaker Make & type					
	4.2	Voltage frequency & No. Of Phases					
	4.3	Utilisation category		A/B			
	4.4	Rated operating duty					
	4.5	Rated breaking capacity					
	a)	MVA					
	b)	Service breaking capacity at, 0.25 P.F. (Ics)		kA (rms)			
	c)	Ultimate breaking capacity (Icu)		kA (rms)			

DATA SHEET – B
MV SWITCHGEAR
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description		Unit	BIDDER'S DATA
CUI T BR	4.6	Short circuit withstand capacity	current	kA (rms)	
			Duration	Sec	

	4.7	Rated making current		kA (peak)	
	4.8	Rated current at site reference ambient temperature (in panel rating)			
	4.9	Type of operating mechanism	Manual, spring assisted	Yes/No	
			Manual, spring charged	Yes/No	
			Motor operated spring assisted	Yes/No	
			Mechanical Spring Charged Indicator	Yes/No	
	4.10	Interlocking provided as per specification		Yes/No	
	4.11	Shunt Trip provided			
	4.12	Protection provided			
	a)	Relays / series releases			
	b)	Relay Type & Settings			
	c)	Under voltage release provided		Yes/No	
				Setting	
	4.13	Minimum No. Of Auxiliary contacts (SPARE)			
	4.14	Control Voltage	For Spring charging		
			For closing & tripping		
			For Indications		
	4.15	Accessories provided		Yes/No	
	a)	Mechanical position indicator for On/Off status			
	b)	Mechanical position indicator for Test & Service position			
	c)	Breaker operation counter			
	4.16	Manual operation provided in addition to electrical operating devices			
	a)	For spring charging & closing		Yes/No	
	b)	For tripping		Yes/No	
	4.17	Annunciator provided		Yes/No	
	4.15	Standards applicable			
5.0 MCCB	5.1	Make			
	5.2	Makers Type designation			
	5.3	Moulded case circuit breakers to be provided			
	a)	For Motor Control Circuits		Yes/No	
	b)	For other circuits		Yes/No	
	5.4	Voltage frequency & No. Phases			
	5.5	Utilisation category		A/B	
	5.6	Rated Operating duty			

DATA SHEET – B MV SWITCHGEAR (To be filled in by the BIDDER and submitted with the BID)				
Sl. No.		Description	Unit	BIDDER'S DATA
RCD	5.7	Rated breaking capacity at, 0.25PF (Ics)	kA (rms)	

	5.8	Ultimate braking capacity (Icu)			
	5.9	Short circuit withstand capacity	Current	kA (rms)	
			Duration	Sec	
	5.10	Rated making current		kA(peak)	
	5.11	Rated current at site ref. Ambient temperature (in panel rating)		Amps	
	5.12	On/Off Operation			
	a)	Manual			
	b)	Power closing device for remote operation			
	c)	Shunt trip			
	5.13	Releases provided		Yes/No	Furnish details
	a)	Over load inverse time			
	b)	Short circuit			
	c)	Earth fault			
	5.14	Accessories required			
	a)	Breaker Auxiliary contacts			
	b)	Fault signalling contact for breaker auto trip through releases			
	5.15	Termination arrangement			
	5.16	Control Voltages		Volts (AC/DC)	
	a)	For operating motor			
	b)	For closing/tripping			
	c)	For Indication			
	5.17	Standards applicable			
6.0 MOTOR PROTECTION CIRCUIT BREAKERS (MPCB)	6.1	Make			
	6.2	Maker's type designation			
	6.3	Motor Protection Circuit Breakers to be provided			
	a)	For Motor Control Circuits		Yes/No	
	b)	For other circuits		Yes/No	
	6.4	Voltage frequency & No. Of Phases			
	6.5	Utilisation category		A/B	
	6.6	Rated Operating duty			
	6.7	Rated service breaking capacity at, 0.25PF (Ics)		kA (rms)	
	6.8	Ultimate breaking capacity (Icu)			

DATA SHEET – B
MV SWITCHGEAR
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description		Unit	BIDDER'S DATA
6.0 MOTOR	6.9	Short circuit withstand capacity	Current	kA (rms)	
			Duration	Sec	

	6.10	Rated making current		kA(peak)	
	6.11	Rated current at site ref. Ambient temperature (in panel rating)		Amps	
	6.12	On/Off Operation			
	a)	Manual			
	b)	Power closing device for remote operation			
	c)	Shunt trip			
	6.13	Releases provided		Yes/No	Furnish details
	a)	Over load inverse time			
	b)	Short circuit			
	c)	Earth fault			
	6.14	Accessories required			
	a)	Breaker Auxiliary contacts			
	b)	Fault signalling contact for breaker auto trip through releases			
	6.15	Termination arrangement			
	6.16	Control Voltages		Volts (AC/DC)	
	a)	For operating motor			
	b)	For closing/tripping			
	c)	For Indication			
	6.17	Standards applicable			
7.0 MINIATURE CIRCUIT BREAKERS (MCB)	7.1	Make			
	7.2	Maker's Type designation			
	7.3	Miniature circuit breakers to be provided			
	a)	For Motor Control Circuit		Yes/No	
	b)	For Other circuit		Yes/No	
	7.4	Voltage frequency & No. Of Phases			
	7.5	Rated operating duty			
	7.6	Rated breaking capacity at, 0.25PF (Ics)		kA (rms)	
	7.7	Short circuit withstand capacity	Current	kA (rms)	
			Duration	Sec	
	7.8	Rated current at site ref. Ambient temperature		Amps	
	7.9	Tripping characteristic curve for			
	a)	For Lighting & small power application			
	b)	For UPS Power application			
	c)	For DC application			

DATA SHEET – B
MV SWITCHGEAR
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description	Unit	BIDDER'S DATA
7.0 MCB	7.10	Positive Switch Operated Indication	Yes/No	
	7.11	Switching C-O cycles (minimum)		
	7.12	Standards applicable		
8.0 CONTACTOR	8.1	Make		
	8.2	Maker's type designation		
	8.3	Contractor to be provided		
	a)	For Motor Control Circuits	Yes/No	
	b)	For other circuits	Yes/No	
	8.4	Voltage frequency & No. Of phases		
	8.5	Rated Operating duty		
	8.6	Rated current at site ref. Ambient temperature	Amps	
	8.7	On/Off Operation		
	a)	Auto	Yes/No	
	b)	Manual	Yes/No	
	c)	Remote power operated	Yes/No	
	8.8	Control Voltage	Volts	
	a)	For coil Voltage	AC/DC	
	8.9	Standards applicable		As per Data Sheet A2
9.0 EARTH FAULT RELAY	9.1	Make		
	9.2	Setting		
	a)	Range		
	b)	Time Setting		
	9.3	Location/Applicable		
10.0 EARTH LEAKAGE CIRCUIT BREAKER (RCCB/RCBO)	10.1	Make		
	10.2	Maker's type designation		
	10.3	Type	RCCB/RCBO	
	10.4	Application		
	a)	For Motor circuits	Yes/No	
	b)	For Lighting circuits	Yes/No	
	c)	For other circuits	Yes/No	
	10.5	Enhanced immunity to unwanted tripping (type 'i') provided	Yes/No	
	10.6	Voltage, frequency & No. Of Phases		
	10.7	Rated operating duty		
	10.8	Rated Breaking capacity at 0.5 PF	kA	
	10.9	Rated current at site ambient temperature	Amps	

DATA SHEET – B
MV SWITCHGEAR
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description	Unit	BIDDER'S DATA
10. ELCB	10.10	Leakage current setting for protection		
	a)	For human safety	mA	
	b)	Fire safety	mA	
	10.11	Positive switch operated indication	Yes/No	
	10.12	Switching C-O cycles		
	10.13	Applicable standard		
11.0 SURGE ARRESTERS	11.1	Make		
	11.2	Maker's type designation		
	11.3	Application		
	11.4	Type		
	11.5	Maximum continuous		
	11.6	Voltage protection level		
	11.7	Rated discharge current for 8/20μs wave		
	11.8	Maximum peak value of 8/20μs wave		
	11.9	Applicable standard		
12.0 CURRENT TRANSFORMER	12.1	Make		
	12.2	Maker's type designation		
	12.3	Type		
	12.4	Class of insulation		
	12.5	CT parameters		
	a)	Rated primary current and ratio		
	b)	Accuracy class and burden		
	c)	Knee point voltage and excitation current		
	12.6	Short circuit withstand current and time kA/1sec	kA	
	12.7	Dynamic current withstand	kAp	
	12.8	Applicable standard		
13.0 VOLTAGE TRANSFORMER	13.1	Make		
	13.2	Maker's type designation		
	13.3	Type		
	13.4	Class of standard		
	13.5	VT parameters		
	a)	Number of windings		
	b)	Voltage ratio		
	c)	Method of connections		

DATA SHEET – B
MV SWITCHGEAR
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description	Unit	BIDDER'S DATA
13. VT	d)	Accuracy class and burden		
	13.6	Rated voltage factor		
	13.7	Applicable standards		
14.0 TESTS	14.1	Are Type Tested Assembly (TTA) panel offered	Yes/No	
	14.2	Are all Type tests as per specification to be conducted	Yes/No	
	14.3	Type test reports submitted with the bid	Yes/No	
			Certificate no.	
15.0 DIMENSIONS	15.1	Total dimension of each complete switchgear	L mm	
			W mm	
			D mm	
	15.2	Width of each vertical section with cable alley	mm	
	15.3	Width of cable alley	mm	
	15.4	Clear space to be kept in front of the switch gear	mm	
	15.5	Clear space to be kept on the rear of the switchgear	mm	
16.0 WEIGHTS	16.1	Approximate weight of each complete switchgear	Kgs	
	16.2	Weight of each vertical section with cable alley	Kgs	
17.0 COMPLETENSS OF OFFER	17.1	Have all the feeders with correct module type been provided in each switchgear as per the single line diagram	Yes/No	
	17.2	Has each type of the module been provided with all the devices as shown in the relevant module drawings	Yes/No	
18.0 SPARE PARTS	18.1	Have unit prices for essential spares as mentioned in Data Sheet A1 furnished	Yes/No	
	18.2	List of recommend spares for three years' operation furnished	Yes/No	

1.0 SCOPE:

1.1. This Specification covers Design, Engineering, Manufacture, Inspection and Testing of HV Ring Main Units. The unit should be extensible on both sides for future requirement. The RMU to be supplied against this specification are required for installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble-free service over the years.

1.2. The RMU offered shall be compact, maintenance free, easy to install, safe and easy to operate and complete with all parts necessary for their effective and trouble free operation. Such parts will be deemed to be within the scope of supply irrespective of whether they are specifically indicated in the specification or not.

1.3. The offered equipment shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the service conditions at site and shall have sufficiently long life in service as per statutory requirements.

1.4. Each RMU shall comprise the required numbers of the following types of modules as shown in the single line diagrams.

a) Vacuum circuit breaker with three position disconnector and earthing switch downstream of the breaker.

b) Bus bar sectionaliser – vacuum circuit breaker / load break switch.

1.5. SPARE

a) The BIDDER shall include in his quote supply of essential spares recommended by OEM required for 3 Year trouble free operation. The bidder shall submit the list of such spares along with the Technical bid.

b) Ordered essential spares shall be delivered along with the main equipments. When erection, testing and commissioning of Dry type Power transformers is included in vendors scope any requirement of commissioning spares shall not be drawn from essential spares supplied. The contractor shall procure the same separately without any cost to owner.

1.6. Recommended spares:

The tenderer shall furnish in his offer a list of recommended spares with unit rates that may be necessary for satisfactory operation and maintenance of circuit breakers and isolators for a period of 5 years. The purchaser reserves right of selection of items and quantities of these spares to be ordered. The cost of such spares shall not be considered for tender evaluation.

1.7. Erection and maintenance tools:

The tenderer shall submit a list and unit rates of all the special tools, equipment and instruments required for erection, testing, commissioning and maintenance of the equipment. The purchaser shall decide the quantity of tools to be ordered. Prices of these tools shall not be considered for tender evaluation. However, the list of necessary tools/equipment which will be supplied free of cost with each RMU shall be furnished separately.

2.0 APPLICABLE STANDARDS

2.1. The RMU Switchgear shall comply with the requirements stated in the following standards and specifications amended upto date:

IEC 62271-200/IEC 60298/IS 12729:1988	General requirement for metal enclosed switchgear
IEC 265	Medium Voltage Switches

IEC 60129 / IEC 62271-102 / IS 9921	Alternating Current disconnectors (Load Break isolators) and earthing switch
IEC 62271 – 100 / IEC 60056 / IS 13118 : 1991	Specification for alternating current breakers
IEC 62271-1 / IEC 60694	Panel design, SF6 / Vacuum circuit breakers
IEC 60044-1 / IEC 60185 / IS 2705:1992	Current transformers
IEC 60265 / IS 9920:1981	High voltage switches
IEC 376	Filling of SF6 gas in RMU
IEC 60273 / IS 2099	Dimension of indoor & Outdoor post insulators with voltage> 1000 V
IEC 60273 / IS 13947 (Part I)	Degree of protection provided by enclosues for low voltage switchgear and control gear.
All Indian electricity rules / Bills amended upto data applicable for clearances, safety and operation of the equipment.	

2.2. The RMU meeting with the requirements of any other authorities standards, which ensures equal or better quality than the standard mentioned above shall also be acceptable. One copy of such standards with authentic English Translations in Hard copy shall be furnished along with the offer.

2.3. In case of conflict between the standards and this specification, the stringent of the two shall be applicable.

3.0 General requirement

3.1. The Ring Main Unit shall be installed at HV junction points and shall comprise circuit breakers enclosed in the main tank using SF6 gas as insulating medium.

3.2. The main tank shall be stainless steel sheet of minimum 3mm thickness and robotically welded with a pressure relief arrangement.

3.3. The circuit breakers shall be suitable for motorised operation when specified in Data sheet A.

3.4. The main tank (inner enclosure of circuit breaker & load break switch assembly) shall be housed in a single compact metal clad enclosed suitable for both indoor/outdoor applications.

3.5. The switchboard shall be designed such that the position of the different device shall be visible to the operator on the front of board and easy to operate and prevent access to all live parts during operation without the use of tools. There shall be no access to exposed conductors.

3.6. An absorption material such as activated alumina in the tank shall be provided to absorb the moisture from SF6 gas to regenerate SF6 gas following arc interruption. A temperature compensated gas pressure indicator offering a simple indicating shall constantly monitor the SF6 insulating medium.

4.0 SULPHER HEXA FLUORIDE GAS(SF_6 GAS):

4.1. The SF_6 gas shall comply with IEC 376,376A and 376B and shall be suitable in all respects for use in RMUs under the stipulated service conditions. The SF_6 shall be tested for purity, dew point, air hydrolysable fluorides and water content as per IEC 376, 376A and 376B and test certificate shall be furnished to the purchaser indicating all the tests as per IEC 376 for each lot of SF_6 Gas.

5.0 ENCLOSURE:

5.1. Outer Enclosure:

5.1.1 The RMU outer enclosure shall be made up of Cold rolled sheet steel (CRCA) of 3mm thickness. The rating of the enclosure shall be suitable for operation on three phase, three wire, 50 cycles, and HV A.C system with short time current rating as specified in Data sheet A.

5.1.2 The complete RMU enclosure shall be of degree of protection IP 55.

5.1.3 The enclosure shall provide full insulation, making the switchgear insensitive to the environment. The active parts of switchgear shall be maintenance free and the unit shall required minimum maintenance.

5.1.4 Each panel of the switchgear shall be identified by an appropriately sized label which shall clearly indicate the functional units and their electrical characteristics.

5.1.5 The switchgear shall be designed such that the position of the different devices is visible to the operator on the front of the board.

5.2. Inner Enclosure (Main Tank):

5.2.1 The tank shall be robotically welded stainless steel sheet of minimum 3mm thickness. The tank shall be sealed and no handling of gas shall be required throughout the 25 years of service life. However, the SF6 gas pressure inside the tank shall be constantly monitored by a temperature compensated gas pressure indicator.

5.2.2 The gas pressure indicator shall be provided with green pressure and red pressure zones. There shall be one non-return valve to fill up the gas. The manufacturer shall guarantee that the maximum leakage rate of SF6 gas will be less than 0.1% / Year. An absorption material such as activated alumina in the tank shall be provided to absorb the moisture from the SF6 gas to regenerate the SF6 gas following arc interruption.

5.2.3 The degree of protection of the inner enclosure shall be IP 67.

5.3. The compact RMU unit shall be provided with a pedestal made up of M.S angle to mount the unit on plain surface. The height of the bottom of cable box shall be minimum 310mm to provide adequate radius for the HT cable terminations.

6.0 BUSBARS:

The three nos. of continues busbars shall be made of EC grade tinned copper. The bus bar connections shall be anti oxide greased.

7.0 CIRCUIT BREAKER UNIT:

7.1. The circuit breaker shall be non draw out type, three pole operated simultaneously by a common shaft

7.2. The arc quenching media shall be SF6 or vacuum as specified in enclosed Data sheet A1.

7.3. The technical parameters of the circuit breaker shall be as specified in enclosed Data sheet A1.

7.4. The operating mechanism shall be spring charged stored energy type. The operating mechanism shall be provided with motor operation. Motorised circuit breakers shall be suitable for remote operation. Provision for manual operation shall also be made.

7.5. Shunt trip shall be provided for relay operation.

7.6. One three position disconnector with earth switch shall be provided downstream of circuit breaker.

7.7. The following accessories shall be provided on the panel front :

a) Operation counter.

b) Local / Remote selector switch for motorised operation.

c) Control switches / Push button for electrical local operation.

d) Local position indicators for circuit breaker, disconnector and earth switch.

e) Spring charge indicator.

f) Mano meter for SF6 tank pressure.

g) Mimic diagram with colour code as per IS 11954.

7.8. The following auxiliary switches and signal contacts shall be provided for remote indication and alarms:

a) Circuit breaker position indication.

b) Disconnector position indication.

c) Earth switch position indication.

d) Circuit breaker tripped signal.

e) SF6 low pressure.

8.0 ACCESSORY EQUIPMENT:

8.1. The following accessory equipment shall be provided in CB unit as shown in Single Line Diagrams / Data sheet A:

a) Capacitor voltage indicating system with integrated indicating lamps for all the three phases.

b) Protection and metering current transformers.

c) Meters (PM).

d) Protection relays – self powered type, numerical relays. The relays shall be provided with RS485 port connection

e) Short circuit / Earth fault indicator (Fault passage indicator).

f) Surge Arresters

9.0 AUXILIARY POWER SUPPLY:

9.1. The auxiliary power supply for operating motors, shunt trip coils, closing coils, indicating lamps in the RMU panels shall be 24 volt DC.

9.2. The DC supply shall be derived from adequately rated rectifier with battery backup.

9.3. The battery shall be sealed maintenance free (SMF) lead acid type. The battery capacity shall be adequate to carry out 10 close and open operations of the LBS and circuit breakers in the RMU.

9.4. The DC supply shall be extended to the RTU unit of the SCADA system which will be located nearby. The battery and charger capacities shall be adequate to meet continuous and two hour emergency load of RTU.

10.0 BUSHINGS:

All the bushings shall be of same height, parallel, equal distances from ground and protected by a cable cover. It is preferable to have bushings accessible from the rear side of the RMU.

11.0 CABLE BOXES:

All cable boxes shall be air insulated suitable for dry type cable terminations. The cable boxes shall be suitable for HV cables of sizes as mentioned in single line diagram. Necessary right angle boot should

be supplied to the cable terminations. The cable box shall be arc resistant as per IEC 62271-200. The internal arc fault test on cable box shall be carried out. The clearance between phase to phase and phase to earth shall be as per IEC 61243-5. The cable termination and gland arrangements shall be appropriate for the type and size of cables specified.

12.0 WIRING & TERMINALS:

12.1. The wiring shall be carried out using multi strand copper conductor flexible PVC insulated wires of 1.1kV grade for AC Power, DC control and CT circuits. Suitable colored wires shall be used for phase identification and interlocking type ferrules shall be provided at both ends of the wires for wire identification. Terminal should be suitably protected to eliminate sulphating. Connections and terminals should be able to withstand vibrations. The terminal blocks should be screw type for controls and disconnecting link type for CT leads with suitable spring washer and lock nuts.

12.2. Flexible wires shall be used for wiring of devices on swinging panels or panel doors. Panel wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminals blocks. The cable shall be uniformly bunched and tied by means of PVC belts and carried in a PVC carrying trough.

12.3. The position of PVC carrying trough and wires should not give any hindrance for fixing or removing relay casing, switches etc. Wire terminations shall be made with solder less crimping type of tinned copper lugs. Core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted with both ends of each wire. Ferrules shall fit tightly on the wire when disconnected. The wire number shown on the wiring shall be accordance with IS 375.

12.4. All wires directly connected to trip circuits of breaker or devices shall be distinguished by addition of a red colour unlettered ferrule.

12.5. Inter connections to adjacent panels shall be brought out to a separate set of terminal blocks located near the slots or holes to be provided at the top portion of the panels. Arrangements shall be made for easy connections to adjacent panels at site and wires for this purpose shall be provided and bunched inside the panels. The bus wire shall run at the top of the panel. Terminals block with isolating links should be provided for bus wire. At least 10% of total terminals shall be provided as spare for further connections. Wiring shall be done for all the contacts available in the relay and other equipment and brought out to the terminal blocks for spare contacts.

12.6. The wiring shall be in accordance to the wiring diagram for proper functioning of the connected equipment. Terminal blocks shall not be 650V grade and shall be piece moulded type with insulation barriers.

12.7. The terminal shall hold wires in the tight position by bolts and nuts with lock washers. The terminal blocks shall be arranged in vertical formation at an inclined angle with sufficient space between terminal blocks for easy wiring.

12.8. The terminals are to be marked with the terminal number in accordance with circuit diagram and terminal diagram.

13.0 EARTHING:

13.1. The vendor shall provide required number of earth pits with interconnection to achieve less than five ohm earth resistance for each RMU.

13.2. Each RMU have to provide earth mat inside the fence with minimum two earth pits. The earth pits shall be constructed in accordance with IS 3043.

13.3. The material for earth conductors shall be GI strip. The conductor size shall be adequate to carry the specific fault current for one second.

14.0 FAULT PASSAGE INDICATORS / EARTH FAULT INDICATORS(FPI / EFI) :

These shall be provided as specified in Data sheet A. These shall facilitate quick detection of faulty section of line. The fault indication may be on the basis of monitoring fault current flow through the device. The unit should be self contained requiring no auxiliary power supply. The FPI shall be integral part of RMU.

15.0 SAFETY FEATURES:

15.1. Pressure relief device

Any accidental overpressure inside the sealed chamber shall be limited by opening of a pressure relief device in the enclosure. Gas will be released to the rear of the unit away from the operator. Manufacturer shall provide type test report to prove compliance with IEC 298 appendix AA internal fault.

15.2. Operating lever

a) An anti reflex mechanism on the operating lever shall prevent any attempts to re open immediately after closing of switch or earthing switch.

b) All manual operations shall be carried out on the front of the switchboard.

c) The effort exerted on the lever by the operator should not be more than 250N for the switch and circuit breaker.

15.3. Front plate:

a) The front shall include a mimic diagram which indicates different functions.

b) The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator.

c) The lever operating direction shall be clearly indicated in the mimic diagram.

d) The name plate shall include the switchboard's main electrical characteristics.

15.4. Danger Board:

The Danger board plate as per relevant IS shall be riveted on the front and rear of RMU.

16.0 SCADA REQUIRMENT:

16.1. The equipment shall be SCADA compatible. The LBS and circuit breakers shall be suitable for operation from SCADA. The status indication of all disconnectors. Circuit breakers and earth switches shall be provided for SCADA. All fault contacts shall provide alarm signals to SCADA.

16.2. All the connection to SCADA shall be wired to a separate terminal board.

17.0 TYPE TESTS:

17.1. The equipment offered in the tender should have been successfully type tested in line with the relevant standards and technical specification, within the last 5 years from the date of offer. The bidder shall be required to submit complete set of the type test reports along with the offer.

17.2. In case these type tests are conducted earlier than 5 years, all type tests as per the relevant standards shall be carried out by the successful bidder in presence of purchaser's representative free of cost before commencement of supply. The undertaking to this effect should be furnished along with the offer without which the offer shall be liable for rejection.

17.3. The list of type tests shall be as follows:

a) Short time current withstand test and peak current withstand test.

b) Lightning impulse voltage with stand test

c) Temperature rise test

d) Short circuit current making and breaking tests.

e) Power frequency voltage withstand test (dry)

f) Capacitive current switching test confirming to IEC

g) Mechanical operation test.

h) Measurement of the resistance of the main circuit.

i) Checking of degree of protection of main tank and outer enclosure.

j) Switch, circuit breaker, earthing switch making capacity.

k) Switch, circuit breaker breaking capacity.

l) Internal arc withstand.

m) Checking of partial discharge on complete unit.

n) Any other test required as per relevant standard.

17.4. In addition, for switches, test reports on rated breaking and making capacity shall be furnished.

17.5. For earthing switches, test reports on making capacity, short time withstand current and peak short-circuit current shall be furnished.

18.0 ACCEPTANCE & ROUTINE TEST:

18.1. All acceptance and routine tests as stipulated in the respective applicable standards for all the equipment shall be carried out by the supplier in the presence of purchaser's representative without any extra cost to the purchaser before dispatch. After finalization of the program of type/acceptance/routing testing, the supplier shall give 15 days advance intimation to the purchaser, to enable him to depute his representative for witnessing the tests.

18.2. The routine tests shall be as follows:

a) Conformity with drawings and diagrams.

b) Measurement of closing and opening speeds.

c) Measurement of operating torque.

d) Checking of filling pressure.

e) Checking of gas-tightness.

f) Dielectric testing and main circuit resistance measurement.

g) Power frequency voltage test.

h) Mechanical operation tests.

i) Any other test required as per the relevant standards.

19.0 INSPECTION:

19.1. The inspection may be carried out by the purchaser at any stage of manufacture. The successful tenderer shall grant free access to the purchaser's representative at a reasonable notice when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with specification and shall not prevent subsequent rejection if the equipment is found to be defective.

19.2. The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. The supplier shall keep the purchaser informed, in advance about such testing programme.

20.0 DRAWINGS AND DOCUMENTS:

The following drawings and documents shall be furnished for purchaser's approval

a) General arrangement drawings showing plan, elevation and typical sectional views
b) Single line diagrams
c) Schematic diagrams
d) Bill of materials
e) Foundation details
f) Instruction manuals
g) Catalogues of spares recommended with drawing to indicate each items of spares
h) List of spares and special tools recommended by the supplier
i) Copies of type test certificates as per latest IS/IEC
j) Drawings of equipments, relays, etc.

DATA SHEET-A1					
HV RING MAIN UNIT					
SL #		Technical Particulars		UNIT	VALUE
1.0 RING MAIN UNIT-SYSTEM DATA	1.1	Scope			
		a) Number of RMU station		No.	1 (SS-14)
		b) Number of ways (modules) in each RMU			3+1 (VVV+M) V- Vaccum Circuit Breaker, M- Metering Module
		c) Details of RMU stations			As per enclosed SLD
	1.2	Rated System Voltage & Phases		kV (rms)	11kV, 3 Ph
	1.3	Highest System Voltage		kV (rms)	12
	1.4	Rated Frequency		Hz	50
	1.5	System Neutral			Effectively Earthed
	1.6	Rated power frequency withstand voltage (1 min)		kV (rms)	28
	1.7	Impulse withstand BIL (1.2/50/μ sec) Line to earth		kVp	±75
	1.8	Short circuit withstand capacity		Current (kA) rms	20
				Duration (sec)	3
	1.9	Short circuit making capacity		kAp	50
	1.10	Short circuit breaking capacity		kA (rms)	20
	1.11	Reference ambient temperature		°C	45
	1.12	Maximum temperature at continuous current rating and under site referance ambient a) Bus bar connectors and contacts b) Cable termination point		 °C °C	 85 85
2.0 RMU CONSTRUCTION	2.1	Type			Metal enclosed, compartmentalized, free standing construction
	2.2	Service location		Indoor / outdoor	Outdoor
	2.3	Enclosure Protection	Main Tank		IP 67
			Outer enclosure		IP 54
	2.4	Doors			--
	2.5	Covers			--

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
	2.6	Sheet metal		3.0 mm thick CRCA
	2.7	Base frame		Frame shall be covered from all four sides by MS plate/sheet. Painting should match with RMU shade.
	2.8	Lifting lugs		Four members
	2.9	Cable entry	Top / Bottom	Bottom
	2.10	Cable type and Size		Aluminium conductor XLPE insulated, armoured & PVC outer sheath. The size of cable shall be as shown in SLD.
	2.11	Cable termination		
	2.11.1	Terminals for cable terminations		Suitable for ring type Bimetalic lug
	2.11.2	Termination type		Heat shrinkable type
	2.11.3	Terminations height		Min height from gland plate shall be 900mm
	2.12	Bus bars		Tinned copper
	a) Continous rated current		Amps	630
	b) Short time current withstand capacity		KA(rms}	20
			sec	3
	c) Bus bar insulation			Fully insulated
	d) Maximum temperature rise above ambient			As per table no. 3 of IEC 60694
	2.13	Earth bus bar	Material	GS
			size	50 x 10mm
	2.14	Earth bus external connection	Material	GS
			size	50x 10mm
	2.15	Earth bus internal connection to all non current carrying metal parts		By 2.5 sq mm copper flexible wire
	2.16	Cooling arrangement		By natural air without fan
	2.17	Clearance in air of live parts		
		a) Phase to phase	mm	120
		b) Phase to earth	mm	120
	2.18	Mimic diagram		On panel front with colour

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
				code as per IS 11954
	2.19	Control Wiring details		
		a) Material of conductor		Stranded copper
		b) Size of wires		Minimum 2.5 sq mm
		c) Voltage Grade	V	1100
		d) Type of insulation		FRLS PVC
	2.20	Labels for meters & indicators		Anodized aluminium with white character on black background
	2.21	Danger plate on front & rear side		Anodized aluminium with white letters on red background
	2.22	Painting surface preparation		Shot blasting or chemical 7 tank process
	2.23	Painting external finish		Powder coated, shade – RAL 7032, uniform thickness 60 micron minimum
	2.24	Painting internal finish		Powder coated, shade – white, uniform thickness 60 micron
3.0 LBS MODULE	3.1	Type		NA
	3.2	Arc interruption medium		
	3.3	Operating mechanism for close and open		
	3.4	Rated current at specified site ambient temperature		
	3.5	a)Rated breaking capacity b)Rated making capacity		
	3.6	Short time current withstand		
	3.7	Auxiliary power supply for motor, local control, local indication		
	3.8	Accessories required		
		a) Loacal / remote selector switch with 2 NO +2NC contact in each position		
		b) Control switch / push button for local operation		
		c) Local position indicators for disconnectors and earth switch		
		d) Mano meter for SF6 tank		
		e) Operation counter		
	3.9	Auxiliary switches and signal contacts required for remote indication and alarm wired to terminal block		NA
		a) Disconnector position		

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
		b) Earth switch position		
		c) SF6 low pressure		
4.0 CIRCUIT BREAKER MODULE	4.1	Type		Three pole operated simultaneously with three position disconnector and earth switch down stream of circuit breaker
	4.2	Arc interruption medium		Vaccum
	4.3	Rated operating duty		0-0.3sec-CO-3min-CO
	4.4	Operating mechanism		Motor & manual spring charged stored energy type
	4.5	Rated current at specified site ambient temperature	Amps	630
	4.6	Rated breaking capacity	kA (rms)	20
	4.7	Rated making capacity	kA (peak)	50
	4.8	Short time current withstand	kA(rms)	20
			Sec	3
	4.9	DC Component	%	40
	4.10	Total break time	ms	<80
	4.11	Total make time	ms	<80
	4.12	Auxiliary control voltage		
		a) Operating motor		Internal Power Pack
		b) Close and shunt trip coil		
		c) Space heater and lighting		
	4.13	Breaker classification as per IEC 62271-100		
		a) Electrical endurance	E1/E2	E2
		b) Mechanical endurance	M1/M2	M2
	4.14	Accessories required		
		a) Operation counter	Yes/No	Yes with minimum four digits & non resettable
		b) Local / remote selector switch with 2NO+2NC contacts	Yes/No	Yes
		c) Local position indicators for circuit breakers, disconnector and earth switch	Yes/No	Yes
		d) Spring charged indication	Yes/No	Yes
		e) Manometer for SF6 tank pressure	Yes/No	Yes

DATA SHEET-A1					
HV RING MAIN UNIT					
SL #		Technical Particulars	UNIT	VALUE	
		f) Emergency trip push button	Yes/No	Yes	
	4.15	Auxiliary switches and signal contacts for remote indication and alarm wired to terminal block			
		a) Circuit breaker position	Nos.	4NO+4NC	
		b) Disconnector position	Nos.	4NO+4NC	
		c) Earth switch position		2NO+2NC	
		d) Circuit breaker tripped		2NO	
		e) SF6 low pressure		2NC	
5.0 EARTH SWITCH	5.1	Type		Three pole, operated simultaneously by a common shaft, for each circuit breaker	
	5.2	Switching in dielectric medium		SF6 gas	
	5.3	Operating mechanism		Manual	
	5.4	Fault making capacity	kAp	50	
	5.5	Auxiliary contacts		2NO+2NC	
	5.6	Minimum number of operations at no load (as per IEC 62271-102)		Mechanical endurance – class MI (1000 operations)	
	5.7	Making capacity endurance of earth switch (as per IEC 62271-102)		Class E2	
6.0 ACCESSORY	6.1	Capacitor voltage indicating system			
		a) Application		In CB modules as shown in Single line diagram (SLD)	
		b) Complete with integrated indicating lamps for R,Y,B phases		Required	
	6.2	Protection and metering current transformer			
		a) Application		As shown in SLD	
		b) Parameters		Protection CT	Metering CT
		i. Ratio		As shown in SLD	As shown in SLD
		ii. Accuracy class		5P10	0.5
		iii. VA burden	VA	By bidder Min 5	5
	6.3	Voltage transformer			
		a) Application		As shown in SLD	

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
		b) Parameters		
		i. Ratio		11kV/√3 / 110/√3/ 110/3 Volt
		ii. Methods of connection		Star / Star/ Open Delta
		iii. Accuracy class		As shown in SLD
	6.4	Protection relay		
		a) Type		Self powered or conventional type, numerical relays as shown in SLD
		b) Relay elements required		As shown in SLD
		c) RS 485 port connection	Yes / No	Yes
	6.5	Fault passage indicator (short circuit & earth fault indicator)		
		a) Application		As shown in SLD
		b) Features required		
		i. Local and remote indication for FPI operated	Yes / No	Yes
		ii. Reset of FPI local and remote	Yes / No	Yes
	6.6	Surge arrester		
		a) Application		As shown in SLD
		b) Type		Gapless, metal oxide
		c) Rated voltage	kV (rms)	11
		d) Nominal discharge current	kA peak	10
7.0. AUXILIARY POWER SUPPLY	7.1	AC power supply		Internal Power Pack
	7.2	DC power supply		
	7.3	Battery		
		a) Type		
		b) capacity	Ah	
	7.4	Battery charger		
8.0 INTERLOCKS	8.1	Load break switch & respective earth switch		NA
	8.2	Circuit breaker & respective earth switch		Mechanical. Only one in close condition at a time.
	8.3	Prevent the removal of respective cable covers if load break switch or circuit breaker is 'ON'		Electrical / Mechanical
	8.4	Prevent the closure of circuit breaker if respective cable cover is open		Electrical / Mechanical

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
	8.5	Cable test plug for CB accessible only if earth switch connected to earth		Mechanical
	8.6	For motorized RMUs prevent motorized operation of CB during manual operation		Electrical / Mechanical. Electrical signal shall be cut off during manual operation.
9.0 CONNECTIONS FOR SCADA	9.1	Connection for SCADA		All connections for SCADA shall be wired to a seperate terminal board
	9.2	Potential free contacts for status indication in SCADA from each module as applicable		
		a) Local / remote selector switch		1 NO contact in each position
		b) Load Break switch (LBS)close/open		NA
		c) Circuit breaker (CB) close / open		2NO+2NC
		d) Earth switch close / open		1NO+1NC
	9.3	Potential free contacts for alarm signal to SCADA from each module as applicable		
		a) Circuit breaker tripped		1 NO
		b) Protection relay operated		1 NO
		c) SF6 gas pressure low		1 NO
		d) Fault passage indicator operated		1 NO
		e) Pressure relief device operated		1 NO / NC
		f) Battery charger fail		1 NO
		g) Any other signal recommended by vendor		
	9.4	Commands for operation from SCADA from each module as applicable		
		a) LBS close and open		NA
		b) CB close and open		Yes
		c) Fault passage indicatior reset		Yes
	9.5	RS 485 port connection from		
		a) Protection relay		Wherever applicable
		b) Multifunction relay		Wherever applicable
10.0 EARTHING	10.1	Earth pit		
		a) Type		--
		b) Number		--
	10.2	Earth grid		

DATA SHEET-A1				
HV RING MAIN UNIT				
SL #		Technical Particulars	UNIT	VALUE
		a) Requirement		--
		b) Earthing conductor Layout		--
		c) Conductor material		--
		d) Conductor size		--

DATA SHEET A2 HV RING MAIN UNIT APPLICABLE STANDARDS			
SL NO.	DESCRIPTION	STANDARDS	
1.	Circuit breakers	IS 13188	IEC 62271-100
2.	High voltage switches	IS 9920	IEC 60265
3.	Isolators	IS 9921	IEC 60129 IEC 62271-102
4.	SF6 Gas for use in electrical equipment		IEC 60376
5.	Degree of protection provided by enclosure	IS 13947	IEC 60947
6.	High voltage switchgear and control gear		IEC 60694
7.	Current transformers	IS 2705	IEC 60185
8.	Voltage transformers	IS 3156	IEC 60186
9.	Surge arresters	IS 3070	IEC 60099
10.	Relays	IS 3231	IEC 60255
11.	Insulators	IS 2544	IEC 60168
12.	Bushings	IS 2099	IEC 60137
13.	Clamps & connectors	IS 5561	IEC 60305
14.	Hot dip galvanising	IS 2629 IS 2633	

DATA SHEET-B					
HV RING MAIN UNIT					
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
SL #		TECHNICAL PARTICULARS		UNIT	VALUE
1.0 RING MAIN UNIT-SYSTEM DATA	1.1	Scope			
		a) Number of RMU stations		Nos.	
		b) Number of ways (modules) in each RMU stations		Nos.	
		c) Deatils of RMU stations		Nos.	
	1.2	Manufacturers Name			
	1.3	Country of manufacturer			
	1.4	Vendor's type designation			
	1.5	Rated system voltage and phases		kV (rms)	
	1.6	Highest System Voltage		kV (rms)	
	1.7	Rated Frequency		Hz	
	1.8	System Neutral			
	1.9	Rated power frequency withstand voltage (1 min)		kV (rms)	
	1.10	Impulse withstand BIL (1.2/50/μ sec) Line to earth		kVp	
	1.11	Short circuit withstand capacity		Current (kA)rms	
				Duration(sec)	
	1.12	Short circuit making capacity		kAp	
	1.13	Short circuit breaking capacity		kA (rms)	
	1.14	Reference ambient temperature		°C	
	1.15	Maximum temperature at continous current rating and under site referance ambient a) Bus bar connectors and contacts b) Cable termination point		°C °C	
RMU SWITCHGEAR CONSTRUC	2.1	Type			
	2.2	Service location		Indoor / outdoor	
	2.3	Enclosure	Main tank		

DATA SHEET-B					
HV RING MAIN UNIT					
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
SL #		TECHNICAL PARTICULARS		UNIT	VALUE
		Protection	Outer Enclosure		
	2.4	Doors			
	2.5	Covers			
	2.6	Sheet metal			
	2.7	Base frame			
	2.8	Lifting lugs			
	2.9	Cable entry		Top / Bottom	
	2.10	Cable type and Size			
	2.11	Cable termination			
	2.11.1	Terminals for cable terminations			
	2.11.2	Termination type			
	2.11.3	Terminations height			
	2.12	Bus bars			
		a) Continous rated current		Amps	
		b) Short time withstand capacity		Current	
				sec	
		c) Bus bar insulation			
		d) Maximum temperature rise above ambient			
	2.13	Earth bus bar		Material	
				size	
	2.14	Earth bus external connection		Material	
				size	
	2.15	Earth bus internal connection to all non current carrying metal parts			
	2.16	Cooling arrangement			
2.0 RMU SWITCHGEAR CONSTRUCTION	2.17	Clearance in air of live parts			
		a) Phase to phase		mm	
		b) Phase to earth		mm	
	2.18	Mimic diagram			
	2.19	Wiring details			
		a) Material of conductor			
		b) Size of wires			

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
		c) Voltage Grade	V	
		d) Type of insulation		
	2.20	Labels for meters & indicators		
	2.21	Danger plate on front & rear side		
	2.22	Painting surface preparation		
	2.23	Painting external finish		
	2.24	Painting internal finish		
	2.25	Overall dimension of Each RMU		
		a) Length	mm	
		b) Depth	mm	
		c) Height	mm	
	2.26	Weight of each RMU	Kg	
3.0 LOAD BREAK SWITCH (LBS) MODULE	3.1	Make		
	3.2	Type		
	3.3	Arc interruption medium		
	3.4	Operating mechanism for close and open		
	3.5	Rated current at specified site ambient temperature	A	
	3.6	Rated breaking current	kA (rms)	
	3.7	Rated making capacity	kAp	
	3.8	Short time current withstand	kA (rms}	
			Sec	
3.0 LOAD BREAK SWITCH (LBS) MODULE	3.9	Auxiliary power supply for motor, local control, local indication		
	3.10	Accessories provided		
		a) Loacal / remote selector switch with 2 NO +2NC contact in each position	Yes / No	
		b) Control switch / push button for local operation	Yes / No	
		c) Local position indicators for disconnectors and earth switch	Yes / No	
		d) Mano meter for SF6 tank	Yes / No	
		e) Operation counter	Yes / No	
	3.11	Auxiliary switches and signal contacts provided for remote indication and		

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
		alarm wired to terminal block		
		a) Disconnector position	Nos.	
		b) Earth switch position	Nos.	
		c) SF6 low pressure	Nos.	
	3.12	Total opening time at rated current	ms	
	3.13	No. of breaks per pole	Nos.	
	3.14	Total length of contact travel	mm	
	3.15	No. of LBS close & open operation cycles guaranteed at		
		a) 25% of rated current		
		b) 50% of rated current		
		c) 75% of rated current		
		d) 100% of rated current		
	3.16	No. of LBS making operations guaranteed at rated fault current electrical endurance class		
	3.17	No. of close & open operations guaranteed at zero current, Mechanical endurance class		
4.0 CB MODULE	4.1	Make		
	4.2	Vendor's type designation		
	4.3	Type		
	4.4	Arc interruption medium		
	4.5	Rated operating duty		
	4.6	Operating mechanism		
	4.7	Rated current at specified site ambient temperature	Amps	
	4.8	Rated breaking capacity	kA (rms)	
	4.9	Rated making capacity	kA (peak)	
	4.10	Short time current withstand	kA(rms)	
			Sec	
	4.11	DC Component	%	
	4.12	Total break time	ms	
	4.13	Total make time	ms	
	4.14	Auxiliary control voltage		

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
		a) Operating motor		
		b) Close and shunt trip coil		
		c) Space heater and lighting		
	4.15	Breaker classified as per IEC 62271-100		
		a) Electrical endurance	E1/E2	
		b) Mechanical endurance	M1/M2	
	4.16	Accessories provided		
		a) Operation counter	Yes/No	
		b) Local / remote selector switch with 2NO+2NC contacts	Yes/No	
		c) Local position indicators for circuit breakers, disconnector and earth switch	Yes/No	
		d) Spring charged indication	Yes/No	
		e) Manometer for SF6 tank pressure	Yes/No	
		f) Emergency trip push button	Yes/No	
	4.17	Auxiliary switches and signal contacts for remote indication and alarm wired to terminal block		
		a) Circuit breaker position	Nos.	
		b) Disconnector position	Nos.	
		c) Earth switch position		
		d) Circuit breaker tripped		
		e) SF6 low pressure		
	4.18	Number of breaks per pole		
	4.19	Total length of contact travel	mm	
	4.20	Nos. of circuit breaker close and open operations guaranteed at:		
		a) 25% of rated current	Nos.	
		b) 50% of rated current	Nos.	
		c) 75% of rated current	Nos.	
		d) 100% of rated current	Nos.	
5.0 EARTH SWITCH	5.1	Type		
	5.2	Switching in dielectric medium		

DATA SHEET-B					
HV RING MAIN UNIT					
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)					
SL #		TECHNICAL PARTICULARS	UNIT	VALUE	
	5.3	Operating mechanism			
	5.4	Fault making capacity	kA		
	5.5	Auxiliary contacts			
	5.6	Minimum number of operations at no load (as per IEC 62271-102)			
	5.7	Making capacity endurance of earth switch (as per IEC 62271-102)			
6.0 ACCESSORY EQUIPMENT	6.1	Capacitor voltage indicating system			
		a) Application			
		b) Complete with integrated indicating lamps for R,Y,B phases			
	6.2	Protection and metering current transformer			
		a) Application			
		b) Parameters		Protection	Metering CT
		i. Ratio			
		ii. Accuracy class			
		iii. VA burden	VA		
	6.3	Voltage transformer			
		a) Application			
		b) Parameters			
		i. Ratio			
		ii. Methods of connection			
		iii. Accuracy class			
	6.4	Protection relay			
		a) Type			
		b) Relay elements provided			
		c) RS 485 port connection	Yes / No		
	6.5	Fault passage indicator (short circuit & earth fault indicator)			
		a) Application			
		b) Features provided			
		i. Local and remote indication for FPI operated	Yes / No		
		ii. Reset of FPI local and remote	Yes / No		
	6.6	Surge arrester			

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
		a) Application		
		b) Type		
		c) Rated voltage	kV (rms)	
		d) Nominal discharge current	kA peak	
7.0 AUXILIARY POWER SUPPLY	7.1	AC power supply		
	7.2	DC power supply		
	7.3	Battery		
		a) Type		
		b) Make		
		c) Vendor's type designation		
		d) Ampere hour capacity	Ah	
		e) No. of cells in series	Nos.	
		f) Cell voltage — Initial	Volts	
		f) Cell voltage — Final	Volts	
	7.4	Battery charger		
		a) Make		
		b) Type		
		c) Dual redundant type	Yes/No	
		d) Input voltage	Volts ac	
		e) Output voltage	Volts dc	
		f) Rated DC current	Amps	
		g) Float charging current		
		h) Boost charging current		
		i) Natural cooling provided for charger	Yes / No	
		j) Rectifier type		
8.0 INTERLOCKS	8.1	Load break switch & respective earth switch		
	8.2	Circuit breaker & respective earth switch		
	8.3	Prevent the removal of respective cable covers if load break switch or circuit breaker is 'ON'		

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
	8.4	Prevent the closure of laod break switch or circuit breaker if respective cable cover is open		
	8.5	Cable test plug for LBS / CB accessible only if earth switch connected to earth		
	8.6	For motorized RMUs prevent motorized operation of LBS / CB during manual operation		
9.0 CONNECTIONS FOR SCADA	9.1	Connection for SCADA wired to separate terminal board		
	9.2	Potential free contacts provided for status indication in SCADA		
		a) Local / remote selector switch		
		b)		
		c) Load Break switch (LBS)close/open		
		d) Circuit breaker (CB) close / open		
		e) Earth switch close / open		
	9.3	Potential free contacts for alarm signal to SCADA		
		a) Circuit breaker tripped		
		b) Protection relay operated		
		c) SF6 gas pressure low		
		d) Fault passage indicator operated		
		e) Battery charger fail		
		f) Any other signal recommended by vendor		
	9.4	Commands for operation from SCADA		
		a) LBS close and open		
		b) CB close and open		
		c) Fault passage indication reset		
	9.5	RS 485 poer connection		
		a) Protection relay		
		b) Multifunction relay		
10.0 EARTH	10.1	Earth pit		
		a) Type		

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
		b) Number provided for each RMU	Nos.	
	10.2	Earth grid		
		a) Conductor material		
		b) Conductor size		
	10.3	Earth resistance of RMU	Ohm	

DATA SHEET-B				
HV RING MAIN UNIT				
(TO BE FILLED IN BY THE BIDDER AND ENCLOSED WITH THE BID)				
SL #		TECHNICAL PARTICULARS	UNIT	VALUE
11.0 DRAWINGS / DATA FURNISHED WITH BID	11.1	Drawings and catalogues		
		a) Plan and section drawings of each RMU	Yes / No	
		b) Single line diagram of each RMU	Yes / No	
		c) Catalogues of major equipment	Yes / No	
	11.2	Type test reports	Yes / No	Furnish list of type test reports
	11.3	Experience list	Yes / No	
	11.4	Recommended spares with unit rates	Yes / No	
	11.5	Recommended special tools and instruments with unit rates	Yes / No	

1.0 SCOPE:

This Specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR's/his SUB-VENDOR's works, delivery to Site and performance testing of oil filled power transformers.

2.0 CODES & STANDARDS:

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

2.2 Transformers shall conform to the currently applicable standards and codes of practice as specified in Data Sheet-A. In case of conflict between the applicable reference standards and this Specification, this specification shall govern.

3.0 GENERAL CONSTRUCTIONAL FEATURES:

3.1 All material used shall be of best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of atmosphere temperature and other atmospheric conditions, overloads, over-excitation, short circuits as per specified standards, without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

3.2 Similar parts, particularly removable ones, shall be interchangeable.

3.3 Exterior of pipes and pipe fittings, screws, studs, nuts and bolts used for external connections shall be hot dip galvanised.

4.0 ELECTRICAL & PERFORMANCE REQUIREMENTS:

4.1 Transformers shall operate without injurious heating at the rated kVA at any voltage within $\pm$10% of the rated voltage of that particular tap.

4.2 Transformers shall be capable of delivering the rated current at a voltage equal to 105% of the rated voltage without exceeding the limiting temperature rise.

4.3 Overloads shall be allowed with in the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tap-changers or other auxiliary equipment shall apply.

4.4 The neutral terminal of windings with star or zig-zag connection shall be designed for the highest overcurrent that can flow through this winding.

4.5 Every care shall be taken to ensure that the design and manufacture of the transformers shall be such as to reduce noise and vibration to the level obtained in good modern practice. The noise level shall not exceed the level specified in applicable standard.

4.6 For transformers with tapping, full power tapping shall be provided.

4.7 The thermal and dynamic ability to withstand short circuit shall be demonstrated by tests or by reference to tests on similar transformers.

4.8 The transformers shall be designed with particular attention to the suppression of harmonic voltage, especially the third and fifth, so as to minimize wave form distortion and from any possibility of high frequency disturbances reaching such a magnitude as to cause interference with communication circuits.

4.9 All rated quantities subject to the VENDOR's guarantees shall be within the tolerances given in applicable standards.

4.10 Unless otherwise specified in Data Sheet –A transformers shall be designed for the following over fluxing withstand capability:

a) 110% - Continuous for all transformers

b) 125% - For 1 minute and 140% for 5 Sec. for generator transformers and unit aux. transformers

Transformers shall operate below the knee of the saturation curve at 110% voltage to preclude ferro resonance and non-linear oscillations.

4.11 The maximum flux density in any part of the core and yokes, at normal voltage and frequency shall be such that the flux density under over voltage conditions as per clauses 4.1, and 4.10 shall not exceed the maximum permissible values for the type of core and yoke material used. The type of material and values of flux density in the core/ yoke for the 100%, 110%, 125% and 140% and the hysterisis characteristic curves shall be included in the bid and in relevant Data Sheet B, and shall be subject to the PURCHASER's approval.

4.12 Transformers, complete with bushings/ cable boxes, shall be designed and constructed to withstand without damage, the effects of external short circuits (as specified at Data Sheet A) as per the specified standards. Account shall be taken of the different forms of system faults that can arise in service, such as line to earth faults and line to line faults associated with the relevant system and transformer earthing conditions.

5.0 CORE:

5.1 The magnetic circuit shall be constructed from high-grade cold rolled non-ageing grain oriented silicon steel laminations.

5.2 The laminations shall be free of all burrs and sharp projections. Each sheet shall have an insulating coating resistant to the action of hot oil.

5.3 The construction is to be of 'core' type.

5.4 The insulation structure for the core to bolts and core to clamp plates shall be such as to withstand a voltage of 2000 V for one minute.

5.5 The completed core and coil assembly of core type units shall be so assembled that the axis and the plane of the outer surface of the coil stack shall not deviate from the vertical plane by more than 25 mm.

5.6 All steel sections used for supporting the core shall be thoroughly shot or sand-blasted, after cutting, drilling and welding.

5.7 The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.

5.8 The core clamping structure shall be designed to minimise eddy current loss.

5.9 The core shall be provided with lugs suitable for lifting the complete core and coil assembly.

5.10 The core and coils assembly shall be so fixed in the tank that shifting will not occur during transport or short circuits.

5.11 The framework and clamping arrangements shall be securely earthed in accordance with clause 6.0.

6.0 INTERNAL EARTHING :

6.1 All internal metal parts of the transformer, with the exception of individual laminations, core bolts and their individual clamping plates shall be earthed inside the tank by copper strap connection to the tank.

6.2 The top clamping structure shall be connected to the tank by a copper strap. The bottom clamping structure shall be earthed by one or more of the following methods:

a) By connection through vertical tie-rods to the top structure

b) By direct metal to metal contact with the tank base

c) By connection to the top structure on the same side of the core as the main earth connection to the tank.

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

6.4 Coil clamping rings of metal at earth potential shall be connected to the adjacent core clamping structure on the same side as the main earth connection in Clause 6.2.

7.0 WINDINGS:

7.1 Windings shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service.

7.2 Windings shall be of copper unless specifically approved by the PURCHASER. The conductors shall be transposed at sufficient intervals in order to minimise eddy currents and equalise the distribution of currents and temperatures along the windings.

7.3 Materials used in the insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil, and shall not soften or be otherwise affected under the operating conditions.

7.4 Varnish application on coil windings may be given only for mechanical protection and not for improvement in dielectric properties. In no case varnish or other adhesive be used which will seal the coil and prevent evacuation of air and moisture and impregnation by oil.

7.5 All threaded connections shall be locked. Leads from the winding to the terminal board and bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.

7.6 Windings and connections shall be braced to withstand shocks during transport or short circuits.

7.7 Permanent current carrying joints in the windings and leads shall be welded or brazed. Clamping bolts for current carrying parts inside oil shall be made of oil resistant material which shall not be affected by acidity in the oil. Steel bolts, if used, shall be suitably treated.

7.8 The completed core and coil assembly shall be dried in vacuum at not more than 0.5mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum oven tank or in the transformer tank. Vapour phase dry out shall be preferred.

8.0 TANK:

8.1 Tank shall be made from good commercial grade, low carbon steel and shall be of welded construction.

8.2 Tank shall be designed to permit lifting, by crane or jacks of the complete transformer assembly filled with oil. Suitable lugs and bosses shall be provided for this purpose.

8.3 Tank together with radiators, conservator, bushings and other fittings shall be designed to withstand without permanent distortion for the following conditions:

a) Full vacuum of 760mm of Hg. for filling with oil by vacuum.

b) Internal gas pressure of 0.35 kg/cm2 (5 lbs/sq.in) with oil at operating level.

8.4 The transformer top shall be provided with a detachable tank cover with a bolted flanged gasket joint. Lifting lugs shall be provided for removing the cover. The surface of the cover shall be suitably sloped so that it does not retain rainwater.

8.5 The material used for gaskets shall be cork-neoprene or approved equivalent. Gasketted joints for tank, bushings and other bolted attachments shall be so designed that the gasket will not be exposed to the weather.

8.6 The exterior of tank and other steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather resistant nature, preferably of distinct colour from the prime and finish coats. The final coat shall be of a glossy, oil and weather resisting non-fading paint of specified shade. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant and oil insoluble paint.

8.7 Tank shall be provided with a pressure release device, which shall operate at a pressure below the test pressure for the tank and radiators. The device shall be rainproof after blowing and shall be provided with a device visible from ground to indicate operation. An equaliser pipe connecting the pressure relief device to the conservator shall be supplied. This device shall be provided for all transformers rated 500 kVA and above. Explosion vent shall be equipped with remote monitoring/alarm contacts.

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

8.9 Manholes with bolted covers shall be provided in the top or sides of transformer for easy access to the lower ends of bushings, tap changers and to permit replacement of auxiliaries without removing tank cover.

8.10 Hermitically Sealed Transformer: Completely oil filled system in which the expansion of the oil is taken up by elastic movement of the permanently sealed, usually corrugated tank. Conservator and Breather are not required for this type of Transformer.

9.0 VALVES:

9.1 Valves shall be of forged carbon steel up to 50mm size and of gunmetal or of cast iron bodies with gunmetal fittings for sizes above 50mm. They shall be of full-way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.

9.2 Every valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be furnished with pipe plugs for protection.

9.3 All valves shall be provided with flanges having machined faces drilled to suit the applicable requirements. Oil-tight blank flanges shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required, the VENDOR shall supply the same.

9.4 Each transformer shall be provided with following valves on the tank:

a) Drain valve with cover plate so located as to completely drain the tank. The same can be used as bottom filter valve and the size shall be 50 mm.

b) Filter valve at top of transformer tank, one of 50mm size.

c) Oil sampling valves not less than 8 mm, at top and bottom of main tank.

d) One 15 mm air release device.

e) Valves between radiators

f) Two plugged pipe outlets for applying vacuum

10.0 UNDER-CARRIAGE:

The under-carriage of the transformer shall be provided with detachable steel flanged wheels or flat rollers as specified in Data Sheet-A. Flanged wheels shall be spaced to allow specified rail gauge. Wheels shall be provided with suitable bearings, which will resist rust and corrosion and shall be equipped with fittings for lubrication. Unless otherwise approved, it shall be possible to swivel the wheels or rollers in two directions, at right angles to or parallel to the main axis of the transformer, thereby permitting movement in two directions. The wheels or rollers will be swivelled after jacking the transformer and they shall be lockable in both the positions.

11.0 TRANSFORMER COOLING:

11.1 Radiators shall be designed to withstand the vacuum and pressure conditions specified for the tank. They shall be so designed as to avoid pockets in which moisture may collect, to completely drain oil into the tank and to prevent formation of gas pockets when the tank is being filled.

11.2 The clearance between all pipe work and live parts shall be more than the clearance for live parts to earth.

11.3 Unless otherwise approved, for transformers rated 5000kVA and above, tank mounted radiators/ coolers shall be of the detachable type with bolted and gasketed flanged connections. The following accessories shall be provided for radiator:

a) Shut-off valves and blanking plates on transformer tank at each point of connection.

b) Top and bottom shut-off valves and blanking plates on each radiator.

c) Lifting lugs

d) Top oil filling plug 19mm size

e) Air release plug at top

f) Oil drain plug at bottom, 19 mm size.

12.0 TAP CHANGING GEAR

12.1 Off-Circuit Tap Changing Gear

The off circuit tap changer shall be operable by means of an operating handle brought outside the tank and operable from ground level. It shall be equipped with an indicating device to show the tap in use and shall be provided with a locking arrangement to lock the switch in any tap position. The tap changer contacts and connections shall be accessible through an access hole having a bolted gasketted cover.

12.2 On-load Tap Changing Gear (OLTC)

The OLTC gear, if specified, shall comply with requirements of enclosed specification # PCPL-4-S4-133.

13.0 CONTROL CABINETS

	OLTC remote control Cabinet	OLTC local control cabinet transformer marshalling box & cooler control Cabinet

Execution	Indoor	Outdoor, weather proof
Mounting	Floor mounted	Tank mounted or mounted on a separate foundation
Wiring	All cooler control, alarm and trip circuits shall be wired for auxiliary DC supply as specified	
General specifications	In accordance with enclosed specification PCPL-4-S4-133 and latest applicable standards	
Special requirements		Bottom of the tank mounted cabin shall be at least 600mm from floor level. Top surface shall be sloped. Indicating lamps & meters shall be covered by a glass window. Gland plates and cable glands as required shall be provided at the bottom

14.0 BUSHINGS:

14.1 All porcelain used in bushings shall be homogeneous, non-porous, uniformly glazed to brown colour and free from blisters, burns and other defects.

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

14.3 Bushings shall be designed and tested to comply with the applicable standards specified in Data Sheet-A. If type test certificates are not available, these tests shall also be carried out in addition to the routine tests.

14.4 Bushings rated for 400 A and above shall have non-ferrous flanges and hardware.

14.5 Liquid / oil filled bushings 36kV and above shall be equipped with liquid level indicators and means for sampling and draining the liquid. The angle of inclination to vertical shall not exceed 30^{O}C.

14.6 Oil in oil filled bushings shall meet the requirements of the transformer oil standards specified in Data Sheet-A.

14.7 Fittings made of steel or malleable iron shall be galvanised.

14.8 Whenever specified in Data Sheet-A, bushings shall be supplied with terminal connector/ clamp suitable for fixing to bushing terminal and the PURCHSER's specified conductors. The connector/ clamp shall be rated to carry the bushing rated current without exceeding a temperature rise of 45^{O}C in an ambient of 50^{O}C.

14.9 Bushings for 36kV (except for neutral bushings) and above shall be provided with adjustable rod gap. For bushings rated lower than 36kV, the gap shall be of double series type to minimise interference from birds.

14.10 The neutral of the star connected winding shall be brought out to a separate bushing terminal. The neutral bushing shall be provided on the tank side to facilitate leading the earth conductor down to the ground level. In addition, tank mounted pin type support insulator shall be provided for supporting the neutral earthing bar of specified section along its run from the neutral bushing to ground level. In case of 4 wire system, additional neutral terminal shall be brought out to cable box or busduct terminal flange for PURCHASER's connection.

14.11 Bushings shall be so located on the transformers that full flashover strength will be utilised and minimum clearances as required for the BIL shall be realised between live parts and live parts to earthed structures.

14.12 The applicable routine and type tests (if certificates of same are not available), as stated in the specified bushing standards shall be carried out.

14.13 Bushing current transformers shall comply with specified standards.

a) It shall be possible to remove turret mounted CT's from the transformer tank, without removing the cover.

b) All the secondary leads including tappings shall be brought to a weather proof outlet box near the bushing. The VENDOR shall arrange conduit wiring from this outlet box up to the transformer marshalling box or control cabinet.

c) Bushing CT name plate shall be mounted on the equipment tank adjacent to the terminal box.

15.0 CABLE BOXES & DISCONNECTING CHAMBERS:

15.1 Cable boxes and sealing ends shall be complete with tinned copper lugs to suit the specified cable and all other accessories including compression glands, and armour earthing clamps.

15.2 Cable boxes shall be designed to accommodate all cable termination fittings or sealing ends as required, including stress/cones or other approved means for grading voltage stress on the terminal insulation of cables operating at voltage of 6.6 kV and above.

15.3 Phase to phase and phase to ground air clearances within the chamber shall be such as to enable either the transformer or each cable to be subjected separately to H.V tests. Clearances shall be subject to the PURCHASER's approval.

15.4 When specified in Data Sheet - A, disconnecting chamber shall be provided to enable the transformer to be removed without unsealing the cables or draining oil from the main tank. The disconnecting chamber shall be air insulated and complete with seal-off bushings, removable flexible connectors/links and removable covers.

16.0 BUS DUCT TERMINATIONS:

16.1 When bus duct termination is specified in Data Sheet A, a flanged bushing or equivalent connection shall be provided to suit PURCHASER's bus ducts. The winding terminations shall be on outdoor type of bushings. The material of the bus duct termination flange shall be non-magnetic unless otherwise approved by the PURCHASER.

17.0 MARSHALLING BOX:

17.1 All the contacts/ terminals of electrical devices mounted on the transformer shall be marshalled to a marshalling box. It shall be in the VENDOR's scope to provide:

a) the interconnecting cabling between the marshalling box and the accessory devices by either PVC insulated wires in GI conduits or PVC insulated armoured cables

b) Necessary compression type brass cable glands at the marshalling box for the above mentioned cables as well as for terminating the PURCHASER's incoming cables from remote panels.

17.2 Marshalling box shall be tank mounted, outdoor, weather proof sheet steel enclosed (min. 2mm thick), with hinged door having padlocking facility and painted as per clause 8.6. All doors, covers and plates shall be fitted with neoprene gaskets. Bottom shall be at least 600mm from the floor level and provided with gland plate and cable glands as required. Top surface shall be sloped.

17.3 All contacts for alarm, trip and indication circuits shall each be electrically free, wired for auxiliary D.C supply as specified and brought out to separate terminals at the terminal blocks in the marshalling box. Terminals shall be rated for 10A. Wiring shall be with stranded copper conductors of sizes not smaller than 1.5 sq. mm. for control and CT circuits.

18.0 OIL:

18.1 Transformer shall be supplied complete with new transformer oil complying with latest applicable standard. 10% extra oil shall be supplied for topping up at site. Oil shall either be filled in the transformer or be supplied in non returned steel drums as specified in Data sheet – A. Transformer shall be transported nitrogen filled, if specified in Data sheet – A.

19.0 FITTINGS & ACCESSORIES:

The following fittings and accessories shall be provided:

19.1 Bushing terminals complete with connectors for the PURCHASER's external conductors or cable boxes, as specified in Data Sheet A.

19.2 Neutral bushing terminal complete with connector for earth conductor specified in Data Sheet A.

19.3 Inspection covers on the top cover of the transformer (for transformers rated 500 kVA and above).

19.4 Terminal marking and rating plates as per the specified standard.

19.5 Two earthing terminals. The tank cover, detachable parts such as radiators, marshalling box, cooler control cabinet, cable boxes, motors etc., shall be effectively earthed.

19.6 Lifting lugs or eyes for:

a) lifting of fully assembled transformer with oil

b) lifting core and coils

19.7 Drain cum sampling valve with plug or cover plate.

19.8 Weather-proof dehydrating breather with silica-gel and oil seal to eliminate constant contact with the atmosphere.

19.9 Oil level indicator with minimum marking.

19.10 Thermometer pocket.

19.11 The conservator of sufficient volume to maintain the oil seal from the minimum ambient temperature of -5^{o} C up to an oil temperature of 100^{o} C, with oil level varying within the minimum and maximum visible levels. The conservator shall be provided with the following accessories:

a) Filling plug, sump and drain valve of 15 mm size for conservator of size 650 mm and 25 mm size for conservator above 650 mm diameter.

b) 150 mm diameter magnetic type oil level gauge with low oil level alarm contacts and/ or a prismatic oil sight gauge, as specified in Data Sheet-A and provided with markings for minimum oil level and oil level at rated temperature rise.

c) A bolted cover at one end for cleaning.

d) Valve for shutting off oil to the transformer

19.12 Jacking lugs, if the transformer filled with oil weighs above 3000kg.

19.13 Hauling eyes on each face of the transformer.

19.14 The under base provided with channel for fixing on a platform or plinth.

19.15 A pressure relief device with contacts for trip and alarm for transformers rated above 500kVA. The device shall be rainproof after operation. An equaliser pipe connecting the pressure relief device to the conservator shall also be supplied.

19.16 Dial type thermometer with two contacts for oil temperature "HIGH" and "TOO HIGH" alarms. Each contact shall be electrically independent and brought out to separate terminals, rated 220V DC, minimum 0.5 A.

19.17 A double float type Buchholz relay as per specified standard shall be provided whenever called for in Data Sheet-A. All gas evolved in the transformer shall collect in this relay. The relay shall be provided with a test cock suitable for flexible pipe connection for checking its operation. A 5mm copper pipe shall be connected from the relay test cock to a valve located about 1.25m above ground level to facilitate sampling with the transformer in service. The device shall be provided with two electrically independent ungrounded contacts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure. These contacts shall be wired up to the transformer marshalling box. The relay shall be provided with shut-off valves on the conservator side as well as the tank side.

19.18 Gas sampling device at an accessible height and an air release cock for Buchholz relay.

19.19 The following valves shall be provided:

a) One (1) top filter valve with blanking plate.

b) One (1) bottom filter valve with blanking plate.

19.20 A device for measuring the hot spot temperature of the winding shall be provided when called for in the Data Sheet-A. The Winding temperature indicator, consisting of the following shall be provided:

a) Temperature sensing element

b) Image coil

c) Current transformer

d) 150mm dia. Local indicating instrument with settable electrically independent contact brought out to separate terminals for winding temperature “HIGH” and “TOO HIGH” alarms. Contacts shall be suitable for 220V DC, rated minimum 0.5 A.

e) A pointer to register the highest temperature reached and capable of being reset without tools.

f) Calibration device.

g) Automatic ambient temperature compensation.

h) In addition to the above, the following remote indication equipment shall be provided when called for in Data Sheet A:

i. Top oil resistor temperature detector in each winding of the transformer to be connected to the PURCHASER’s multipoint temperature recorder for HV and LV winding temperature indication.

ii. Remote winding temperature indicator, flush mounted instrument for mounting on the PURCHASER’s panel.

19.21 Transformers up to 500kVA shall be provided with explosion vent.

20.0 TESTS:

20.1 Routine Tests

20.1.1 All routine tests as per applicable standard shall be carried out on each transformer without any extra charges.

20.1.2 The routine tests shall also include the following:-

a) Oil leakage test: The main transformer tank and all oil filled compartments necessary for a complete transformer including coolers shall be filled with transformer oil and subjected to a pressure of 0.35kg/ sq cm above the pressure that would atain under normal conditions with full head of oil. The pressure shall be maintained for 12 hours during which time no oil

leakage shall occur. When heat run test is specified, the oil pressure test shall be performed immediately after heat run. Otherwise, the test may be performed at ambient temperature.

b) Magnetic balance test for 3 phase units.

c) Measurement of tanδ and capacitance of each winding to earth (with all other windings connected to earth) and between all windings, connected together, to earth.

20.2 Type Tests

a) The type tests shall include all tests as per applicable standards. Type test reports not older than 5 years from the date of bidding will be considered for acceptance.

b) The dielectric tests shall include lightning impulse chopped on the tail.

c) The type test shall include vacuum withstand test on tank and radiators.

20.3 Special Tests

The bidder shall quote extra unit price for carrying out the following tests:-

a) Measurement of zero-sequence impedance of three phase transformer.

b) Short circuit test.

c) Temperature rise test

d) Measurement of harmonics of the no load current.

e) Measurement of acoustic noise level.

f) Dielectric Test with Lightning impulse chopped on the tail.

20.4 All auxiliary equipment shall be tested as per the relevant standards. Test certificates shall be submitted for bought out items. High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.

20.5 Test reports

20.5.1 Test results shall be corrected to a reference temperature of $75^{O}C$.

20.5.2 Two copies of test results shall be submitted for PURCHASER's approval before despatch of transformer.

21.0 LOSSES

21.1 Bids will be evaluated based on the formula furnished in Data Sheet - A.

21.2 For the purpose of evaluation of Bids, the quoted load losses and iron losses shall be increased to take into consideration tolerance as permitted by applicable standards.

21.3 Should the losses as measured on the transformer after manufacture be found in excess of the quoted values of the guaranteed losses with plus tolerance, the VENDOR shall pay to the PURCHASER, penalty charges based on the charges indicated in Data Sheet-A.

22.0 REJECTION

The PURCHASER may reject any transformer if during tests or service any of the following conditions arise:

22.1 No load loss exceeds the guaranteed value by 20% or more.

22.2 Load loss exceeds the guaranteed value by 20% or more.

22.3 Impedance value exceeds the guaranteed value by $\pm$ 10% or more.

22.4 The difference in impedance values of any two phases during single phase short circuit impedance test exceeds 2% of the average value guaranteed by the VENDOR.

22.5 Oil or winding temperature rise exceeds the specified value by 5^{o} C.

22.6 Transformer fails on impulse test voltage withstand test.

22.7 Transformer fails on power frequency voltage withstand test.

22.8 Transformer is proved to have been manufactured not in accordance with the agreed specification.

22.9 The PURCHASER reserves the right to retain the rejected transformer and take it into service until the VENDOR replaces, at no extra cost to the PURCHASER, the defective transformer by a new transformer.

22.10 Alternatively, the VENDOR shall repair or replace the transformer within a reasonable period to the PURCHASER's satisfaction at no extra cost to the PURCHASER.

23.0 DOCUMENTATION

On award of contract, the following drawings and data shall be furnished in four sets for approval before start of manufacture:

i. General arrangement (GA) drawings of transformer with plan and elevation and Bills of Material.

ii. Transformer foundation layout drawing.

iii. Shipping drawing showing dimensions and weights.

iv. GA drawings of HV and LV bushings and termination details.

v. Rating plate diagram.

vi. Valve schedule.

vii. Control schematic and wiring diagram for transformer marshalling box/ cooler control cabinet.

viii. Control schematic and wiring diagram for OLTC.

ix. Erection drawing.

x. Quality plan for design, manufacture and testing.

xi. O & M manual.

24.0 SPARES:

24.1 The BIDDER shall quote itemised prices for the following essential spares required for 3 years trouble free operation.

24.1.1 Complete set of gaskets.

24.1.2 One bushing of each type.

24.1.3 Dial type thermometer

24.1.4 Oil level gauge

24.1.5 Complete set of winding temperature-indicating equipment

24.1.6 Pressure relief value

24.1.7 Silica-gel breather

24.1.8 One valve of each type

24.1.9 Buchholz relay or fault pressure relay

24.1.10 One CT of each type

24.1.11 OLTC motor

24.1.12 Bushing of each type/ rating.

24.2 Bidder shall also quote unit prices for any other spares that he recommends to be kept in stock for 3 years trouble free operation.

24.3 Prices quoted for 'Essential spares' will be considered for bid evaluation whereas the prices quoted for 'Recommended spares' will not be considered for bid evaluation.

24.4 Ordered essential spares shall be delivered along with the main equipments. When erection, testing and commissioning of transformers is included in vendor's scope any requirement of commissioning spares may be met by drawing from essential spares and be replaced free of cost at the earliest.

25.0 INCLUSIONS

The following items shall be deemed to be included in the VENDOR's basic scope of supply:

25.1 Interconnecting cables with supporting and terminating accessories for connections between the transformer main marshalling kiosk and all electrical measuring, monitoring and protective devices mounted on the transformer. For this purpose, either PVC insulated wires in GI conduits or PVC insulated, armoured cables shall be used.

25.2 Necessary compression type, brass cable glands shall be provided at the marshalling box (kiosk) for the cables mentioned in clause 25.1 as well as for terminating the incoming power cables from remote panels.

DATA SHEET – A1					
SL.NO		DESCRIPTION		UNIT	DATA
1.0 GENERAL	1.1	Application/ designation			Distribution Transformer
	1.2	Quantity required		Nos.	1
	1.3	Installation		Indoor/ Outdoor	Outdoor
	1.4	Degree of protection as per IS 2147			IP 55
2.0 RATINGS	2.1	Rating		kVA	1000
	2.2	Number of phases & frequency			Three phase,50Hz
	2.3	Number of windings			Two (2)
	2.4	Type of cooling			ONAN
	2.5	No load voltage	HV	kV	11
			LV	kV	0.433
			TV	kV	NA
	2.6	Winding Connection	HV		Delta
			LV		Star
			TV		NA
	2.7	Vector group			Dyn11
	2.8	Percentage impedance (HV to LV)		%	5
	2.9	Direction of Power Flow		HV to LV/ LV to HV/ Bi directional	HV to LV
	2.10	Winding Insulation Category	HV	Uniformly/ Non uniformly Insulated	Uniformly
			LV ~~& TV~~		Uniformly
3.0 SYSTEM VOLTAGE	3.1	Nominal system voltage	HV	kV	11
			LV	kV	0.415
			TV	kV	NA
	3.2	Highest system voltage	HV	kV	12
			LV	kV	0.457
			TV	kV	NA
	3.3	System fault level	HV/ LV	kA	25/50

DATA SHEET – A1					
SL.NO		DESCRIPTION		UNIT	DATA
4.0 NEUTRAL EARTHING	4.1	System neutral			
		HV			Effectively Earthed
		LV			Effectively Earthed
	4.2	Transformer neutral			
		HV			NA
		LV			Effectively Earthed
5.0 INSULATION WITHSTAND	5.1	Impulse (1.2/50 μ sec wave)	HV	kV_p	75
			LV ~~& TV~~	kV_p	NA
	5.2	Power frequency withstand voltage DRY	HV	kV	28
			LV ~~& TV~~	kV	3
		Power frequency withstand voltage WET	HV	kV	28
			LV ~~& TV~~	kV	3
	5.3	Transformer Neutral power frequency withstand voltage	HV	kV	NA
			LV	kV	3
6.0. TEMP. RISE	6.1	Reference ambient temperature		˚C	45
	6.2	Oil by thermometer over the ambient		K	45˚C
	6.3	Winding by resistance over the ambient		K	50˚C
7.0 TAP CHANGING	7.1	Taps required: On load / off circuit			Off Circuit
	7.2	Tapping on windings			HV
	7.3	Total tapping range		%	+5 to -10
	7.4	Tapping Steps		%	2.5
	7.5	Control	Manual / automatic		Manual
			Local / remote		Local
	7.6	Control cubicle by			NA
	7.7	Voltage class of OLTC		kV	NA
	7.8	Current rating of OLTC		A	NA
	7.9	Type of OLTC installation In tank/ Separately mounted			NA

DATA SHEET – A1						
SL.NO		DESCRIPTION			UNIT	DATA
8.0. DETAILS OF TRAFO. FOR PARALLELOPERATION	8.1	Manufacturer's name				NA
	8.2	Rating			kVA	
	8.3	Exact turns ratio				
	8.4	Tapping range				
	8.5	Full load loss corrected to 75^{O}C			kW	
	8.6	% impedance at principal tapping				
	8.7	Vector group				
9.0 BUSHINGS	9.1	Voltage class	HV Line end		kV	12
			LV Line end		kV	3
			TV Line end		kV	NA
			HV neutral		kV	NA
			LV neutral		kV	3
	9.2	Impulse wave withstand (1.2/50 μ sec wave)	HV		kV_p	75
			LV ~~& TV~~		kV_p	NA
	9.3	Power frequency withstand for 1 Min.	HV Line end		kV	28
			LV Line end		kV	3
			HV neutral		kV	NA
			LV neutral		kV	3
	9.4	Minimum clearance	HV ph to ph		mm	As per CBIP
			LV ph to ph		mm	25
			HV ph to earth		mm	As per CBIP
			LV ph to earth		mm	25
	9.5	Minimum creepage distance (total protected)	HV Line end		mm	300
			LV Line end		mm	25
			HV neutral		mm	NA
			LV neutral		mm	25
	9.6	Bushing CT details	HV phase Bushings		Nos	NA
					Parameters	NA
			HV Neutral bushing.		Nos	NA
					Parameters	NA
		Bushing CT details	LV Phase Bushings		Nos	NA
					Parameters	NA
			LV Neutral		Nos	2

DATA SHEET – A1					
SL.NO		DESCRIPTION		UNIT	DATA
			bushing	Parameters	NCT-1 1600/1A, CL:PS,15VA NCT-2 800/1A, CL: 5P10, 15VA (Vk, Rct and Im shall be decided during detail engg.)
10.0 TERMINAL CONNECTIONS	10.1	HV line end bushing/ cable box/ Cable box with disconnecting chamber.			Cable box with disconnecting chamber
	10.2	LV line end bushing/ cable box/ cable box with disconnecting chamber/ Bus duct.			Cable box with disconnecting chamber
	10.3	HV neutral bushing/ Cable box/ Cable box with disconnecting chamber			NA
	10.4	LV neutral bushing/ Cable box/ Cable box with disconnecting chamber/ Bus duct.			Separate neutral bushing for earth connection
	10.5	Bushing terminals	Required	Yes/No	NA
			Size of take off conductor	HV	NA
				LV	NA
	10.6	Cable box, lugs and glands	Required	Yes/No	Yes
			Size of cable	HV	3C x 240 Sq.mm., 11kV (E) grade, Al, XLPE, Armoured power
				LV	6R x 3.5C x 300 Sq.mm., Al, XLPE, Armoured power cable
11.0 EARTHING TERMINAL	11.1	Material of conductor	Body		GS
			Neutral		Cu
	11.2	Size of conductor	Body	mm	50 x 10
			Neutral	mm	50 x 8
12.0 MISCELLANEOUS	12.1	Wheels	Plain/ flanged		Plain
			Unidirectional/ bi-directional		Bi-Directional
	12.2	Vacuum withstand capability of Main tank with bushings, radiators, fittings & accessories			760mm of Hg
	12.3	Transformer to be transported	Filled with oil	Yes/No	Yes
			Without oil with inert gas, Gas Cylinder and accessories, pressure gauge	Yes/No	NA
13.0 OPTIONAL FITTINGS REQUIRED	13.1	Magnetic oil level gauge with low oil level alarm contacts as per clause 19.10		Yes/No	Yes
	13.2	Pressure relief device as per clause 19.15		Yes/No	Yes
	13.3	Dial type thermometer with two contacts for oil temp. as per clause 19.16		Yes/No	Yes

DATA SHEET – A1				
SL.NO		DESCRIPTION	UNIT	DATA
	13.4	Gas and oil actuated i.e., Bucholz relay as per clause 19.17	Yes/No	Yes
	13.5	Winding temperature indicator with two contacts with two contacts as per clause 19.20	Yes/No	Yes
	13.6	On load tap changer as per specification PCPL-4-S4-133	Yes/No	No
	13.7	Oil surge relay with alarm and trip contacts for OLTC	Yes/No	No
	13.8	Valves as per clause 9.0	Yes/No	Yes
	13.9	Four plain rollers in place of fixing channels	Yes/No	Yes
14.0 EVALUATION & PENALTY	14.1	Formula for evaluation of bids (W_i = No Load loss, W_c = Load loss & W_p = Auxiliary Loss)		Refer Section-3 (Specific technical req.)
	14.2	Rates of penalty for exceeding the guaranteed losses per kW	W_i W_c W_p	Refer Section-3 (Specific technical req.)
15.0 ESSENTIAL SPARES	15.1	Complete set of gaskets	Set	1
	15.2	Bushing of each type	Nos	1
	15.3	Dial type thermometer	Nos	1
	15.4	Complete WTI equipment	Nos	1
	15.5	Pressure relief valve/ Explosion vent diaphragras	Nos	1
	15.6	Silica gel breather	Nos	1
	15.7	Buchholz relay	Nos	1
	15.8	One valve of each type	Nos	1
	15.9	Cooler fan & Fan motor of each type		NA
	15.10	Oil pump & Pump motor of each type		NA
	15.11	OLTC motor	Nos	NA
	15.12	Oil Level gauge	Nos	1 No
	15.13	Bushing CT of each type		NA
	15.14	Miscellaneous spare (contactors, control switches, MCBs, indication lamps etc)	10% of quantity used	
16.0 NOTES	16.1			
	16.2			
	16.3			
	16.4			

DATA SHEET A2 APPLICABLE STANDARDS			
SL.NO.	ITEM	STANDARD	
1.0	Power transformer	IS 2026	IEC 60076
2.0	Fitting & Accessories for Power transformers	IS 3639	IEC
3.0	Guide for Loading of oil immersed transformers	IS 6600	IEC 60354
4.0	Insulating Oil	IS 335	IEC 60296
5.0	Bushings	IS 2099	IEC 60137
6.0	Degree of protection	IS 2147	IEC 60144
7.0	Buchholz relay	IS 3637	IEC
8.0	On load tap changer	IS 8468	IEC 60214
9.0	Application Guide for OLTC	IS 8478	IEC 60542
10.0	Code of Practices for selection, Installation and maintenance of Transformer	IS 10028	IEC

DATA SHEET B (To be filled in by the BIDDER and enclosed with the bid)					
SL. NO.		DESCRIPTION		UNIT	BIDDER'S DATA
1.0 GENERAL	1.1	Make			
	1.2	Quantity required		Nos.	
	1.3	Installation		Indoor/ Outdoor	
	1.4	Degree of protection as per IS 2147			
2.0 RATINGS	2.1	Rating		kVA	
	2.2	Number of phases & frequency			
	2.3	Number of windings			
	2.4	Type of cooling			
	2.5	No load voltage	HV	kV	
			LV / TV	kV / kV	
	2.6	Winding Connection	HV		
			LV / TV		
	2.7	Vector group			
	2.8	Percentage impedance		%	
	2.9	Direction of Power Flow		HV to LV	
				LV to HV	
				Bi directional	
	2.1	Winding Insulation Category	HV	Uniformly/ non uniformly Insulated	
			LV / TV		
	2.11	Winding Conductor Material			
	2.12	Highest System Voltage for which transformer windings are suitable	HV	kV	
			LV / TV	kV / kV	
	2.13	Transformer Neutral Earthing	HV		
			LV		
3.0 INSULATION WITHSTAND	3.1	Impulse (1.2/50 μ-sec wave)	HV	kV_p	
			LV / TV	kV_p / kV_p	
	3.2	Power frequency withstand voltage DRY	HV	kV	
			LV / TV	kV / kV	
		Power frequency withstand voltage WET	HV	kV / kV	
			LV	kV	
		Transformer Neutral-power frequency withstand voltage	HV	kV	
			LV	kV	

DATA SHEET B
(To be filled in by the BIDDER and enclosed with the bid)

SL. NO.		DESCRIPTION			UNIT	BIDDER'S DATA
4.0 TEMPERATURE RISE	4.1	Reference ambient temperature			^{O}C	
	4.2	Oil by thermometer over the ambient			^{O}C	
	4.3	Winding by resistance over the ambient			^{O}C	
5.0 TAP CHANGING	5.1	Taps provided On load / off load				
	5.2	Tapping on windings				
	5.3	Total tapping range			%	
	5.4	Tapping Steps			%	
	5.5	Control	Manual / automatic			
			Local / remote			
	5.6	Control cubicle by				
	5.7	Voltage class of OLTC			kV	
	5.8	Current rating of OLTC			A	
	5.9	Type of OLTC installation				
		In tank/ Separately mounted				
6.0 DETAILS OF TRANSFORMER FOR PARALLEL OPERATION	6.1	Manufacturer's Name				
	6.2	Rating			kVA	
	6.3	Exact turns ratio				
	6.4	Tapping range				
	6.5	full load loss corrected to $75^{o}C$			kW	
	6.6	% impedance at principle tapping				
	6.7	Vector Group				
7.0 BUSHINGS	7.1	Voltage Class		HV Line end	kV	
				LV Line end / TV	kV / kV	
				HV Neutral	kV	
				LV Neutral	kV	
	7.2	Impulse wave withstand (1.2/50 µ Sec wave)		HV	kVp	
				LV / TV	kVp	
	7.3	Power frequency withstand for 1 min		HV Line end	kV	
				LV & TV Line	kV	

DATA SHEET B
(To be filled in by the BIDDER and enclosed with the bid)

SL. NO.		DESCRIPTION		UNIT	BIDDER'S DATA
			end		
			HV Neutral	kV	
			LV Neutral	kV	
	7.4	Minimum clearance	HV Ph to Ph	mm	
			LV & TV Ph to Ph	mm	
			HV Ph to earth	mm	
			LV & TV Ph to earth	mm	
	7.5	Minimum creepage distance (total protected)	HV Line end	mm	
			LV & TV Line end	mm	
			HV neutral	mm	
			LV neutral	mm	
	7.6	Bushing CT details	LV Phase Bushings	Nos.	
				Parameters	
			LV Neutral bushing		
8.0 TERMINAL CONNECTIONS	8.1	HV line end bushing/ cable box/ Cable box with disconnecting chamber.			
	8.2	LV line end bushing/ cable box/ cable box with disconnecting chamber/ Bus duct.			
	8.3	HV neutral bushing/ Cable box/ Cable box with disconnecting chamber			
	8.4	LV neutral bushing/ Cable box/ Cable box with disconnecting chamber/ Bus duct.			
	8.5	Bushing terminals	Required	Yes/No	
			Size of take off conductor	HV	
				LV	
	8.6	Cable box, lugs and glands	Required	Yes/No	
			Size of cable	HV	
				LV	
9.0 EARTHING TERMINAL	9.1	Material of conductor			
	9.2	Size of conductor		mm	

DATA SHEET B
(To be filled in by the BIDDER and enclosed with the bid)

SL. NO.		DESCRIPTION		UNIT	BIDDER'S DATA
10.0 MISCELLANEOUS	10.1	Wheels	Plain / flanged		
			Unidirectional / bi-directional		
	10.2	Vacuum withstand capability of Main tank with bushings, radiators, fittings & accessories			
	10.3	Transformer to be transported	Filled with oil	Yes/No	
			Without oil with inertgas, Gas Cylinder and accessories, pressure gauge	Yes/No	
11.0 FITTINGS PROVIDED	11.1	Magnetic oil level gauge with low oil level alarm contacts as per clause 19.10		Yes/No	
	11.2	Pressure relief device as per clause 19.15		Yes/No	
	11.3	Dial type thermometer with two contacts for oil temp. as per clause 19.16		Yes/No	
	11.4	Gas and oil actuated i.e., Bucholz relay as per clause 19.17		Yes/No	
	11.5	Winding temperature indicator with two contacts with two contacts as per clause 19.20		Yes/No	
	11.6	On load tap changer as per specification PCPL-4-S4-133		Yes/No	
	11.7	Valves as per clause 9.0		Yes/No	
	11.8	Four plain rollers in place of fixing channels		Yes/No	
	11.9	Online dissolved gas analyser with all fillings as per specification		Yes/No	
	11.10	All fittings and fixtures for nitrogen injected fire protection system as per specification.		Yes/No	
12.0 GUARANTEED LOSSES	12.1	No load looses (core loss and dielectric loss) at 100% voltage and frequency		kW	
	12.2	Load loss at rated current as 75^{o}C winding temperature		kW	
	12.3	Auxiliary load losses at rated output		kW	
13.0 GUARANTEED PERFORMANCE DATA	13.1	Regulation at full load, 0.85 pf at 75^{o}C winding temperature			
	13.2	External short circuit withstand capacity		KA	
				Sec	
				%	
	13.3	Magnetising current as rated voltage and frequency in percent of full load current			
	13.4	No Load current		A	
	A	At 100% of rated voltage		A	

DATA SHEET B (To be filled in by the BIDDER and enclosed with the bid)					
SL. NO.		DESCRIPTION		UNIT	BIDDER'S DATA
	B	At 110% of rated voltage			
	13.5	Efficiency at 75°C		%	
	A	Full load, unity power factor		%	
	B	Full load, 0.85pf			
	13.6	Maximum flux density		Wb/m^2	
	A	At rated voltage		Wb/m^2	
	B	At 110% rated voltage			
	13.7	Over fluxing capability		Yes/No	
14.0		OLTC Control scheme conforms to specification		Yes/No	
15.0		Remote OLTC control panel conforms to specification		Yes/No	
16.0		Transformer marshalling Box and cooler control cabinet conforms to specification		Furnish list	
17.0 TESTS	17.1	List of Routine Test to be carried out		Furnish list	
	17.2	List of type carried out / to be performed		Furnish list	
	17.3	List of other tests to be carried out against extra price, quoted else where		Furnish list	
18.0		Total weight	Without oil	Kg	
19.0		Over all oil Dimension (L x W x H)		mm	
20.0		Total Quantity of Oil			
21.0		General arrangement drawing of the transformer attached with the bid		Yes/No	
				DRG No	
22.0 ESSENTIAL SPARES	22.1	Complete set of gaskets		No	
	22.2	Bushing of each type		No	
	22.3	Dial type thermometer		No	
	22.4	Complete WTI equipment		No	
	22.5	Pressure relief valve/ Explosion vend diaphragras		No	
	22.6	Silica gel breather		No	
	22.7	Buchholz relay		No	
	22.8	One valve of each type		No	
	22.9	Cooler fan & Fan motor of each type		No	
	22.1	Oil pump & Pump motor of each type		No	
	22.1	OLTC motor		No	
	22.1	Oil Level gauge		No	
	22.1	Bushing CT of each type		No	

DATA SHEET B (To be filled in by the BIDDER and enclosed with the bid)				
SL. NO.		DESCRIPTION	UNIT	BIDDER'S DATA
	22.1	Miscellaneous spare (contractors control switches, MCBs, indication lamps in cooler control Cabinet)		

1.0 SCOPE:

1.1 This specification covers the design, material, construction features, manufacture, inspection and testing at the Vendor's / his SUB-Vendor's Works, delivery to site and performance testing of metal-enclosed Medium Voltage Switchgear of voltage not exceeding 1,100 V AC.

2.0 CODES & STANDARDS:

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

2.2 Equipment shall conform to the latest applicable Standards as mentioned in Data Sheet- A2. In case of conflict between the Standards and this specification, more stringent requirement of the two shall govern.

3.0 SHEET METAL WORK:

3.1 The switchgear frame shall be fabricated using thick cold rolled sheet steel plate as per general industry standard.

3.2 The thickness of sheet steel shall be as states in Data sheet-A1. Mounting plates shall be fabricated from 3mm thick cold rolled sheet steel.

3.3 All panel edges and door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.

3.4 Cut outs shall be true in shape and devoid of sharp edges.

3.5 The complete structure shall be rigid, self-supporting, and free from vibration, twists and bends.

4.0 PAINTING:

4.1 All sheet steelwork shall be phosphated in accordance with the following procedure and in accordance with applicable standards mentioned in Data Sheet-A2.

4.2 Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.

4.3 Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

4.4 After phosphating, thorough rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromatic solution and oven drying.

4.5 After phosphating, the sheet metal shall be subjected to powder coating process. The powder coating to be carried out by spraying the Polyester Epoxy powder (60/ 40) using an electrostatic gun, or Corona gun. After uniform deposition of the powder to the required thickness, i.e., 100 microns minimum, or as per Data Sheet A, on to the object, it is transferred to a curing oven.

4.6 Depending on the paint grade, type of finish, the painted object shall be cured in an oven under controlled environment to attain uniform wrinkle & scratch free finish.

4.7 The final finished thickness of paint film on steel shall not be less than 100 microns, and shall not be more than 150 microns.

4.8 Finished painted appearance of equipment shall present an aesthetically pleasing appearance, free from dents and uneven surfaces.

5.0 CONSTRUCTIONAL FEATURES:

5.1 Switchgear shall be:

a) Of the metal clad, indoor, floor mounted modular type

b) Of compartmentalised design in accordance with IEC 60439-1. The form of internal separation shall be as stated in Data sheet A1.

c) Made up of the requisite vertical sections

d) Of dust and vermin proof construction

e) Provided with a degree of protection as stated in Data sheet A1.

f) Easily extendable on both sides by adding vertical sections after removing the end covers

g) Provided with a metal sill frame made of structural steel channel section properly drilled for mounting the Switchgear along with necessary mounting hardware. All hardware shall be zinc plated and passivated.

h) Provided with labels on the front and rear indicating the switchgear designation

i) Provided with cable entry facilities at top with thick removable gland plates of thickness as per general industry standard on POWER panels with necessary cable glands. These plates shall be non-magnetic.

j) Of uniform height of not more than 2450 mm

k) Of single front or double front execution as specified in Data Sheet-A

l) Provided with gaskets all round the perimeter of adjacent panels, panel and base frame, removable covers and doors

m) Provided with busbars running at the top or bottom, as required, all along the length of the switchgear in a separate sheet steel enclosure.

5.2 Operating devices shall be incorporated only at the front of the switchgear. No equipment needing manual operation shall be located at a height less than 250 mm above ground level.

5.3 The switchgear shall be divided into distinct vertical sections, each comprising:

a) A completely metal enclosed busbar compartment running horizontally.

b) Individual feeder modules arranged in multi-tier formation. It is essential that the modules are integral multiplies of the basic unit size to provide for flexibility in changes, if any, at site.

c) Enclosed vertical busbars serving all modules in the vertical section. For safety isolation of the vertical bus bars, insulating barrier with cut-outs shall be provided to allow the power stab-in contacts to engage with vertical busbars.

d) A vertical cable alley covering the entire height. The cable alley shall be 500 mm wide for modules of 400 Ampere and above and minimum 250 mm for modules less than 400 Ampere.

e) Separation barrier between main bus bar, auxiliary power & control buses as required shall be located to enable easy identification, maintenance and segregation from the main power buses. Tap-off connections from these buses shall be arranged separately for each vertical section.

5.4 Each vertical section shall be equipped with space heaters, which may be located in the cable alley.

5.5 One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchgear except for the horizontal busbar compartment. However, each shipping section shall have metal sheets at both ends.

5.6 All equipment associated with a single circuit shall be housed in a separate module compartment of the vertical section. The compartment shall be sheet steel enclosed on all sides and the rear, with rubber

grommets provided on the cable alley side for power and control cable entry. The front of the compartment shall be provided with a hinged door. Components mounting details and panel fabrication details shall be submitted by VENDOR for PURCHASER's approval.

5.7 For draw-out type modules, only the handles of control and selector switches, push buttons, knobs & cut-outs for lamps and meters shall be arranged on the front doors of the respective compartments to permit operation without opening the door. On circuit breaker controlled circuits, protective relays shall be mounted on the front door of the compartment. All other equipment pertaining to a circuit shall be mounted on the withdrawable chassis. All cut-outs shall be provided with gaskets for dust proofing.

5.8 Current transformers shall not be directly mounted on the buses. Current transformers on circuit breaker controlled circuits shall be mounted on the fixed portion of the compartment.

5.9 In Air Circuit Breaker compartments, external cable connections shall be carried out in separate cable compartments for power and control cables.

5.10 After isolation of the power and control connections of a circuit, it shall be possible to safely carry out maintenance in a compartment with the busbars & adjacent circuits live.

5.11 The withdrawable chassis shall move on suitable guides and on suitable plated steel or stainless steel rollers or balls to facilitate easy withdrawal.

5.12 Cable alleys shall be provided with suitable hinged doors. It shall be possible to safely carry out maintenance work on cable connections to any one circuit with the busbars and adjacent circuits live. Adequate number of slotted cable support arms shall be provided for clearing the cables.

5.13 Rear of single front switchgear shall be provided with removable panels. It shall be possible for one person to remove and fix the removable panel.

5.14 All doors shall be provided with concealed type hinges and captive screws.

5.15 The withdrawable chassis housing circuit breakers shall be of the fully draw out type.

5.16 The withdrawable chassis housing feeder control equipment not incorporating air circuit breakers shall be one of the following types as specified in Data sheet A1:

5.16.1 Fixed Type Withdrawable Chassis:

In this type of construction, all power connections to the equipment mounted on the withdrawable chassis shall be of bolted type. All control circuit connections to equipment mounted on the withdrawable chassis shall be carried out through conventional terminal blocks mounted in the respective chassis. It shall be possible to draw out the chassis after unbolting/unscrewing all the power and control circuit connections to the equipment mounted on the withdrawable chassis.

5.16.2 Fully draw out type withdrawable chassis:

In this type of construction, it shall be possible to draw out the withdrawable chassis without having to unscrew or unbolt any connections to the equipment mounted on the withdrawable chassis. The power and control draw out type connections shall be of the stab-in or sliding type. All draw out contacts, including for auxiliary and control wiring shall be of self aligning type.

5.17 Interchangeability:

5.17.1 All identical equipment and corresponding parts including chassis of draw out modules of the same size and rating shall be interchangeable without having to carryout modifications. For trouble free interchangeability, the draw out arrangements shall be designed such that normal dimensional variations are taken care of by self-aligning feature of the modules.

5.17.2 Components and equipment that are not fully interchangeable are liable for rejection. VENDOR shall replace all such equipment by interchangeable equipment at his cost.

5.18 The draw-out contacts shall be only between copper/ copper alloy/ aluminium faces, which are silver or tin plated. The contact design shall be such that there should be no arcing/ deformation under the associated peak short-circuits current.

5.19 Switchgear shall be designed in such a way that all component equipment and bus-bars operate satisfactorily without exceeding their respective maximum permissible rise in temperature under ambient temperature conditions prevailing within the switchgear cubicle, with reference ambient temperature outside the switchgear cubicles as specified in Data Sheet-A1.

5.20 Provision of ventilating louvers is considered undesirable. If ventilating louvers are considered essential by the VENDOR, these may be provided. However, all ventilating louvers shall be provided with fine-screened brass or GI meshes to prevent entry of vermin and dust.

5.21 Safety Features.

5.21.1 Door interlock

The door of each compartment shall be so interlocked such that the door cannot be opened unless the circuit is off.

5.21.2 Shrouding of live parts

Bolted power cable connections and other accessible live parts shall be covered with removable shrouds to prevent direct contact with live parts.

5.21.3 Finger touch proof

All terminal block connections as well as connections to terminals of all devices shall be finger touch proof.

6.0 MODULE TYPES:

6.1 The various types of modules indicating the control requirements of each type are detailed in the enclosed Single line diagram(s).

6.2 All devices shown in the module drawings shall be included in the scope of supply.

6.3 Physical size of compartment for each type of control and current rating shall be so chosen that all the basic and additional equipment can be housed in the compartment. No equipment/ devices associated with any particular circuit shall be permitted to be mounted in any other circuit module.

7.0 MAIN & AUXILIARY BUSES

7.1 Main Buses & Taps:

7.1.1 Switchgear shall be provided with three phase or three phase and neutral busbars as specified in Data Sheet- A1.

7.1.2 Busbars shall be of uniform cross section throughout the length of the switchgear, and up to the terminals of the incoming feeder circuit breaker/ switch.

7.1.3 The busbars shall be made of high conductivity copper or aluminium alloy of E91E grade as specified in Data Sheet-A1.

7.1.4 Busbars shall be provided with at least the minimum clearances in air as specified in Data sheet-A1.

7.1.5 All bus-bars, bus-taps shall be insulated with close fitting sleeve of hard, smooth, dust and dirt free plastic insulation of high dielectric strength (450 V/mil) to provide a permanent high dielectric non-ageing and non-tracking protection; impervious to moisture, tropical conditions and fungi. The insulation shall be non-inflammable and self-extinguishing and in fast colours to indicate phases. The joints shall be insulated in such a way as to provide for accessibility of contact bolts for maintenance. Joints shall

be covered with removable moulded shrouds made out of fibre glass reinforced polyester. The dielectric strength and properties shall hold good for the temperature range of 0°C to 90°C. If the insulating sleeve is not coloured but black, busbars shall be colour-coded with coloured bands at suitable intervals.

7.1.6 Busbars shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents for the associated switchgear. Busbar supports shall be made of glass reinforced moulded plastic material or cast resin or Hylam sheets or Permali wood.

7.1.7 Separate supports shall be provided for each phase of the busbars. If a common support is provided for all three phases, anti-tracking barriers shall be incorporated.

7.1.8 Busbar joints shall be complete with high tensile steel bolts, Belleville washers and nuts. Bus bars shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.

7.2 Auxiliary Buses

7.2.1 Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirements. The material of control power supply buses shall be of electrolytic copper. The material for space heater power supply buses shall be same as that for the main power buses. Auxiliary bus bars and necessary connections to the associated circuits shall be in the VENDOR's scope.

8.0 INSULATORS:

8.1 Material:

8.1.1 The insulators shall be preferably made of SMC or Glass Filled Epoxy or equivalent type of non-hydroscopic insulating supports are acceptable.

8.2 Mechanical Strength:

The insulators shall possess sufficient mechanical strength to withstand the forces due to momentary short circuit currents of magnitude detailed in this specification. The spacing of the bus insulators shall be decided giving due factor of safety.

8.3 Electrical Strength:

As a consequence of current loading and variation in external temperatures, condensation of moisture may take place on the surface of the insulators. Hence the insulators shall have a high creepage distance and a withstand voltage rating sufficient to provide specified insulation under highly humid conditions.

8.4 Successful VENDOR shall furnish calculations for bus bar support spacing and selection for approval before commencement of manufacturing activity.

9.0 AIR CIRCUIT BREAKERS:

9.1 The air circuit breaker (ACB) shall be Four pole/ Triple pole/ Triple pole and Neutral (TPN) as shown in single line diagrams/ Data sheet A.

9.2 Circuit breakers shall be provided with:

9.2.1 Air break draw out type, mounted along with its operating mechanism on a wheeled carriage moving on guides, designed to align correctly and allow easy movements.

9.2.2 The shunt and/or series trip as specified in Data Sheet-A. Even for series trip breaker, shunt trip shall be provided when specified in Data sheet A.

9.2.3 An operating mechanism of the type specified in Data Sheet-A1

9.2.4 Mechanically operated targets to show 'Open', 'Closed', 'Service' and 'Test' positions of the circuit breaker

9.2.5 Mechanically operated, red 'trip' push button, shrouded to prevent accidental operation

9.2.6 Locking facilities in the 'Service', 'Test, and 'Isolated', positions. In test position, the breaker will be tested without energising the power circuits. The breaker shall remain fully housed inside the compartment in the test position.

9.2.7 6 NO and 6 NC potential free auxiliary contacts, rated 6A at 240V AC and 1A (inductive breaking at 220V DC).

9.2.8 'Red', 'Green' and 'Amber' indicating lamps to show 'Closed', 'Open', and 'Auto-trip' conditions of the circuit breaker when breaker operation is controlled by a control switch.

9.2.9 Circuit breakers shall be provided with in-built microprocessor based over load, short circuit and earth fault releases with adjustable time delay settings. The release shall have add on feature for communication with PLC/SCADA.

9.3 Circuit breakers shall be provided with the following interlocks:

9.3.1 It shall not be possible to plug-in a closed circuit breaker, or to draw out a circuit breaker in the closed position.

9.3.2 It shall not be possible to operate a circuit breaker unless it is in the fully plugged-in, test, or fully isolated position.

9.3.3 Suitable position switches having 2 NO + 2 NC contacts shall be provided for each position of the breaker for indication and interlocking purposes.

9.4 Circuit breaker closing and trip coils shall be rated for satisfactory operation on a control supply system voltage indicated in Data Sheet-A1.

9.5 Whenever specified in Data Sheet-A1, breakers shall be provided with castle key interlocking device to prevent paralleling of two breakers.

9.6 Closing and trip coil shall operate satisfactorily under the following conditions of supply voltage variation:

9.6.1 Closing coils - 85% to 110% of rated voltage.

9.6.2 Trip coils - 70% to 110% of rated voltage.

9.7 In addition to the adjustable current setting range specified in the Data Sheet, short circuit releases shall be provided with at least four adjustable time delay settings. If it is not possible to provide the specified adjustable current setting range for the short circuit releases, shunt trip circuit breakers shall be offered and indicated in Data Sheet - B by the VENDOR.

9.7.1 Each of the foregoing releases shall be provided with a single pole, double throw, and potential free alarm contact rated for 0.5A, 220V DC.

9.8 Operating Mechanism:

9.8.1 Circuit breaker shall be provided with a manual operating mechanism or power operated mechanism as specified in Data Sheet-A1.

9.8.2 Manually operated mechanism shall be of the spring charging stored energy type, unless otherwise specified in Data Sheet-A1.

9.8.3 Power operated mechanism shall be of the motor wound spring charging stored energy type.

9.8.4 The closing action of the circuit breaker shall charge the tripping spring ready for tripping.

9.8.5 Speed of closing of contacts shall be independent of the speed with which the handle is operated.

9.8.6 .All stored energy mechanisms shall be provided with mechanical indicators to show the 'Charged' and 'Discharged' conditions of the spring.

9.8.7 Circuit breakers provided with stored energy operating mechanisms shall be provided with the following interlocks:

a) The circuit breaker shall not close unless the spring is fully charged.

b) Shocks, vibrations, or failure of springs shall not operate the breaker or prevent intended tripping.

9.8.8 Power operated mechanisms shall be:

a) Provided with a universal motor suitable for operation on AC and DC control supplies specified in Data Sheet-A1 with voltage variation from 85% to 110% rated voltage.

b) Designed to enable a continuous sequence of closing and opening operation as long as power is available and at least one opening operation on power supply failure.

c) Provided with emergency manual charging facilities

d) Provided with facilities for remote panel closing and opening operations whenever specified in Data Sheets as per breaker module designation and respective enclosed control scheme drawing.

9.8.9 Spring charging time for power operated mechanism shall not exceed 15 seconds.

9.8.10 Power operating mechanisms shall be provided with the following additional features:

a) Closing of the circuit breaker shall automatically initiate recharging the spring to make the circuit breaker ready for the next closing operation.

b) The motor shall be mechanically de-coupled as soon as the emergency manual charging handle is coupled

c) The circuit breaker mechanism shall make one complete closing operation once the control switch has been operated and the first device in the control scheme has responded even though the control switch is released before the closing operation is complete provided there is no counter trip impulse.

d) Closing controls shall be so arranged that only one closing operation of the circuit breaker shall result from each close initiating impulse, even if the breaker trips while the initiating device is held in the 'Close' position. An electrical anti-pumping relay shall be provided on the circuit breaker chassis for this purpose, incorporated in the circuit breaker.

9.9 Protection Co-ordination:

It shall be the responsibility of the VENDOR to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers/motor starters, to provide satisfactory discrimination.

10.0 MOULDED CASE CIRCUIT BREAKERS:

10.1 Moulded case circuit breakers (MCCB) shall be provided when called for in Data Sheet-A1. The MCCBs shall conform to the latest applicable standards.

10.2 MCCB in AC circuits shall be of Four pole (4P)/ Triple pole (3P)/ Triple pole and Neutral (TPN) construction arranged for simultaneous 3/ 4 pole manual closing and opening and for automatic instantaneous tripping on short circuit. If indicated in Data Sheet-A1, power closing device for remote operation and/ or shunt trip shall be provided. Operating mechanism shall be quick-make, quick-break and trip-free type. The ON, OFF & TRIP positions of the MCCB shall be clearly indicated and visible to the operator when mounted as in service. Front of board operating handle shall be provided.

10.3 The MCCB shall be provided with short circuit and overload releases with adjustable current and time settings.

10.4 The MCCB shall be provided with the following accessories when called for in Data Sheet A1 / Module drawings:-

a) 'NO' and 'NC' auxiliary contacts.

b) Fault contact for breaker trip through releases.

The number of each type of contact shall be as indicated in the module drawings. If adequate number of contacts are not available, auxiliary relays shall be provided to multiply the contact.

10.5 MCCB shall be capable of withstanding the thermal stresses caused by overloads and the mechanical stress caused by the peak short circuit current of value associated with the switchgear rating. The maximum tripping time under short circuit shall not exceed 20 milliseconds.

10.6 MCCB shall have provision for pad locking in off position.

11.0 MOTOR PROTECTION CIRCUIT BREAKERS:

11.1 Motor protection circuit breakers (MPCB) shall be provided for motor feeders as shown Data Sheet A/ Single Line Diagrams.

11.2 The MPCB shall be similar to MCCB except that the overload release shall be selected to suit the motor rating. The overload release shall have adjustable time and current setting.

11.3 The rating of the MPCB shall be selected to provide type 2 co-ordinations with the contactors/soft starter/ VFD of the circuit.

11.4 MPCB shall be provided with the accessories similar to MCCB.

12.0 MINIATURE CIRCUIT BREAKERS:

12.1 Miniature Circuit Breakers (MCB) shall be provided for auxiliary power and lighting circuits as shown in single line diagrams.

12.2 The MCB shall be 3 pole/ TPN/ 2 pole/ SPN type as shown in single line diagrams and shall comply with latest applicable standards as mentioned in Data sheet A2.

12.3 The MCB shall have overload and short circuit releases. The tripping characteristic curve shall be of type B/C/D as shown in Data sheet-A1.

12.4 The MCB shall be fixed type, manually operated.

12.5 The MCB shall be provided with auxiliary contacts and fault signalling contact when required as per Data Sheet-A1 or module drawings.

13.0 EARTH LEAKAGE CIRCUIT BREAKER:

13.1 Earth leakage circuit breaker shall be either RCCB or RCBO type as shown in Data Sheet-A1/ Single line diagrams. These shall comply with the latest applicable standard.

13.2 The RCCB shall detect the earth leakage current and trip on earth leakage current above the set value. This shall be used in conjunction with the MCB.

13.3 The RCBO shall have overload and short circuit protection in addition to earth leakage protection.

13.4 The leakage current sensitively shall be as indicated in data sheet A1.

13.5 RCCB/ RCBO of (i) type shall be supplied when called for in Data sheet A1. RCCB/ RCBO of this type shall be immune to nuisance tripping due to,

a) Harmonics generated by the load.

b) Transient switching current.

c) Transient over voltages due to lightning, switching of switchgear etc.

14.0 CONTACTORS:

14.1 Contactors shall be electro-magnetic, double air break, non gravity type and shall comply with the latest applicable standard as mentioned in Data sheet.

14.2 Contactors shall have utilisation category as mentioned in Data sheet-A1 and shall be suitable for uninterrupted duly unless otherwise stated in Data sheet.

14.3 The Contactor shall have minimum two 'NO' and two 'NC' auxiliary contacts. If additional contacts are required as per module drawing, auxiliary relays shall be supplied to multiply the contact.

14.4 The operating coil of the contactor shall have insulation class E or better.

14.5 The coil voltage shall be as mentioned in Data sheet-A1.

15.0 MOTOR STARTERS:

15.1 Each AC induction motor starter module shall be provided with any of the following types of starters as indicated in the Data sheet and/ or single line diagram.

a) Direct on line (DOL) starter.

b) Start/Delta starter. (Open/close transition)

c) Reversing starter.

d) Variable speed drive.

e) Soft starter.

15.2 The motor starters shall be in accordance with specification no PCPL-4-S4-155 and associated Data sheets.

16.0 CURRENT TRANSFORMERS:

16.1 Current transformers shall be of dry type.

16.2 Current transformer shall have a short time withstand rating equal to the short time withstand rating of the associated switchgear for one second for breaker feeders. For feeders with fuse/ MCCB/ MPCB/ MCB, CT shall have withstand capacity equal to let through current of associated SCPD.

16.3 The minimum performance requirements of current transformers shall be as per the single diagram(s) enclosed.

16.4 Notwithstanding the above clause 16.3, it shall be the Vendor's responsibility to co-ordinate the current transformer burden with the requirements of relays, instruments and leads associated with that particular current transformer.

16.5 Test links shall be provided in both secondary leads of the CTs to easily carry out current and phase angle measurement tests.

16.6 All current transformers shall be earthed through a separate earth link on the terminal block to permit easy measurement of the current transformer insulation resistance.

17.0 VOLTAGE TRANSFORMERS:

17.1 Voltage transformers shall be of dry type.

17.2 The minimum performance requirements of voltage transformers are as per the single line diagram(s) enclosed.

17.3 All secondary windings of voltage transformers including open delta windings shall be rated for 110 V/ √3 per phase.

17.4 Voltage transformer shall have a continuous over voltage factor of 1.2 and short time over voltage factor as follows:

1.5 for 30 seconds in case of effectively earthed system,

1.9 for 8 hours in case of non-effectively earthed system where all earth faults are detected and cleared,

1.9 continuous in case of non-effectively earthed system where it is expected to operate with uncleared earth faults in the system

17.5 Voltage transformers shall be complete with suitably rated MPCB on the primary side and RCBO on the secondary side. The rupturing capacity rating of the associated switchgear shall be brought down to the capacity of MCB by use of fault limiting devices mounted close to the bus.

17.6 It shall be possible to replace voltage transformers without having to de-energise the main bus bars.

17.7 The terminals of V.T. secondary and tertiary windings, which are required to be connected to earth, shall be earthed by an isolating link without a fuse.

18.0 INDICATING INSTRUMENTS & METERS:

18.1 Electrical indicating instruments shall be of minimum 96 mm square size, 90 degree scale deflection with a class of accuracy as mentioned in Data Sheet-A1/ Single line diagram(s), suitable for flush mounting.

18.2 Indicating instruments shall have provision for zero adjustment outside the cover.

18.3 Instrument dials shall be parallax free with black numerals on a white dial.

18.4 Watt-hour metes shall be of the direct reading electrodynamometer type complete with cyclometer type dials and reverse running stops.

18.5 Wherever shown in single line diagram, single digital multifunction meter (MF) of approved make shall be provided. The multifunction meter shall monitor voltage, current, frequency, power factor, power (kVA, kW, kVAR) and energy (kVAh, kWh, kVARh both inductive and capacitive). The MF shall have communication port to communicate with plant PLC/ SCADA.

19.0 INDICATING LAMPS

19.1 Indicating lamp shall be:

Of the multiple LED type and of low watt consumption,

Provided with step-down transformer,

Provided with translucent lamp covers of colours ‘Red’, ‘Green’ and ‘Amber’ as required in the control wiring diagrams,

19.2 Bulbs and lenses shall easily be replaceable from the front

20.0 CONTROL & SELECTOR SWITCHES:

20.1 Control and selector switches shall be: Of the rotary type with enclosed contacts,

Adequately rated for the purpose intended (min. acceptable rating is 10A continuous at 240V AC and 1A (inductive break) 220V DC), provided with escutcheon plates clearly marked to show the positions.

20.2 Control switches shall be: Of the spring return to normal type, Provided with pistol grip type handles.

20.3 Control switches for circuit breaker control shall be provided with Contact development as specified in bill of material of enclosed drawings.

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

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

21.0 PUSH BUTTONS:

21.1 Push buttons shall be: Of the momentary contact, push to actuate type rated to carry 10A at 240V AC & 1A (inductive breaking) at 220V DC Fitted with self reset, 2 NO and 2 NC contacts provided with integral escutcheon plates marked with its function.

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

21.3 'Stop' and 'Trip' push buttons shall be red in colour

21.4 All other push buttons shall be black in colour

22.0 SURGE ARRESTERS:

22.1 Surge Arresters shall be provided on the Incomer circuit of switchboards as indicated in the Single Line Diagram/Data sheet A.

22.2 The Surge Arresters shall be of voltage limiting type (Varistor/ clamping diode) unless otherwise specified in Data Sheet A.

22.3 The Surge Arrester shall have the following features:-

a) Draw out type.

b) Single pole (1P)/ Single pole and Neutral (1P+N)/Triple pole (3P)/ Triple pole and Neutral (3P+N) as indicated in Data sheet A.

c) Operating indicator on front panel.

d) Contact for remote indication.

22.4 The Surge Arrester shall have the technical particulars as stated in data sheet A1.

22.5 The Surge Arrester shall:-

a) Limit the voltage to a maximum value Up for any current equal to or less than nominal value In.

b) Automatically stop conducting when the surge is over.

c) Withstand minimum 15 discharges at rate discharge current (In) without damage.

23.0 SPACE HEATERS:

Space heaters for switchgear panels shall be: Suitable for operation on a supply system specified provided with single pole MCB with overload and short circuit release provided with humidistat to cut-in the heaters to prevent condensation of moisture on insulating parts.

24.0 CABLE TERMINATIONS:

24.1 Suitable compression type, heavy duty brass cable glands with check nuts, rubber sealing ring and brass washers mounted on a removable gland plate shall be provided to support all power and control cables entering the switchgear, if asked for in Data Sheet-A1. Cable glands shall incorporate built-in facilities for earthing the wire armour of cables. Cable glands shall be plated to avoid corrosion.

24.2 Power cable glands and crimping type lugs suitable for the cable sizes indicated shall be supplied. Approximate quantity of control cable glands for different types of modules are indicated in the module wiring diagrams, bill of material. If during the course of detailed engineering of the switchgear it is found necessary to provide more glands or glands of higher size than those envisaged, the VENDOR shall provide and accommodate the same in the relevant modules.

24.3 The VENDOR shall select the power cable glands and lugs based on the cable sizes provided at Data Sheet-A1/ Single Line Diagram.

24.4 For supporting and clamping cable cores at regular intervals inside the cable alleys, suitable slotted angles, up to the respective terminal blocks, shall be provided.

24.5 Necessary crimping type of tinned-copper cable lugs for connecting the individual cores to the respective terminals shall be provided.

24.6 When a Core Balance CT (CBCT) is provided for earth fault protection and the armour clamping is done before the CBCT looking from inside the module, insulated pig tail of sufficient length shall be provided for grounding the armour taking the ground lead through the CBCT

25.0 INTERNAL WIRING:

25.1 Wiring inside the switchgear shall be carried out with 1100/ 650 V grade, FRLS PVC insulated, stranded conductor wires. Minimum size of conductor for power circuits is 4 sq.mm copper or equivalent size aluminium conductor. Control circuits shall be wired using copper conductor of at least 2.5 sq.mm for CT circuits and 1.5 sq.mm for VT and other circuits, the number and size of strands shall be 7 of 0.67 mm and 0.5 mm diameter respectively.

25.2 Engraved identification ferrules, marked to correspond with the wiring diagrams shall be fitted to each wire. Ferrules shall be of yellow colour with black lettering.

25.3 Wires forming part of a tripping circuit of circuit breaker shall be provided with an additional red ferrule marked ‘T’.

25.4 Spare auxiliary contacts of all equipment forming part of the switchgear shall be wired up to the terminal blocks.

25.5 Wiring for any equipment supplied by the PURCHASER for which the VENDOR has to provide cut-outs (where indicated in the data sheets) shall be provided upto the terminal blocks.

25.6 Spare and unassigned modules shall be complete with internal wiring.

25.7 Wiring shall be terminated on preferably stud type terminal blocks such that the wires are connected by cable lugs with nuts and washers/ lock nuts.

25.8 Not more than two connections shall be made on any one terminal.

26.0 TERMINAL BLOCKS:

26.1 Terminal blocks (both for power and control circuits) shall be of reputed make especially for CT and VT circuits. It shall comprise finely threaded pairs of brass studs of at least 6 mm diameter, links between each pair of studs, washers, nuts and lock nuts. The studs shall be securely locked within the mounting base to prevent their turning. Insulated barriers shall be provided between adjacent terminals.

26.2 Terminals for circuits with voltage exceeding 110 V shall be shrouded. Terminal blocks shall be grouped depending on voltage level of the circuit. Different voltage groups of terminal blocks shall be segregated.

26.3 Terminal blocks shall be adequately rated to carry the current of the associated circuit. Minimum rating of the terminal block is 10A.

26.4 Terminals shall be numbered for identification as per enclosed drawings. Engraved white-on-black labels shall be provided on the terminal blocks, describing the function of the circuit.

26.5 Where duplication of a terminal block is necessary, it shall be achieved by solid bonding links.

26.6 Terminal blocks for CT secondary lead wires shall be provided with shorting, disconnecting and earthing facilities.

26.7 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks.

26.8 Minimum 10% spare terminal blocks shall be provided.

27.0 LABELS:

27.1 All labels shall comprise white letters on a black background

27.2 Labels shall be made of non-rusting metal or 3-ply lamicoid, or engraved PVC

27.3 Labels shall be properly fixed, with provision to prevent disorientation due to expansion.

27.4 Size of lettering shall be 6 mm, unless otherwise specified.

27.5 Module name plates shall be provided both at front and back of the panel.

27.6 Manufacturer's rating plate shall be provided with panel description, rating, year of manufacturing, serial number of the panel, etc.

28.0 EARTHING:

28.1 Each Switchgear shall be provided with an earth busbar running along entire length of the board. Material and size of the earth busbar shall be as specified in Data sheet-A1. At either end of the earth bus, one (1) clamp type terminal with nuts, bolts and washers shall be provided for bolting the PURCHASER'S earthing conductor of size and material indicated in Data sheet-A1. In case the earth bus is provided near top of the switchgear, one down comer at either end shall be provided for connection to the PURCHASER's earthing conductor.

28.2 Earth busbar shall be supported at suitable intervals.

28.3 Positive connection between all the frames of equipment mounted in the switchboard and earth busbar shall be provided by using insulated copper wire/ bare busbars of cross section equal to that of the busbar, or equal to half the size of circuit load current carrying conductor, whichever is smaller.

29.0 TESTS:

29.1 Type Tests

The switchgear shall be fully type tested assembly (TTA) in accordance with IEC 60439-1. The type tests to be performed on the switchgear shall include the following in accordance with IEC 60439-1:

a) Temperature rise test.

b) Verification of dielectric properties.

c) Short circuit withstand test.

d) Effectiveness of the protection circuit.

e) Clearances and creepage distances.

f) Mechanical operation.

g) Degree of protection.

29.2 Routine Tests.

Routine tests on the fully assembled and wired switchgear shall be carried out as per applicable standards. The routine tests shall include:-

a) Dielectric Test.

b) Verification of wiring as per approved schematics.

c) Electrical control, protection, interlock and sequential operation tests.

29.3 BIDDER shall submit available type test reports of temperature rise and short circuit tests of similar switchgear. In addition, calculations of temperature rise shall be submitted for approval.

29.4 Routine tests shall be carried out on all associated equipment supplied with switchgear, as per relevant standards. Type test certificates of all associated equipment shall be furnished.

29.5 Certified copies of all type and routine test certificates shall be submitted for the PURCHASER's approval before dispatch of the switchgear.

30.0 DRAWINGS & DATA:

30.1 As part of the proposal, BIDDER shall furnish the following drawings and data:

a) For each switchgear, overall dimensional drawing showing front view, plan, elevation and cross-section.

b) Data Sheet-B duly filled in.

All drawings and data sheets shall be annotated in English.

31.0 SPARE PARTS

31.1 Whether included in the VENDOR's recommendation or not, unit prices of essential spares as indicated in Data Sheet A1 shall be quoted.

31.2 The BIDDER shall furnish list of recommended spares for three years satisfactory operation.

DATA SHEET - A1								
Sl. No.		Description				Unit	Data	
1.0 SWITCHGEAR & BUSBAR RATING	1.1	Rated Voltage, Phases & Frequency					415V, 3Ph & 50Hz	
	1.2	System Neutral Earthing : Effectively / Non effectively					Effectively earthed	
	1.3	Maximum System Voltage				Volts	456.5	
	1.4	One minute Power Frequency Voltage						
	a)	Power Circuits				Volts	2500	
	b)	Control Circuits				Volts	1500	
	c)	Aux. Circuits connected to sec. Of CTs				Volts	2000	
	1.5	Continuous Current Rating of Bus bars under Site reference Ambient Temperature					See Bus bar details (Sl. No.2.0)	
	1.6	Reference Ambient Temperature				^{0}C	45 ^{0}C	
	1.7	Maximum Temperature of Busbars, droppers & contacts at continuous current rating under site reference ambient Temp.				^{0}C	85 ^{0}C	
	1.8	Short circuit withstand for Busbars & Droppers						
	a)	Short Time (3 s) at 415V				kA (rms)	50	
	b)	Dynamic Rating				kA (Peak)	110	
	1.9	Standard Applicable					As per Data sheet A2	
2.0 SWITCHGEAR PARTICULARS	Designation		Busbar Details			Single Front (SF) Double Front (DF)	Fully draw out (FD) Fixed (F)	Cable Entry Top (T) Bottom (B)
			Amps	Cu/ Al	TP/ TPN	SF/ DF	FD/ F	T/B
	1.	LT PANEL (Extension Panel - Physics Science RMU	1600	Al	TPN	SF	F	B
	2.							
	3.							
	4.							
	5.							
	6.							

DATA SHEET - A1								
Sl. No.		Description				Unit	Data	
	7.							
	8.							
	9.							
	10.							
3.0 SWITCHGER CONSTRUCTIONAL REQUIREMENTS	3.1	Panel internal form of separation as per IEC 60439-1					Form 3b	
	3.2	Sheet Steal	Type		Cold rolled/ Hot rolled		Cold rolled	
			Thickness		Frame	mm	2	
					Doors	mm	1.6	
					Covers	mm	1.6	
	3.3	Degree of protection as per IS:13947					IP54	
	3.4	Colour finish shade as per IS:5				Interior	Glossy white	
						Exterior	RAL:7032	
	3.5	Earthing Bus				Material	GS	
						Size	50 x 10	
	3.6	Purchaser's Earthing Conductor				Material	GS	
						Size	50 x 10	
	3.7	Clearances in air of live parts (Min.)				Phase to Phase	25.4mm	
						Phase to Earth	25.4mm	
	3.8	Metal enclosed Bus duct/Bus trunking / Cable entry to cubicles if required				a) Top/ Bottom	Bottom	
						b) Indoor/ Outdoor	Indoor	
	3.9	Busbar Insulation	Air insulated with phase barriers			Yes/ No	No	
			Fully insulated			Yes/ No	Yes	
	3.10	Safety Interlocks,						
	a)	Door Interlock				Yes/ No	Yes	
	b)	Shrouding of live parts				Yes/ No	Yes	
	c)	Finger touch proof connection				Yes/ No	Yes	
4.0 ACB	4.1	Circuit Breaker utilisation category				A/ B	B	
	4.2	Voltage frequency & No. Of Phases					415V, 50Hz & 3Ph	

DATA SHEET - A1					
Sl. No.		Description		Unit	Data
	4.3	Rated operating duty			0-0.03Sec-CO-3min-CO
	4.4	Rated breaking capacity			
	a)	MVA			36
	b)	Service breaking current at, 0.25 P.F.(I_{CS})		kA (rms)	50
	4.5	Short circuit withstand capacity	Current	kA (rms)	50
			Duration	second	1
	4.6	Rated making current		kA (peak)	110
	4.7	Rated current at site reference ambient temperature (in panel rating)			To suit circuit rating (Refer SLD)
	4.8	Type of operating mechanism	Manual, spring assisted	Yes/ No	No
			Manual, spring charged	Yes/ No	Yes (For Emergency operation)
			Motor operated spring assisted	Yes/ No	Yes
			Mechanical Spring Charged Indicator	Yes/ No	Yes
	4.9	Key Interlocking required		Yes/ No	Yes
	4.10	Shunt Trip required		Yes/ No	Yes
	4.11	Protection required			
	a)	Relays / series releases			Microprocessor based overload, short circuit and earth fault releases with adjustable current and time delay settings with self diagnostic & provision for addition of a communication feature (SCADA)
	b)	Relay Type & Settings			Both current & time variable.
	c)	Under voltage release required		Yes/ No	Yes
				Setting	Both Voltage & time variable.
	4.12	Minimum No. Of Auxiliary contacts (Spare after meeting all the scheme requirements)			2NO + 2NC (After meeting all scheme requirements)
	4.13	Control Voltage	For spring charging motor	Volts AC/ DC	From Existing panel (Will be confirmed later)
			For closing & tripping	Volts AC/	

DATA SHEET - A1					
Sl. No.		Description		Unit	Data
				DC	
			For Indications	Volts AC/ DC	
	4.14	Accessories required			
	a)	Mechanical position indicator for On/Off status		Yes/ No	Yes
	b)	Mechanical position indicator for Test & Service position		Yes/ No	Yes
	c)	Breaker operation counter		Yes/ No	Yes
	4.15	Manual operation required in addition to electrical operating devices			
	a)	For spring charging & closing		Yes/ No	Yes
	b)	For tripping		Yes/ No	Yes
	4.16	Annunciator required		Yes/ No	Yes
	4.17	Standards application			As per Data sheet A2
5.0 MOULDED CASE CIRCUIT BREAKER (MCCB)	5.1	Moulded case circuit breakers to be provided			
	a)	For Motor Control Circuits		Yes/ No	No
	b)	For other circuits		Yes/ No	Yes
	5.2	Voltage frequency & No. Phases			415V, 50Hz & 3Ph
	5.3	Utilisation category		A/B	B
	5.4	Rated Operating duty			0-0.03sec – CO – 3min – CO
	5.5	Rated service breaking capacity at, 0.25PF (I_{CS})		kA (rms)	50
	5.6	Short circuit withstand capacity	Current	kA (rms)	50
			Duration	s	1
	5.7	Rated making current		kA (peak)	110
	5.8	Rated current at site ref. Ambient temperature (in panel rating)		A	To suit circuit rating (Refer SLD)
	5.9	On/Off Operation			
	a)	Manual		Yes/ No	Yes
	b)	Power closing device for remote operation		Yes/ No	Yes
	c)	Shunt trip		Yes/ No	Yes
	5.10	Releases required			
	a)	Over load inverse time		Yes/ No	Microprocessor based overload, short circuit
	b)	Short circuit		Yes/ No	

DATA SHEET - A1					
Sl. No.		Description		Unit	Data
	c)	Earth fault		Yes/ No	and earth fault releases with adjustable current and time delay settings
	5.11	Accessories required			
	a)	Breaker Auxiliary contacts			Yes
	b)	Fault signalling contact for breaker auto trip through releases		Yes/No	Yes
	5.12	Termination arrangement			Terminal Spreaders shall be provided with phase barriers.
	5.13	Control Voltages			
	a)	For operating motor		Volts (AC/ DC)	From Existing Panel (Will be confirmed later)
	b)	For closing/tripping		Volts (AC/ DC)	
	c)	For Indication		Volts (AC/ DC)	
	5.14	Standards applicable			As per Data Sheet A2
6.0 MOTOR PROTECTION CIRCUIT BREAKER (MPCB)	6.1	Motor Protection Circuit Breakers to be provided			NA
	a)	For Motor Control Circuits		Yes/ No	
	b)	For other circuits		Yes/ No	
	6.2	Voltage frequency & No. Of Phases			
	6.3	Utilisation category		A/B	
	6.4	Rated Operating duty			
	6.5	Short circuit withstand capacity	Current	kA (rms)	
			Duration	s	
	6.6	Rated service breaking capacity at, 0.25PF (I_{cs})		kA (rms)	
	6.7	Rated making current		kA (rms)	
	6.8	Rated current at site ref. Ambient temperature (in-panel rating)		A	
	6.9	On/Off Operation			
	a)	Manual		Yes/ No	
	b)	Power closing device for remote operation		Yes/ No	
	c)	Shunt trip		Yes/ No	

DATA SHEET - A1					
Sl. No.		Description		Unit	Data
	6.10	Releases required			
	a)	Over load inverse time			
	b)	Short circuit			
	c)	Earth fault		Yes/ No	
	6.11	Accessories required			
	a)	Breaker Auxiliary contact			
	b)	Fault contact for breaker Auto trip			
	c)	Manual Hand RESET feature without opening door of MCC			
	6.12	Termination arrangement			
	6.13	Control Voltages			
	a)	For operating motor		Volts (AC/DC)	
	b)	For closing/tripping		Volts (AC/DC)	
	c)	For Indication & Control		Volts (AC/DC)	
	6.14	Standards applicable			
7.0 MINIATURE CIRCUIT BREAKER	7.1	Miniature circuit breakers to be provided			
	a)	For Motor Control Circuit		Yes/No	No
	b)	For Other circuit		Yes/No	Yes (for control circuit)
	7.2	Voltage frequency & No. Of Phases			110, 50Hz & 1Ph
	7.3	Rated operating duty			
	7.4	Rated service breaking capacity (at, 0.25PF) (I_{cs})		kA (rms)	10
	7.5	Short circuit withstand capacity	Current	kA (rms)	10
			Duration	s	1
	7.6	Rated current at site ref. Ambient temperature		A	As per circuit requirements
	7.7	Tripping characteristic curve for			
	a)	For Lighting & small power application			B Curve
	b)	For UPS Power application			D Curve
	c)	For DC application			D Curve (DC MCB)
	7.8	Positive Switch Operated Indication			Required

DATA SHEET - A1				
Sl. No.		Description	Unit	Data
	7.9	Switching C-O cycles (minimum)		20,000
	7.10	Standards applicable		As per Data Sheet A2

DATA SHEET - A1				
Sl. No.		Description	Unit	Data
8.0 CONTACTOR	8.1	Contractor to be provided		NA
	a)	For Motor Control Circuits	Yes/ No	
	b)	For other circuits	Yes/ No	
	8.2	Voltage frequency & No. Of phases		
	8.3	Rated Operating duty		
	8.4	Rated current at site ref. Ambient temperature	A	
	8.5	On/ Off Operation		
	a)	Auto	Yes/ No	
	b)	Manual	Yes/ No	
	c)	Remote power operated	Yes/ No	
	8.6	Control Voltage	Volts	
	a)	For coil Voltage	AC/ DC	
	8.7	Standards applicable		
9.0 EARTH FAULT RELAY	9.1	Make		NA
	9.2	Setting		
	a)	Range		
	b)	Time Setting		
	9.3	Location		
10.0 EARTH LEAKAGE CIRCUIT BREAKER (RCCB/RCBO)	10.1	Type	RCCB/ RCBO	NA
	10.2	Application		
	a)	For Motor circuits	Yes/ No	
	b)	For Lighting circuits	Yes/ No	
	c)	For other circuits	Yes/ No	
	10.3	Enhanced immunity to unwanted tripping (type 'i') required	Yes/ No	
	10.4	Voltage, frequency & No. Of Phases		
	10.5	Rated operating duty		

DATA SHEET - A1				
Sl. No.		Description	Unit	Data
	10.6	Rated service breaking capacity at 0.5 PF(Ics)	kA (rms)	
	10.7	Rated current at site ambient temperature	Amps	
	10.8	Leakage current setting for protection		
	a)	For human safety	mA	
	b)	For Fire safety	mA	
	10.9	Positive switch operated indication		
	10.10	Switching C-O cycles		
	10.11	Applicable standard		
11.0 SURGE ARRESTERS	11.1	Application		Surge Protection
	11.2	Type		2
	11.3	Maximum continuous operating voltage	V	440
	11.4	Voltage protection level	kV	1.8
	11.5	Rated discharge current for 8/20μs wave	kA	20
	11.6	Maximum peak value of 8/20μs wave	kA	40
	11.7	Applicable standard		As per Datasheet A2
12.0 CURRENT TRANSFORMER	12.1	Type		Cast epoxy resin
	12.2	Class of insulation		B
	12.3	CT parameters		
	a)	Rated primary current and ratio		As per SLD
	b)	Accuracy class and burden		As per SLD
	c)	Knee point voltage and excitation current		As per SLD
	12.4	Short circuit withstand current and time kA/1sec	kA(rms)	50
	12.5	Dynamic current withstand	kAp	110
	12.6	Applicable insulation		As per Data sheet – A2
13.0 VOLTAGE TRANSFORMER	13.1	Type		NA
	13.2	Class of insulation		
	13.3	VT parameters		
	a)	Number of windings		
	b)	Voltage ratio		
	c)	Method of connections		
	d)	Accuracy class and burden		
	13.4	Rated voltage factor		

DATA SHEET - A1					
Sl. No.		Description		Unit	Data
	13.5	Applicable standards			
14.0 MODULE DRAWINGS	Module Type	Description	Drawing No		
	1				
	2				
	3				
	4				
	5				
	6				
15.0 TESTS	15.1	Fully Type Tested Assembly (TTA) to be provided as per IEC-60439-1		Yes/No	
	15.2	Type Tests shall include:-			
	a)	Temperature rise test		Yes/No	Valid Type Test reports shall be submitted for all breakers
	b)	Dielectric Tests		Yes/No	
	c)	Short circuit withstand test		Yes/No	
	d)	Clearance and creepage distances		Yes/No	
	e)	Mechanical operations		Yes/No	
	f)	Degree of Protection		Yes/No	
	15.3	Routine Tests			As per applicable standard
16.0 ESSENTIAL SPARES TO BE SUPPLIED	16.1	COMPLETE Air Circuit breaker with operating mechanism and releases where specified of the following ratings			
	a)				
	b)				
	c)				
	d)				
	16.2	Complete MCCB/MPCB with operating mechanism and releases of the following ratings			
	a)				
	b)				
	c)				
	d)				
	16.3	Complete MCB with releases of the following			

DATA SHEET - A1				
Sl. No.		Description	Unit	Data
		rating		
	a)			
	b)			
	c)			
	d)			
	16.4	Complete RCBO with releases		
	16.5	Closing & tripping coils		
	16.6	Operating motors		
	16.7	Auxiliary contact blocks		
	16.8	Moving auxiliary contact blocks		
	16.9	Breaker control switches		
	16.10	Service selector switches		
	16.11	Indicating Lamps with series Resistors		
	a)	Red		
	b)	Green		
	c)	Amber		
	d)	Blue		
	f)	White		
	16.12	Voltage Transformer of each rating		
	16.13	Control Transformer of each rating		
	16.14	Surge Arrester		
17.0 NOTES		Bidders to indicate spares required for 3 years trouble free operation of the unit.		

DATA SHEET – A2				
APPLICABLE STANDARDS				
Sl. No.	Description	STANDARDS		
01	Specification for low voltage switchgear and control gear		IS:13947	
02	AC circuit breakers		IS:13947, Part 2	IEC 60947-2
03	Factory built assemblies of Switchgear and control gear for voltages up to and including 1000V AC & 1200V DC.		IS:8623	
04	Air break switches		IS:13947 Part 3	
05	Miniature circuit breakers		IS:13032	IEC-60898
06	Contactors & Starters		IS:13947 Part 4	
07	Control switches/push buttons		IS:13947 Part 5	
08	Current transformers		IS:2705	
09	Voltage transformers		IS:3156	
10	Relays		IS:3231	
11	Indicating instruments		IS:1248	
12	Arrangement for busbars main connections and accessories		IS:5578 IS:11353	
13	AC electricity meters		IS:8530,722,13010,13779,11448	
14	Degree of protection		IS:2147	
15	The performance of AC control gear equipment rated up to 600V for use on high prospective fault current system			
16	Code of practice for installation and maintenance of switchgear		IS:10118	
17	Climate proofing of electrical		--	
18	Code of practice for phosphating iron & steel		IS:6005 BS:3189	
19	Wrought aluminium & aluminium alloys for electrical purposes		IS:5082	

DATA SHEET – B47
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description	Unit	BIDDER'S DATA
1.0 SWITCHGEAR & BUSBAR RATING	1.1	Rated Voltage, Phases & Frequency		
	1.2	System Neutral Earthing : Effectively / Non effectively		
	1.3	Maximum System Voltage	Volts	
	1.4	One minute Power Frequency Voltage	Volts	
	a)	Power Circuits		
	b)	Control Circuits		
	c)	Aux. Circuits connected to sec. Of CTs		
	1.5	Continuous Current Rating of Bus bars under Site reference Ambient Temperature		
	1.6	Reference Ambient Temperature	°C	
	1.7	Maximum Temperature of Busbars, droppers & contacts at continuous current rating under site reference ambient Temp.	°C	
	1.8	Short circuit withstand for Busbars & Droppers		
	a)	Short /Time (1sec) at 415V	kA (rms)	
	b)	Dynamic Rating	kA (Peak)	
	1.9	Standard Applicable		As per Data sheet A2

2.0 SWITCHGEAR PARTICULARS	Designation		Busbar Details			Single Front (SF) Double Front (DF)	Fully draw out (FD) Fixed (F)	Cable Entry Top (T) Bottom (B)
			Amps	Cu/AL	TP/TPN	SF/DF	FD/F	T/B
	1.							
	2.							
	3.							
	4.							
	5.							
	6.							
	7.							
	8.							
	9.							
	10.							
	11.							
	12.							
	13.							
	14.							
	15.							

74DATA SHEET – B
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description		Unit		BIDDER'S DATA
3.0 SWITCHGEAR CONSTRUCTIONAL REQUIREMENTS	3.1	Panel internal form of separation as per IEC 60439-1				
	3.2	Sheet Steal	Type	Cold rolled/ Hot rolled		
			Thickness	Frame	mm	
				Doors	mm	
				Covers	mm	
				Partitions	mm	
	3.3	Degree of protection as per IS:13947				
	3.4	Colour finish shade as per IS:5		Interior		
				Exterior		
	3.5	Earthing Bus		Material		
				Size		
	3.6	Purchaser's Earthing Conductor		Material		
				Size		
	3.7	Clearances in air of live parts (Min.)		Phase to Phase		
				Phase to Earth		
	3.8	Metal enclosed Bus duct/Bus truning/ Cable entry to cubicles if required		a) Top/ Bottom		
				b) Indoor/ Outdoor		
	3.9	Busbar Insulation	Air insulated with phase barriers	YES/NO		
			Fully insulated	YES/NO		
	3.10	Safety Interlocks		Yes		
	a)	Door Interlock		Yes		
	b)	Shrounding of live parts		Yes		
	c)	Finger touch proof connection		Yes		
4.0 AIR CIRCUIT BREAKER	4.1	Circuit Breaker Make & type				
	4.2	Voltage frequency & No. Of Phases				
	4.3	Utilisation category		A/B		
	4.4	Rated operating duty				
	4.5	Rated breaking capacity				
	a)	MVA				
	b)	Service breaking capacity at, 0.25 P.F. (Ics)		kA (rms)		
	c)	Ultimate breaking capacity (Icu)		kA (rms)		

DATA SHEET – B
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description		Unit	BIDDER'S DATA
4.0 AIR CIRCUIT BREAKER	4.6	Short circuit withstand capacity	current	kA (rms)	
			Duration	Sec	
	4.7	Rated making current		kA (peak)	
	4.8	Rated current at site reference ambient temperature (in panel rating)			
	4.9	Type of operating mechanism	Manual, spring assisted	Yes/No	
			Manual, spring charged	Yes/No	
			Motor operated spring assisted	Yes/No	
			Mechanical Spring Charged Indicator	Yes/No	
	4.10	Interlocking provided as per specification		Yes/No	
	4.11	Shunt Trip provided			
	4.12	Protection provided			
	a)	Relays / series releases			
	b)	Relay Type & Settings			
	c)	Under voltage release provided		Yes/No	
				Setting	
	4.13	Minimum No. Of Auxiliary contacts (SPARE)			
	4.14	Control Voltage	For Spring charging		
			For closing & tripping		
			For Indications		
	4.15	Accessories provided		Yes/No	
	a)	Mechanical position indicator for On/Off status			
	b)	Mechanical position indicator for Test & Service position			
	c)	Breaker operation counter			
	4.16	Manual operation provided in addition to electrical operating devices			
	a)	For spring charging & closing		Yes/No	
	b)	For tripping		Yes/No	
	4.17	Annunciator provided		Yes/No	
	4.15	Standards applicable			
5.0 MCCB	5.1	Make			
	5.2	Makers Type designation			
	5.3	Moulded case circuit breakers to be provided			
	a)	For Motor Control Circuits		Yes/No	
	b)	For other circuits		Yes/No	
	5.4	Voltage frequency & No. Phases			
	5.5	Utilisation category		A/B	
	5.6	Rated Operating duty			

DATA SHEET – B
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description		Unit	BIDDER'S DATA
5.0 MOULDED CASE CIRCUIT BREAKER (MCCB)	5.7	Rated breaking capacity at, 0.25PF (Ics)		kA (rms)	
	5.8	Ultimate braking capacity (Icu)			
	5.9	Short circuit withstand capacity	Current	kA (rms)	
			Duration	Sec	
	5.10	Rated making current		kA(peak)	
	5.11	Rated current at site ref. Ambient temperature (in panel rating)		Amps	
	5.12	On/Off Operation			
	a)	Manual			
	b)	Power closing device for remote operation			
	c)	Shunt trip			
	5.13	Releases provided		Yes/No	Furnish details
	a)	Over load inverse time			
	b)	Short circuit			
	c)	Earth fault			
	5.14	Accessories required			
	a)	Breaker Auxiliary contacts			
	b)	Fault signalling contact for breaker auto trip through releases			
	5.15	Termination arrangement			
	5.16	Control Voltages		Volts (AC/DC)	
	a)	For operating motor			
	b)	For closing/tripping			
	c)	For Indication			
	5.17	Standards applicable			
6.0 MOTOR PROTECTION CIRCUIT BREAKERS (MPCB)	6.1	Make			
	6.2	Maker's type designation			
	6.3	Motor Protection Circuit Breakers to be provided			
	a)	For Motor Control Circuits		Yes/No	
	b)	For other circuits		Yes/No	
	6.4	Voltage frequency & No. Of Phases			
	6.5	Utilisation category		A/B	
	6.6	Rated Operating duty			
	6.7	Rated service breaking capacity at, 0.25PF (Ics)		kA (rms)	
	6.8	Ultimate breaking capacity (Icu)			

DATA SHEET – B
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description		Unit	BIDDER'S DATA
6.0 MOTOR PROTECTION CIRCUIT BREAKERS (MPCB)	6.9	Short circuit withstand capacity	Current	kA (rms)	
			Duration	Sec	
	6.10	Rated making current		kA(peak)	
	6.11	Rated current at site ref. Ambient temperature (in panel rating)		Amps	
	6.12	On/Off Operation			
	a)	Manual			
	b)	Power closing device for remote operation			
	c)	Shunt trip			
	6.13	Releases provided		Yes/No	Furnish details
	a)	Over load inverse time			
	b)	Short circuit			
	c)	Earth fault			
	6.14	Accessories required			
	a)	Breaker Auxiliary contacts			
	b)	Fault signalling contact for breaker auto trip through releases			
	6.15	Termination arrangement			
	6.16	Control Voltages		Volts (AC/DC)	
	a)	For operating motor			
	b)	For closing/tripping			
	c)	For Indication			
	6.17	Standards applicable			
7.0 MINIATURE CIRCUIT BREAKERS (MCB)	7.1	Make			
	7.2	Maker's Type designation			
	7.3	Miniature circuit breakers to be provided			
	a)	For Motor Control Circuit		Yes/No	
	b)	For Other circuit		Yes/No	
	7.4	Voltage frequency & No. Of Phases			
	7.5	Rated operating duty			
	7.6	Rated breaking capacity at, 0.25PF (Ics)		kA (rms)	
	7.7	Short circuit withstand capacity	Current	kA (rms)	
			Duration	Sec	
	7.8	Rated current at site ref. Ambient temperature		Amps	
	7.9	Tripping characteristic curve for			
	a)	For Lighting & small power application			
	b)	For UPS Power application			
	c)	For DC application			
	7.10	Positive Switch Operated Indication		Yes/No	
	7.11	Switching C-O cycles (minimum)			
	7.12	Standards applicable			

DATA SHEET – B
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description	Unit	BIDDER'S DATA
8.0 CONTACTOR	8.1	Make		
	8.2	Maker's type designation		
	8.3	Contractor to be provided		
	a)	For Motor Control Circuits	Yes/No	
	b)	For other circuits	Yes/No	
	8.4	Voltage frequency & No. Of phases		
	8.5	Rated Operating duty		
	8.6	Rated current at site ref. Ambient temperature	Amps	
	8.7	On/Off Operation		
	a)	Auto	Yes/No	
	b)	Manual	Yes/No	
	c)	Remote power operated	Yes/No	
	8.8	Control Voltage	Volts	
	a)	For coil Voltage	AC/DC	
	8.9	Standards applicable		As per Data Sheet A2
9.0 EARTH FAULT RELAY	9.1	Make		
	9.2	Setting		
	a)	Range		
	b)	Time Setting		
	9.3	Location/Applicable		
10.0 EARTH LEAKAGE CIRCUIT BREAKER (RCCB/RCBO)	10.1	Make		
	10.2	Maker's type designation		
	10.3	Type	RCCB/RCBO	
	10.4	Application		
	a)	For Motor circuits	Yes/No	
	b)	For Lighting circuits	Yes/No	
	c)	For other circuits	Yes/No	
	10.5	Enhanced immunity to unwanted tripping (type 'i') provided	Yes/No	
	10.6	Voltage, frequency & No. Of Phases		
	10.7	Rated operating duty		
	10.8	Rated Breaking capacity at 0.5 PF	kA	
	10.9	Rated current at site ambient temperature	Amps	
	10.10	Leakage current setting for protection		
	a)	For human safety	mA	
	b)	Fire safety	mA	
	10.11	Positive switch operated indication	Yes/No	
	10.12	Switching C-O cycles		
	10.13	Applicable standard		

DATA SHEET – B
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description	Unit	BIDDER'S DATA
11.0 SURGE ARRESTERS	11.1	Make		
	11.2	Maker's type designation		
	11.3	Application		
	11.4	Type		
	11.5	Maximum continuous		
	11.6	Voltage protection level		
	11.7	Rated discharge current for 8/20μs wave		
	11.8	Maximum peak value of 8/20μs wave		
	11.9	Applicable standard		
12.0 CURRENT TRANSFORMER	12.1	Make		
	12.2	Maker's type designation		
	12.3	Type		
	12.4	Class of insulation		
	12.5	CT parameters		
	a)	Rated primary current and ratio		
	b)	Accuracy class and burden		
	c)	Knee point voltage and excitation current		
	12.6	Short circuit withstand current and time kA/1sec	kA	
	12.7	Dynamic current withstand	kAp	
	12.8	Applicable standard		
13.0 VOLTAGE TRANSFORMER	13.1	Make		
	13.2	Maker's type designation		
	13.3	Type		
	13.4	Class of standard		
	13.5	VT parameters		
	a)	Number of windings		
	b)	Voltage ratio		
	c)	Method of connections		
	d)	Accuracy class and burden		
	13.6	Rated voltage factor		
	13.7	Applicable standards		
14.0 TESTS	14.1	Are Type Tested Assembly (TTA) panel offered	Yes/No	
	14.2	Are all Type tests as per specification to be conducted	Yes/No	
	14.3	Type test reports submitted with the bid	Yes/No	
			Certificate no.	

DATA SHEET – B
(To be filled in by the BIDDER and submitted with the BID)

Sl. No.		Description	Unit	BIDDER'S DATA
15.0 DIMENSIONS	15.1	Total dimension of each complete switchgear	L mm	
			W mm	
			D mm	
	15.2	Width of each vertical section with cable alley	mm	
	15.3	Width of cable alley	mm	
	15.4	Clear space to be kept in front of the switch gear	mm	
	15.5	Clear space to be kept on the rear of the switchgear	mm	
16.0 WEIGHTS	16.1	Approximate weight of each complete switchgear	Kgs	
	16.2	Weight of each vertical section with cable alley	Kgs	
17.0 COMPLETENSS OF OFFER	17.1	Have all the feeders with correct module type been provided in each switchgear as per the single line diagram	Yes/No	
	17.2	Has each type of the module been provided with all the devices as shown in the relevant module drawings	Yes/No	
18.0 SPARE PARTS	18.1	Have unit prices for essential spares as mentioned in Data Sheet A1 furnished	Yes/No	
	18.2	List of recommend spares for three years' operation furnished	Yes/No	

1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

2.2 The cables shall conform to the latest applicable standards as specified in the relevant Data Sheet A2. In case of conflict between the standards and this specification, the stringent of the two shall apply. Equipment complying with other authoritative standards such as British, American, VDE will also be considered, if offered.

3.0 DESIGN AND PERFORMANCE REQUIREMENTS:

3.1 Cable Construction:

3.1.1 Three Core Cables:

a) Conductor Well compacted, stranded copper or Aluminium circular shaped as mentioned in data sheet A.

b) Conductor screen Conductor screen shall be provided over the conductor by extrusion of non – metallic semiconducting compound.

c) Insulation Cross-linked polyethylene applied by extrusion. The XLPE shall be gas cured. The thickness of the insulation shall be as per applicable standards.

d) Insulation Screen Shall consist of two parts, namely metallic and non metallic.

i) The non metallic part shall be applied directly over the insulation of each core by extruded semiconducting compound.

ii) The metallic part shall consist of non magnetic metallic tape (preferably copper tape) applied over the non metallic part.

e) Core identification By colouring of XLPE insulation up to 3.3kV cables. By numerals printed on the cores for cables above 3.3kV

f) Inner sheath The laid up cores shall be provided with extruded PVC compound inner sheath. The shape of the cable shall be as circular as possible. The thickness of the inner sheath shall be as per applicable standard.

g) Armouring Single/ double galvanised steel wire/ strip armouring shall be provided as mentioned in Data sheet A. The thickness of galvanised steel wire or strip shall be as per applicable standards.

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

The outer sheath shall be:-

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

3.1.2 Single Core cables

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

a) The armouring shall constitute the metallic part of screening.

b) The armour shall be of non – magnetic material.

3.2 Requirement of special FRLS-PVC sheath:

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

3.2.2 Test for Flame Retardance

a) Oxygen Index

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

b) Flammability

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

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

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

3.2.3 Test for Smoke Generation

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

a) ASTM-D-2843

b) ASTM-E-662

c) 3 metre cube test chamber.

3.2.4 Tests for Acid Gas Generation

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

3.2.5 Tests for Resistance to Ultra Violet Radiation

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

3.2.6 Tests for Water Absorption

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

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

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

4.0 TEMPERATURE RISE AND CURRENT RATINGS:

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

4.2 Current Ratings

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

a) Rated continuous current

b) Rated 1.0 second current

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

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

a) Laid in ground and in air

b) Laid flat and laid in trefoil formation

c) The metallic screens with both ends bonding and with single point bonding/cross bonding.

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

a) Variation in ground temperature

b) Variation in soil thermal resistivity

c) For two cables laid side by side at 300, 600 and 900 mm centres.

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

5.0 CABLE ACCESSORIES

5.1 Bidder shall include in his offer, the equipment and materials required for making cable splices and cable termination. The terminations may be taped type for lower voltages up to 22 kV and prefabricated type for higher voltages.

Full details of the splicing and terminating procedures shall be given in the tender.

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

6.0 CABLE DRUMS:

6.1 Cables shall be supplied in non-returnable drums of sturdy construction. All ferrous and other metal parts of drum shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.

6.2 The length of cable on each drum shall be determined by the manufacturer considering the transport limitations from manufacturer's works to the site.

6.3 Bidders shall indicate in the offer, the maximum length for each size of cable, which can be furnished on one drum. However before packing the cables on drums, the successful bidder shall obtain Purchaser's approval for the drum length of cable in the drum

7.0 TESTS AND TEST REPORTS:

7.1 Bidder shall give a complete list of routine and type tests proposed to be performed in his tender.

7.2 Routine Tests shall be performed on each drum length. All tests as per applicable standard shall be performed.

7.3 Type Tests: Bidder shall furnish full particulars of the type tests as per applicable standard proposed to be carried out by him. Valid type test reports not older than 5 years shall be submitted with the bid. If such reports are not available, the tests shall be carried out without any extra cost.

7.4 Acceptance Tests: Acceptance tests shall be carried out in accordance with the applicable standard.

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

8.0 INFORMATION TO BE GIVEN BY BIDDER:

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

8.1 Detailed drawings with dimensions of the cable and all accessories, including –

a) Cross sectional view of cable, indicating the material used in each type of construction.

b) Splices, straight joints and trifurcating boxes

c) Terminations, showing mounting arrangement

8.2 Complete specifications of covering used to protect sheath and reinforcing tapes co corrosion

8.3 Descriptive information regarding cable and accessories and test of installations of similar cables now in service with description, cable performance, outages suffered and cause of outages.

8.4 Recommended method for locating conductor faults, apparatus required for locating the faults and their price.

9.0 ERECTION & MAINTENANCE TOOLS & EQUIPMENT AND SPARE:

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

9.2 Equipment:

a) Capacitance Bridge: This shall be suitable for operation on both A.C. mains and storage batteries. Facilities shall be provided for both audio and visual indications of the balance of the bridge.

b) Fault Locating equipment:

1. Digital fault locating equipment along with the accessories like surge generator etc.

2. Acoustic detector for locating underground fault by capacitor discharge method.

3. Equipment for locating PVC Sheath fault.

DATA SHEET – A1								
SL. NO.		DESCRIPTION		UNIT	DATA			
1.0 GENERAL	1	Application/ designation			Power Cable			
	1.2	Installation	Above Ground		In cable trays			
			Below Ground		Cable Trench			
	1.3	Design ambient temperature		^{o}C	45			
	1.4	Ground Temperature		^{o}C	35			
	1.5	Minimum drum length		m	--			
2.0 SYSTEM DATA	2.1	Number of phases & frequency			3 Ph, 50Hz			
	2.2	Nominal system voltage		kV	11			
	2.3	Highest system voltage		kV	12			
	2.4	Impulse (1.2/50 μ sec wave)withstand voltage		kV_p	75			
	2.5	Power frequency withstand voltage		kV	28			
	2.6	System neutral			Effectively Earthed			
	2.7	System Fault Level		kA(rms)	25			
	2.8	CB Breaking capacity		kA(rms)	25			
	2.9	Relay & CB Opening time		m sec	800			
3.0 DESCRIPTION OF CABLE	3.1	Cable type			H1 11kV(E)	H2 11kV(E)	H3	H4
	3.2	No. of cores			3	3		
	3.3	Conductor size		Sq. mm	400	240		
	3.4	Conductors						
	a)	Material		Cu/Al	Al	Al		
	b)	Stranded		Yes/No	Yes	Yes		
	3.5	Conductor screen			Extruded non-metallic semi conducting compound			
	3.6	Core insulation						
	a)	Material			XLPE applied by extrusion. XLPE shall be gas cured			
	b)	Thickness of insulation			As per applicable standards			
	3.7 a)	Insulation screen Non-metallic part			Extruded semiconductive compound			
	b) i)	Metallic part For single core cables			NA			
	ii)	For multi core cables			Copper tape			
	3.8 a)	Core identification Up to 3.3 kV cables			NA			
	b)	Cables above 3.3 kV			By numerals printed on the cores			

DATA SHEET – A1							
SL. NO.		DESCRIPTION	UNIT	DATA			
3.0 DESCRIPTION OF CABLE				Cable type			
				H1 11kV(E)	H2 11kV(E)	H3	H4
	3.9	Inner sheath					
	a)	Material		Extruded conductor screening	Extruded conductor screening		
	b)	Thickness of inner sheath		As per applicable standards			
	3.10	Armouring	GS/AL				
	a)	Material Galvanised steel/Aluminium		GS	GS		
	b)	Type: Single wire/strip / Double wire/strip		Single wire	Single wire		
	c)	Dimension of wire/strip		As per applicable standards			
	3.11	Outer sheath					
	a)	Material PVC/FRLS PVC		PVC	PVC		
	b)	Thickness of outer sheath		As per applicable standards			
	c)	Colour		Black			
	3.12 a)	Temperature rise Maximum conductor temperature during continuous operation at rated current		90 °C			
	b)	Temperature rise for short circuit rating with initial conductor temperature of 90		250°C			
	3.13	Quantity		As per BOQ (Section-5)			

DATA SHEET – A2

APPLICABLE STANDARDS

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

	cables Specification, Part-3 for working voltages from 66kV up to and including 220kV	
24	Elastomeric insulation and sheath of electric cables	IS 6380 :1984
25	Polyethylene insulation and sheath of electric cables	IS 6474 : 1984
26	Brass glands for PVC cables	IS 12943 : 1990
27	Conductors of insulated electric cables and flexible cords (First revision)	IS 8130 :1984

DATA SHEET –B

To be filled in by the BIDDER and submitted with the bid.

SL #	Description	Unit	Bidder's Data			
1.0	Cable Type as per Data sheet A		H1	H2	H3	H4
2.0	Name of manufacturer					
3.0	Whether IS marked?	Yes/No				
4.0	Voltage grade					
5.0	Number of cores					
6.0	Conductor size	Sq. mm				
7.0	Conductors					
a)	Material					
b)	Number & diameter of wires					
8.0	Conductor screen					
9.0	Core insulation					
a)	Material					
b)	Curing process					
c)	Thickness of insulation	mm				
10.0	Insulation screen					
a)	Non-metallic part					
b)	Metallic part i) For single core cables ii) For multi core cables					
11.0	Core identification					
12.0	Inner sheath					
a)	Material					
b)	Thickness of inner sheath					
13.0	Armouring					
a)	Material Galvanised steel/Aluminium	GS/AL				
b)	Type: Single wire/strip Double wire/strip					
c)	Dimension of wire/strip					
14.0	a) Outer sheath Material PVC/FRLS PVC					
b)	Thickness of outer sheath					
c)	Colour					
15.0 a)	Temperature rise Maximum conductor temperature during continuous operation at rated current					
b)	Temperature rise for short circuit rating with initial conductor temperature of 90					
16.0	Quantity					
			Cable Type			

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

SL #	Description	Unit	Bidder's Data			
			H1	H2	H3	H4
17.0	Nominal overall diameter of completed cable	mm				
18.0	Nominal weight per meter of completed cable	Kg/mm				
19.0	Minimum radius of bend round which cable can be laid i. Direct ii. In ducts	mm				
20.0	Nominal internal diameter of pipes or ducts required	mm				
21.0	Maximum D.C. resistance of conductor per Km at 20^0C	Ohm				
22.0	Maximum A.C. resistance of conductor per Km at 90^0C	Ohm				
23.0	Equivalent star reactance per Km of 3 phase circuit at power frequency	Ohm				
24.0	Maximum electrostatic capacitance per core per Km of cable	F				
25.0	Maximum charging current per conductor per Km of cable at nominal voltage	A				
26.0	Maximum dielectric loss of cable per km of 3 phase circuit, laid direct in ground, at normal voltage, frequency and maximum conductor temperature					
27.0	Impedance per km of 3 phase circuit at normal power frequency and maximum conductor temperature: i. Positive and negative sequence ii. Zero sequence	 Ohm Ohm				
28.0	Normal drum length of cable	m				
29.0	Approximate shipping weight & size of drum	kg. m				
30.0	Rated current for standard condition of laying					
			Cable Type			
			H1	H2	H3	H4
31.0	Derating factors for variations in					
a)	Ambient air temperatures					
b)	Ground temperatures					
c)	Ground thermal resistivity					
d)	Depth of burial of 0.5 m, 0.75 m, 1.25					

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

SL #	Description	Unit	Bidder's Data			
	m, 1.5m					
e)	for two cables laid side by side in ground at centre distances 300, 400, 600mm ,900 mm					
32.0	Furnish chart showing derating factor for different spacing of cables considering multicore cables installed in horizontal formation in single row as well as in different tiers under the following methods of laying: i. Cables laid in formed concrete trenches with removable covers ii. Cables laid in cable trays iii. Cables laid in ground one meter below the ground level iv. Cables laid in pipes or ducts					
33.0	Recommended operating temperatures: i. Continuous ii. Emergency iii. After short circuit	 ^{0}C ^{0}C ^{0}C				
34.0	Short circuit capacity for 1 second, for initial and final conductor temperatures as per item 15	kA (RMS)				

ADDENDUM TO DOCUMENT No: PCPL-4-S4-162

1. Clause No. 4.4.2, 4.15: These clauses are not applicable for this tender.
2. Clause No. 8.1: This clause is not applicable for this tender.
3. Clause No. 10.4.2, 10.4.3, 10.4.4: These clauses are not applicable for this tender.

1.0 SCOPE:

This Specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR's / his SUB-VENDOR's Works, delivery to Site and performance testing of segregated / Non – segregated phase metal enclosed bus ducts.

2.0 CODES & STANDARDS:

2.1 The design, material, construction, manufacture, inspection, testing and performance of segregated / non segregated phase metal enclosed bus duct shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards. Nothing in this Specification shall be construed to relieve the VENDOR of this responsibility.

2.2 Equipment shall conform to the latest applicable standards as mentioned in Data Sheets. In case of conflict between the standards and this Specification, this specification shall govern.

3.0 DEFINITION:

A segregated phase bus duct is one in which phase conductor with its associated connections, joints, accessories and insulating supports are enclosed in an earthed metal housing with either metal or insulation barrier between the phases. If the BIDDER offers insulated barriers, the type, composition, electrical withstand characteristics and thickness of the insulating material used shell be indicated by the BIDDER in his bid and shall be subject to the PURCHASER'S approval.

4.0 BUSDUCT ENCLOSURE:

4.1 Material:

4.1.1 The enclosure shall be made of steel or aluminium alloy as specified in Data Sheet-A. The grade of steel or aluminium alloy shall be indicated by the BIDDER in his Bid and shall be subject to the PURCHASER's approval.

4.2 Shape:

4.2.1 Except as noted otherwise in Data Sheet-A, the section of the busduct enclosure shall either be square or rectangular.

4.3 Mechanical Strength:

4.3.1 The design of the Busduct enclosure shall be such that it will withstand the internal or external pressures resulting from the following:

a) Normal operating conditions,

b) Momentary short-circuit currents (Peak),

c) Rigours of adverse weather conditions, and

d) Combination of the above.

4.3.2 The enclosure shall be of sturdy construction to have inherent strength to withstand the above forces.

4.4 Construction:

4.4.1 The Busduct shall be designed for indoor/ outdoor installation as specified in Data Sheet-A, with a dust and vermin-proof construction.

4.4.2 Busduct installations meant for outdoor application shall be of weatherproof construction and shall have degree of protection IP-66 and shall be indicated by the BIDDER in Data Sheet-B.

4.5 Painting:

4.5.1 The outside of the busduct enclosure shall be given a finish as per the PURCHASER's requirement specified in Data Sheet-A.

4.6 Temperature Rise:

4.6.1 Under normal operating conditions, the hot spot temperature of the enclosure shall not exceed 70°C. In areas where the operating personnel are likely to touch the enclosure during operation, either the enclosure temperature shall be limited to 60°C or suitable thermal barrier shall be provided.

4.7 Flexible Expansion and Rubber Bellow Joints:

4.7.1 Flexible expansion joints for the enclosure shall be provided wherever deemed necessary by the VENDOR. The flexible joints shall take care of expansion and contraction due to temperature variations and fault conditions.

4.7.2 Rubber bellow joints shall be provided at terminations at transformers and switchgear cubicles.

4.8 Bonding:

4.8.1 Necessary bonding shall be provided at the above expansion joints if made of insulating material.

4.9 Terminal Enclosures and Flanges:

4.9.1 Three-phase terminal enclosures shall be provided with flanged ends with drilling dimensions to suit the flanges at equipment terminals. The busduct shall be properly aligned with the equipment terminals.

4.9.2 The flanges shall be provided with gaskets, nuts, bolts etc.

4.10 Gaskets:

4.10.1 The gasket material and thickness shall be so selected as to satisfy the operating conditions imposed by temperature, weathering durability etc. Care shall be exercised to ensure that covers fit easily, that the required compression of the gaskets can be obtained without damage to the inspection covers by bolts and that covers do not bend after this compression has been applied. Over-compression of the gaskets shall be avoided.

4.10.2 The material of the gasket shall preferably be neoprene closed-cell sponge rubber or equivalent.

4.10.3 Flanges with gaskets shall be provided at the equipment terminal connections.

4.11 Inspection covers

4.11.1 Provision shall be made for periodic inspection of insulators by means of inspection covers. The inspection covers shall be provided at the bottom with quick-acting stainless steel clamps and shall have gaskets. There shall be no joints or fixing bolts on the top surface through which water could seep through.

4.12 Drain plugs and vents

Filter type drain plugs shall be installed at low points along the run of the bus duct to drain out automatically any moisture condensing within the bus enclosure. The drain plugs shall be fitted with porous filter elements which will permit the escape of moisture but prevent the ingress of dust. The filter elements shall be easily removable for cleaning purposes.

4.13 Miscellaneous Hardware:

4.13.1 The busduct shall not have any through bolts. All nuts and bolts shall be mild steel hot dip galvanised. M.S. spring washers shall be provided for making satisfactory joints. Clamps, splice plates etc. shall be provided wherever necessary.

4.14 Earthing:

4.14.1 Necessary earthing arrangement as applicable shall be provided with clamps to receive the PURCHASER'S station earthing bus. All accessories and hardware required for the earthing arrangement shall be provided by the VENDOR.

4.15 Rain Cover

Whenever the outdoor portion of the busduct is not of welded construction but of bolted type, a continuous hood made of non-magnetic material shall be provided over the entire length of the outdoor portion of the busbuct to prevent ingress of water particles due to rainfall directly on busduct enclosure. This hood shall be mounted on bus duct supporting structures and all hardware and accessories required for mounting the hood and its supports shall be subject to the PURCHASER'S approval.

5.0 BUS CONDUCTOR:

5.1 Material

The material of the conductor shall be aluminium alloy or copper as specified in Data Sheet-A. The grade of aluminium alloy or copper shall be indicated by the BIDDER in his Bid and shall be subject to the PURCHASER's approval.

5.2 Rating

The bus conductor shall be designed to carry the rated current under specified Site operating conditions without exceeding enclosure final temperature of 70°C. Also, the temperature of the bus shall not exceed 250°C while carrying the specified short circuit current for one second when a fault occurs at the operating temperature.

5.3 Shape:

5.4 Except as noted otherwise in Data Sheet-A, the section of the bus conductors used shall be either rectangular, tubular or hollow square/rectangular type and the cross sectional area shall be based on the current rating.

5.5 Mechanical Strength:

The bus conductors and insulated supports shall withstand without permanent deformation, deterioration of conductor material and reduction in the BIL value of the busduct, the stresses consistent with the momentary short circuit current specified in this Specification.

5.6 Joints:

5.6.1 Adjacent sections of the busduct shall be bolted to provide an efficient, electrically continuous and mechanically strong connection.

5.6.2 Welded Expansion Joints:

Flexible aluminium or copper connectors welded to the main busbars shall be provided wherever deemed necessary.

5.6.3 Bolted Rigid Joints:

The connectors shall be of the same material as the conductor and these shall be silver-plated to ensure an efficient connection. The bolting schedule and contact pressures shall conform to accepted codes of practice.

5.6.4 Bolted Flexible Joints:

Flexible braided copper connections shall be provided at the equipment terminal connections. Bimetallic connectors shall be provided between the busbar and the copper flexible if the bus conductor is of aluminium alloy. The joints shall be capable of 25-mm settlement of the equipment mounting pads. The joints shall be suitably designed to take care of the vibration at the terminals as well as the expansion and contraction of the busbars.

5.6.5 Bolted Expansion Joints:

Expansion joints made of aluminium or copper strips shall be provided wherever deemed necessary by the VENDOR, to take care of expansion and contraction of the busbars under normal operating conditions.

5.6.6 All the above joints shall be tested for temperature rise to prove the adequacy of the design. The maximum temperature rise at the joints shall be less than the specified temperature rise for the busbars.

5.7 Hardware:

5.7.1 All bolts, nuts and lock washers used in the busduct assembly shall be of high tensile steel and plated for corrosion resistance. Spring washers of 'Belleville' type or equivalent shall be used.

5.7.2 Suitable splice plates and bimetallic connectors shall be provided wherever necessary.

5.8 Disconnecting Links:

5.8.1 Disconnecting links with rating same as that of the main bus bars shall be provided in the run of the busduct to facilitate disconnection of the busbars during testing and maintenance. The separation of the busbar sections with the bolted links removed shall be sufficient to withstand the rated Power Frequency withstand voltage of the busduct.

5.9 Shorting Links

5.9.1 Shorting jumpers, for the purpose of drying out the equipment before commissioning or for carrying out short circuit test on the equipment, rated for the main bus current shall be supplied for shorting the busduct at a location, adjacent to the disconnecting links.

5.9.2 The shorting links shall have drilling dimensions matching those of the main bus disconnecting links. Suitable supporting structures and support insulators for the shorting links if necessary shall also be offered.

6.0 PHASE BARRIERS

6.1 When segregated type of phase busduct is specified in data sheet-A, phase barriers shall be provided between the phases.

6.2 The phase barriers shall be of metal or insulating material as specified in data sheet-A. When metal barriers are specified, the material shall be same as that of the busduct enclosure material.

6.3 Insulated phase barriers, when specified, shall be made of non-hygroscopic insulating material such as fibre glass.

7.0 BUS SUPPORT INSULATORS

7.1 Within the busduct the bus shall be mounted and supported on insulators. The insulators shall be mounted on resilient pads provided in the bus enclosure.

7.2 Material:

7.2.1 The insulators shall be either porcelain or resin cast.

7.2.2 For busducts with voltage rating upto 1100 volt. 'PERMALI' wood or equivalent type of non-hygroscopic insulating supports are acceptable.

7.3 Mechanical strength

The insulators shall possess sufficient mechanical strength to withstand the forces due to momentary short circuit currents. The spacing of the bus insulators shall be decided giving due factor of safety.

7.4 Electrical Strength:

As a consequence of current loading and variation in external temperatures in the external sections of the busduct, condensation of moisture may take place on the surface of the insulators. Hence, the insulators shall have a high a high creepage distance and a withstand voltage rating sufficient to provide specified insulation under highly humid conditions.

8.0 WALL FRAME ASSEMBLY AND SEAL OFF BUSHINGS

8.1 Wall frame assembly

Wherever the busduct passes through the plant building wall, from indoors to outdoors, a wall frame assembly with seal-off bushings shall be provided to prevent any leakage of rain water, infiltration of dust and air temperature variations from indoors to outdoors. The wall frame shall be fabricated out of aluminium angles and sheet and shall be suitable for grouting in the wall. It shall be provided with flages on both sides to receive the busduct flanges.

8.2 Seal-off Bushings

The busduct shall be equipped wherever necessary with seal-off bushings to prevent interchange of air at different temperatures. The seal-off bushings shall be flanged type.

8.3 Material

The insulators for wall frame assembly and seal-off bushings shall be of porcelain. Also the bushings shall be designed for thermal expansion/contraction due to temperature differential for outdoor/indoor use.

8.4 Mechanical strength

The insulators shall withstand the maximum short circuit forces under fault conditions specified. The insulator material shall not deteriorate under normal operating temperatures or due to temperature rise under fault conditions.

8.5 Electrical strength

The electrical properties of the insulator shall be in conformity with this specification.

9.0 PHASE CLEARANCES:

9.1 The minimum phase to phase and phase to earth clearances of busbars within the enclosures shall be as specified in Data Sheet-A.

10.0 BUS DUCT SUPPORTS

10.1 Material

The supporting structures shall be fabricated from standard steel sections and shall be hot dip galvanised after fabrication. The hot dip galvanising shall be in accordance with standards listed in data sheet-A

10.2 Mechanical strength

The supporting structures shall be designed to withstand the dead weight of the busduct and also the short circuit forces under maximum fault conditions and also the wind load and forces due to seismic accelerations which are specified in data sheet-A and/or section-2 entitled ‘Project Information’. Calculations shall be furnished to substantiate the above and shall be subject to the PURHASER’S approval.

10.3 Accessories and hardware

The supporting structures shall include supporting members, brackets, hangers, longitudinal beams, channels, nuts, bolts, washers and all other hardware which are necessary for the erection and support of the entire busduct installation. All the accessories and hardware of ferrous material shall be hot dip galvanised.

10.4 Method of support

10.4.1 Indoor portion of the busduct may be supported from the floor or ceiling beams.

10.4.2 Outdoor portion of the busduct shall be supported from ground below on suitable foundation in the ground.

10.4.3 The foundations and structures in outdoor area shall clear the transformers, transformer foundations, cable trenches, etc.

10.4.4 The foundations and structures for busduct in outdoor area shall clear the transformers, transformer foundations, cable trenches etc.

10.5 Earthing:

10.5.1 Each supporting structure shall be securely connected at two points to the PURCHASER's station earthing bus. All necessary hardware, such as clamps, connectors etc., required for this purpose shall be furnished by the VENDOR.

10.6 Markings:

10.6.1 All components of the busduct along with the supporting structure shall be distinctly marked for erection in accordance with the erection drawings to be prepared & furnished by the VENDOR. These marks shall be made in a manner as not to be obliterated and erased in transit or to damage the galvanising of the busduct or the supporting structure.

11.0 MISCELLANEOUS:

11.1 Studs, nuts, bolts and tapped holes shall conform to SI units and to relevant standards. Only hexagonal nuts shall be used. All bolt holes shall be spot faced for nuts.

11.2 Castings and forging shall conform to respective material specifications and shall be free from flaws. They shall be machined true as per good workshop practice. Welding shall be performed in accordance with relevant recognised standards.

11.3 All threaded pipe connections and fittings, pipe flanges and tube fittings shall comply with relevant standards.

11.4 Caution boards shall be supplied indicating voltage rating warning about enclosure temperature at every transport section.

12.0 DESIGN REQUIREMENTS OF BUSWAYS:

12.1 The bid shall contain design calculation in support of the following parameters of the busduct design:

a) Sizing of the busbars vis-à-vis thermal capability to withstand rated continuous current and one second short time current.

b) Spacing of the insulators vis-à-vis mechanical strength to withstand forces due to momentary short circuit current.

c) Heat loss and temperature rise calculations for conductor and enclosure. Wherever rain hood is provided the effects of solar radiation may be neglected while calculating temperature rise.

12.2 The bid shall be complete with all heat loss calculations. All formulae and other information from which the heat losses have been derived shall be enlisted.

13.0 SPACE HEATERS

13.1 The busduct shall be provided with space heaters of adequate capacity to maintain the internal temperature above the dew point to prevent moisture condensation within the busduct. The space heaters shall be rated for 240V single phase, 50Hz, AC supply. The space heater shall be automatically controlled by humidistats.

14.0 DRAWINGS

The VENDOR shall furnish the following drawings for the busduct for purchases approval:-

14.1 General arrangement and dimensioned layout of the busduct installation showing the connections to equipment and tap-offs, if any.

14.2 Drawing showing the requirement of embedments in PURCHASER'S floors, ceilings, walls etc.

14.3 Structural drawings along with foundation details for the structures.

14.4 Drawing showing the terminal connections between the busduct and the equipment terminals.

14.5 Details of seal-off bushing and wall frame assembly.

14.6 Details of busduct bonding arrangement.

14.7 Itemised bill of material for complete busduct covering all the components and associated accessories.

14.8 Arrangement of the bus, insulators etc. within the busduct.

14.9 Details showing a typical busduct joint between sections.

14.10 Details of typical rigid and expansion connections

15.0 TESTS & TEST REPORTS:

15.1 The following type and routine tests shall be conducted on representative section of the busduct assembly. The busduct assembly tested shall include bolted connections and flexible connections.

15.2 The tests shall be conducted as per standards indicated in these specifications.

15.3 Type Tests:

The Type tests shall include the following tests:

a) One-minute power frequency withstand voltage test.

b) Impulse withstand test

c) Megger test

d) Temperature rise test of conductors and enclosures.

e) Short circuit Current withstand test.

f) IP Class test.

g) Any other test required as per relevant standard.

15.4 Routine Tests:

The routine tests shall include the following tests:-

a) One-minute power frequency withstand voltage test.

b) Megger test.

c) Dimentional verification

d) Any other required as per relevant standard.

15.5 Test Report for Components:

Manufacturer's type and routine test certificates shall be submitted for tests conducted as per relevant standards for the following components:

a) Insulators

b) Seal off bushings

c) Bolted and flexible joints

d) Busbars

e) Enclosure material

f) Galvanising of support structures

16.0 SPARES:

Whether included in the BIDDER's recommendation or not, unit prices of the following items or the items recommended by them shall be quoted together with their suggested quantities and catalogue numbers:

a) Bus support insulators

b) Flexible connectors

c) Bends

d) Isolating links

e) Different type of gaskets

f) Seal off bushing.

DATA SHEET – A1						
Sl No.		Description			Unit	Data
1.0 BUS DUCT	1.1	Type of Busduct	Segregated phase			Segregated phase busduct
			Non segregated phase			
	1.2	Type of cooling				Naturally cooled
	1.3	Installation			Indoor/ Out door	Indoor
	1.4	Degree of protection of enclosure			Indoor/ ~~Out door~~	IP54
2.0 RATING	2.1	Rated voltage & Frequency			V & Hz	11000V & 50Hz
	2.2	Highest system voltage			V	12000
	2.3	One minute power frequency withstand voltage			kV (rms)	28
	2.4	1.2/50µs impulse withstand voltage			kVp	75
	2.5	Continuous current rating of Bus Ducts under site conditions			A	1250
	2.6	Momentary current rating			kA (Peak)	45.35
	2.7	Short time rating		Current	kA (rms)	18.14
				Duration	Sec	3
	2.8	No. Of Phases				3
	2.9	Maximum ambient temperature			^{o}C	45
	2.10	Max. Temperature of Busbars at rated current and maximum ambient temperature			^{o}C	85
	2.11	Max. temperature of Enclosure at rated current and at maximum ambient temperature			^{o}C	70
3.0 BUS CONDUCTOR	3.1	Bus conductor material And sleeves			Cu/Al	Aluminium and raychem
	3.2	Shape of conductor				By bidder
	3.3	Cross section area of conductor			Sq mm	By bidder
4.0 BUS ENCLOSURE	4.1	Bus Enclosure Type				Non-magnetic
	4.2	Bus Enclosure Material				MS sheet steel
	4.3	Shape of Enclosure				Rectangular
	4.4	Enclosure Thickness			mm	3
	4.5	Clearance at terminating ends:		Ph to Ph		120
				Ph to Earth	mm	120
	4.6	Type of joints between adjacent section of Bus conductor			Welded/ Bolted	Bolted
	4.7	Phase barrier material				Aluminium alloy
	4.8	Thickness of phase barrier			mm	3
	4.9	Dimensions of enclosure	Height		mm	By bidder
			Width		mm	

DATA SHEET – A1					
Sl No.		Description		Unit	Data
.0 BUSWAY COMPONENTS & ACCESSORIES	5.1	Straight length – Indoor		Mtrs	As per section-5 and layout drawings
	5.2	Straight length – outdoor		Mtrs	
	5.3	90^{o} degree bend (vertical/Horizontal)		Nos	
	5.4	Adaptor box - switchboard end		Nos	
	5.5	Adaptor box – Transformer end		Nos	
	5.6	Braided copper flexible at switchboard end		Set	
	5.7	Braided copper flexible at transformer end		Set	
	5.8	Galvanised steel support structure		Set	
	5.9	Busduct hanger supports		Set	
	5.10	Wall frame assembly with seal off bushings.		Set	
	5.11	All other materials as required			
6.0 GENERAL	6.1	External Earthing Conductor	Material		Cu
			Size	mm	50 x 6
	6.2	Finish of Busduct	Exterior		RAL 7032
			Interior		Black mat finish
	6.3	Layout drawing enclosed		Yes/ No	Yes
				DRG No.	PCPL-1414-4-CT-105
	6.4	Rain hood required for outdoor part		Yes/ No	NA

NOTE: The quantities indicated are as estimated for bidding purpose. Any other item which may be required for completion of the job and not specified shall be quoted by the vendors complete with unit rates.

DATA SHEET – A2			
APPLICABLE STANDARDS			
Sl No.	DESCRIPTION	STANDARDS	
01	Busways	IS 8084	
02	Bus Conductor material	IS 5082	
03	Porcelain Post Insulator	IS 2544	IEC 60168
04	Hot Dip Galvanizing	IS 2629 IS 2633	
05	Phosphate treatment of Iron & Steel	IS 6005	

DATA SHEET – B

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

Sl No.		Description		Unit	Bidder's Data
1.0 BUSDUCT	1.1	Type of Busduct	Segregated phase		
			Non segregated phase		
	1.2	Type of cooling			
	1.3	Installation		Indoor/Out door	
	1.4	Degree of protection of enclosure		Indoor/Out door	
2.0 RATING	2.1	Rated voltage & Frequency		V & Hz	
	2.2	Highest system voltage		V	
	2.3	One minute power frequency withstand voltage		kV (rms)	
	2.4	1.2/50µs impulse withstand voltage		kVp	
	2.5	Continuous current rating of Bus Ducts under site conditions		A	
		Momentary current rating		kA (Peak)	
	2.6	Short time rating	Current	kA (rms)	
			Duration	Sec	
	2.7	No. Of Phases			
	2.8	Maximum ambient temperature		^{0}C	
	2.9	Max. Temperature of Busbars at rated current and maximum ambient temperature		^{0}C	
	2.10	Max. Final temperature of Enclosure at rated current and at maximum ambient temperature		^{0}C	
3.0 BUS CONDUCTOR	3.1	Bus conductor material			
	3.2	Shape of conductor			
	3.3	Cross section area of conductor		mm^2	
4.0 BUS ENCLOSURE	4.1	Bus Enclosure Type			
	4.2	Bus Enclosure Material			
	4.3	Shape of Enclosure			
	4.4	Enclosure Thickness		mm	
	4.5	Clearance at terminating ends:	Ph to Ph		
			Ph to Earth		
	4.6	Type of joints between adjacent section of Bus conductor		Welded/ Bolted	
	4.7	Phase barrier material			
	4.8	Thickness of phase barrier		mm	
	4.9	Dimensions of enclosure	Height	mm	
			Width	mm	

DATA SHEET – B

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

Sl No.		Description		Unit	Bidder's Data
5.0 BUSDUCT DATA	5.1	Resistance/metre/Phase at 20°c	a) Conductor	Ohm	
			b) Enclosure		
	5.2	Inductive reactance/metre/phase		Ohm	
	5.3	Capacitive reactance/metre/phase at 20°C		Ohm	
	5.4	Heat loss in the busduct at full load		Watts	
	5.5	Weight of 3-phase duct at full load		Kg/metre	
	5.6	Standard section length		M	
	5.7	Minimum required clearances between the periphery of the busduct and structural steel and reinforced concrete along the route of the route of the busduct. i) Minimum clearance to structural steel work parallel to the duct. ii) Minimum clearance to structural steel work perpendicular to the duct.		mm mm	
6.0 INSULATORS	6.1	Manufacturer			
	6.2	Applicable standard			
	6.3	Type			
	6.4	Rated voltage		kV	
	6.5	One minute withstand voltage (power frequency)	Dry	kV	
			Wet	kV	
	6.6	Impulse withstand voltage (1.2/50 microsecond wave)		kV(peak)	
	6.7	Minimum creepage distance		mm	
	6.8	Cantilever strength	Upright	kg	
			Under hung	kg	
	6.9	Weight of each insulator		kg	
7.0 SEAL OFF BUSHINGS	7.1	Manufacturer			
	7.2	Applicable standard			
	7.3	Type			
	7.4	Quantity			
	7.5	Rated voltage			
	7.6	Rated current			
	7.7	One minute dry withstand voltage			
	7.8	Minimum creepage distance			
8.0 GENERAL	8.1	External Earthing Conductor	Material		
			Size	mm	
	8.2	Finish of Busduct	Exterior		
			Interior		
	8.3	Layout drawing enclosed		Yes/No	
				DRG No.	
	8.4	Rain hood required for outdoor part		Yes/No	

DATA SHEET – B

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

Sl No.		Description		Unit	Bidder's Data
9.0 FLEXIBLE CONNECTIONS		Flexible connector (both for expansion joints and termination)			
	9.1	Material			
	9.2	No. Of flexiable provided		Nos	
	9.3	Cross sectional areas of each lamination		Sq. mm	
	9.4	No. Of laminations per flexible		Nos.	
	9.5	Plating for flexible	Type		
			Thickness		
10.0 TESTS	10.1	Type Tests			
	a)	List of Type tests attached		Yes/No	
	b)	Certificate Nos.			
	10.2	List of Routine tests to be carried out attached		Yes/No	
11.0 DRGS	11.1	Typical dimensional drawing enclosed		Yes/No	
				DRG No.	
	11.2	Layout drawing enclosed		Yes/No	
				DRG No.	
12.0 START UP AND ESSENTIAL SPARES	01				
	02				
	03				
	04				
	05				
	06				
	07				
	08				
	09				
	10				
	11	Unit price of spare parts furnished		Yes/No	

1.0 SCOPE

1.1 This specification covers the requirements of XLPE insulated Power Cables up to 1.1 kV and PVC insulated control cables rated 1.1kV.

2.0 CODES & STANDARDS

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

2.2 Unless otherwise specified, the cables shall conform to the latest applicable standards as specified in the relevant Data Sheet A2.

3.0 DESIGN FEATURES OF POWER CABLES

3.1 Multi Core Cables

a) Conductor: Well compacted, stranded copper or aluminium as stated in Data sheet A.

b) Insulation: Cross linked Polyethylene (XLPE) applied by extrusion.

c) Inner Sheath: The laid up cores shall be provided with Extruded PVC inner sheath. It shall be as circular as possible.

d) Armouring: Shall be provided when specified in Data sheet A and shall be applied over the inner sheath.

e) Outer Sheath: Extruded outer sheath shall be applied over inner sheath in case of unarmoured cables and over the armouring in case of armoured cables.

3.2 Single Core Cables

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

a) The armouring shall be applied over the insulation and shall be with non magnetic material as stated in data sheet A.

b) The extruded PVC outer sheath shall be applied over the insulation in case of unarmoured cables and over the armouring in case of Armoured cables.

3.3 Armouring

The armouring shall comprise the following:-

a) For multi core cables: Single / double steel wire / strip as stated in data sheet A.

b) For Single core cables: Single / double Aluminium or copper wire / strip as stated in data sheet A.

3.4 Outer Sheath

The outer sheath shall be as follows:-

a) With PVC / HR PVC / FRLS Compound as stated in Data sheet A.

b) Black in colour.

c) Shall have reduced flame propagation property.

3.5 Requirement of special sheath for FRLS cable:

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

3.5.2 Test for Flame Retardance

c) Oxygen Index

The critical oxygen index value shall be minimum 29 at 250^{0}C when tested for temperature index test as per ASTMD-2863.

d) Flammability

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

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

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

3.5.3 Test for Smoke Generation

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

d) ASTM-D-2843

e) ASTM-E-662

f) 3 metre cube test chamber.

3.5.4 Tests for Acid Gas Generation

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

3.5.5 Tests for Resistance to Ultra Violet Radiation

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

3.5.6 Tests for Water Absorption

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

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

3.6 Temperature Rise

a) The maximum conductor temperature shall not exceed 90^{0}C during continuous operation at rated current.

b) The short circuit rating (current and withstand time) of cables shall be as specified in Data Sheet A. The temperature shall not exceed 250^{0}C with initial conductor temperature of 90^{0}C.

c) The bidder shall furnish charts for derating factors under different conditions of laying.

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

4.0 DESIGN FEATURES OF CONTROL CABLES

4.1 Cable Construction

4.1.1 The Cables shall be multicore with number of cores as stated in Data Sheet A.

4.1.2 The Construction of the cables shall be as follows:

a) Conductor

i. Material: Shall be annealed high conductivity, stranded copper.

ii. Size: The cross sectional area of the conductor shall be as stated in Data Sheet A

b) Core Insulation

Shall be Extruded PVC compound Type A as per IS 5831.

c) Inner Sheath

The laid up cores shall be provided with Extruded PVC inner sheath.

d) Armouring

Shall be provided when specified in Data sheet A. The armouring shall be by single galvanised steel round wire or strip in accordance with the relevant standards.

e) Outer Sheath

Extruded outer sheath shall be applied over the inner sheath for unarmoured cables and over the armouring in case of armoured cables. The outer sheath shall be with PVC/ HR PVC/ FRLS PVC Compound as stated in Data Sheet A and shall have reduced flame propagating properties. It shall be black in colour.

f) Core numbering shall be in accordance with the relevant standards.

4.2 Requirement of special sheath for FRLS cable:

4.2.1 These shall be same as specified in Clause-3.5.

5.0 TESTS

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

6.0 CABLE DRUMS

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

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

7.0 CABLE LENGTH

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

8.0 DATA TO BE FURNISHED

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

DATA SHEET–A1-01 (POWER CABLES)			
Sl.No	Description	Unit	Data
1	SYSTEM PARTICULARS		
1.1	Nominal Power system Voltages	kV	1.1
1.2	Maximum system voltage for continuous operation	kV	1.1
1.3	System neutral earthing	UE/E	Earthed
1.4	Fault level of the system to which the cable will be connected	kA rms. for 1 sec	-
1.5	Ground temperature	^{0}C	35
1.6	Design ambient temperature	^{0}C	45
2	TYPE OF CABLE LAYING		
a)	Laid side by side touching	Above Ground	In Cable Trays
		Below Ground	Trenches

DESCRIPTION OF CABLES		
Sl. No	Description	Data
1	Designation	Power Cables
2	Conductor	
a)	No. of wires	As per BOQ (Section-5)
b)	Size (sq. mm)	As per BOQ (Section-5)
c)	Stranded/ Solid	Stranded
d)	Material	Cu
3	Core Insulation Material	XLPE
4	Filler Material	PVC
5	Inner Sheath Material	Extruded PVC
6	Armour	
a)	Material	Single steel Wire/Strip
b)	Type	
7	Outer Sheath	FRLS PVC

NOTE:
SIZE AND LENGTH OF CABLES AS PER Section-5

DATA SHEET – A1-02 (CONTROL CABLES)			
Sl.No	Description	Unit	Data
1	SYSTEM PARTICULAR		
1.1	Nominal Power system Voltages	kV	1.1
1.2	Maximum system voltage for continuous operation	kV	1.1
1.3	System neutral earthing	UE/E	Earthed
1.4	Fault level of the system to which the cable will be connected	kA rms. for 1 sec	NA
1.5	Ground temperature	^{0}C	35
1.6	Design ambient temperature	^{0}C	45
2	TYPE OF CABLE LAYING		
a)	Laid side by side touching	Above Ground	In Cable Trays
		Below Ground	Trenches

DESCRIPTION OF CABLES		
Sl. No	Description	Data
1	Designation	Control Cables
2	Conductor	
a)	No. of wires	As per Section-5
b)	Size (sq. mm)	As per Section-5
c)	Stranded/ Solid	Stranded
d)	Material	Cu
3	Core Insulation Material	PVC
4	Filler Material	PVC
5	Inner Sheath Material	Extruded PVC
6	Armour	
a)	Material	Single steel Wire/Strip
b)	Type	
7	Outer Sheath	FRLS PVC
NOTE: SIZE AND LENGTH OF CABLES AS PER Section-5		

DATA SHEET- A2		
APPLICABLE STANDARDS		
Sl. No.	Description	Applicable Standards
1	Rubber insulated cables: Part 1 With Copper conductor	IS 434 : Part I : 1964
2	Rubber insulated cables: Part 2 With aluminium conductor	IS 434 : Part 2 : 1964
3	Flexible Trailing Cables for use in Coal Mines	IS 691:1984
4	Paper insulated lead-sheathed cables for rated voltage up to and including 33kV Specification	IS 692 :1994
5	Varnished cambric insulated cables (Revised)	IS 693 :1965
6	PVC insulated cables for working voltages up to and including 1100 V	IS 694 :1990
7	Code of practice for installation and maintenance of power cable up to and including 33kV rating (Second Revision)	IS 1255 :1983
8	PVC insulated (heavy duty) electric cables: Part 1 for working voltages up to and including 1100 V	1S 1554 : Part 1: 1988
9	Specification for PVC Insulated (Heavy duty) Electric cable -Part 2: For working voltage from 33kV up to and including 11kV	1S 1554 : Part 2: 1988
10	Polyethylene insulated cable for working voltage up to and including 1100 V	IS 1596: 1977
11	Aluminium conductor for insulated cables	IS 1753 :1967
12	Specification for Cotton Selvedge Tape for Electric Cables	1S 2847: 1964
13	Copper conductor is insulated cables and cords	IS 2982 :1965
14	Thermoplastic insulated weather proof cables : Part 1 PVC insulated and PVC sheathed	IS 3035 :Part1: 1965
15	Recommended current rating for cables : Part 4 Polyethylene insulated cables	IS 3961 : Part4 :1968
16	Recommended current rating for cables : Part 5 PVC insulated light duty cables	IS 3961 : Part5 :1968
17	Mild steel wires, formed wires and tapes for armouring of cables	IS 3975 :1999
18	PVC insulated (heavy duty) electric cables with solid aluminium conductor for voltages up to and including 1100 V	IS 4288 : 1988
19	Recommended short circuit rating of high voltage PVC cables	IS 5819 : 1970
20	PVC insulation and sheath of Electric Cables	IS 5831 :1984
21	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-1 for working voltages up to and including 1100V	IS 7098 : Part 1 : 1988
22	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-2 for working voltages from 3.3kV up to and including 33kV	IS 7098 : Part 2 : 1985
23	Cross linked Polyethylene insulated and Thermoplastic sheathed cables Specification, Part-3 for working voltages from 66kV up to and including 220kV	IS 7098 : Part 3 : 1993
24	Elastomeric insulation and sheath of electric cables	IS 6380 :1984
25	Polyethylene insulation and sheath of electric cables	IS 6474 : 1984
26	Brass glands for PVC cables	IS 12943 : 1990
27	Conductors of insulated electric cables and flexible cords (First revision)	IS 8130 :1984

DATA SHEET-B1 (POWER CABLES)
(To be filled in by the bidder and submitted along with the bid)

SL. No.	DESCRIPTION		UNIT	Type of Cable, as per BOQ		
				A	B	C
1	Name of Manufacturer					
2	Standards as Applicable for the Specified Types of Cables in Data Sheet A1 & A2					
2.1	Whether IS marked?		Yes/No			
3	Conductor		Al/Cu			
3.1	Stranded Conductors as indicated in Data Sheets		Yes/No			
4	Core Insulation XLPE		Yes/No			
4.1	Core Insulation -					
	a) Extruded or any special feature					
	b) Dielectric strength		kV/mm			
4.2	Colour coding for cores					
5	Inner Sheath Insulation Extruded PVC		Yes/No			
6	Outer Sheath					
6.1	Type		Extruded PVC/ HR PVC/ FRLS			
6.2	Fungicide and termite proof		Yes/No			
6.3	Markings on outer sheath					
	a) IS					
	b) Length at one meter intervals					
7	Armour-					
	a) Material					
	b) Size					
8	Rated Voltage, suitable for Earthed system					
9	a) Conductor temperature for continuous ratings		^{0} C			
	b) Conductor temperatures for 1 Sec short circuit current ratings		^{0} C			
	c) Emergency overload temperature		^{0} C			
10	Minimum bending radius		mm			
11	Maximum length per drum and weight of drum for cable sizes:					
	a) Up to 10 mm^2		m, kg			
	b) Up to 70 mm^2		m, kg			
	c) For sizes> 70 mm2 (indicate for each specified size)	Sizes	mm^2			
		Drum				
		i) Length	m			
		ii) Weight	kg			

DATA SHEET-B1 (POWER CABLES) (To be filled in by the bidder and submitted along with the bid)					
SL. No.	DESCRIPTION	UNIT	Type of Cable, as per BOQ		
			A	B	C
12	Tolerance on drum length	± m			
13	a) All tests will be carried out as per applicable standards and any other tests if specified in Section '3' or Data Sheet A1 & 2 of the Specification	Yes/No			
	a) If 'No', give separate details or deviations here				
14	Other Parameters of Cables:				
14.1	Thickness of insulation	mm			
14.2	Diameter under armour	mm			
14.3	Diameter over armour	mm			
14.4	Overall diameter	mm			
14.5	Weight/ m	kg			
14.6	Resistance/ km	Ohm			
14.7	Reactance/ km	Ohm			
14.8	Capacitance/ km	µF			
15	Derating factors for variations in:				
15.1	Ambient air temperature				
15.2	Ground temperature				
15.3	Depth of laying				
15.4	Soil Resistivity				
15.5	Method of laying				

DATA SHEET-B2 (CONTROL CABLES)
(To be filled in by the bidder and submitted along with the bid)

SL. No.	DESCRIPTION	UNIT	Type of Cable, as per BOQ		
			A	B	C
1	Name of Manufacturer				
2	Standards as Applicable for the Specified Types of Cables in Data Sheet A1 & A2				
2.1	Whether IS marked?	Yes/No			
3	Conductor	Al/Cu			
3.1	Stranded Conductors as indicated in Data Sheets	Yes/No			
4	Core Insulation Extruded PVC	Yes/No			
4.1	Dielectric strength	kV/mm			
4.2	Colour coding for cores				
5	Inner Sheath Extruded PVC	Yes/No			
6	Outer Sheath				
6.1	Type Extruded PVC/ HR PVC/ FRLS				
6.2	Fungicide and termite proof	Yes/No			
6.3	Markings on outer sheath				
	a) IS				
	b) Length at one meter intervals				
7	Armour-				
	a) Material				
	b) Size				
8	Rated Voltage, suitable for Earthed system				
9	Conductor temperature for continuous ratings	^{0}C			
10	Minimum bending radius	mm			
11	Maximum length per drum and weight of drum for cable sizes specified in Data Sheet A:				
	a) Sizes	mm^2			
	b) Drum				
	i) Length	m			
	ii) Weight	kg			
12	Tolerance on drum length	± m			
13	a) All tests will be carried out as per applicable standards and any other tests if specified in Section '3' or Data Sheet A1 & 2 of the Specification	Yes/No			
	b) If 'No', give separate details or deviations here				
14	Other Parameters of Cables:				
14.1	Thickness of insulation	mm			
14.2	Diameter under armour	mm			
14.3	Diameter over armour	mm			
14.4	Overall diameter	mm			
14.5	Weight/ m	kg			
14.6	Resistance/ km	Ohm			
14.7	Reactance/ km	Ohm			
14.8	Capacitance/ km	µF			
15	Derating factors for variations in:				

DATA SHEET-B2 (CONTROL CABLES) (To be filled in by the bidder and submitted along with the bid)					
SL. No.	DESCRIPTION	UNIT	Type of Cable, as per BOQ		
			A	B	C
15.1	Ambient air temperature				
15.2	Ground temperature				
15.3	Depth of laying				
15.4	Soil Resistivity				
15.5	Method of laying				

ADDENDUM TO DOCUMENT No: PCPL-4-S4-230

1. PCPL-4-S4-230 : This document shall be applicable only to Earthing System. Hence “Earthing and Lightning Protection system” wherever specified shall be read as “Earthing system.”
2. Clause No. 3.2,4.10, 4.11, 4.12: These clauses are not applicable for this tender
3. Clause No.6.0: This clause is not applicable for this tender.

1.0 SCOPE

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

2.0 CODES AND STANDARDS

2.1 The earthing and lightning protection systems shall comply with all currently applicable standards regulations and safety codes of the locality where the installation is to be carried out. Nothing in this specification shall be constructed to relieve the CONTRACTOR of this responsibility.

2.2 The installation work shall conform to the latest applicable electricity rules, standards and codes of practice for earthing and lightning protection system.

3.0 SCOPE OF SUPPLY

3.1 The earthing and lightning protection conductors and earth electrodes shall be supplied by the CONTRACTOR when specifically indicated in layout drawings and bill of quantity (Section-5). Conductors shall be free from rust scale and other electrical and mechanical defects and all materials used shall conform to relevant standards or approved by the PURCHASER. The sizes, materials and quantity shall be as listed in layout drawings and bill of quantity (Section-5).

3.2 Test links in suitable weather proof enclosures as shown in enclosed drawing shall be supplied by the CONTRACTOR for connection between each lightning conductor down comer and earth electrode.

4.0 SCOPE OF INSTALLATION WORK

4.1 The installation work shall include unloading, storing, laying, fixing, and jointing/termination, testing and commissioning associated with the safety earthing system of the plant and lightning protection system for switchyard/substation. All welding/brazing equipment, necessary tools and testing equipment shall be furnished by the CONTRACTOR.

4.2 The CONTRACTOR shall be responsible for any installation materials which are lost or damaged during installation. All damages and thefts shall be made good by the CONTRACTOR till the installation is handed over to the PURCHASER.

4.3 The CONTRACTOR shall carryout the lightning protection and earthing of all structures as indicated in the PURCHASER'S drawings.

4.4 The CONTRACTOR shall install bare conductors, braids, etc., required for system and individual equipment earthing. All work such as cutting, bending, supporting, painting, coating, drilling, brazing soldering, welding, clamping, bolting and connecting onto structures, equipment frames, terminals, rails or other devices shall be in the CONTRACTOR'S scope of work. All incidental hardware and consumables such as fixing cleats/clamps anchor fasteners, lugs, bolts nuts washers, bitumen compound, adhesive, anti-corrosive paint as required for the complete work shall be deemed to be included by the CONTRACTOR as part of the installation work.

4.5 The quantities sizes, and material of earthing conductors and electrodes to be installed shall be as indicated in layout drawings and bill of quantity (Section-5), and routes of the conductors and locations of electrodes shall be shown on the project drawings. The alignments of conductors are approximately shown in the earthing drawings and these may be suitably shifted / finalized in consultation with the site ENGINEER / PURCHASER to avoid any interference. If earth connection to any device is not shown specifically in the relevant earthing drawings, it shall be field routed.

4.6 The tap connections (earthing leads) from the floor embedded main earthing grid to the equipment of more than 500mm long shall be embedded in floor by the CONTRACTOR where required, together

with associated civil work such as excavation/chasing, concreting and surfacing, if not already done by the civil contractor. The concrete cover over the conductor shall not be less than 50mm.

4.7 The depth of burial of earth conductors in outdoor areas shall be as per data sheet A1 and project drawings. The scope of installation of earth conductors in outdoor areas, buried in ground shall include excavation in earth up to 600mm deep and 450mm wide (unless otherwise stated), laying of conductor at 600mm depth (unless stated otherwise), brazing / welding as required of main grid conductor joints as well as risers of 50mm length above ground at required locations and backfilling. Back filling material to be placed over buried conductor shall be free from stones and other harmful mixtures. Backfill shall be placed in layers of 150mm uniformly spread along the ditch, and tampered utilizing pneumatic tampers or other approved means. If the excavated soil is found unsuitable for backfilling, the CONTRACTOR shall arrange for suitable soil from outside.

4.8 The scope of installation of earth connection leads on steel structures/walls shall include laying the conductors, welding/cleating at specified intervals, welding/brazing to the main earth grids risers, coating welded/brazed joints by bituminous paint.

4.9 The scope of installation of electrodes shall include installation of these electrodes as indicated in layout drawings, specification (Section-3) and BOQ (Section-5) and connecting to main buried earth grid, as per enclosed drawings / relevant standards. The scope of work shall include excavation, construction of the earth pits including all materials required for construction of the earth pits, placing the pipe, providing and fixing test links on those pipes in test pits and connecting to main earth grid conductors.

4.10 The scope of installation of lightning Protection Conductors on the roofs of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods where necessary, laying, fastening /cleating/welding of the down comers on the walls/columns of the building and connection to the test links above ground level.

4.11 Support Cleats used for roof conductors at tiled roof area shall be fixed to the tiles using water proof adhesive as the same cannot be fixed by screws.

4.12 The scope of installation of the test links shall include mounting of the same at specified height on wall/column by suitable brackets and connections of the test link to the earth electrode.

4.13 All earth pits shall be interconnected using buried ground grid conductor.

5.0 EARTHING SYSTEM:

5.1 The installation work shall be carried out in accordance with the following specification:-

Earthing and lightning protection system – Installation notes.

5.2 Wherever main earthing conductor crosses cable trenches, they shall be buried below the trench floor.

5.3 Suitable earth risers approved by the PURCHASER shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of the main earth conductors. The minimum length of such riser inside the building shall be 200mm and outdoors shall be 500mm above ground level. The risers to be provided shall be marked in project drawings.

5.4 Wherever earthing conductor passes through walls, galvanized iron sleeves shall be provided for the passage of the earthing conductor. The pipe ends shall be sealed by the CONTRACTOR by suitable water proof compound.

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

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

5.7 Earth Electrodes

a) The type of earth electrodes shall be as indicated in Data sheet A1

b) Electrodes shall as far as practicable, be embedded below permanent moisture level

c) Some electrodes shall be housed in test pits with concrete covers for periodic testing of earth resistivity. Installation of rod/pipe/plate electrodes in test pits shall be convenient for inspection, testing and watering.

d) Earth pits shall be treated with salt and charcoal if average resistivity of soil is more than 20 ohm. Metre.

6.0 LIGHTNING PROTECTION SYSTEM:

6.1 The installation work shall be carried out in accordance with the specification mentioned in Para 5.1.

6.2 The material, type, size and quantities of components shall be as mentioned in layout drawings and BOQ (Section-5).

6.3 The methods of lightning protection system to be adopted are:

a) By horizontal roof conductors and down conductors

b) By down conductors for Metal roof structures where the minimum thickness of sheet metal used for roofing is in accordance with the applicable standard.

c) By shield wires supported on poles/ masts

The particular method of protection depends on dimensions of the structure protected aesthetics and convenience.

6.4 Air Termination System

a) Horizontal air terminations comprising of horizontal roof conductors shall be used for all buildings.

b) A few vertical air terminations shall be provided, wherever necessary and GS rods of 20mm dia. and 1m long shall be used.

6.5 Down Conductors:

6.5.1 Air termination system shall be connected to the earth by down comers fixed along the outer surface of building/structure. Each down comer shall be terminated to a separate Treated test earth electrode. The material of down conductors will be as specified in BOQ and layout drawings. There shall not be any sharp bends and turns in the down conductors.

6.5.2 The number of down conductors shall be provided in accordance with the applicable standards.

6.5.3 Lightning protection system down conductors shall not be connected to other earthing conductors above ground level. Also no intermediate earthing connection shall be made to lightning arrester, transformer and CVT earthing leads which shall be directly connected to pipe/plate/rod electrode.

6.6 Test Links:

Each down comer shall be provided with a link one meter above ground level for dismantling the electrodes and taking measurements. The links shall be made up of aluminium and housed in PVC or glass filled nylon enclosure box to prevent corrosion.

6.7 Termination And Joints:

a) All joints in the horizontal roof conductors shall be of welded type. Where it is likely to damage the roof material like asbestos or sheet steel, riveted joints shall be used.

b) Connection between roof conductors and down comers shall be of welded type. Where it is likely to damage the roof material like asbestos or sheet steel, riveted joints shall be used.

c) Down Comers shall be connected to test links by bolted connections

d) The lead from test link to earth electrodes shall have bolted connection at both ends.

e) Individual earth electrodes in turn shall be connected to station earthing system by welded joint at grid and bolted joint at electrodes.

f) All pipes carrying hazardous materials shall be bonded at the joints couplings and shall be earthed.

6.8 Earth pits of Lightning protection system shall be interconnected to the plant ground grid below ground level.

6.9 The lightning protection of special structures as mentioned below shall be carried in accordance with applicable standards

a) Tall structures exceeding 30 meter in height.

b) Structures with roofs of high flammability.

c) Buildings with explosive or highly flammable contents.

7.0 TESTING OF EARTHING SYSTEM

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

8.0 CONTRACTOR'S LICENCE

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

9.0 WORKMANSHIP

9.1 The CONTRACTOR shall ensure workmanship of good quality and shall assign qualified supervisors/engineers and competent welders/labour who are skilled, careful and experienced in their traders. The PURCHASER's ENGINEER shall reserve the right to reject non competent persons employed by the CONTRACTOR, if the workmanship is not of good order.

10.0 SAFETY

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

ADDENDUM TO DOCUMENT No: PCPL-4- S4-221

1. Clause No. 1.1(d): The clause shall be read as “Supply, Installation, Testing and Commissioning of Earthing systems.”
2. Clause No. 1.1(e): This clause is not applicable for this tender.
3. Clause No.3.3: This clause is not applicable for this tender.
4. Clause No.4.9, 4.10: These clauses are not applicable for this tender.
5. Clause No 6.0 : All the points covered under this Clause shall be applicable only to Earthing System.
6. Clause No.7.0: This clause is not applicable for this tender.
7. Clause No.8.1: The clause shall be read as “All checks and tests as per the MANUFACTURE’S drawings/manuals, relevant code of installation and the enclosed commissioning checks as listed here under for various types of equipment e.g. Transformers, HV & MV switchgear, relays and meters, Cables, Busducts, etc., shall be carried out by the CONTRACTOR as part of the installation work.”
8. Clause No. 8.4, 8.6, 8.7, 8.8, 8.9, 8.12: These clauses are not applicable for this tender.

   Clause No. 8.11: The clause shall be read as “Commissioning checklist for Earthing system.

1.0 SCOPE

1.1 This specification covers the requirements of supply and/or Installation of any or all the following equipment/systems:-

a) Installation, Testing and commissioning of equipment to be supplied by the owner.

b) Supply, Installation, Testing and Commissioning of equipment to be supplied by the contractor.

c) Supply, Installation, Testing and Commissioning of cabling system including supply of cable trays and all other cable carriers, cable laying and termination accessories.

d) Supply, Installation, Testing and Commissioning of Earthing and Lightning Protection systems.

e) Supply, Installation, Testing and Commissioning of Lighting system.

1.2 The exact requirements shall be as specified under Section-3 of this specification, other relevant specifications and data sheets under Section-4 and price schedule.

1.3 This specification details the broad guidelines for installation, testing and commissioning of electrical equipment. The work shall, however, at all times be carried out strictly as per the instructions of the OWNER/ENGINEER/MANUFACTURER.

2.0 CODES AND STANDARDS

2.1 The electrical installation work shall comply with the latest applicable standards, Regulations, Electricity Rules and Safety Codes of the locality where the installation is carried out. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility.

2.2 Applicable standards for installation and testing of equipment and systems are indicated in Data Sheet A2. However, this list is not intended to be comprehensive. Any other relevant codes and standards shall also be applicable.

3.0 GENERAL SCOPE

3.1 The CONTRACTOR shall take the equipments to be erected from the storage yard/stores/sheds/railway siding, transport the equipment where required in actual position, erect, assemble all parts of the equipment and test and commission the same.

3.2 The CONTRACTOR shall furnish all tools. Welding equipment, rigging materials, testing equipment, test connections etc., required for complete installation, testing and commissioning of the items included in the contract work.

3.3 The OWNER may engage specialist engineers from the equipment MANUFACTURERS to supervise the installation, testing and commissioning of their equipment. The CONTRACTOR shall extend full co-operation to these engineers and carry out the works as per their instructions. The CONTRACTOR'S work shall include minor rewiring/modifications as may be necessitated during commissioning. Providing such assistance shall be deemed to be included in the CONTRACTOR'S basic scope.

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

3.5 It will be the CONTRACTOR's responsibility to obtain approval /clearance from local statutory authorities including Electrical Inspector, wherever applicable, for conducting of any work or for installation carried out which comes under the purview of such authorities.

3.6 The work shall be carried out strictly as per the instructions and layout drawings of the OWNER/MANUFACTURER. In case of any doubt/misunderstanding as to correct interpretation of the drawings or instructions, necessary clarifications shall be obtained from the OWNER/ENGINEER. The CONTRACTOR shall be held responsible for any damage to the equipment consequent to not following

the MANUFACTURER'S instructions correctly. All necessary drawings, MANUFACTURER'S equipment manuals shall be obtained by the successful bidder who after completion of work must submit the same to the OWNER/ENGINEER.

3.7 All thefts of equipment/component parts, after taken over by the CONTRACTOR, until the installation is handed over to the OWNER, shall be made good by the CONTRACTOR.

3.8 The CONTRACTOR shall have a separate cleaning gang to clean all equipment under erection and as well as the work area and the project site at regular intervals to the satisfaction of the OWNER/ENGINEER. In case the cleaning is not to the OWNER'S satisfaction, he will have the right to carry out the cleaning operations and any expenditure incurred by the OWNER in this regard will be to the CONTRACTOR'S account.

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

3.10 The CONTRACTOR shall carry out touch-up painting on any equipment indicated by the OWNER/ENGINEER, if the finish paint on the equipment is soiled or marred during installation handling. The paint will be supplied by the OWNER.

3.11 The CONTRACTOR shall ensure workmanship of good quality and shall assign qualified supervisors/engineers and competent labourers who are skilled, careful and experienced in their several trades in similar works. The OWNER/ENGINEER shall reserve the right to reject non-competent persons employed by the CONTRACTOR, if the workmanship is not of good order.

3.12 It shall be the responsibility of the CONTRACTOR to obtain necessary License/ Authorisation/ permit for work from the Licensing Board of the locality/state where the CONTRACTOR's firm should also hold valid permits issued or recognised by the Licensing Board of the locality/state where the work is to be carried out.

4.0 EQUIPMENT INSTALLATION WORK

4.1 The CONTRACTOR shall supply, install, test and commission all the equipment as per scope. The quantities, approximate sizes and weights of the equipment shall be indicated in relevant data sheets and BOQ (Section-5).

4.2 Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Tolerances shall be as established in the MANUFACTURER's drawings or as stipulated by the ENGINEER. No equipment shall be permanently bolted down to foundation or Structure until the alignment has been checked and found acceptable by the OWNER/ENGINEER.

4.3 Care shall be exercised in handling to avoid distortion to stationary structures, the marring of finish, or damaging of delicate instruments or other electrical parts. Adjustments shall be made as necessary to the stationary structures for plump and level, for the sake of appearance or to avoid twisting of frames, binding of hinged members, etc.

4.4 The CONTRACTOR shall move all equipment into the respective buildings through the regular doors or floor openings provided specifically for lifting the equipment. The CONTRACTOR shall make his own arrangement for lifting heavy equipment and materials. The CONTRACTOR shall move the equipment from storage site to the crane, attach to the crane hook to the points(s) provided specifically for handling and install in final location. Operation of the crane shall be by qualified personnel only. No part of the structure shall be utilised to lift or erect any equipment without prior permission of the OWNER/ENGINEER.

4.5 Foundation work for all transformers, switchgear, motors, control panels, switchyard equipments, desks and minor modifications to foundations, wherever found necessary for proper installation will be carried out by the CONTRACTOR.

4.6 All external cabling including end connections and earthing will be carried out separately under cabling and earthing works respectively.

4.7 Transformers

4.7.1 Supply, Inspection, storage, installation, testing and commissioning of transformers shall be in accordance with the specified code of practice and MANUFACTURER'S instructions.

4.7.2 Whenever stated in Data Sheet A1, transformers will be delivered without oil, filled with inert gas and without bushings and externally mounted accessories. As applicable, the CONTRACTOR shall:

(a) Assemble the transformers with all Fittings such as bushings, cooler banks radiators, conservators, values, piping, Cable boxes, marshalling boxes, OLTC, cooling fans/pumps, etc.,

(b) Arrange for Oil filtration before filling.

(c) Provide wedges/clamps to rigidly station all Transformers on rails.

(d) Connect the transformer's terminals

(e) Lay and terminate the cables/conduits between all the accessories mounted on the transformer tank/cooler and transformer marshalling Kiosk.

(f) The oil-filtration equipment shall be arranged by the CONTRACTOR.

4.7.3 Care shall be taken during handling of insulating oil to prevent ingress of moisture or foreign matter. In the testing, circulating, filtering or otherwise handling of oil, rubber hoses shall not be used. Circulation and filtering of oil, the heating of oil by regulated short-circuit current during drying runs and sampling and testing of oil shall be in accordance with the MANUFACTURE'S instructions and specified Code of Practice.

4.8 Switchgear, control/relay panels

4.8.1 Switchgear and control relay panel/desks shall be supplied and installed in accordance with specified Code of Practice and the MANUFACTURER'S instructions. The switchgear/ panels shall be installed on finished surfaces, concrete, or steel sills. The CONTRACTOR shall be required to install and assign any channel sills, which form part of the foundations. In joining shipping sections of the switchgear/ panels/ control centres together, adjacent housing or panel sections provided shall be bolted together after alignment has been completed. Power bus, enclosures, ground and control splices of conventional nature shall be cleaned and bolted together, being drawn up with torque wrench of proper size or by other approved means. Tape or compound shall be applied where called for by the MANUFACTURER'S drawings.

4.8.2 The CONTRACTOR shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied separately, they shall be mounted only after the associated control panels/desks have been erected and aligned. The blocking materials/mechanism employed for the safe transit of the instruments and relays shall be removed after ensuring that the panels/desks have been completely installed and no further movement of the same would be necessary. Any damage to relays and instruments shall be immediately reported to the OWNER/ENGINEER and shall be made good by the CONTRACTOR.

4.8.3 Whenever applicable, the CONTRACTOR shall install compressed air plants associated with the switchgear. The installation shall be complete with compressor sets, receivers, control panels, compressed air pipes, valves and other accessories.

4.9 Motors

4.9.1 Unless otherwise specified, the motors will be installed by the respective vendors of the driven equipment. However, the CONTRACTOR under this specification shall undertake the testing and commissioning of the motor. The installation/ commissioning shall be as per the applicable code of practice and the MANUFACTURER'S instructions.

4.10 Battery and Chargers

4.10.1 Installation and testing of battery shall be done in strict compliance with the manufacturer's instructions. Each cell is filled with electrolyte in accordance with the MANUFACTURER'S instructions. Battery shall be set up on racks as soon as possible after receipt, utilising lifting devices supplied by the MANUFACTURER. The cells shall not be lifted by the terminals. Contact surfaces of battery terminals and inter-cell connectors shall be cleaned, coated with protective grease and assembled. Each connection shall be properly tightened. Each cell shall be tested with hydrometer and thermometer and results logged. Freshening charge, if required, shall be added. When turned over to the OWNER, the battery shall be fully charged and electrolyte shall be at full level and have specified specific gravity.

4.11 Busduct/ Busways

4.11.1 The CONTRACTOR shall carry-out installation of busduct/ busway as required in the OWNER'S / MANUFACTURER's plan and elevation drawings of Substation showing equipment layout details, etc., equipment connections, (unless otherwise specified), will be supplied by the OWNER. The quantities of all equipment will be indicated in the bill of materials on the drawings and/or Data Sheet A1.

4.11.2 Whenever specified in Section 3, the CONTRACTOR shall undertake the design, fabrication, supply and installation of busduct support structures as per the OWNER/ENGINEER'S requirements.

4.11.3 Wherever called for, the wall frame assembly for busduct run from outdoor shall be installed by the contractor.

5.0 CABLING SYSTEM INSTALLATION WORK

5.1 Scope of Work

a) Supply and Installation of cables.

b) Supply and installation of the following item:-

i) Cable Carrier System including cable trays and tray covers complete with all accessories necessary such as coupler plates, elbows, tees, bends, reducers, stiffeners and all hardware.

ii) GI rigid and flexible conduits/pipes.

iii) Cable terminations kits, cable glands, lugs, trefoil clamps etc.,

iv) Miscellaneous items like junction/marshalling boxes, push button stations etc.,

c) The cabling system installation work shall include unloading, storing, installation, fixing, jointing/termination, testing and commissioning of complete cabling system items and any other work/items necessary for completing the job.

5.2 The installations work shall be carried out in accordance with the following documents:-

a) Cabling System

b) Cable Installation Notes

5.3 Major civil works are included in the scope of this specification. These include construction of cable trenches, cable tunnels, duct banks etc. The required embedment plates shall be supplied and installed by the contractor at the time of civil construction. Minor civil works such as making holes/grooves in floor slab/wall and patching up in an approved manner any holes made in the walls/floors by the CONTRACTOR, embedment of short lengths of conduits, plates in floors, walls etc. shall also be deemed to be included in the scope of CONTRACTOR.

5.4 Schedule of Quantities

The material, type, size and quantities of all items shall be as mentioned in schedule of prices (Section-5).

6.0 EARTHING AND LIGHTNING PROTECTION SYSTEM INSTALLATION

6.1 Scope of work

a) Supply and installation of all earthing and lightning conductors, electrodes and accessories as mentioned in the Section-3 and schedule of prices (Section-5).

b) The installation work shall include unloading, storing, laying, fixing, joining/terminations, testing and commissioning of the safety earthing system of the plant and lightning protection system for switchyard, building and allied structures. All welding/brazing equipment, necessary tools and testing equipment shall be furnished by the CONTRACTOR.

6.2 The installation work shall be carried out in accordance with the following specifications:-

a) Earthing and Lightning Protection

b) Earthing and Lightning Protection system Installation Notes.

6.3 The CONTRACTOR shall carry out the lightning protection and earthing of all equipment/panel/structures as indicated in the drawings, specification and BOQ (Section-5). Whether specifically shown in drawings or not, building columns, hand rails, miscellaneous items such as junction/marshalling boxes, field switches, cable boxes etc., shall be earthed.

6.4 The CONTRACTOR shall install bare/insulated, copper/aluminium/steel conductors, braids, etc., required for system and individual equipment earthing. All work such as cutting, bending, supporting, painting/coating, drilling, brazing/soldering/welding, clamping, bolting and connection onto structures, equipment frames, terminals, rails or other devices shall be in the CONTRACTOR'S scope of work. All incidental hardware and consumable, such as fixing cleats/clamps, anchor fasteners, lugs, bolts, nuts, washers, bitumastic compound, anti-corrosive paint as required for the complete work shall be deemed to be included by the CONTRACTOR as part of the supply and installation work.

6.5 Schedule of Quantities

The material, type, size and quantities of supply and installation items shall be as mentioned in the specific requirements (Section-3) and schedule of prices (Section-5).

7.0 LIGHTING SYSTEM INSTALLATION WORK

7.1 Scope of work

a) Supply, Installation, testing and commissioning of lighting fixtures with lamps and accessories.

b) Supply and installation of lighting system equipment such as lighting distribution boards (LDB'S), lighting panels(LPs), receptacles, light control switches, ceiling fans, lighting wires, conduits junction boxes, lighting poles, towers, etc., if called for in the scope.

c) The installation work shall include unloading, storing unpacking, fixing of all equipment, routing and laying of conduits/cables, wiring, termination, testing and commissioning of all the equipment of lighting system.

7.2 The supply and installation of all mounting accessories, earthing wires and incidental hardware and consumable like fixing saddles, spacer plates, junction boxes and conduits required for the fitting fixing/suspension points, joint boxes and connectors, jointing, ferrules, all fixing brackets, screws and studs, shall be deemed to be included as a part of work. Mounting accessories like saddles, spacer plates, joint boxes, junction boxes and fixing hardware shall be of galvanised mild steel, black enamelled steel.

7.3 Schedule of quantities

The material, type, size and quantities of all items shall be as mentioned in specific requirements (Section-3) and schedule of prices (Section-5).

8.0 TESTING AND COMMISSIONING

8.1 All checks and tests as per the MANUFACTURE'S drawings/manuals, relevant code of installation and the enclosed commissioning checks as listed here under for various types of equipment e.g. Transformers, Neutral Grounding Resistors, HV & MV switchgear, isolators, CTs, PTs, motors, relays and meters, Battery, Chargers, DCDB, Cables, Busducts, etc., shall be carried out by the CONTRACTOR as part of the installation work.

8.2 Commissioning checklist for switchgear

8.2.1 Preliminary checks

a) Check for physical damage

b) Check for tightness of all bolts, clamps and connecting terminals using torque wrench

c) Check cleanliness of panels, insulators, switchgear

d) Check earthing

e) Check for proper cable tags and ferrules

f) Whether breaker can be inserted properly

g) Breaker contacts should be fixed tightly with fixed contacts

8.2.2 Commissioning checks

a) High voltage test for 415V & 11kV switchgear

b) Insulation resistance test on HV & auxiliary circuits

c) Milli-voltage drop test on busbar joints (Ductor test)

d) Checks on meters

e) Checks on CTs & PTs

f) Functional checks on the auxiliary circuits

g) Contact travel measurements for VCB's

h) Measure the ground clearances for outdoor PCVCB's

i) Check for interlocks

j) Check for electrical and manual operation of Breakers

k) Checks on power cable termination or busduct termination.

l) Calibration of all meters and relays

8.3 Commissioning checklist for busducts

8.3.1 Preliminary checks

a) Check busbar fastener tightness using torque wrench.

b) Check busbar fixing insulators for any damage, crack, chipping etc.,

c) Check CT secondary wiring and fixing support

d) Check ventilation plug

e) Check breather

f) Cleanliness of duct inside enclosure

8.3.2 Commissioning checks

a) Insulation resistance value to be measured for each phase

b) High voltage test on busbar supporting insulators for HT busduct. Test value to be referred from IS

c) Milli-volt drop test on busbar joints(Ductor test)

8.4 Commissioning checklist for CTs & PTs

8.4.1 Preliminary checks

a) Check for physical damage

b) Check for tightness of all bolts, clamps, connecting terminals and drain plug

c) Check cleanliness

d) Check earthing of CT, PT & Junction boxes

e) Check for CT polarity (P1, P2, S1, S2, etc.,) and disconnecting links.

f) Check for correct level of oil and leakages (wherever applicable)

g) Check for proper cable tags and ferrules.

8.4.2 Commissioning checks

a) Dielectric test of oil (wherever applicable)

b) Insulation resistance test for both primary and secondary

c) CT polarity tests

d) Ratio test on all cores

e) Milli-volt drop test on busbar joints

f) Measurement of ground clearances from the primary terminals (wherever applicable)

g) Spare, CT cores, if any, to be shorted and earthed

8.5 Commissioning checklist for Transformer

8.5.1 Preliminary checks

a) Check for physical damage

b) Check for tightness of all bolts, clamps and connecting terminals

c) Check cleanliness

d) Check earthing of Transformer tank, Neutral bushing , marshalling box, cable box, cooling equipment etc.,

e) Check for correct oil level and oil leakage

f) Check for proper cable tags and ferrules.

8.5.2 Commissioning checks

a) Insulation test of windings and PI values

b) Insulation resistance on auxiliary circuits, primary and secondary

c) Milli-volt drop test on busbar joints

d) Functional tests on auxiliary circuits

e) Operational tests on OLTC

f) Measurement of ground clearances from primary terminals

g) BDV testing of insulating oil before and after filtration.

h) Check for operation of all relays, protection devices and interlocks

i) Polarity check

j) Hipot test on 11kV terminations

k) Capacitance and tan delta test of condenser type of bushing before assembly, wherever such bushings are provided

l) Forced cooling system(wherever applicable)

i) Check for operation of valves
ii) Check for operation of flow switches
iii) Check for motor insulation, vibration, directions of rotation
iv) Check for operational test of complete system.

8.6 Commissioning checklist for Isolators

8.6.1 Preliminary checks

a) Check for physical damage

b) Check for tightness of all bolts, clamps and connecting terminals

c) Check cleanliness

d) Check earthing

e) Check for proper cable tags and ferrules.

f) Whether isolator can be operated manually

8.6.2 Commissioning checks

a) Insulation resistance test on auxiliary circuits

b) Milli-voltage drop test on busbar joints

c) Functional checks on the auxiliary circuits

d) Measure the ground clearances

e) Checks for interlocks

8.7 Commissioning checklist for control panels

8.7.1 Preliminary checks

a) Check for physical damages

b) Check cleanliness

c) Check tightness of all clamps and terminal connections

8.7.2 Commissioning checks

a) Check continuity of each wire and connections as per relevant drawings

b) Insulation test of each wire

c) Check on settings of protection relays, timers, alarms, tripping devices etc.,

d) Functional checks of meters

e) Functional checking of all control circuits e.g. closing, tripping, controls, interlock, supervision and alarm circuits.

f) Calibration of all meters and relays

8.8 Commissioning checklist for Battery and Battery charger

8.8.1 Battery

a) Check for physical damages

b) Check for specific gravity during charge and discharge

c) Check for cell voltage during charge and discharge

8.8.2 Battery charger

a) Check for physical damage

b) Insulation test of all circuits

c) Functional check of all controls, alarms and indications

d) Measurement of voltage regulation

e) Voltage and current (both A.C & D.C) at no load and different loads.

8.9 Commissioning checklist for Motors

8.9.1 Preliminary checks

a) Check for physical damage

b) Check for tightness of all bolts, clamps and connecting terminals

c) Check for ground connections of body and terminal boxes

d) Check for clearances inside terminal box

e) Check for bearing lubrication

8.9.2 Commissioning checks

a) Check for continuity of motor windings

b) Insulation testing of motor windings

c) Check for resistance of motor winding in case of large motors

d) Check for continuity of RTD Connections

e) Check for phase sequence and rotation

f) Check for the following parameters:

i) Starting and no load currents
ii) No load operation – observe vibrations, temperature rise of motor body and bearings
iii) On load operation - observe vibrations, temperature rise of motor body and bearings
iv) In case of forced cooling, inlet and outlet temperature of cooling air

g) Check for controls and interlocks

h) Check for overload and short circuit relay/release settings. Also, locked rotor relay settings wherever applicable.

8.10 Commissioning checklist for cable

8.10.1 Preliminary checks

a) Check for physical damages

8.10.2 Commissioning checks

a) High voltage test for HV cables(3.3kV and above)

b) Insulation test for 1100 Volt power and control cables between each core and to armour/sheath

c) Check for continuity

d) Check for proper connections

8.11 Commissioning checklist for Earthing & Lightning protection system

8.11.1 Preliminary checks

a) Check for physical damages

b) Check for tightness of all bolts, clamps and connecting terminals

c) Check for proper markings

d) Check for proper treatment of all welded joints

8.11.2 Commissioning checks

a) Measurement of earth grid resistivity of the system as well as at selected earth pits.

8.12 Commissioning checklist for lighting system

8.12.1 Preliminary checks

a) Check for physical damages

b) Check for tightness of all bolts, clamps and connecting terminals

c) Check for proper markings

d) Check for operation of all fittings.

8.12.2 Commissioning checks

a) Measurement of earth leakage current in each circuit

b) Lux measurement at identified areas.

ADDENDUM TO DOCUMENT No: PCPL-4-S4-223

1. Clause No. 3.2.5: This clause is not applicable for this tender.
2. Clause No.3.7.4: The following sentence may be treated as deleted. “Fire proof sealing shall be done for pipe inserts in floor slabs, in walls of pressurised rooms and hazardous area and wherever indicated in project drawings.”
3. Clause No: 3.10: This clause is not applicable for this tender.

1.0 SCOPE:

1.1. This specification covers the requirements of cabling system installation work. The installation, testing and commissioning of the complete cabling system shall be carried out in accordance with the enclosed cable installation notes OWNER'S/ENGINEER'S typical and specific project drawings, and as stipulated in this specification. Supply items shall be quoted separately against specification; however, the installation of all items shall be quoted for in this specification.

2.0 CODES AND STANDARDS:

2.1. The cabling system installation work shall comply with the latest applicable Standards, Regulations and Safety Codes of the locality where the installation is carried out. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility.

2.2. The installation work shall conform to the latest applicable Codes of Practices, Electricity Rules, Fire Insurance Regulations and Standards.

3.0 INSTALLATION WORK SCOPE:

3.1. General Scope:

3.1.1. The installation work shall include unloading, storing, laying, fixing, jointing/termination, testing, commissioning and any other work items necessary for completing the job.

3.1.2. The CONTRACTOR shall furnish all supervision, labour, tools, welding equipment, tackles and testing equipment as required for installation work. All incidental hardware and miscellaneous items such as saddles, spacers, nuts/bolts/washers, anchor fasteners, cable route and joint markers and protective covers for buried cables, cable identification tags and ferrules, nylon cord/GI wire, earthing as required for the cabling installation shall be deemed to be included by the CONTRACTOR as part of installation work.

3.1.3. Civil works for construction of cable trenches/tunnels/duct banks, cable carrier supports on main pipe rack structure, provision of embedded conduits/pipes in RCC/masonry structures & across roads/railway tracks shall be included from the cable installation CONTRACTOR'S scope unless otherwise specified in Section-3 or Project Drawings. Minor civil works such as patching up in an approved manner any holes made in the walls by the CONTRACTOR, embedment of short lengths of conduits in floors, walls, etc. shall be deemed to be included in the CONTRACTOR'S scope of work. The CONTRACTOR shall work in co-ordination with the other Contractors at site.

3.1.4. Any changes in routes of cables which are required to be made to suite site conditions shall be carried out by the CONTRACTOR in consultation with the ENGINEER/OWNER and after his approval. All such changes shall be marked by the CONTRACTOR on respective project drawings/ cable & conduit schedule for finalisation by the OWNER/CONSULTANT'S/Design Office.

3.1.5. The MANUFACTURER'S/OWNER'S/ENGINEER'S drawings, cable schedules, instructions & recommendations shall be correctly followed by the CONTRACTOR in handling, laying, testing and commissioning of the cabling system. In case of any doubt/misunderstanding as to correct interpretation of drawings/instructions, necessary clarifications shall be obtained by the CONTRACTOR from the ENGINEER/OWNER.

3.1.6. CONTRACTOR shall make good all thefts and damage of cables or equipment, to which cables are to be connected, till the installation is handed over to the OWNER.

3.1.7. The CONTRACTOR shall arrange suitable means to clear the areas/routes/trenches to facilitate and proceed with cable laying work without any obstruction. It will be the responsibility of the CONTRACTOR to clean the trenches/tunnels, remove cable drums, surplus/waste materials and all other similar items after the installation work is complete.

3.2. Cable Laying:

3.2.1. The Contractor shall install, test and commission power and control cables, Instrumentation cables. The quantities, sizes and types of cables shall be as indicated in BOQ.

3.2.2. The cables shall be laid in cable trays, trenches, directly buried, in vertical raceways, clamped on structures/walls/ceiling, pulled through pipes and conduits etc., as per the relevant cable installation practices notes and typical/project drawings.

3.2.3. The cable installation shall generally conform to enclosed specification no. PCPL-4-S4-224: Cable Installation Notes.

3.2.4. The scope of cable laying shall include laying, pulling cables as above, proper dressing of cables on cable trays, racks, vertical raceways and supply & installation of cable fixing saddles, spacers & nylon cord for tying as required. Supply of special trefoil and wooden clamps for 1 core cables shall be quoted separately. However, the installation of trefoil/wooden clamps for clamping the cables shall be included in the installation cost of relevant cables.

3.2.5. The work of excavation, back filling etc., associated with direct buried of cables shall be separately indicated.

3.3. Cable Termination:

3.3.1. All cables that will be laid by the CONTRACTOR shall be connected at both ends to switchgear, panels, equipment, local push buttons, and instruments of junction / marshalling boxes terminals as the case may be.

3.3.2. The scope of termination at each end shall include dressing and connection of all the cores of the cables. The following shall be included in the scope of work:

Making the requisite holes in the bottom/gland plate of the switchgear for cable boxes/glands, fixing the cable boxes/glands, terminating the cables in the cable boxes/glands, earthing the cable armour, crimping the cable lugs on each core (for XLPE/PVC cables, the bare conductor from cable box shall be taped up to the lug) neatly clamping the cables inside switchgear/panels' cable alleys, wiring troughs & connecting to correct terminals as per the OWNER's/ MANUFACTURER's wiring diagrams & cable schedules. The cable and core identifying lugs & ferrules respectively shall be supplied & installed by the CONTRACTOR as part of cable termination work.

3.3.3. All cable terminations shall be solder less crimping type. The CONTRACTOR shall use proper crimping tools of Dowel or equivalent make. The crimping tools used shall be subject to the OWNER's/ ENGINEER's approval.

3.3.4. Supply of lugs, glands, cable boxes, junction boxes shall be indicated separately as per specification.

3.3.5. Spare cores of control cables shall be connected to spare terminal blocks, where available, with appropriate ferrules. If there are no spare terminal blocks, the spare cores shall be bunched together & shall be neatly kept inside the panel.

3.3.6. Copper-Aluminium bimetallic strips shall be provided between Copper and Aluminium connections.

3.4. Cable Trays Installation:

3.4.1. The CONTRACTOR shall install the type & sizes of cable trays as indicated in the specification/BOQ.

3.4.2. The trays & accessories details shall be as per enclosed specification no. PCPL-4-S4-224 and drawings referred to therein.

3.4.3. The scope of cable trays installation shall include the installation of the associated accessories like coupler plates, elbows, drop-outs, tees & bends as required in Project layout drawings. The CONTRACTOR shall also include earthing of the cable trays at distances not exceeding 10 M length by means of min. size 25 x 3 mm GS flat (unless otherwise noted).

3.4.4. Supply of cable trays and accessories shall be indicated separately as per Specification.

3.5. Cable Tray Covers Installation:

3.5.1. Vertical raceways/trays & outdoor trays shall be covered by 16 gauge painted/galvanised MS sheet covers as indicated in the Project drawings.

3.5.2. The estimated lengths & widths of these covers shall be as indicated in specification/BOQ. The scope of work shall include the installation of these covers including necessary screws when required for fixing to vertical raceways.

3.5.3. Supply shall be indicated separately as per Specification.

3.6. Cable Tray Mounting Arrangements, Vertical Raceways & Cable Carrier Structures:

3.6.1. The CONTRACTOR shall fabricate, install & paint the following as per enclosed specification no. PCPL-4-S4-224, drawings referred to therein and project drawings:

a) Mounting arrangements for cable trays. Any cable trays junction bends, which are non-standard, shall be fabricated as racks to suit installation drawings.

b) Vertical cable raceways & steel accessories (angles & plates) required to seal the floor openings in the case of indoor raceways.

c) Cable carrier structures (racks) for cable trenches and tunnels.

d) Supporting steel for junction/marshalling boxes, push buttons, vertical structures for clamping trefoil cables cable-boxes if mounted below switchgear etc., as required.

3.6.2. The above mounting structures/cable racks shall be fabricated from standard structural steel members as indicated on enclosed drawings (channels, plates, angles & flats). The estimated quantity of steel shall be as indicated in BOQ. The supply of steel if required to be furnished by the CONTRACTOR will be indicated in specification/ BOQ and the rate for the same shall be stated separately by him in this quotation.

3.6.3. The scope of installation of structural steel shall include fabrication, installation, painting earthing to system grid of all vertical raceways & cable carrier structures in tunnels/trenches by min. size 25x3 mm GS flat (unless noted otherwise), as indicated in enclosed drawings/notes, supply of incidental accessories like anchor fasteners, bolts, nuts, washers, welding works as required for fabrication & installation. Contractor will do all floor plate inserts/steel embedments in walls required for welding the cable support structures to the same. If any extra floor plates are required in certain locations for convenience of cable fasteners the same shall be supplied and installed by the Contractor.

3.6.4. All structural steel shall be painted as per instructions given in enclosed drawings/notes on cable tray mountings, trenches, tunnels & cabling practices. Where any cuts or holes are made or welding is done on painted/galvanised steel work/cable-trays these shall be painted in the original manner.

3.7. Conduits/Pipes Installation:

3.7.1. The CONTRACTOR shall install all conduits/pipes required for the cable work as per enclosed drawings/notes. The sizes & quantities shall be as indicated in BOQ.

3.7.2. The conduit and pipe installation shall be generally in accordance with the enclosed specification no. PCPL-4-S4-224.

3.7.3. Conduits/pipes shall be laid buried in ground, laid along the walls/structural members, along floors & ceilings. Conduits & pipe sleeves which are required to be embedded in walls, roof slabs, floors trench & tunnel walls, under roads and tracks etc., will in general be furnished in place wherever necessary by the CONTRACTOR for the portion of civil. The CONTRACTOR shall install conduit/pipe sleeves in place wherever necessary by breaking walls/floors as required by the OWNER/ ENGINEER to his satisfaction. All conduits/pipes shall have their ends closed by caps until cables are pulled.

3.7.4. Water proof sealing shall be done for all outdoor to indoor conduit/pipe inserts by means of bell mouth termination pieces & bitumen based cold set water proof compound. Fireproof sealing shall be done for pipe inserts in floor slabs, in walls of pressurised rooms & hazardous area and wherever indicated in

project drawings. The supply rates of the necessary water-proof/fire-proof sealing compounds shall be separately indicated by the CONTRACTOR.

3.7.5. The scope of installation of conduits/pipes shall include supply & installation of all accessories like tees, elbows, pull-boxes, conduit end plugs, bell-mounts, GS wire for cable pulling, GS saddles, spacers, screws, nuts & bolts.

3.8. Sealing of Floor Openings:

3.8.1. All floor openings for vertical cable trays/raceways shall be sealed by fireproof compound with one hour withstand rating fireproof materials.

3.8.2. The scope of work shall include preparing & laying of the compound. The supply rate for the compound shall be indicated separately by the CONTRACTOR & the installation of steel accessories required for closing the opening shall be as indicated in Clause 3.6.

3.9. Cable Joints:

3.9.1. The CONTRACTOR shall supply and carry out Cable jointing wherever necessary & approved by the ENGINEER. The work shall be carried out as per the cable & jointing kit Manufacturer's instructions furnished to the CONTRACTOR.

3.9.2. The scope of jointing of various sizes & type of power cables shall include all necessary special tools & incidental accessories and HV pressure testing of the joints.

3.10. Junction/Marshalling Boxes/Push-Button Station Installation:

3.10.1. The CONTRACTOR shall supply and install the junction/marshalling boxes wherever indicated in the Project drawings for the convenience of marshalling several cables at a local point near equipment or central to various field mounted equipment. The estimated sizes & quantity of these boxes shall be indicated in Data Sheet/BOQ.

3.10.2. Unless otherwise specified, the CONTRACTOR shall install the push-button stations local to motors as per relevant enclosed typical cabling practices drawings. The quantity of these push-button stations shall be indicated in the Data Sheet/BOQ.

3.10.3. The scope of installation of junction/marshalling boxes & push-button stations shall be mounting on walls, columns, structures, including bolts, nuts, screws & welding work as necessary.

4.0 WORK DETAILS:

4.1. The installation, testing and commissioning of Cabling System shall be carried out in accordance with specification no. PCPL-4-S4-224, drawings referred to therein and project drawings.

4.2. Cable shall be protected at all times from mechanical injury and from absorption of moisture at unprotected ends. Damaged cables shall be replaced at the CONTRACTOR's expense.

4.3. Additional requirements for any specific installation which are not covered by these specifications will be detailed in the relevant project layout drawings.

5.0 CONTRACTOR'S LICENSE:

It shall be the responsibility of the CONTRACTOR to obtain necessary license/Authorisation/permit for work from the Licensing Board of the locality/State where the work is to be carried out. The persons deputed by the CONTRACTOR'S firm should also hold valid permits issued or recognised by the Licensing Board of the Locality/State where the work is to be carried out.

6.0 WORKMANSHIP:

The CONTRACTOR shall ensure workmanship of good quality & shall assign qualified Supervisor/Engineers and competent labour who are skilled, careful and experienced in their several trades in similar works. The OWNER/ENGINEER shall reserve the right to reject non-competent persons employed by the CONTRACTORS, if the workmanship is not of good order.

7.0 SAFETY:

The contractor shall ensure adherence to all safety norms such as use of safety shoes, belts, helmets, gloves etc., and sign OWNER's safety conditions for work at site.

ADDENDUM TO DOCUMENT No: PCPL-4- S4-231

1. PCPL-4- S4-231: This document shall be applicable only to Earthing System. Hence “Earthing and Lightning Protection system” wherever specified shall be read as “Earthing system.”
2. Clause No. 1.4 Sub-Clause No. (b), (d), (h): These clauses are not applicable for this tender.
3. Clause No. 3.7, 3.8: These clauses are not applicable for this tender.
4. Clause No. 7.0: This clause is not applicable for this tender.
5. Clause No. 8.1, 8.2, 8.3, 8.4, 8.5: These clauses are not applicable for this tender.
6. Clause No. 9.0: This clause is not applicable for this tender.
7. Clause No. 10.0: This clause is not applicable for this tender.

1.0. GENERAL

1.1 These notes shall be read and construed in conjunction with Lightning Protection and Earthing drawings and specifications. In case of conflict between these notes and drawings/ specifications, the later shall prevail.

1.2 Earthing conductor layout is shown diagrammatically. Exact location of earthing conductors, earth electrodes and test pits, and earthing connections may be changed to suit the site conditions. Major modifications should be referred to OWNER/ENGINEER for clearance.

1.3 Neutral points of systems of different voltages, metallic enclosures and frame works associated with current carrying equipment and extraneous metal works associated with electric systems shall be connected to a single earthing system unless stipulated otherwise.

1.4 Earthing and lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of Practice and Regulations existing in the locality where the system is installed.

a)	Code of practice for earthing	IS:3043
b)	Code of practice for the protection of Buildings and allied structures against lightning	IS: 2309
c)	Indian Electricity Rules, 1956	
d)	Protection of Structures against lightning	IEC 61024 / 61312
e)	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.	IEEE Std 142-1991
f)	IEEE Recommended Practice for Powering and Grounding Electronic Equipment	IEEE Std 1100-1999
g)	IEEE Guide for Safety in AC Substation Grounding	IEEE Std 80-2000
h)	IEEE Guide for Direct Lightning Stroke Shielding of Substations	IEEE Std 998-1996 (R2002)

2.0. EARTHING CONDUCTOR LAYOUT

2.1 Earthing conductors in outdoor areas shall be buried 600mm below finished grade level unless stated otherwise stated in Data sheet A1.

2.2 Minimum 6000mm spacing between rod/pipe electrodes and 8000 mm spacing between plate electrodes shall be provided unless stipulated otherwise.

2.3 Earthing conductor around the building shall be buried in earth at a min. distance of 1500 mm from outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid min. 1500 mm away from such location.

2.4 Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.

2.5 Earthing conductors along their run on columns, walls etc., shall be supported by suitable welding/cleating at intervals of 1000 mm and 750 mm respectively.

2.6 Tap connections from the floor earthing grid to the equipment/structure to be earthed shall be terminated on the earthing terminals of the equipment, if the equipment is available at the same time of laying the grid. Otherwise, 'earth insert' with temporary wooden cover of 'earth riser' as shown in the drawing shall be provided near the equipment foundation/pedestal for future connections of the equipment earthing terminals.

2.7 In outdoor areas, buried conductors shall be brought 500 mm above ground level for tap connections to equipment.

2.8 Earthing conductors crossing the road shall be either installed in hume pipes or laid at greater depth to suit the site conditions.

2.9 Wherever earthing conductor cross u/g service ducts, pipes, trenches, tunnels, railway tracts etc., it shall be laid min. 300 mm below them. The earthing conductor shall be re-routed in case it fouls with equipment foundations.

2.10 Wherever earthing conductor passes through walls, floors, etc., galvanised conduit sleeves shall be provided for the passage of the conductor. Both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

2.11 Water stops shall be provided wherever earth conductor enters the building from outside, below ground level.

3.0. EQUIPMENT AND STRUCTURE EARTHING

3.1 Earthing pads/terminals shall be provided by the SUPPLIER of the apparatus/equipment at accessible positions. The connection between earthing pads/terminals and the earthing grid shall be made by short and direct earthing leads free from kinks and splices.

3.2 Whether specifically shown in drawings or not, steel/RCC columns, metallic stairs, handrails, etc., of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by the earthing lead. Electrical continuity shall be ensured by bonding the different sections of hand rails and metallic stairs.

3.3 Electrical conduits, pipes and cable tray sections shall be bonded to ensure electrical continuity and connected to earthing conductors at regular intervals. Apart from intermediate connections, end and beginning points shall also be connected to earthing system.

3.4 Metallic conduits and pipes shall not be used as earth continuity conductor.

3.5 A separate earthing conductor shall be provided for earthing lighting fixtures, receptacles, switches, junction boxes, lighting conduits, poles, etc. This conductor in turn will be connected to the main earth.

3.6 When an earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water and steam, conduits/pipes and steel reinforcement in concrete, it shall be bonded to the same.

3.7 Street lighting poles, junction boxes on the poles, flood light supporting structures etc., shall be connected to the earthing conductor running along with the supply cable and, in turn, shall be connected to earthing grid conductor at minimum two points.

3.8 Railway tracks within plant area shall be bonded across fish plates and connected to earthing grid at several locations. At the point where the track leaves the plant area, the rail section shall be provided with insulated joint at both ends.

3.9 Buried earthing conductor shall be run 1000 mm outside the switchyard fence. Every alternate post of the fence shall be connected to earthing grid by one lead and gates by flexible braid of the earthed post.

3.10 Miscellaneous items such as junction boxes, field switches, cable ends, boxes/glands, fittings and fixtures shall be earthed whether specifically shown or not.

3.11 Flexible earthing connections shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.

3.12 Auxiliary earth mat of 150mmX150mm spacing at a depth of 300mm from FGL, to be provided in front of outdoor HV isolator/ earth switch operating mechanism boxes, covering an area of 1000mmX1000mm. The auxiliary earth mat shall be connected to the switchyard main earth mat at

minimum two points. The size of auxiliary earth mat conductor shall be as detailed at the construction drawing. Operating handle shall be bonded to earthing structure by flexible conductor.

4.0. JOINTS

4.1 Earthing connections to equipment earthing pads/ terminals shall be bolted type with GI bolts and nuts. Contact surfaces shall be free from scale, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections after being checked and tested, shall be painted with anti-corrosive /compound.

4.2 Connection between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded/brazed type. For rust protection, the welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.

4.3 Steel to copper connections shall be brazed type.

4.4 Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.

4.5 Welding/brazing surfaces shall be cleaned and made free of all oxide films, grease, oil or any foreign material. However, the jointing surfaces should not be made too smooth/highly polished to prevent the jointing metal from flowing away.

4.6 The items to be welded/brazed shall not be clamped/tied tightly (at the same time clearance should not be excessive), to allow the flux/alloy to run freely through the joint and alloy itself with the surface to be joined together.

4.7 All brazing shall be done by oxy-acetylene torch flame.

4.8 All welded connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.

4.9 Bending of large dia rod/thick conductors shall be done preferably by gas heating.

4.10 All arc welding with large dia. conductors shall be done with low hydrogen contact electrodes.

4.11 For brazing, alloys of silicon bronze/ phosphorus copper/phosphorus-silver-copper shall be used.

5.0. CABLE EARTHING

5.1 Metallic sheaths, screens and armour of all multi core cables shall be earthed at both equipment and switchgear ends.

5.2 Sheath and armour of single core power cables shall be earthed at switchgear end only.

6.0. TESTING OF EARTHING SYSTEM

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

7.0. LIGHTNING PROTECTION SYSTEM:

7.1 The methods of lightning protection system to be adopted are:

d) By Horizontal Roof Conductors and down comers

e) By down comers for metal roof structures

f) By Shield wires supported on poles/mast

The particular method of protection depends on dimensions of the structure protected aesthetics and convenience

7.2 Horizontal Air Terminations :

Horizontal air terminations comprising of horizontal roof conductors shall be used for all buildings.

7.3 Down Conductors:

a) Air termination system shall be connected to the earth by down comers fixed along the outer surface of building / structure. Each down comer shall be terminated to a separate treated test earth electrode. The material of down conductors will be same as that of Horizontal roof conductors. There shall not be any sharp bends, turns and joints in the down conductors.

b) The down comers shall not be connected to any other earthing conductors above ground level.

7.4 Test Links:

Each down comers will be provided with a link one meter above ground level for dismantling the electrodes and taking measurements. The links shall be made up of aluminium and housed in PVC or glass filled nylon enclosure box to prevent corrosion.

7.5 Component Sizes:

The following material and size of conductors and earth electrodes shall be used unless otherwise mentioned in Data sheet A1.

a.	Horizontal Air Termination	AL. strip	25 x 3mm
b.	Down comer	AL strip	25 x 3mm
c.	Test link to grid connection	GS strip	25 x 6mm
d.	Earth electrode	Rod/CI pipe/Plate	As per drawings and BOQ

8.0. MODE OF TERMINATION AND JOINTS:

8.1 All joints in the horizontal roof conductors shall be of welded type. Where it is likely to damage the roof material like asbestos or sheet steel, riveted joints will be used.

8.2 Connection between roof conductors and down comers shall be of welded type. Where it is likely to damage the roof material like asbestos or sheet steel, riveted joints shall be used.

8.3 Connection between metal roof and down comer shall be bolted type using 2 Nos. M10 bolt and nuts.

8.4 Down Comers will be connected to test links by bolted connections

8.5 The lead from test link to Pipe electrodes shall have bolted connection at both ends.

8.6 Individual pipe electrodes in turn shall be connected to station earthing system by welded joint at grid and bolted joint at electrodes.

8.7 Welding/brazing surfaces shall be cleaned and made free of all oxide films, grease, oil or any foreign material. However, the jointing surfaces should not be made too smooth/highly polished to prevent the jointing metal from flowing always.

8.8 The items to be welded/brazed shall not be clamped/tied tightly (at the same time clearance should not be excessive), to allow the flux/alloy to run freely through the joint and alloy itself with the surface to be joined together.

8.9 All brazing shall be done oxy-acetylene torch flame.

8.10 All welded connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.

9.0. LAYING:

9.1 Precautions shall be taken such as providing an up stand and using PVC or glass filled nylon clamps, so that contact with cement mortar is avoided. When the roof conductors are closer to beams less than 2M. Bonding between the beam columns and down comer shall be provided to prevent side flashing.

9.2 Pipes carrying hazardous substances shall be protected by suitable steel wire or lightning conductors at a height to provide total protection against lightning. Joint in these pipe lines shall be bonded by a copper flexible with copper clamps on either side of the joints. Pipe line shall be earthed at both ends. Either isolation shall be provided by keeping the lightning conductor 2M away or they shall be bonded if they are close to each other.

9.3 Routing of lightning conductors down comer shall be done in such a way that they do not run parallel with power control and instrumentation cable. They shall be taken by crossing at 90^{O}C. If parallel routing is unavoidable minimum distance of 2m shall be ensured.

10.0. SURGE ARRESTORS:

10.1 All important circuits catering to expensive appliances shall be protected by 415/240V, TPN/SPN, 40/10kA surge arrestors to protect the equipment from transferred surges. This shall include TV/Video circuits, EPABX, Computers, PLC etc. Unit rates shall be quoted for supply and installation of these surge arrestors as required by OWNER.

11.0. EARTHING SYSTEM:

11.1 The proposed Lightning Protection System earth pits shall be interconnected to the station Earth grid. Connection from test link to earth grid shall be by GS flat of size as indicated in BOQ (Section 5) and layout drawings.

1.0 SCOPE:

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

2.0 GENERAL REQUIREMENTS:

2.1. Standard cable grips & reels shall be utilized for cable pulling. Maximum pull tension shall not exceed recommended value for the cable measured by tension dynamometer. In general, any lubricant that does not injure the overall covering & does not set up undesirable conditions of electrostatic stress or electrostatic charge may be used in pulling insulated cables in conduits & ducts. In particular soap shall not be used as lubricant. After pulling cable, the CONTRACTOR shall record cable identification & date pulled, neatly with waterproof ink on linen tags at all cable ends. This is in addition to the cable identification tags to be tied by GI wire at each end of the cable.

2.2. Cable take-off from drums shall be so planned as to avoid using joints & splices in the run of the cable. Cable splices shall be made only after obtaining permission of the ENGINEER. Splice shall be made by the CONTRACOTR for each type of wire or cable in accordance with the instructions issued by the cable MANUFACTURER and the Engineer.

2.3. When power cables are laid in the proximity of communication cables, minimum separation between power & communication cables shall be not less than 460mm for single-core cables & 300 for multi-core cables. Power & communication cables shall, as far as possible cross at right angles to each other.

2.4. Un-armoured cables shall be protected in conduits up to 2.5m from floor level.

2.5. The CONTRACTOR shall make connections to small electrically operated devices on equipment installed as accessories to, or assembled with other equipment & requiring 2 wire or 3 wire connections. Connections to recording instruments, float switches, limit switches, pressure switches, thermocouples, thermostats & other miscellaneous equipment shall be done as per the MANUFACTURER's/ENGINEER's drawings and schedules.

2.6. The CONTRACTOR shall be responsible for correct phasing of the motor power connections & shall interchange connections at the motor terminal box, if necessary, after each motor is test run.

2.7. The CONTRACTOR shall make terminations for each type of wire or cable in accordance with instructions issued by cable MANUFACTURER and the ENGINEER.

2.8. Control cable terminations shall be made in accordance with wiring diagrams/cable interconnection diagram & cable schedules furnished to the CONTRACTOR for this purpose. Where on testing, reversal or other rearrangement of connections turns out to be necessary, additional work of reconnecting and testing shall be performed by the CONTRACTOR at no extra cost to the OWNER.

2.9. Jointing of cables shall be carried out in accordance with relevant Standard Codes of practice & the MANUFACTURER's special instructions. The CONTRACTOR shall supply hardware like clips & clamps and tools required for cable jointing work. Cables shall be firmly clamped on either sides of a straight through joint at not more than 300 mm away from the joints. Identification tags shall be provided at each joint & at all cable terminations. Single core cable joints shall be marked so that phase identity at each joint shall be determined easily. The joints shall be located at the most suitable places. There shall be sufficient overlap of cables to allow for the removal of cable ends, which may have been damaged.

2.10. Where cables are to be installed at temperatures below $3^{o}C$, they shall be heated to about $10^{o}C$ for not less than 24 hours (in a heated building or in a tent with protective coverings of the cables). The cable laying must be carried out swiftly so as not to allow the cable to cool down too much.

3.0 OUTDOOR CABLE INSTALLATION

3.1. Directly buried cables shall be laid as per project cable layout drawings. The cables shall be laid on a bedding of minimum 75mm sand at the bottom of the trench and covering it with additional sand of minimum 75mm and protecting it by means of tiles, bricks or slabs. HV cables shall be protected by concrete slab. Cable route markers shall be put at 15 metre intervals. At least one marker shall be provided if the length of the buried cable is less than 15 metres. Bends shall be identified by route markers at both ends. Buried cables in trefoil formation shall be bound by plastic tapes or 3 mm dia. Nylon cord every 750 mm.

3.2. The minimum depth of laying from ground surface to the top of cable shall be as follows unless otherwise shown in cable layout drawings:-

a) High voltage cables, 3.3 kV to 11 kV 900 mm

b) High voltage cables, 22 kV and 33 kV 1050 mm

c) Medium voltage and Low voltage cables 750 mm

d) Control cables 750 mm

3.3. Joints in directly buried cables shall be identified by joint markers at each joint location.

3.4. In each outdoor cable run greater than 60m, some extra cable length shall be kept at a suitable point to enable a straight through joint to be made should the cable develop fault at a later date.

3.5. Where cables cross roads and water, oil, gas or sewage pipes, the cables shall be laid in Hume or steel pipes. For road crossings, the pipe for the cable shall be buried at not less than 1000 mm unless otherwise noted in the drawings. Hume pipes shall be preferred to steel pipes from the point of view of corrosion.

3.6. Control cables and small power cables in trenches and tunnels shall be run in ladder type cable trays(maximum tray width 600 mm) supported on trench/tunnel carrier arms. The cables shall be tied to tray rungs by means of 3 mm dia. Nylon cord at an interval of 5000 mm and also at bends.

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

4.0 CABLE TRAY INSTALLATION

4.1. The type & sizes of cable trays shall be as indicated in the specification, drawings and BOQ.

4.2. Cable trays shall be run in concrete trenches or run overhead supported from building steel, floor slab, pipe rack etc.,

4.3. Vertical trays/race ways shall be covered by removable 16 gauge MS/GS sheet covers wherever shown in project drawings.

4.4. Cable tray installation shall comply with the following requirements:

a) Cable trays shall be supported at an interval of not exceeding 1000 mm for horizontal and straight runs, unless otherwise specified.

b) Embedded parts of cable trays, if any, shall be painted with 2 coats of bitumen paint. All site fabricated metal work such as cable tray supports, mounting brackets etc, used in buildings/areas classified as chemically CORROSIVE shall be cleaned for removal of rust, and scale & shall be given 2 coats of corrosion resistant epoxy paint. Any cuts and holes drilled in the galvanised and epoxy finished metal work shall be given two coats of epoxy paint.

c) The length of tray supporting members will depend on the number of tray tiers required at a particular section. The details shown in the drawings for various tray sections are typical only.

d) Minimum vertical clearance between the bottom of the lowest cable tray tier and any other obstruction shall be 300 mm unless otherwise shown in project drawings.

e) Minimum vertical clearance between the top most tray tier and any structural member shall be 300 mm. Wherever, cable tray passes vertically through floors, platforms, it shall be made totally enclosed by covering with 16 SWG. Galvanised sheet covers.

f) When cable trays are installed in tiers, the minimum vertical clearance between tiers shall be 275 mm, unless otherwise indicated in the drawing.

g) Working space of 600 mm min. shall be maintained on one side of each Cable tray or where grouped in rows adjacent to each other, a min. working space to 800 mm shall be maintained over each cable tray.

h) All cable trays and vertical cable raceways shall have identification designation, as per ENGINEER's drawing painted at each end of the tray and raceways. For long lengths of trays, the identification shall be painted at intermediate points also.

5.0 CABLES IN TRAYS/ON RACKS

5.1. Different voltage grade cables shall be laid in separate trays when trays are arranged in tiers, HV cables shall be laid in top trays and cables of subsequent voltage grades in lower tiers of trays.

5.2. Control cables shall be run in a separate tray, similarly, Instrument cables shall be run in a separate tray.

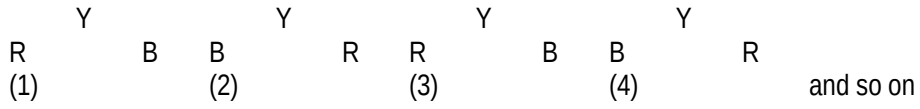
5.3. The HV power cables of 3.3kV and above shall be laid in trays/on racks as follows:

a) In single layer only without exception.

b) 3 Crore cables to be laid in touching formation.

c) Single core cables to be laid in trefoil groups with spacing equal to diameter of the cable between edges of the trefoils.

d) Cables in trefoil groups of the same circuit shall be laid as indicated below so as to ensure balanced current distribution:



5.4. 1100V grade power cables of 120 mm^2 size and above shall normally be laid in single layer in trays/on racks. In exceptional cases, these may be laid in double layer if shown on the drawings or with the permission of the ENGINEER.

5.5. Smaller 1100V grade power cables below 120 mm^2 may be run in double layers, where required, due to space restrictions.

5.6. Control and instrumentation cables can be laid upto a minimum of three layers in each tray/rack.

5.7. Control cables and small power cables on racks shall be run in ladder type cable trays supported on rack carrier arms. The cables shall be tied to tray rung by means of 3 mm dia. nylon cord at an interval of 5 metre and also at bends.

6.0 BENDING RADII FOR CABLES

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

Type and voltage Grade of Cable	Minimum bending radius

	Single core	Multi-core	
		Armoured	Un-armoured
a) XLPE insulated upto 11 kV	20D	15D	15D
b) XLPE insulated upto 22 kV	20D	15D	15D
c) XLPE insulated upto 33 kV	20D	20D	20D
d) PVC insulated 1.1 kV	15D	15D	15D
e) XLPE insulated 1.1 kV	15D	15D	15D
f) Rubber insulated 600 V	-	8D	10D
g) Mineral insulated 300 kV	-	8D	-

Where D is overall diameter of Cable

(For High voltage XLPE insulated cables, recommendation of MANUFACTURERs shall be checked and followed if higher values are recommended).

6.2. The above values may be reduced to 70% when making only one bend such as in Case of installing an end termination.

7.0 TERMINATION, CLAMPING AND MISCELLANEOUS DETAILS

7.1. Cable entry to motors, push button stations and other electrical devices shall be from the bottom as far as possible or from the sides. Top entry shall be avoided particularly for outdoor equipment.

7.2. Identification tags made from aluminium sheet shall be attached to each end of each cable by means of GI binding wire. Tags shall be additionally put at an interval of 30 meters on long runs of cables and in pull boxes.

7.3. Cable glands

7.3.1. The cable glands shall be made from solid drawn brass rods, machined for smooth finish, Cadmium, Nickel plated and passivated to protect against corrosion.

7.3.2. Cable glands for armoured cables shall be double seal cone grip compression (Double compression) type unless otherwise stated. The cone and clamping ring for armour shall be suitable to accommodate armouring wire/strip/tape.

7.3.3. Cable glands for unarmoured cables shall be single seal compression type similar to above but without the cone and clamping ring for the armour.

7.4. Cable lugs

7.4.1. Cable lugs shall be tinned copper for both copper and Aluminium cables. For Aluminium cables, bi-metallic paste shall be applied.

7.4.2. All cable terminations shall be solder less crimping type. Whenever lugs are required to be supplied, adequate size crimping lugs of approved make shall be used by the CONTRACTOR. The crimping tools shall be adequate for the lugs sizes.

7.5. Saddle type clamps to suit number of cables to be clamped at a particular location shall be used to clamping cables running along walls, ceilings, structures, etc. The interval between adjacent clamps shall be shown on the relevant project drawings.

7.6. Single core power cables for 3 phase AC circuits laid in trays/racks/trenches in trefoil groups shall be held in trefoil clamps placed at an interval of 3metre. The details of trefoil clamp shall be as shown in project drawing. The trefoil groups of cables shall be additionally tied by means of 3 mm dia, Nylon cord as follows:

a) At an interval of 1metre when laid in cable trays/racks.

b) At an interval of 750 mm when laid in trenches without cable trays.

7.7. Wooden cleats when required for vertically supporting one or more single core cables per phase, such as on vertical framework near transformer cable boxes, shall be made out of well seasoned wood and given two coats of fire retarding paint of approved quality.

8.0 CONDUIT AND PIPE INSTALLATION

8.1. All conduit/pipe sleeves shall be sealed at both ends against ingress of water after the cables have been pulled.

8.2. All conduit/pipes sleeves shall be extended at least 50 mm on both sides of wall/floor/ceiling.

8.3. Exposed conduit/pipe runs shall be adequately clamped at an interval of 2metre.

8.4. All installed conduits/pipes shall have their ends temporarily closed by caps or other approved means until cable in pulled.

8.5. When two lengths of conduits are joined together through a coupling, running threads more than twice the length of coupling shall be provided on any one length to facilitate easy dismantling of the two conduits. Threads shall be painted with zinc rich paint.

8.6. GI pull wires of adequate size shall be laid in all conduits before installation.

8.7. After the installation of all the cables, the unused pipe inserts (spares/future) shall be cut to the floor level and plugged flush with brass plug.

9.0 TESTING AND COMMISSIONING OF CABLES

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

Voltage grade of cable	Meggar rating
1.1 kV	500 V
3.3 kV, 6.6 kV and 11 kV	1000 V
22 kV and 33 kV	2.5 kV motorized meggar

9.2. High Voltage Testing

9.2.1. All cables of 1.1kV grade 400 mm^2 and above and all HV cables shall be subjected to DC or AC high voltage test after jointing and terminating but before commissioning as per the relevant standards. Testing with DC voltages should be preferred, as test equipment required is compact, easily portable and requires low power. The DC test voltages applicable in India shall be as per Table 4 in IS 1255. The cable cores must be discharged on completion of DC high voltage test and cable shall be kept earthed until it is put into service.

9.2.2. DC test voltage for old cables should be 1.5 times rated voltage or less depending upon the age of cables, repair or nature of jointing work carried out.

9.2.3. In each test, the metallic sheath/screen/armour should be connected to earth.

9.3. Continuity of all the cores, correctness of all connections, as per wiring diagrams, correctness of polarity and phasing of power cables and proper earth connection of cable gland, cable boxes, armour and metallic sheath shall be checked.

10.0 EARTHING

10.1. Earthing of cables

10.1.1. Metallic sheaths, screens and armour of all multi-core cables shall be earthed at both equipment and switchgear end.

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

10.1.3. Earthing of power cable with core balance CT shall be as shown in the project drawings.

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

10.3. Earthing of cable trays

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

10.4. Earthing of Conduits and pipes

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

11.0 PAINTING

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

a) For indoor installations- one shop coat of red oxide zinc chromate primer and two site coats of aluminium alkyd paint as specified.

b) For outdoor and corrosive atmosphere indoors/outdoors painting with a two pack epoxy coating.

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

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

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

12.2. Test certificates of cables tested at site.

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

SCHEDULE OF DEVIATION FROM TECHNICAL SPECIFICATION

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

SECTION	SPECIFICATION NO	CLAUSE NO	DEVIATION

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

COMPANY SEAL

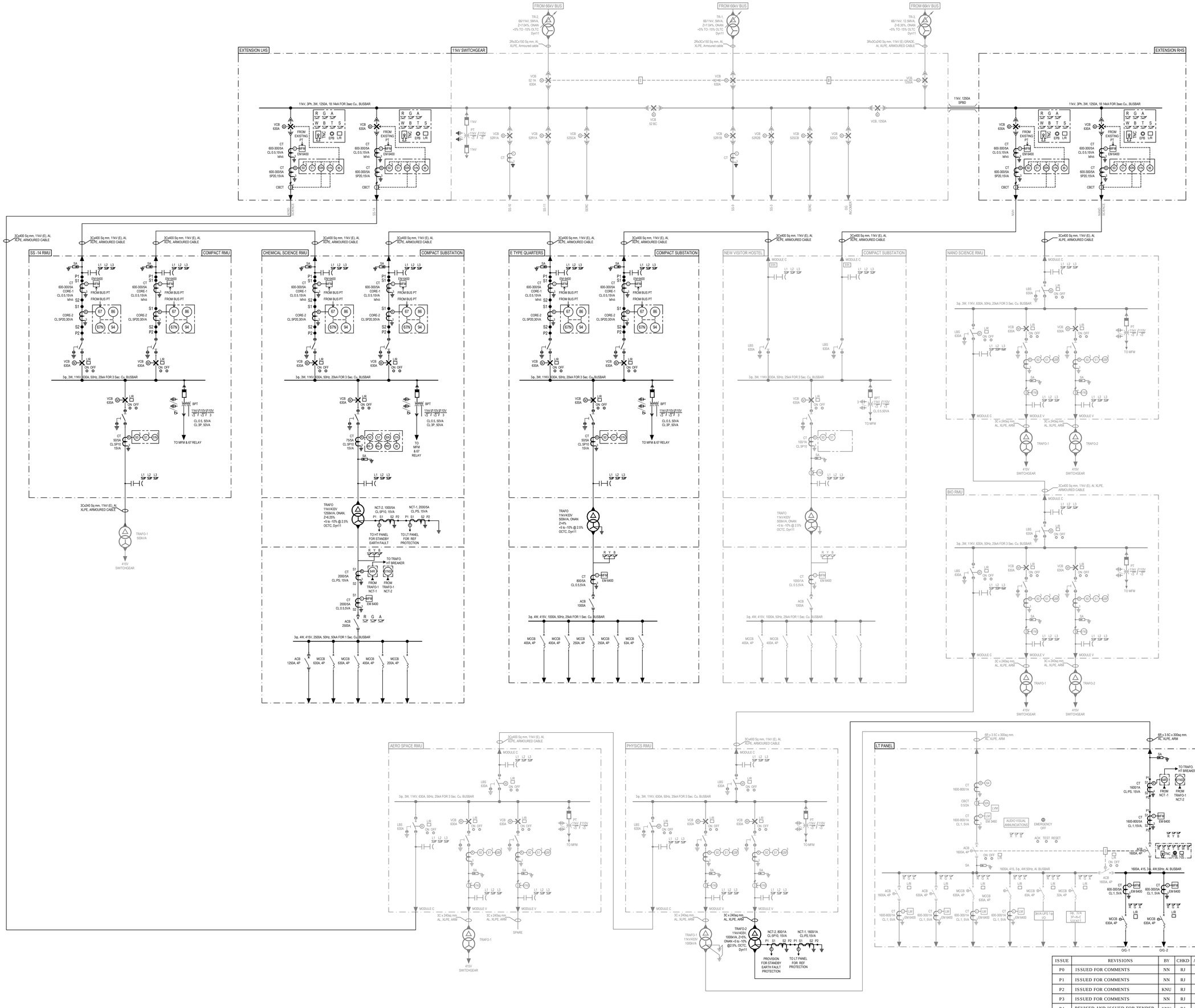
SIGNATURE .....

NAME .....

DESIGNATION .....

COMPANY .....

DATE .....



LEGEND & ABBREVIATIONS

	TR	TRANSFORMER
	I	INSTRUMENTATION
	R	RELAYING
MFM	MFM	MULTI FUNCTION METER
PT	PT	POTENTIAL TRANSFORMER (NO. INDICATES QUANTITY)
BPT	BPT	BUS POTENTIAL TRANSFORMER
L1	L1	VOLTAGE INDICATING LAMPS
L2	L2	
L3	L3	
ON	ON	PUSH BUTTON
OFF	OFF	
R Y G	R Y G	INDICATION LAMP
R	R	RED - BREAKER "ON"
G	G	GREEN - BREAKER "OFF"
A	A	AMBER - TRIP ON FAULT
W	W	WHITE - TRIP CIRCUIT HEALTHY
B	B	BLUE - SPRING CHARGED
T	T	WHITE - BREAKER IN TEST POSITION
S	S	YELLOW - BREAKER IN SERVICE POSITION
CT	CT	CURRENT TRANSFORMER (NO. INDICATES QUANTITY.
CBCT	CBCT	CORE BALANCE CURRENT TRANSFORMER
VCB	VCB	VACUUM CIRCUIT BREAKER WITH MOTOR OPERATION
		DRAW OUT TYPE
SA	SA	SURGE ARRESTER
		HT FUSE
LR	LR	LOCAL REMOTE SELECTOR SWITCH
TNC	TNC	TRIP-NEUTRAL-CLOSE SWITCH
		THREE POSITION DISCONNECTOR WITH EARTH SWITCH
CVI	CVI	CAPACITOR VOLTAGE INDICATING SYSTEM WITH INTEGRATED INDICATING LAMPS
		POSITION INDICATOR
		INTERLOCK
ACB	ACB	AIR CIRCUIT BREAKER
MCCB	MCCB	MOULDED CASE CIRCUIT BREAKER

RELAY ABBREVIATIONS

50	INSTANTANEOUS O/C RELAY
51/51N 51NG	INVERSE DEFINITE MINIMUM TIME OVER CURRENT RELAYS, SUFFIX-N-GROUND, SUFFIX-NS, STAND BY EARTH
62BF	CIRCUIT BREAKER FAILURE RELAY (FEED BACK TO SCADA)
64R	RESTRICTED EARTH FAULT RELAY
67/67N	DIRECTIONAL OVER CURRENT RELAYS RELAY SUFFIX-N-GROUND
94	TRIPPING OR TRIP FREE RELAY
86	LOCKOUT RELAY
SPBD	SEGREGATED PHASE BUS DUCT

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMMENTS	NN	RJ	R.V	25.07.15
P1	ISSUED FOR COMMENTS	NN	RJ	R.V	26.09.15
P2	ISSUED FOR COMMENTS	KNU	RJ	R.V	26.10.15
P3	ISSUED FOR COMMENTS	NN	RJ	R.V	20.01.16
P4	REVISED AND ISSUED FOR TENDER	KNU	RJ	R.V	03.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : N.T.S | DATE : 29.06.15 | DRAWN : HR | CHKD : RJ | APPD : R.V

TITLE: KEY SINGLE LINE DIAGRAM

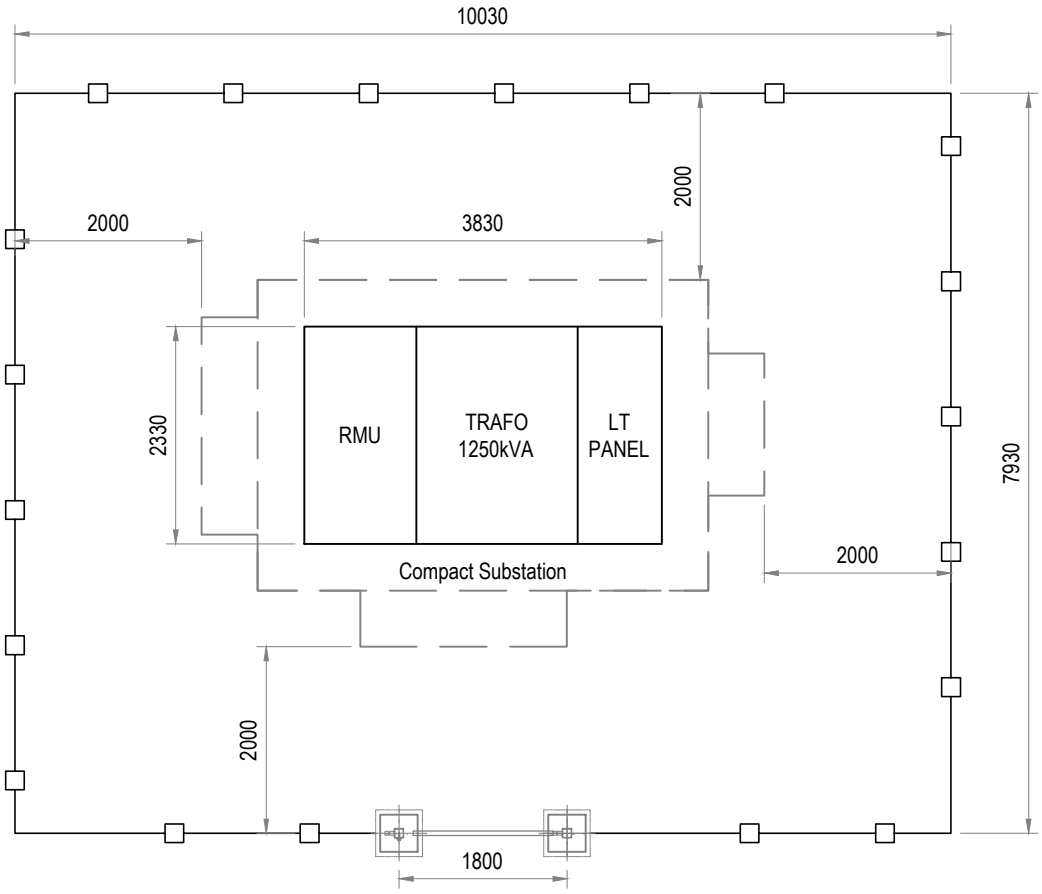
DRAWING NO : PCPL-1414-4-SLD-102

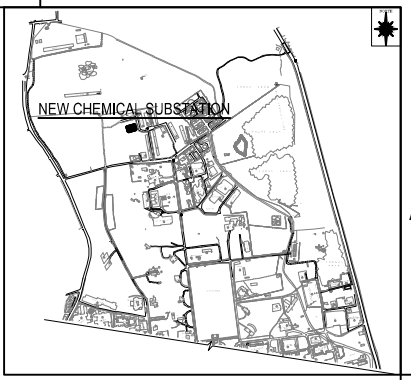
JOB NO. : 1414 | DATE: 10.11.14 | REV: P4

SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size : A0
PCPL-1414-4-SLD-102.dwg





NEW CHEMICAL SCIENCE

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT
2. PCPL-1414-4-CT-102 - CABLE TRENCH LAYOUT NEW CHEMICAL SUBSTATION .
3. PCPL-1414-4-GL-101 - EARTHING LAYOUT NEW CHEMICAL SUBSTATION.

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. PANEL DIMENSIONS ARE TENTATIVE ONLY. EXACT DIMENSION WILL BE FURNISHED AFTER APPROVAL OF VENDOR DRAWING.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMMENTS	NN	RJ	R.V	09.10.15
P1	REVISED & ISSUED FOR COMMENTS	NN	RJ	R.V	26.09.15
P2	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P3	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	03.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : 1:75
DATE : 28.07.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: GENERAL ARRANGEMENT NEW CHEMICAL SUBSTATION

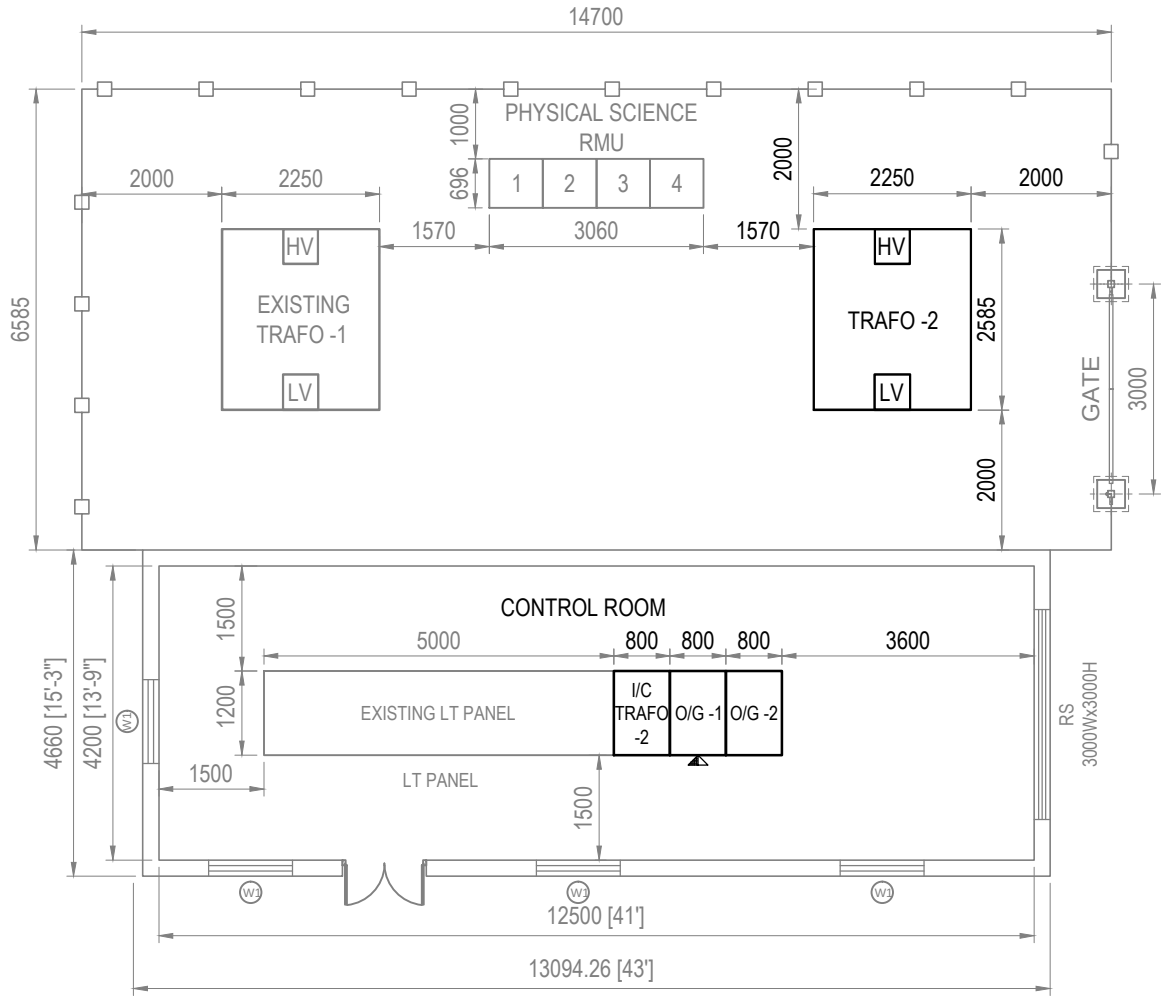
DRG NO : PCPL-1414-4-GA-101

JOB NO.: 1414 | DATE: 10.11.14 | REV: P3

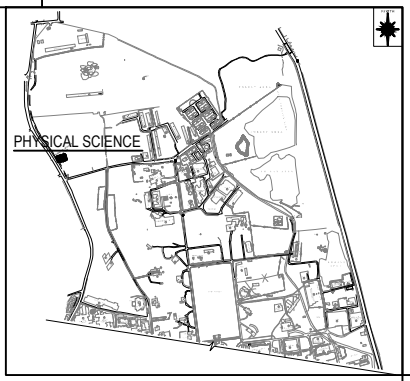
SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A4
PCPL-1414-4-GA-101P3



PHYSICAL SCIENCE SUBSTATION



LEGEND:

PANEL

PANEL FRONT

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. PANEL DIMENSIONS ARE TENTATIVE ONLY. EXACT DIMENSION WILL BE FURNISHED AFTER APPROVAL OF VENDOR DRAWING.

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT
2. PCPL-1414-4-CT-103 - CABLE TRENCH LAYOUT PHYSICAL SCIENCE SUBSTATION
3. PCPL-1414-4-GL-102 - EARTHING LAYOUT PHYSICAL SCIENCE SUBSTATION

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMENTS	NN	RJ	R.V	29.07.15
P1	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P2	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	03.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : N.T.S
DATE : 28.07.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: GENERAL ARRANGEMENT PHYSICAL SCIENCE SUBSTATION

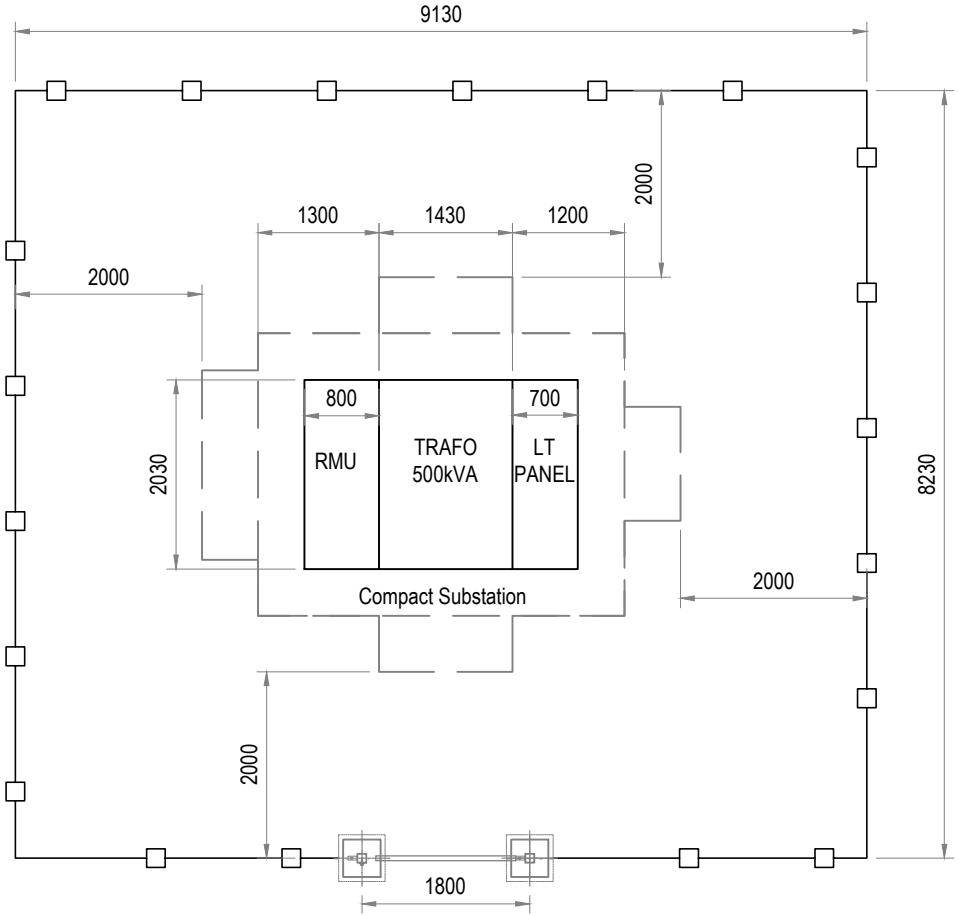
DRG NO : PCPL-1414-4-GA-102

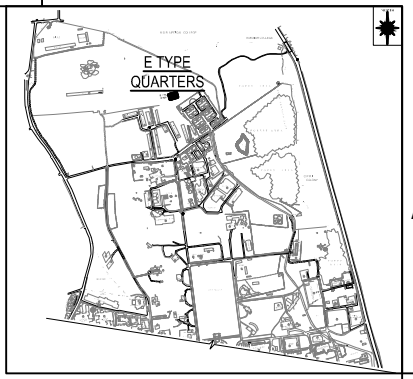
JOB NO.: 1414 | DATE: 10.11.14 | REV: P2

SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A4
PCPL-1414-4-GA-102P2





E -TYPE QUARTERS

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GL-103 - EARTHING LAYOUT E TYPE QUARTERS.
3. PCPL-1414-4-CT-104 - CABLE TRENCH LAYOUT E TYPE QUARTERS.

NOTE:

1. ALL DIMENTIONS ARE IN mm
2. PANEL DIMENSIONS ARE TENTATIVE ONLY. EXACT DIMENSION WILL BE FURNISHED AFTER APPROVAL OF VENDOR DRAWING.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMMENTS	NN	RJ	R.V	09.10.15
P1	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P2	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	24.10.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : 1:75
DATE : 05.10.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: GENERAL ARRANGMENT E TYPE QUARTERS

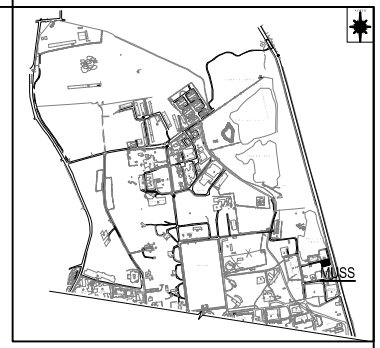
DRG NO : PCPL-1414-4-GA-103

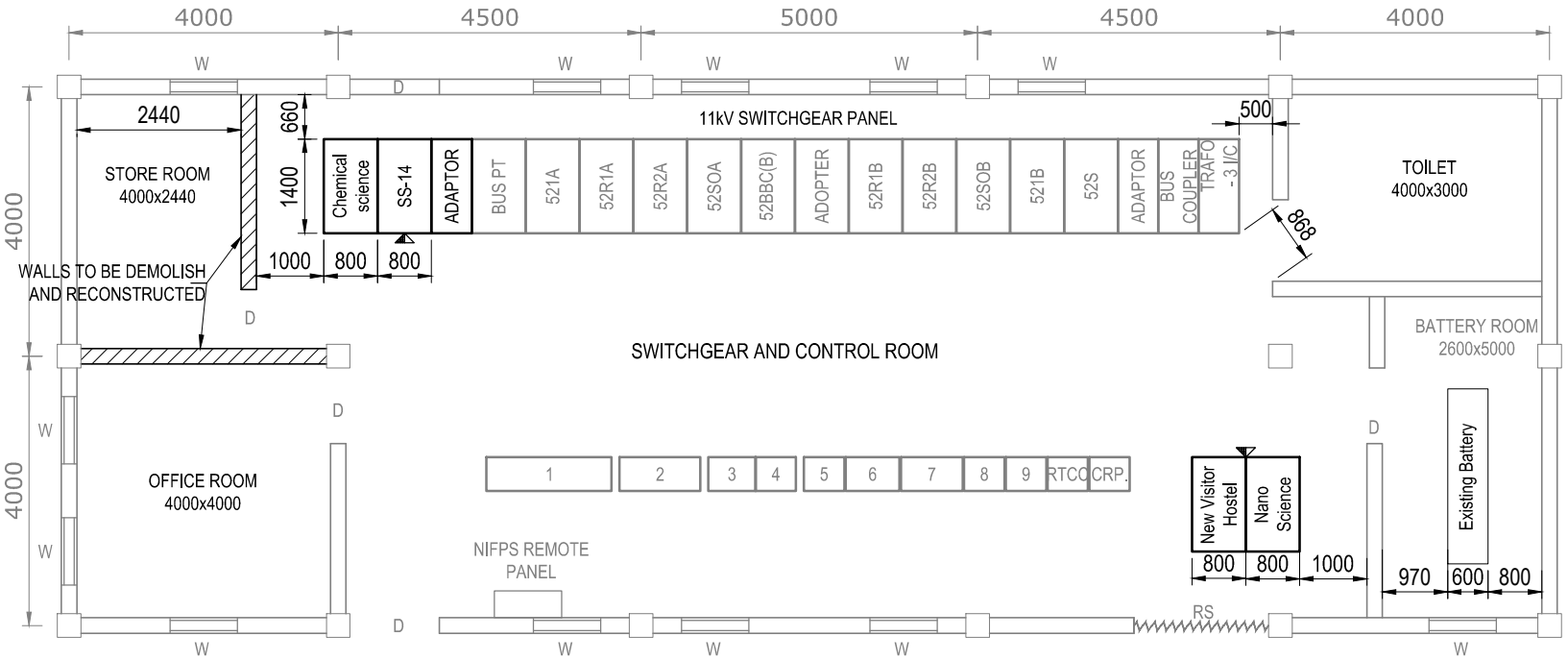
JOB NO.: 1414 | DATE: 10.11.14 | REV: P2

SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A4
PCPL-1414-4-GA-103P2





LEGEND:

PANEL

PANEL FRONT

CONTROL ROOM

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GL-104 - EARTHING LAYOUT MUSS CONTROL ROOM.
3. PCPL-1414-4-CT-105 - CABLE TRENCH & BUSWAY LAYOUT MUSS CONTROL ROOM.

NOTE:

1. ALL DIMENTIONS ARE IN mm
2. PANEL DIMENSIONS ARE TENTATIVE ONLY. EXACT DIMENSION WILL BE FURNISHED AFTER APPROVAL OF VENDOR DRAWING.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P1	REVISED & ISSUED FOR TENDER	KNU	RJ	R.V	03.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : N.T.S
DATE : 05.11.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: GENERAL ARRANGMENT MUSS CONTROL ROOM

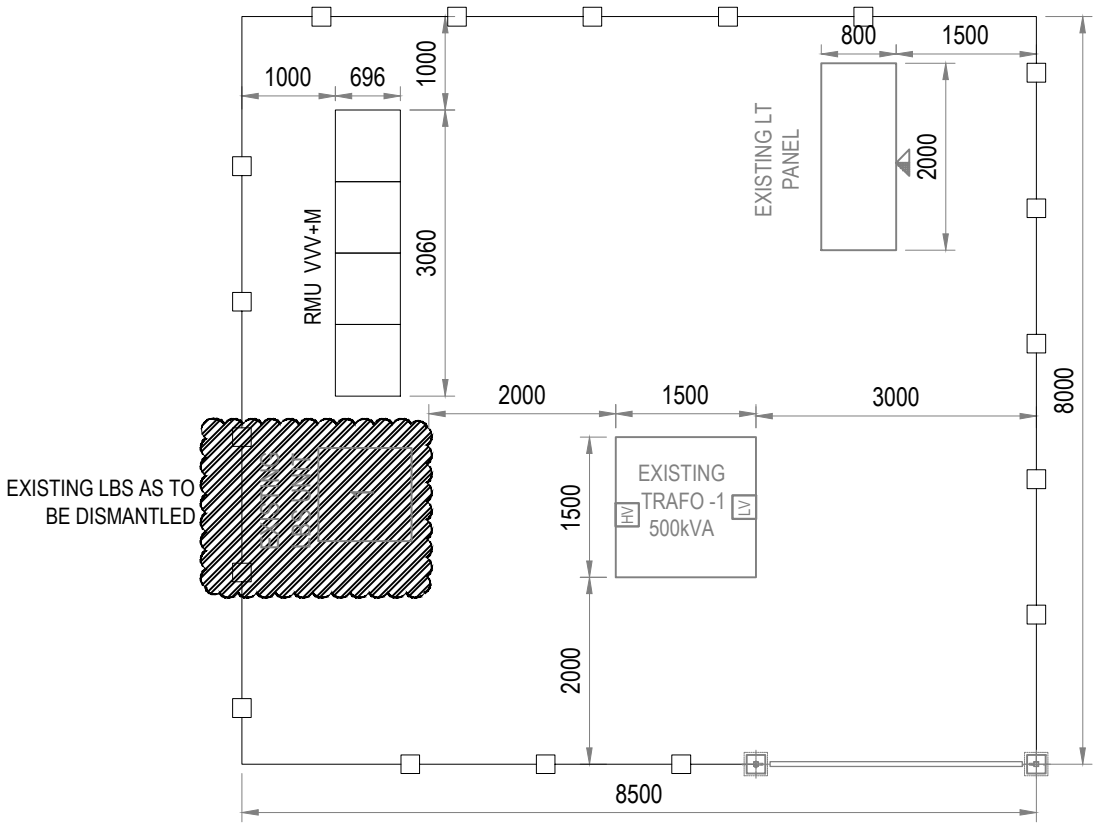
DRG NO : PCPL-1414-4-GA-104

JOB NO.: 1414 | DATE: 10.11.14 | REV: P1

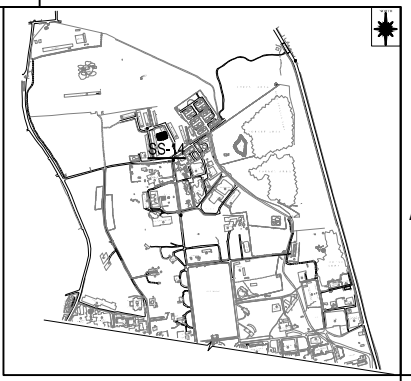
SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size - A4
PCPL-1414-4-GA-104P1



SS-14



REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GL-105 - EARTHING LAYOUT SS -14.
3. PCPL-1414-4-CT-106 -CABLE TRENCH LAYOUT SS -14.

NOTE:

1. ALL DIMENSIONS ARE IN mm
2. RMU LOCATION AND DIMENSIONS ARE TENTATIVE ONLY, IT MAY VARIES ACCORDING TO SITE CLEARANCE. EXACT RMU DIMENSION WILL BE FURNISHED AFTER APPROVAL OF VENDOR DRAWING.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR TENDER	KNU	RJ	R.V	25.10.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : 1:75
DATE : 28.07.15
DRAWN : NN
CHKD : RJ
APPD : R.V

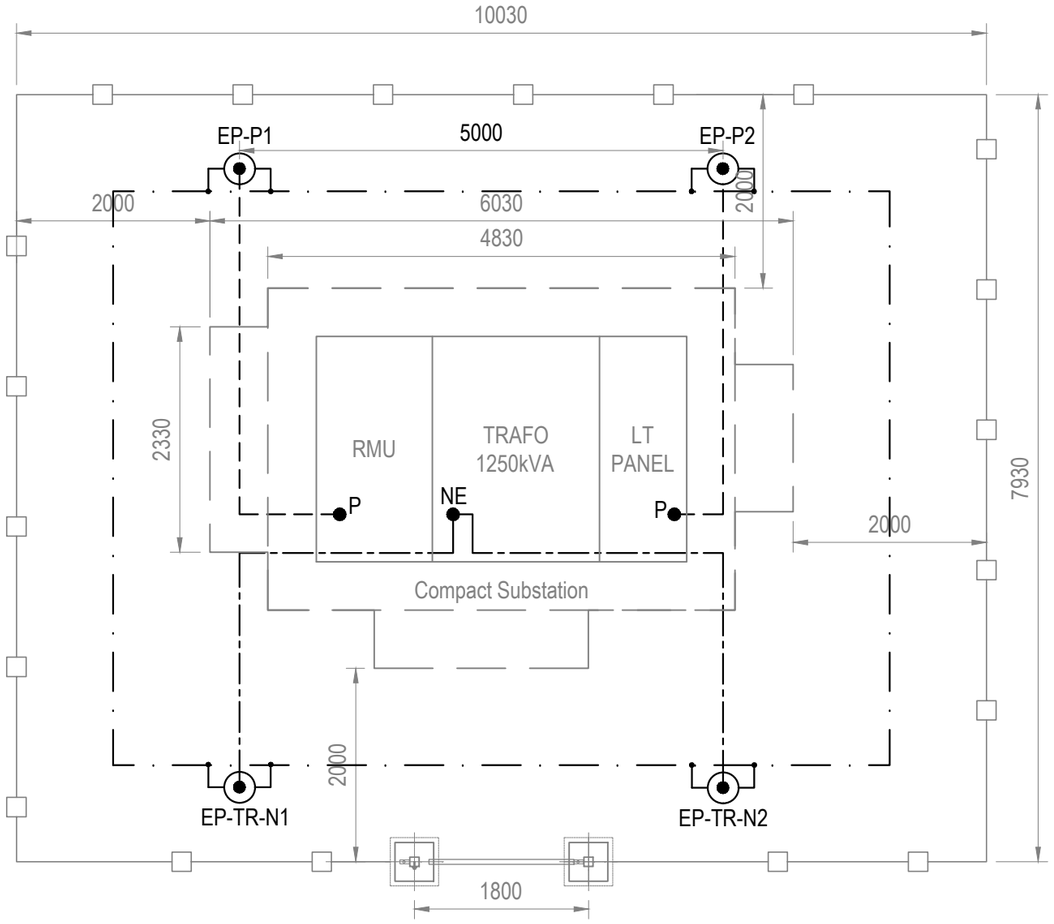
TITLE: GENERAL ARRANGEMENT SS -14

DRG NO : PCPL-1414-4-GA-105
JOB NO.: 1414 | DATE: 10.11.14 | REV: P0

SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

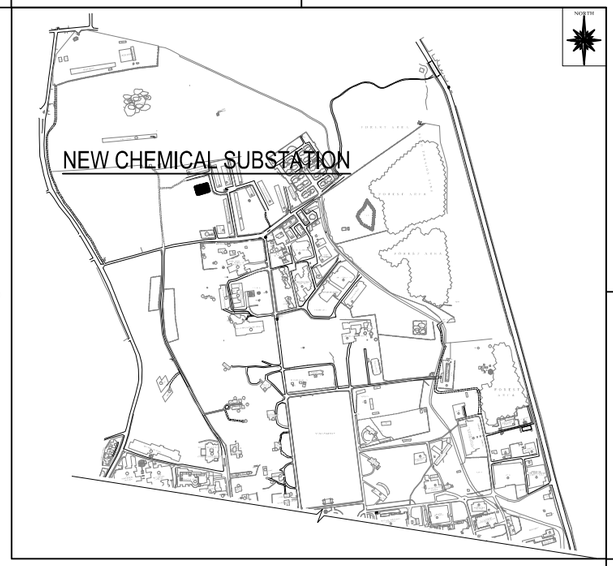
Size -A4
PCPL-1414-4-GA-105P0



NEW CHEMICAL SCIENCE

LEGEND

- MAIN EARTH GRID 50x10 mm GS STRIP
- AUXILIARY EARTH GRID 50x10 mm GS STRIP
- TRANSFORMER NEUTRAL EARTHING 50x8 mm Cu. STRIP
- TREATED EARTH PITS



BILL OF MATERIAL		
SL.NO	EQUIPMENT	QTY
1	TREATED EARTH PITS	4 NOS.
2	MAIN EARTH GRID 50x10 mm GS STRIP	29 m
3	AUXILIARY EARTH GRID 50x10 mm GS STRIP	20 m
4	TRANSFORMER NEUTRAL EARTHING 50x8 mm Cu. STRIP	20 m

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. THE MAIN EARTHGRID CONDUCTOR SHALL BE BURIED AT MIN. 600mm FROM FGL.
3. LOCATION OF INTERCONNECTION TO THE PLANT EARTH GRID IS INDICATIVE ONLY HOWEVER IT CAN BE MODIFIED BASED ON LOCATION OF THE PANEL WITH MINIMUM TWO INTERCONNECTIONS.
4. REROUTING FOR MAIN EARTH GRID SHALL BE CARRIED OUT IN CASE OF ANY OBSTRUCTIONS.
5. WHEREVER THE EARTHING GRID CROSSES TRENCHES, PIPES, CONDUITS ETC., THE SAME SHALL BE LAID AT MINIMUM 300mm BELOW TRENCH.
6. ALL BURIED GROUND GRID CONDUCTOR SHALL BE 1m. AWAY FROM THE BUILDING WALLS/ FOUNDATIONS.
7. ALL METAL PIPE LINES SHALL BE PROVIDED WITH EQUIPOTENTIAL BONDING AT ALL FLANGED COUPLINGS AND THE PIPE LINE TO BE EARTHED AT TWO POINTS.
8. MINIMUM DISTANCE OF 5M TO BE MAINTAINED BETWEEN TWO EARTH PITS.
9. ALTERNATE FENCE POST SHALL BE CONNECTED TO MAIN EARTH CONDUCTOR.

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-CT-102 - CABLE TRENCH LAYOUT NEW CHEMICAL SUBSTATION .
3. PCPL-1414-4-GA-101 - GENERAL ARRANGEMENT NEW CHEMICAL SUBSTATION.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	28.08.15
P1	REVISED & ISSUED FOR COMMENTS	NN	RJ	R.V	26.09.15
P2	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P3	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	03.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : 1:1
DATE : 26.08.15
DRAWN : NN
CHKD : RJ
APPD : R.V

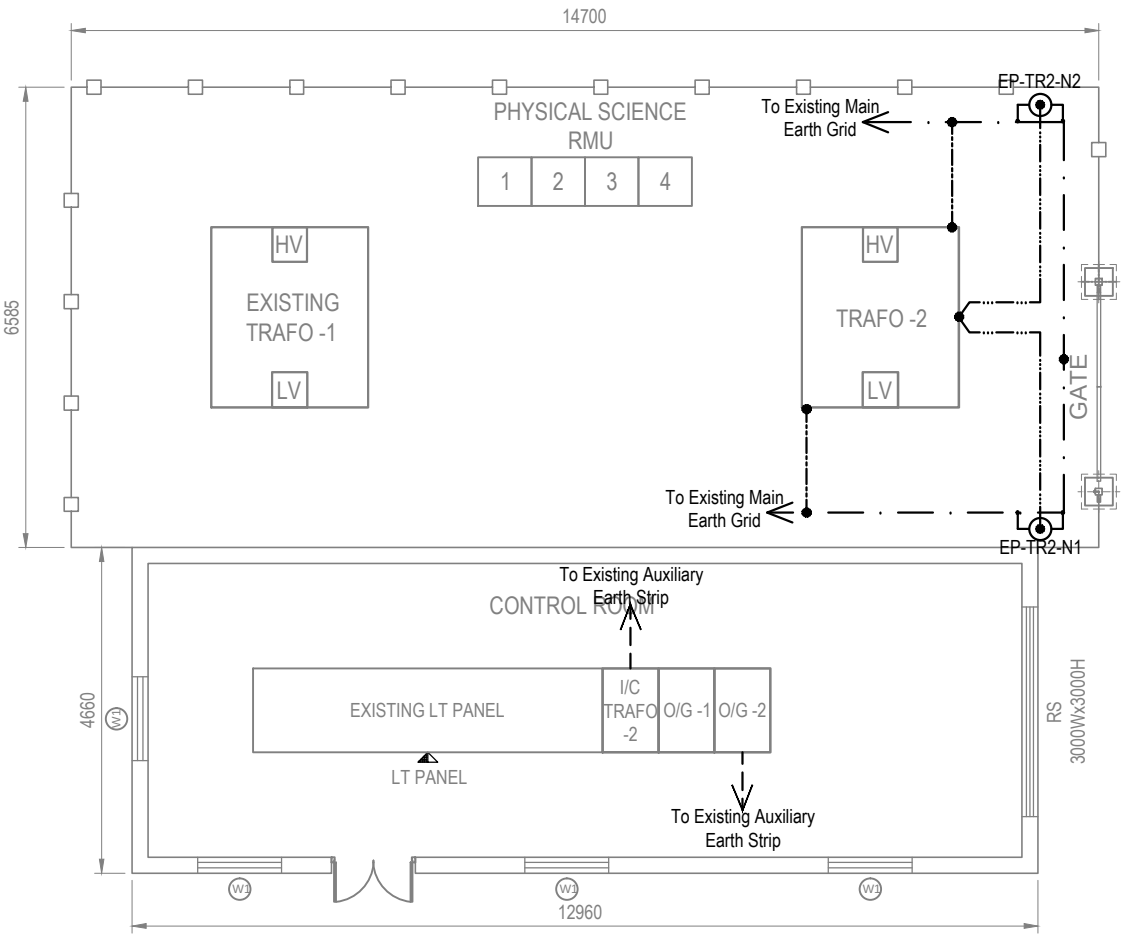
TITLE: EARTHING LAYOUT NEW CHEMICAL SUBSTATION

DRAWING NO : PCPL-1414-4-GL-101
JOB NO.: 1414 DATE: 10.11.14 REV: P3

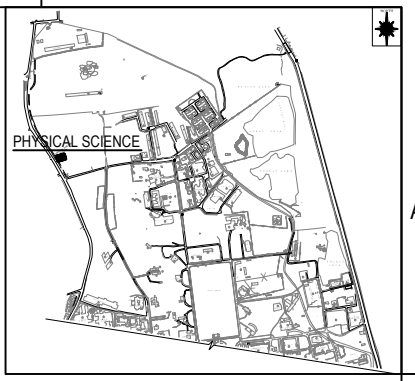
SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A3
PCPL-1414-4-GL-101P3



PHYSICAL SCIENCE SUBSTATION



LEGEND

- MAIN EARTH GRID 50x10 mm GS STRIP
- AUXILIARY EARTH GRID 50x10 mm GS STRIP
- TRANSFORMER BODY EARTHING 50x10 mm GS STRIP
- TRANSFORMER NEUTRAL EARTHING 50x8 mm Cu. STRIP
- TREATED EARTH PITS

BILL OF MATERIAL

SL.NO	EQUIPMENT	QTY
1	TREATED EARTH PITS	2 NOS.
2	MAIN EARTH GRID 50x10 mm GS STRIP	-
3	AUXILIARY EARTH GRID 50x10 mm GS STRIP	5 m
4	TRANSFORMER BODY EARTHING 50x10 mm GS STRIP	10 m
5	TRANSFORMER NEUTRAL EARTHING 50x8 mm Cu. STRIP	15 m

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT
2. PCPL-1414-4-CT-103 - CABLE TRENCH LAYOUT PHYSICAL SCIENCE SUBSTATION
3. PCPL-1414-4-GA-102 - GENERAL ARRANGEMENT PHYSICAL SCIENCE SUBSTATION

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. LOCATION OF INTERCONNECTION TO THE PLANT EARTH GRID IS INDICATIVE ONLY HOWEVER IT CAN BE MODIFIED BASED ON LOCATION OF THE PANEL WITH MINIMUM TWO INTERCONNECTIONS.
3. REROUTING FOR EARTH GRID SHALL BE CARRIED OUT IN CASE OF ANY OBSTRUCTIONS.
4. WHEREVER THE EARTHING GRID CROSSES TRENCHES, PIPES, CONDUITS ETC., THE SAME SHALL BE LAID AT MINIMUM 300mm BELOW TRENCH.
5. MINIMUM DISTANCE OF 5M TO BE MAINTAINED BETWEEN TWO EARTH PITS.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMENTS	NN	RJ	R.V	29.07.15
P1	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P2	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	03.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : N.T.S
DATE : 28.07.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: EARTHING LAYOUT PHYSICAL SCIENCE SUBSTATION

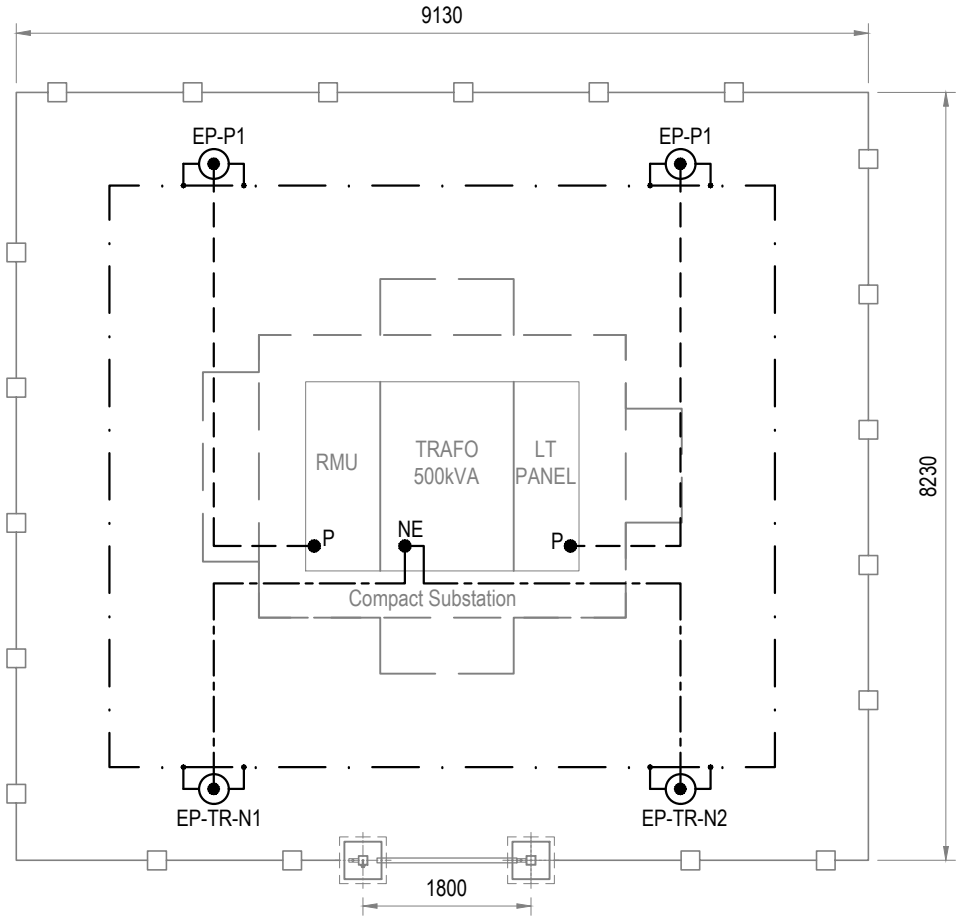
DRG NO : PCPL-1414-4-GL-102

JOB NO.: 1414 | DATE: 10.11.14 | REV: P2

SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

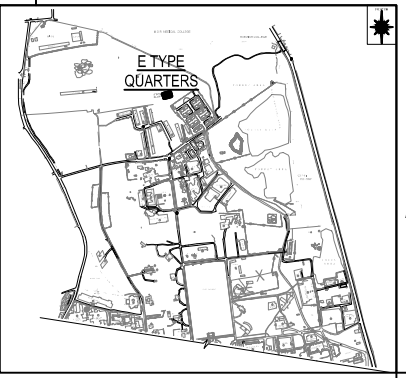
Size -A4
PCPL-1414-4-GL-102P2



E TYPE QUARTERS

LEGEND

- MAIN EARTH GRID 50x10 mm GS STRIP
- AUXILIARY EARTH GRID 50x10 mm GS STRIP
- TRANSFORMER NEUTRAL EARTHING 50x8 mm Cu. STRIP
- TREATED EARTH PITS



BILL OF MATERIAL

SL.NO	EQUIPMENT	QTY
1	TREATED EARTH PITS	4 NOS.
2	MAIN EARTH GRID 50x10 mm GS STRIP	28 m
3	AUXILIARY EARTH GRID 50x10 mm GS STRIP	22 m
4	TRANSFORMER NEUTRAL EARTHING 50x8 mm Cu. STRIP	22 m

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. THE MAIN EARTHGRID CONDUCTOR SHALL BE BURIED AT MIN. 600mm FROM FGL.
3. LOCATION OF INTERCONNECTION TO THE PLANT EARTH GRID IS INDICATIVE ONLY HOWEVER IT CAN BE MODIFIED BASED ON LOCATION OF THE PANEL WITH MINIMUM TWO INTERCONNECTIONS.
4. REROUTING FOR MAIN EARTH GRID SHALL BE CARRIED OUT IN CASE OF ANY OBSTRUCTIONS.
5. WHEREVER THE EARTHING GRID CROSSES TRENCHES, PIPES, CONDUITS ETC., THE SAME SHALL BE LAID AT MINIMUM 300mm BELOW TRENCH.
6. ALL BURIED GROUND GRID CONDUCTOR SHALL BE 1m. AWAY FROM THE BUILDING WALLS/ FOUNDATIONS.
7. ALL METAL PIPE LINES SHALL BE PROVIDED WITH EQUIPOTENTIAL BONDING AT ALL FLANGED COUPLINGS AND THE PIPE LINE TO BE EARTHED AT TWO POINTS.
8. MINIMUM DISTANCE OF 5M TO BE MAINTAINED BETWEEN TWO EARTH PITS.
9. ALTERNATE FENCE POST SHALL BE CONNECTED TO MAIN EARTH CONDUCTOR.

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 -COMPOSITE CABLING LAYOUT
2. PCPL-1414-4-GA-103 - GENERAL ARRANGEMENT E TYPE QUARTERS.
3. PCPL-1414-4-CT-104 - CABLE TRENCH LAYOUT E TYPE QUARTERS.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMMENTS	NN	RJ	R.V	09.10.15
P1	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	20.01.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : 1:75
DATE : 05.10.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: EARTHING LAYOUT E TYPE QUARTERS

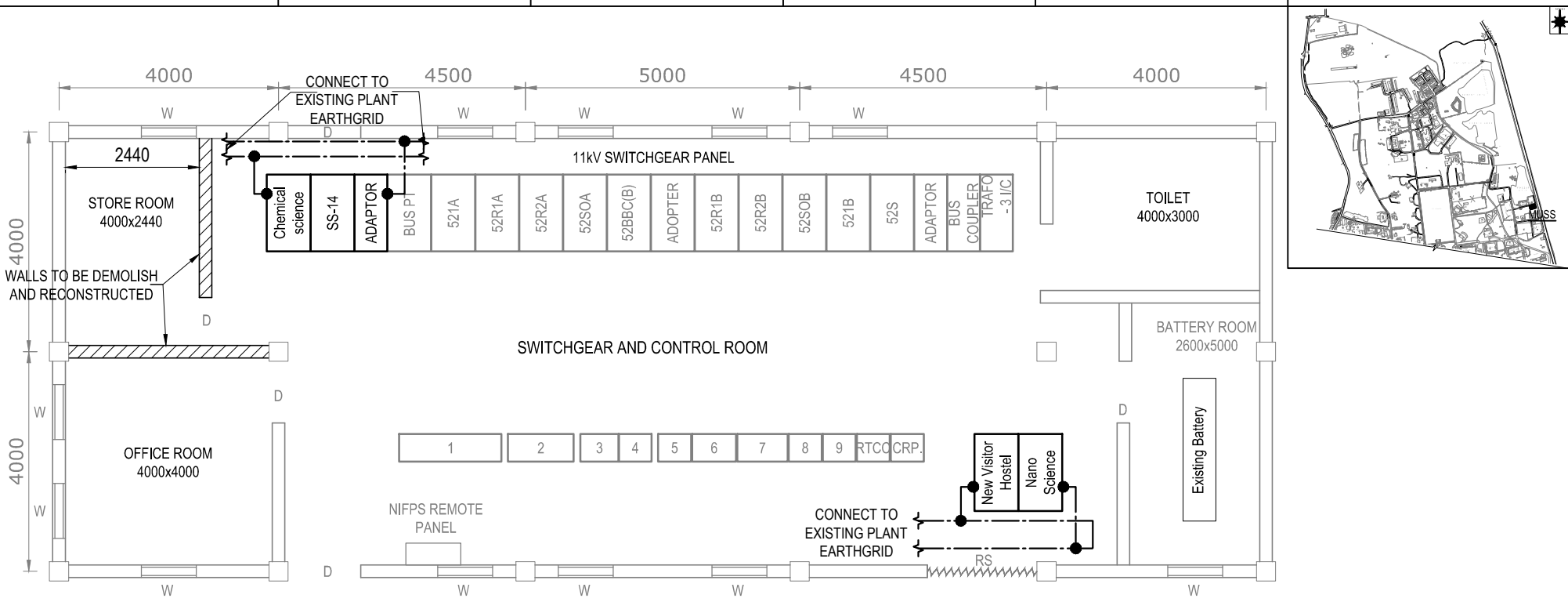
DRG NO: PCPL-1414-4-GL-103

JOB NO.: 1414 | DATE: 10.11.14 | REV: P1

SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A4
PCPL-1414-4-GL-103P1



CONTROL ROOM

LEGEND

50x10mm GS STRIP PANEL EARTH CONDUCTOR

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GA-104 - GENERAL ARRANGEMENT MUSS CONTROL ROOM.
3. PCPL-1414-4-CT-105 - CABLE TRENCH & BUSWAY LAYOUT MUSS CONTROL ROOM.

BILL OF MATERIAL

SL.NO	EQUIPMENT	QTY
1	AUXILIARY EARTH GRID 50x10 mm GS STRIP	35m

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. LOCATION OF INTERCONNECTION TO THE PLANT EARTH GRID IS INDICATIVE ONLY HOWEVER IT CAN BE MODIFIED BASED ON LOCATION OF THE PANEL WITH MINIMUM TWO INTERCONNECTIONS.
3. REROUTING FOR EARTH GRID SHALL BE CARRIED OUT IN CASE OF ANY OBSTRUCTIONS.
4. WHEREVER THE EARTHING GRID CROSSES TRENCHES, PIPES, CONDUITS ETC., THE SAME SHALL BE LAID AT MINIMUM 300mm BELOW TRENCH.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P1	REVISED & ISSUED FOR TENDER	KNU	RJ	R.V	03.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : N.T.S
DATE : 05.11.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: EARTHING LAYOUT MUSS CONTROL ROOM

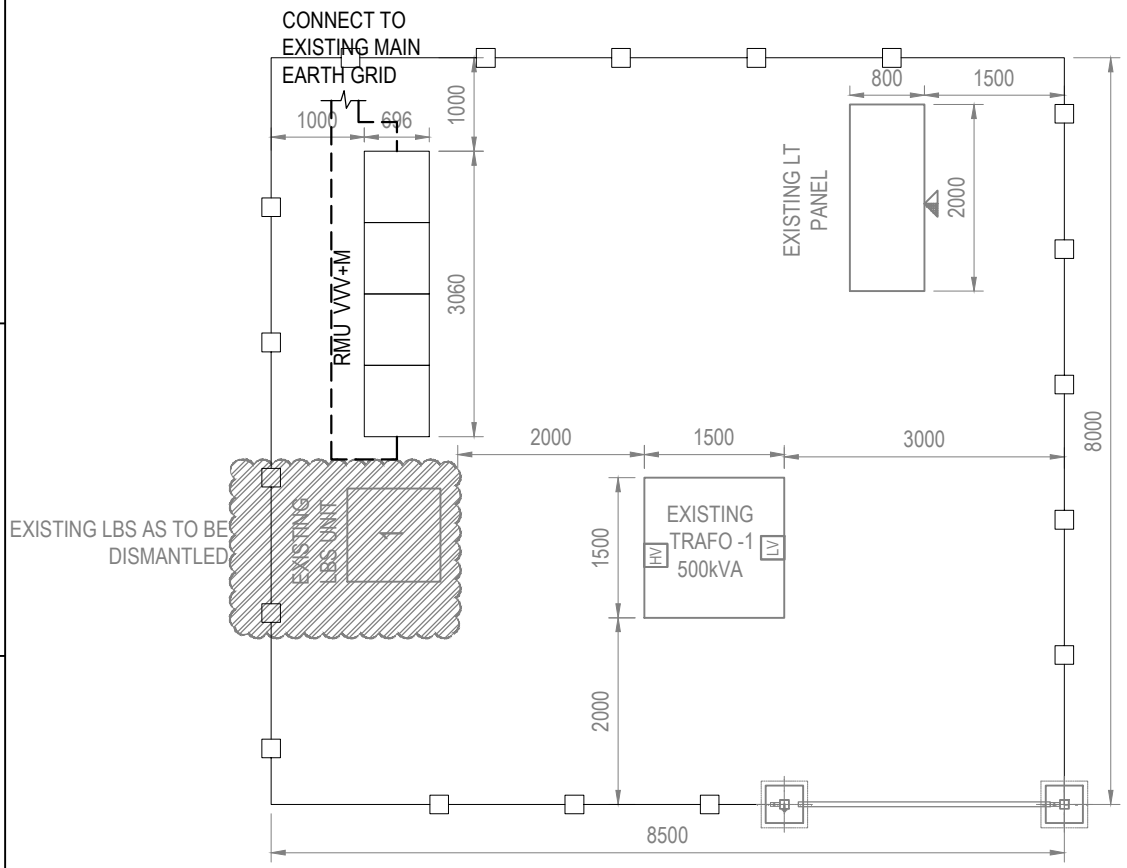
DRG NO : PCPL-1414-4-GL-104

JOB NO.: 1414 | DATE: 10.11.14 | REV: P1

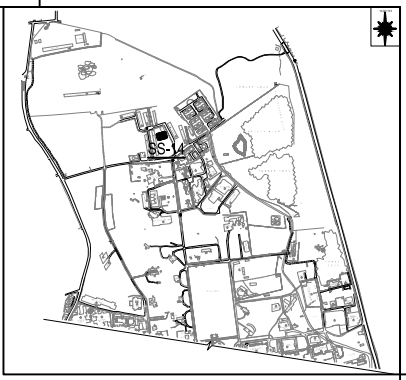
SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A4
PCPL-1414-4-GL-104P1



SS-14



LEGEND

AUXILIARY EARTH GRID 50x10 mm GS STRIP

BILL OF MATERIAL		
SL.NO	EQUIPMENT	QTY
1	AUXILIARY EARTH GRID 50x10 mm GS STRIP	15 m

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. LOCATION OF INTERCONNECTION TO THE PLANT EARTH GRID IS INDICATIVE ONLY HOWEVER IT CAN BE MODIFIED BASED ON LOCATION OF THE PANEL WITH MINIMUM TWO INTERCONNECTIONS.
3. REROUTING FOR EARTH GRID SHALL BE CARRIED OUT IN CASE OF ANY OBSTRUCTIONS.
4. WHEREVER THE EARTHING GRID CROSSES TRENCHES, PIPES, CONDUITS ETC., THE SAME SHALL BE LAID AT MINIMUM 300mm BELOW TRENCH.

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GA-105 - GENERAL ARRANGEMENT SS -14.
3. PCPL-1414-4-CT-106 -CABLE TRENCH LAYOUT SS -14.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR TENDER	KNU	RJ	R.V	25.10.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : 1:75
DATE : 28.07.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: EARTHING LAYOUT SS-14

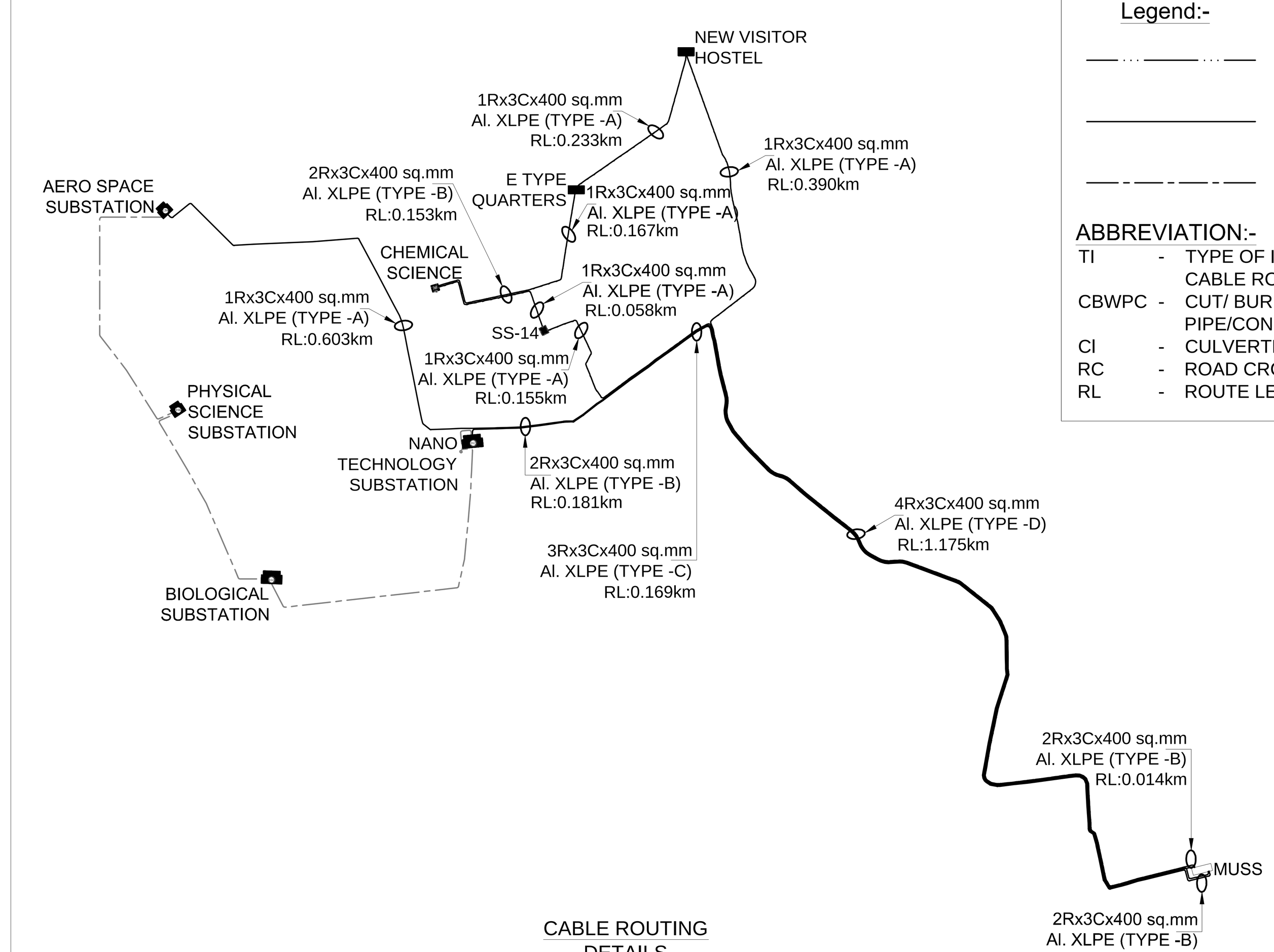
DRG NO : PCPL-1414-4-GL-105

JOB NO. : 1414 | DATE: 10.11.14 | REV: P0

SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A4
PCPL-1414-4-GL-105P0



CABLE ROUTING DETAILS

Legend:-

— · · · —	RING -4
———	RING -5
— - — - —	RING -5 EXISTING CABLE

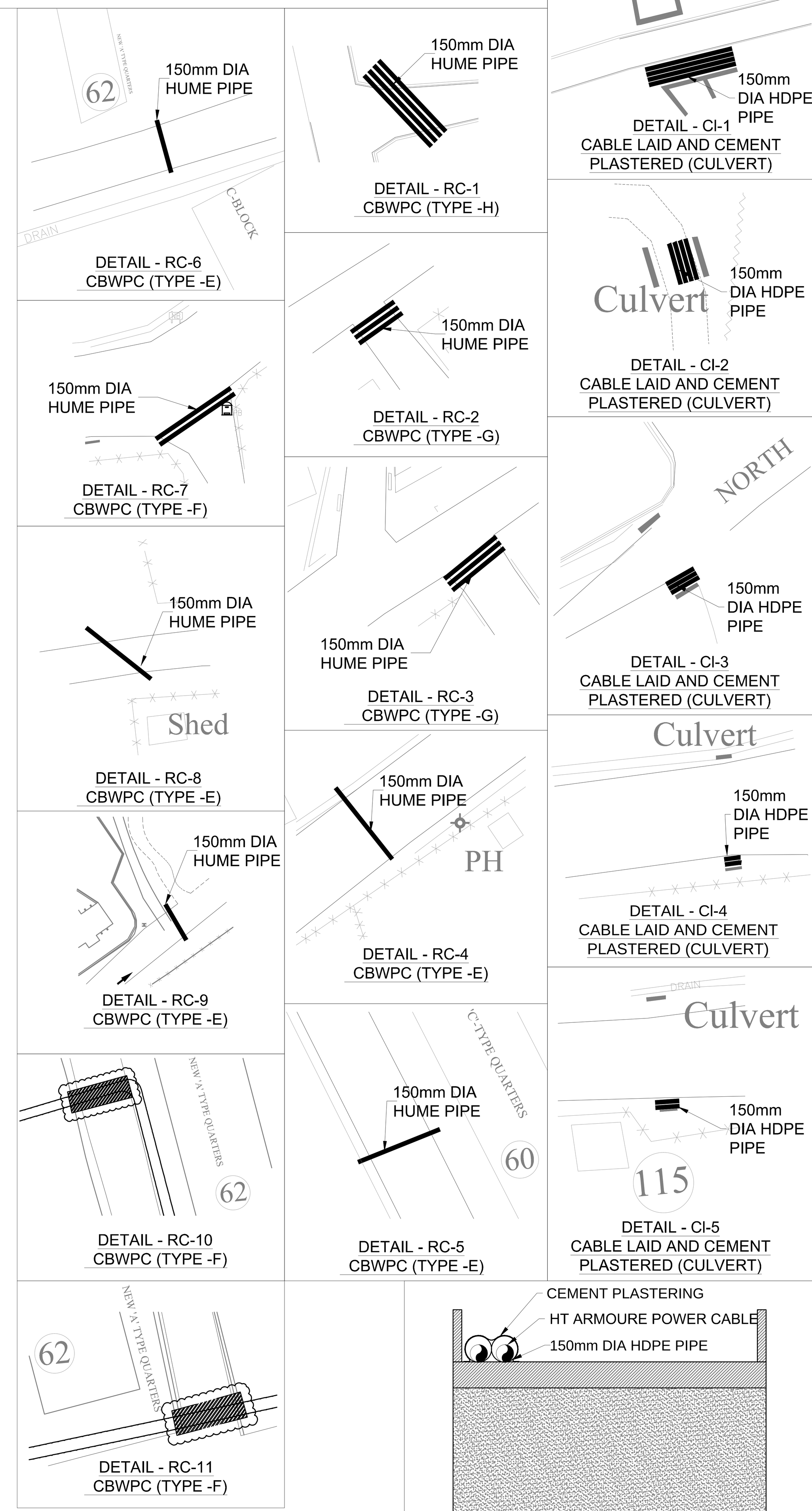
ABBREVIATION:-

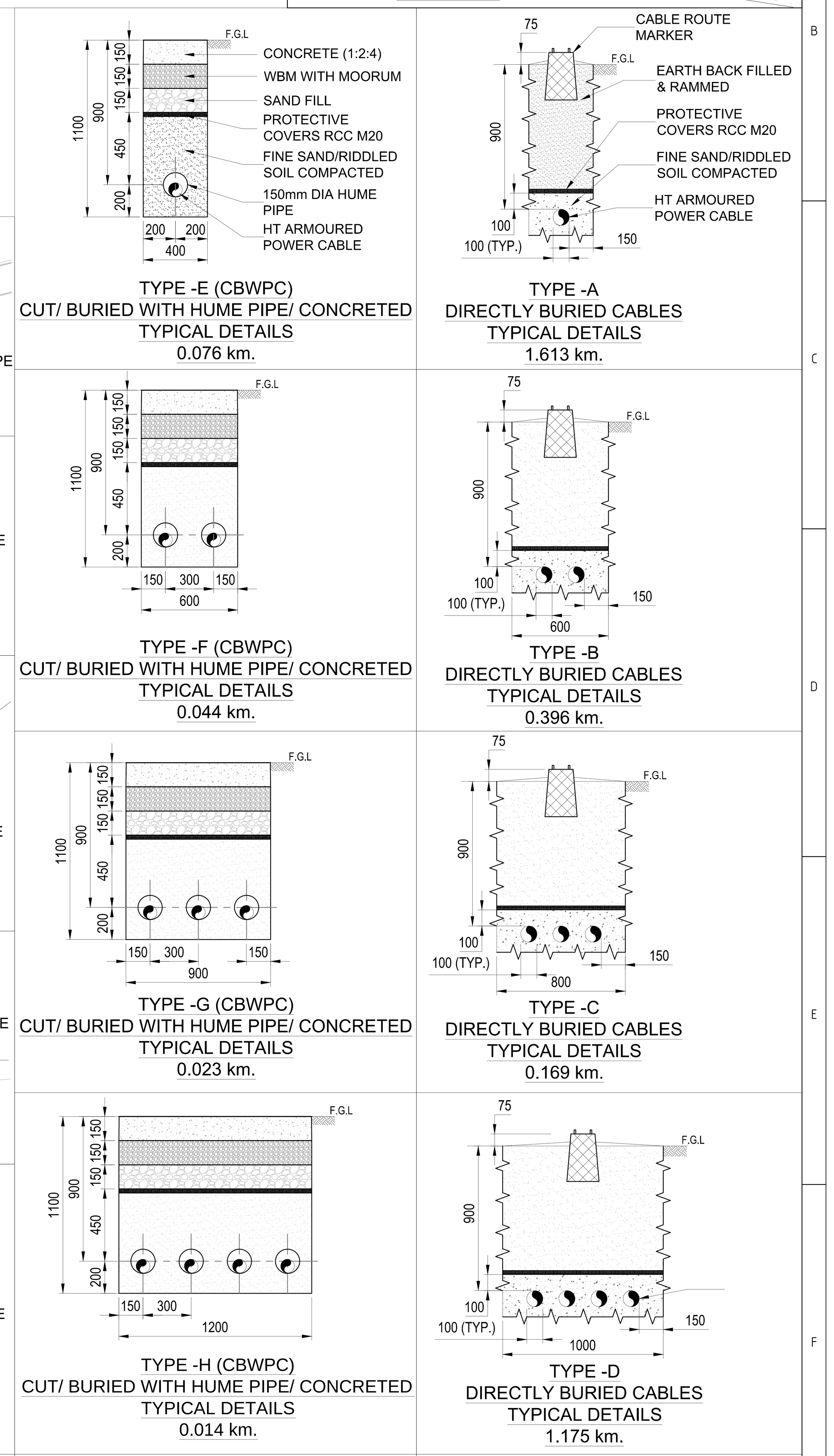
TI	- TYPE OF INTERRUPTIONS NEAR CABLE ROUTING
CBWPC	- CUT/ BURIED WITH HUME PIPE/CONCRETED
CI	- CULVERTER
RC	- ROAD CROSSING
RL	- ROUTE LENGTH

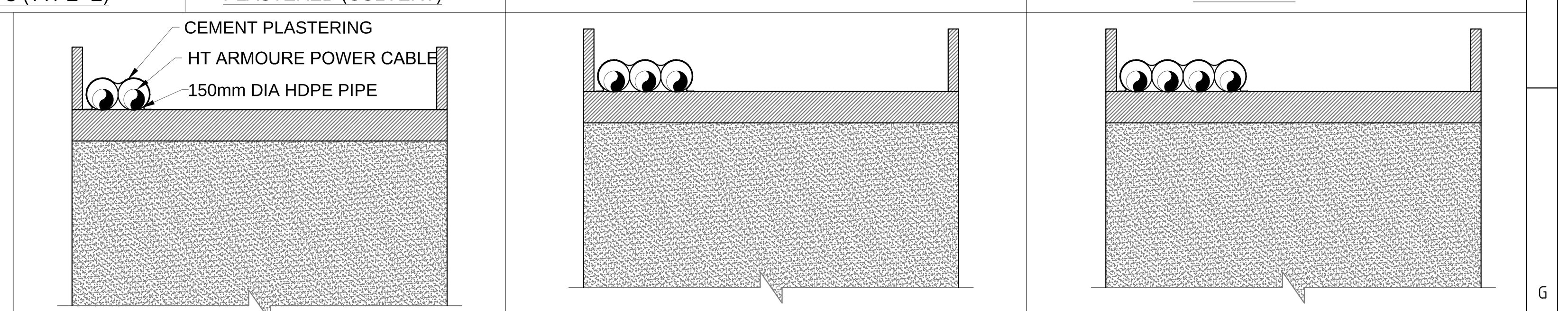
Type of Interruptions near Cable Trench Routing

TI-1	Lamp Post
TI-2	Sandalwood and Other Tress
TI-3	EPB(Electrical Panel Board)
TI-4	Man Hole
TI-5	NALA

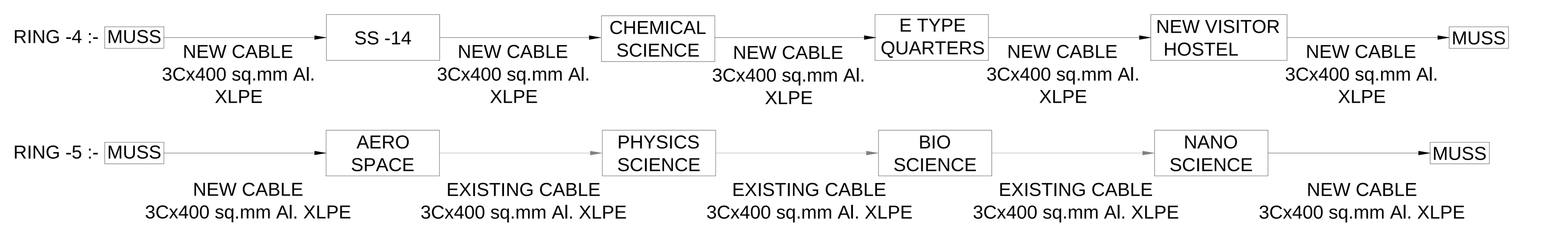

KEY PLAN







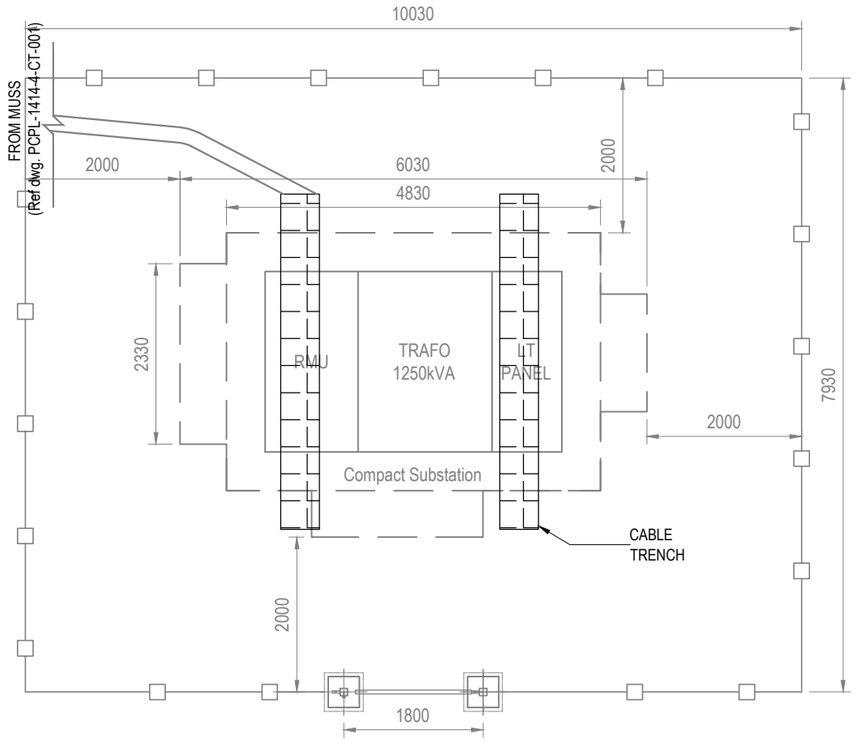
TYPICAL VIEW OF TWO CABLE LAID AND CEMENT PLASTERED (CULVERT) (CI-4, CI-5) 0.011 km.	TYPICAL VIEW OF THREE CABLE LAID AND CEMENT PLASTERED (CULVERT) (CI-3) 0.007 km.	TYPICAL VIEW OF FOUR CABLE LAID AND CEMENT PLASTERED (CULVERT) (CI-1, CI-2) 0.024 km.



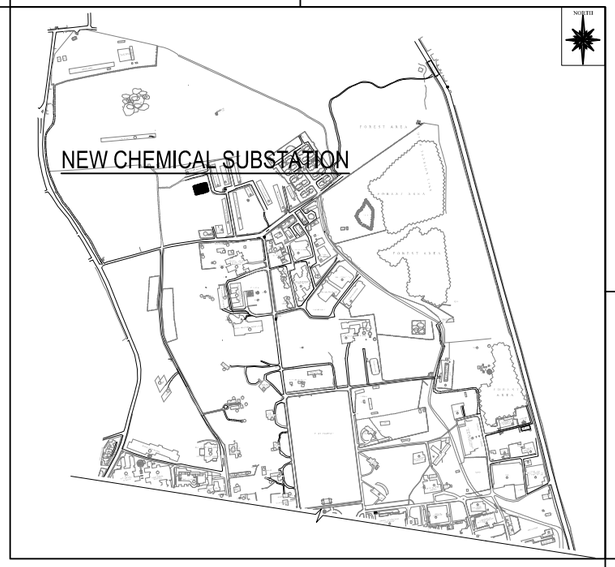
Sl.No	DESCRIPTION	TOTAL CABLE LENGTH
1	RING 4	3.890 km
2	RING 5	3.723 km
	TOTAL	7.613 km

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMMENTS	NN	RJ	R.V	20.08.15
P1	REVISED & ISSUED FOR COMMENTS	NN	RJ	R.V	22.09.15
P2	REVISED & ISSUED FOR COMMENTS	KNU	RJ	R.V	26.10.15
P3	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P4	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	03.11.16

CLIENT :M/s INDIAN INSTITUTE OF SCIENCE
PROJECT :ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS
SCALE : N.T.S
DATE : 14.08.15
DRAWN : NN
CHKD : RJ
APPD : R.V
TITLE: COMPOSITE CABLING LAYOUT
DRAWING NO : PCPL-1414-4-CT-101
JOB NO.: 1414 DATE: 10.11.14 REV: P4
SHEET NO. 01 OF 01
CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE
Size -A0
PCPL-1414-4-CT-101P4



NEW CHEMICAL SCIENCE

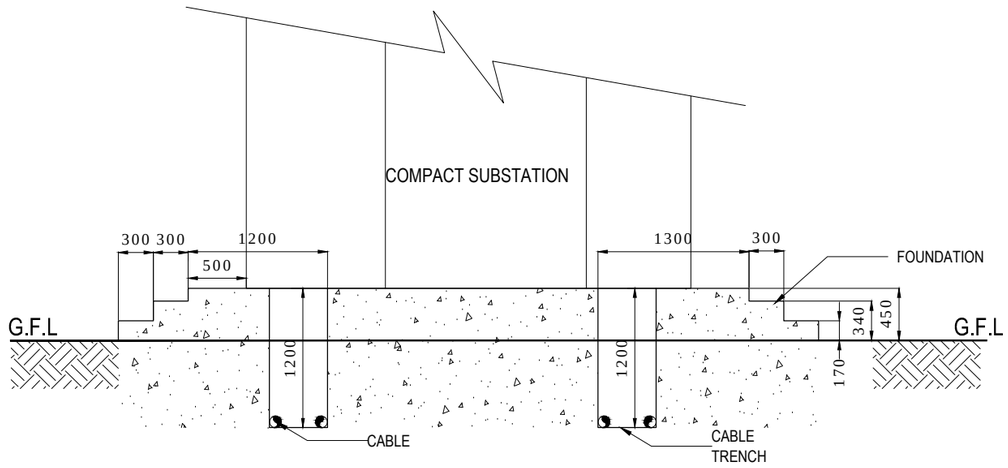


NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ROUTING OF CABLE TRENCH SHALL BE CHANGED AT SITE IF NECESSARY TO AVOID INTERFERENCE WITH PIPES/ DUCTS ETC., AFTER OBTAINING CLARENCE FROM SITE ENGINEER.
3. THE FOUNDATION SHOULD BE SUITABLE FOR STATIC LOAD OF 10TON.
4. HT & LT CABLE TRENCH DEPTH SHOULD BE MINIMUM 1.2M.

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT
2. PCPL-1414-4-GA-101 - GENERAL ARRANGEMENT NEW CHEMICAL SUBSTATION.
3. PCPL-1414-4-GL-101 - EARTHING LAYOUT NEW CHEMICAL SUBSTATION.

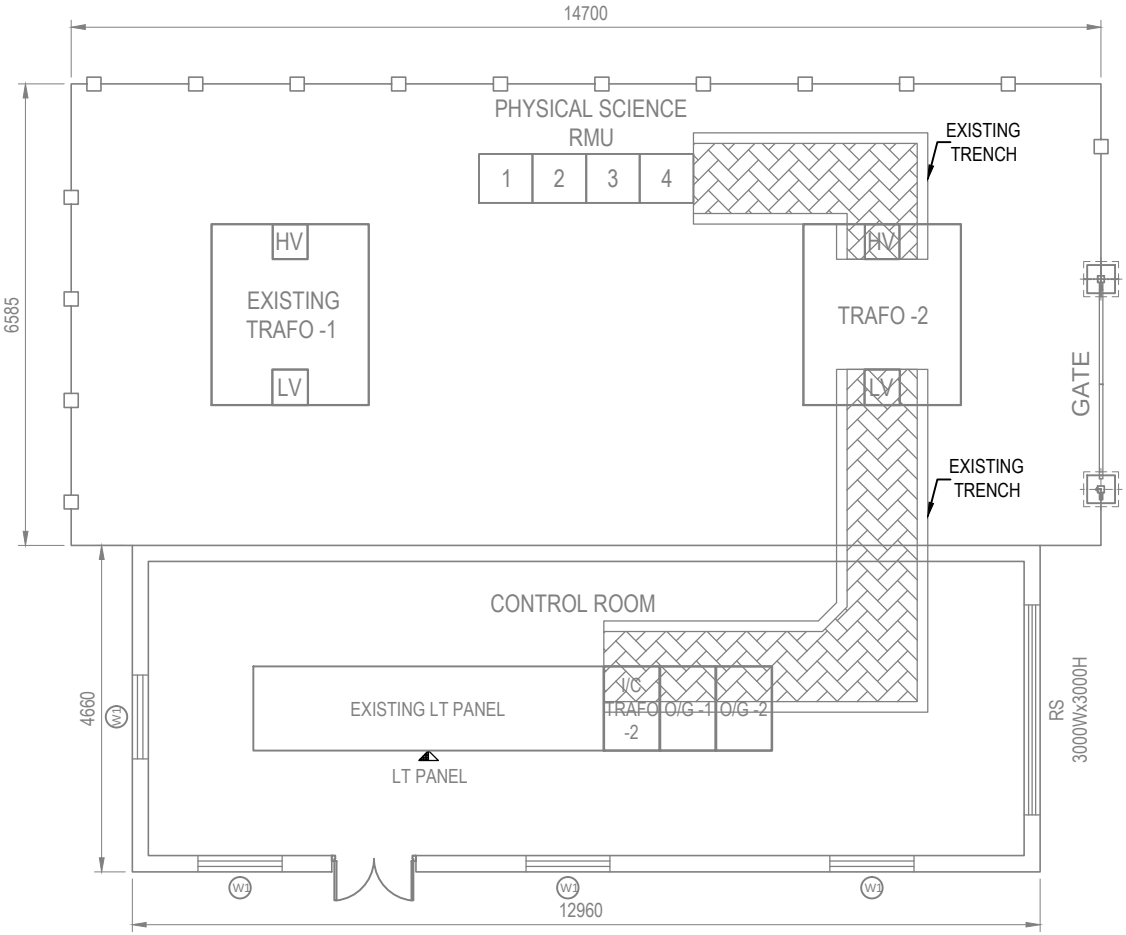


SECTIONAL VIEW
CSS FOUNDATION AND TRENCH

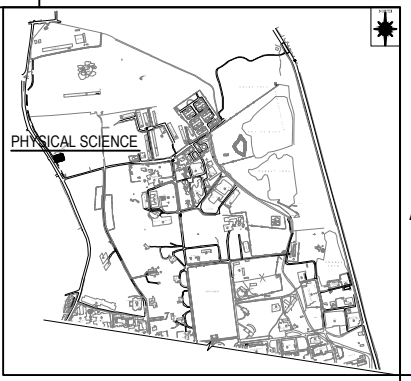
ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMMENTS	NN	RJ	R.V	28.08.15
P1	REVISED & ISSUED FOR COMMENTS	NN	RJ	R.V	26.09.15
P2	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P3	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	03.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE
PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS
SCALE : 1:1
DATE : 26.08.15
DRAWN : NN
CHKD : RJ
APPD : R.V
TITLE: CABLE TRENCH LAYOUT NEW CHEMICAL SUBSTATION
DRAWING NO : PCPL-1414-4-CT-102
JOB NO.: 1414 DATE: 10.11.14 REV: P3
SHEET NO. 01 OF 01
CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A3
PCPL-1414-4-CT-102P3



PHYSICAL SCIENCE SUBSTATION



NOTE:

1. ALL DIMENSIONS ARE IN mm
2. EXISTING TRENCH SHALL BE USED FOR CABLING ROUTING.

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GA-102 - GENERAL ARRANGEMENT PHYSICAL SCIENCE SUBSTATION
3. PCPL-1414-4-GL-102 - EARTHING LAYOUT PHYSICAL SCIENCE SUBSTATION

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMENTS	NN	RJ	R.V	29.07.15
P1	REVISED & ISSUED FOR COMMENTS	NN	RJ	R.V	26.09.15
P2	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P3	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	03.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : N.T.S
DATE : 28.07.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: CABLE TRENCH LAYOUT PHYSICAL SCIENCE SUBSTATION

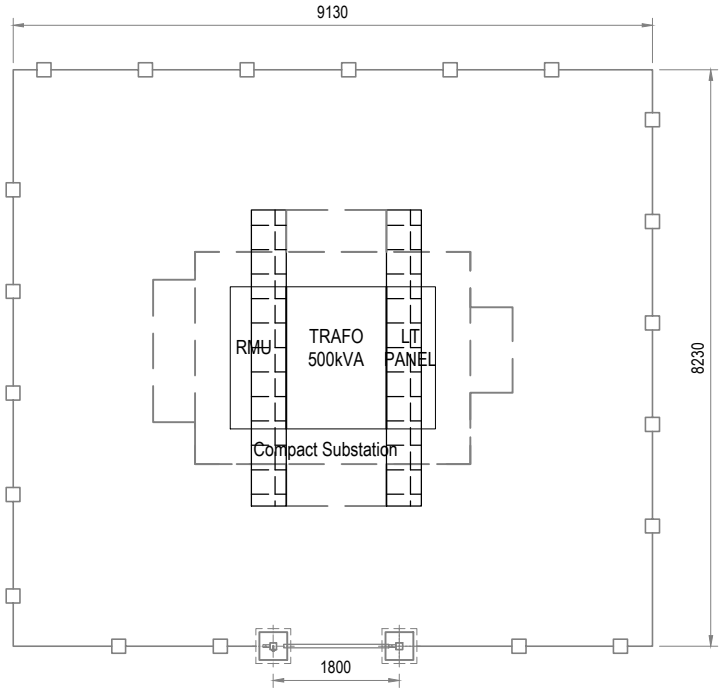
DRG NO : PCPL-1414-4-CT-103

JOB NO.: 1414 | DATE: 10.11.14 | REV: P3

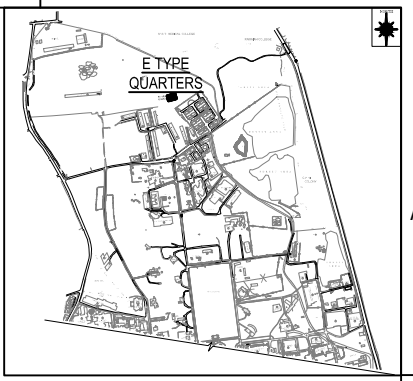
SHEET NO. 01 OF 01

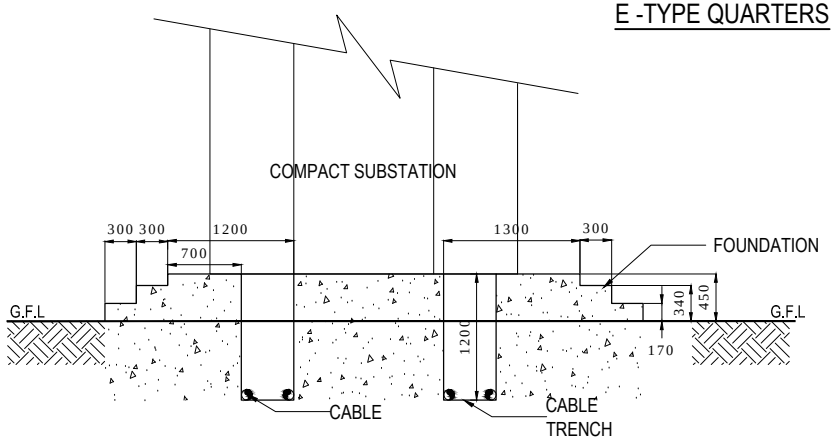
CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A4
PCPL-1414-4-CT-103P3



E -TYPE QUARTERS





SECTIONAL VIEW
FOUNDATION AND TRENCH
9 meter

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GA-103 - GENERAL ARRANGEMENT E TYPE QUARTERS.
3. PCPL-1414-4-GL-103 - EARTHING LAYOUT E TYPE QUARTERS.

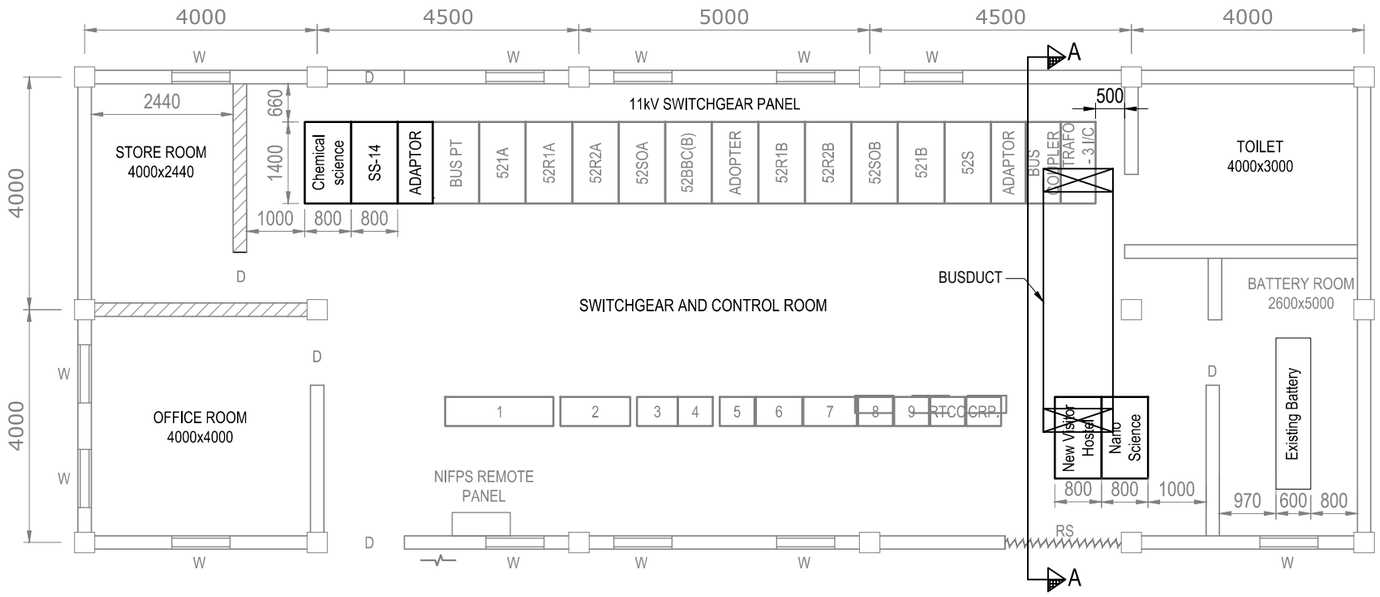
NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ROUTING OF CABLE TRENCH SHALL BE CHANGED AT SITE IF NECESSARY TO AVOID INTERFERENCE WITH PIPES/ DUCTS ETC., AFTER OBTAINING CLARENCE FROM SITE ENGINEER.
3. THE FOUNDATION SHOULD BE SUITABLE FOR STATIC LOAD OF 6.5TON.
4. HT/LT CABLE DEPTH SHOULD BE MIN. 1.2M.

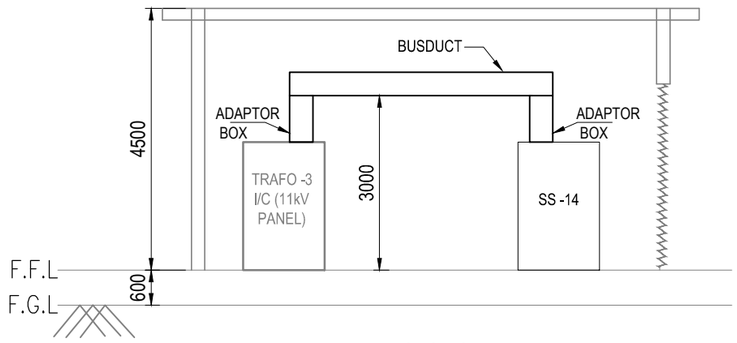
ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR COMMENTS	NN	RJ	R.V	09.10.15
P1	REVISED & ISSUED FOR TENDER	NN	RJ	R.V	20.01.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE
PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS
SCALE : 1:75
DATE : 05.10.15
DRAWN : NN
CHKD : RJ
APPD : R.V
TITLE: CABLE TRENCH LAYOUT E TYPE QUARTERS
DRG NO : PCPL-1414-4-CT-104
JOB NO.: 1414 | DATE: 10.11.14 | REV: P1
SHEET NO. 01 OF 01
CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A4
PCPL-1414-4-CT-104P1



CONTROL ROOM



SECTION AA

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GA-104 -GENERAL ARRANGEMENT MUSS CONTROL ROOM.
3. PCPL-1414-4-GL-104 - EARTHING LAYOUT MUSS CONTROL ROOM.

NOTES:

1. ALL DIMENSIONS ARE IN MM.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P1	REVISED & ISSUED FOR TENDER	KNU	RJ	R.V	03.10.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : N.T.S
DATE : 05.11.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: CABLE TRENCH & BUSWAY LAYOUT MUSS CONTROL ROOM

DRAWING NO : PCPL-1414-4-CT-105

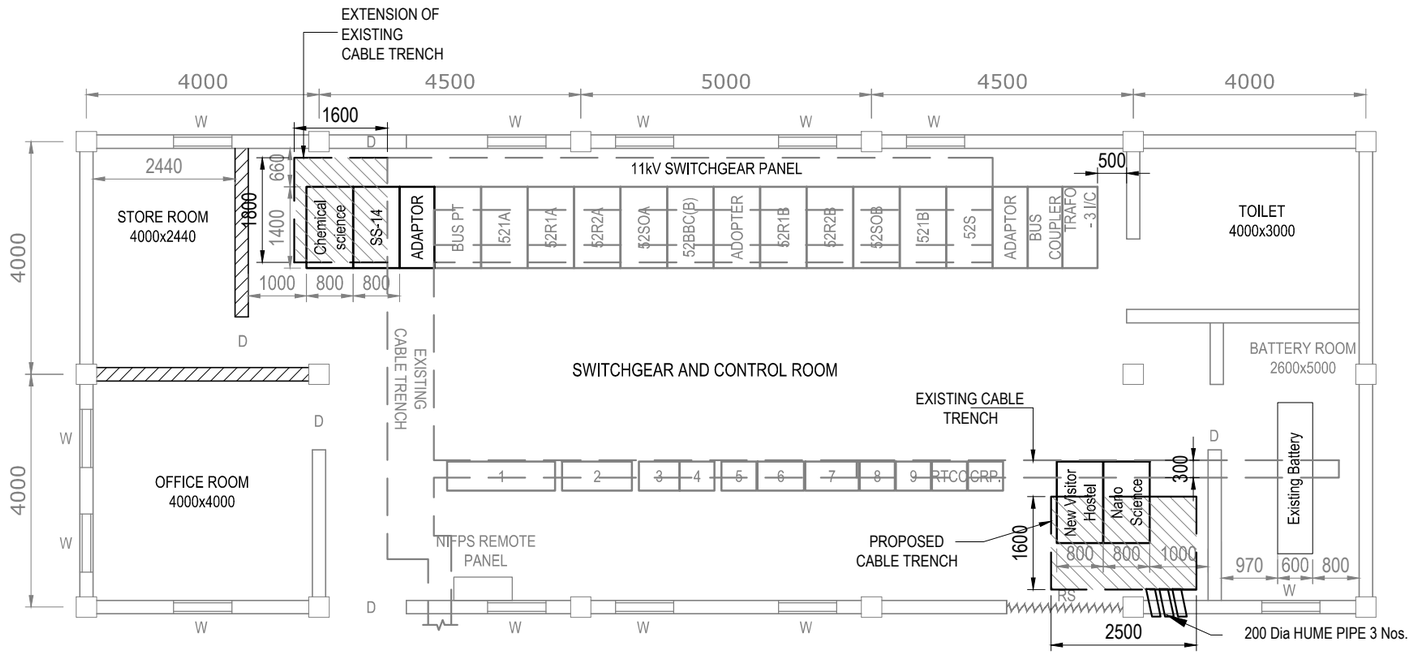
JOB NO.: 1414 | DATE: 10.11.14 | REV: P1

SHEET NO. 01 OF 02

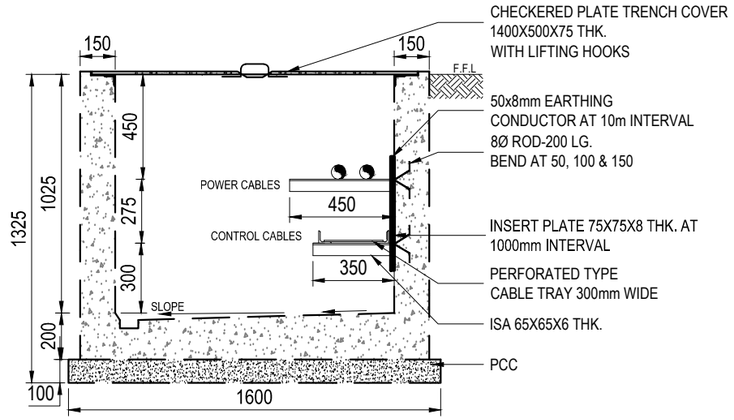
CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A3

PCPL-1414-4-CT-105P1



CONTROL ROOM



SECTIONAL DETAILS OF CABLE TRENCH
5 METER

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GA-104 - GENERAL ARRANGEMENT MUSS CONTROL ROOM.
3. PCPL-1414-4-GL-104 - EARTHING LAYOUT MUSS CONTROL ROOM.

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ROUTING OF CABLE TRENCH SHALL BE CHANGED AT SITE IF NECESSARY TO AVOID INTERFERENCE WITH PIPES/ DUCTS ETC., AFTER OBTAINING CLARENCE FROM SITE ENGINEER.

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P1	REVISED & ISSUED FOR TENDER	KNU	RJ	R.V	03.10.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : N.T.S
DATE : 05.11.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: CABLE TRENCH & BUSWAY LAYOUT MUSS CONTROL ROOM

DRAWING NO : PCPL-1414-4-CT-105

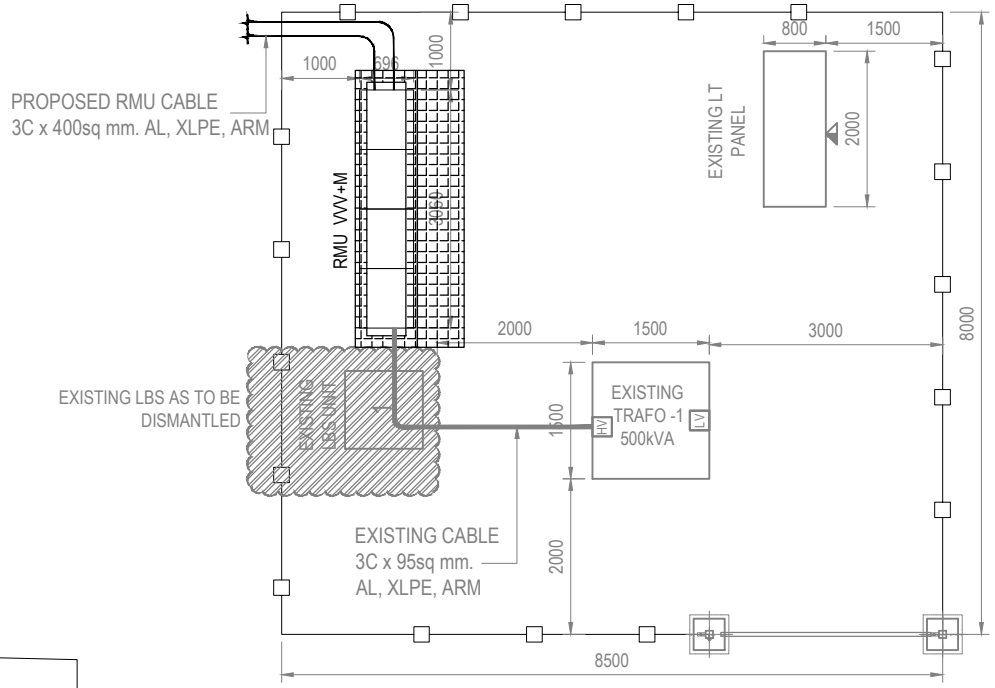
JOB NO.: 1414 DATE: 10.11.14 REV: P1

SHEET NO. 02 OF 02

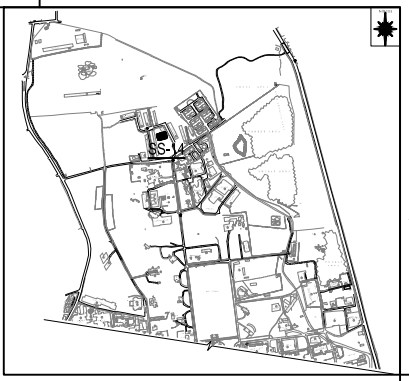
CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

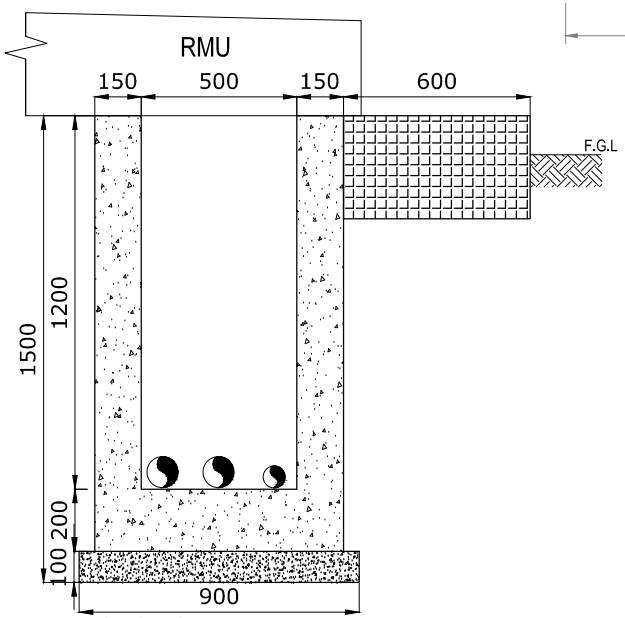
Size -A3

PCPL-1414-4-CT-105P1



SS-14





SECTIONAL VIEW
CABLE TRENCH

REFERENCE DRAWING:-

1. PCPL-1414-4-CT-101 - COMPOSITE CABLING LAYOUT.
2. PCPL-1414-4-GA-105 - GENERAL ARRANGEMENT SS -14.
3. PCPL-1414-4-GL-105 - EARTHING LAYOUT SS -14.

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ROUTING OF CABLE TRENCH SHALL BE CHANGED AT SITE IF NECESSARY TO AVOID INTERFERENCE WITH PIPES/ DUCTS ETC., AFTER OBTAINING CLARENCE FROM SITE ENGINEER

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR TENDER	KNU	RJ	R.V	25.10.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : 1:75
DATE : 28.07.15
DRAWN : NN
CHKD : RJ
APPD : R.V

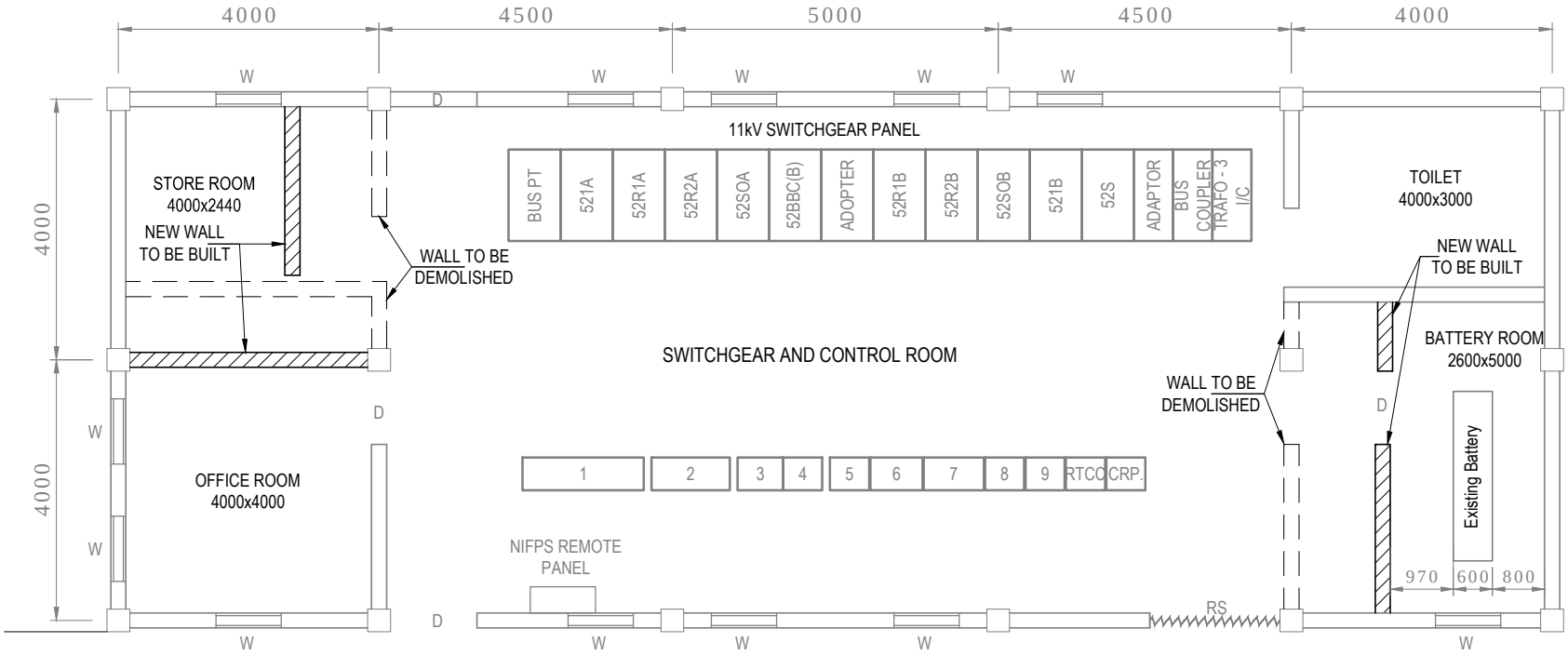
TITLE: CABLING LAYOUT SS-14

DRG NO : PCPL-1414-4-CT-106
JOB NO. : 1414 | DATE: 10.11.14 | REV: P0

SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size -A4
PCPL-1414-4-CT-106P0



CONTROL ROOM

ISSUE	REVISIONS	BY	CHKD	APPD	DATE
P0	ISSUED FOR TENDER	NN	RJ	R.V	20.01.16
P1	REVISED AND ISSUED FOR TENDER	NN	RJ	R.V	07.11.16

CLIENT : M/s INDIAN INSTITUTE OF SCIENCE

PROJECT : ELECTRICAL SYSTEM UPGRADATION AT IISc CAMPUS

SCALE : N.T.S
DATE : 05.11.15
DRAWN : NN
CHKD : RJ
APPD : R.V

TITLE: ARCHITECTURAL LAYOUT MUSS CONTROL ROOM

DRG NO : PCPL-1414-2-ARC-101
JOB NO.: 1414 | DATE: 10.11.14 | REV: P1

SHEET NO. 01 OF 01

CONSULTANT : POET CONSULTANTS PVT LTD., BANGALORE

Size - A4
PCPL-1414-2-ARC-101P1

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
CHEMICAL SUBSTATION													
	NOTE:- Supply wherever specified installation, testing as specified and commissioning of the following conforming to the specifications and drawings. All materials and workmanship shall conform to latest Standards and statutory requirements.												
	SECTION-1												
1	COMPACT SUBSTATION												
1.1	Supply, Installation, Testing & Commissioning of the Outdoor Compact Secondary Sub-station (CSS) as per specifications, drawings and data sheets comprising of following in three	Set	1										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	distinct compartments												
1.1.1	11kV, 630A, 20kA for 3 seconds, Non-Extensible 3 way Compact Ring Main Unit (VVV+M) comprising Vacuum circuit breaker with three position disconnector and earth switch downstream of the breaker for incomers & outgoing feeder. The circuit breakers shall be suitable for motorised operation from remote panel/SCADA. Metering module & All control, status indication, monitoring and protection devices shall be provided as per specification, drawings and datasheets												
1.1.2	1 No. of 11/0.433kV, 1250kVA, Oil Filled Hermetically sealed Transformer with vector group Dyn11, Z= 6.25% .												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	The Tap changer shall be provided for variation of HV voltage with a tap setting of +5% to -10% , Tapping Steps at 2.5% etc.,as per specification, drawings and datasheets												
1.1.3	1 No. of 415V, 3 Phase, 4wire, MV Switchgear as per specification, drawings and datasheets comprising of the followin a) 1No.2500A, 4P ACB Incomer b) 1 No. Of 1250A, 4P ACB Outgoing feeder c) 2 Nos. Of 630A, 4P MCCB Outgoing feeders d) 1 No. Of 400A, 4P MCCB Outgoing feeder e) 1 No. Of 200A, 4P MCCB Outgoing feeder												
	SUB TOTAL												
	SECTION-2												
2	CABLING SYSTEM												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
2.1	Supply and installation of RC Hume Pipe NP2 class of following sizes from buried cable to cable trench, complete with sealing of pipe ends on installation of cables.												
2.1.1	200mm dia	RM	2										
	SUB TOTAL												
	SECTION-3												
3	EARTHING												
3.1	Supply, Installation / laying and termination of the following sizes of earth flats, mats and wires, directly buried / laid in cable trays / drawn through pipe sleeves / run along structures as per specifications and drawings. All joints in the run of conductor shall be welded/ brazed/ fastened/ riveted.												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
3.1.1	50 x 10 mm GS strip for main earth grid	m	29										
3.1.2	50 x 10 mm GS strip for auxilary earth grid	m	20										
3.1.3	50 x 8 mm Cu strip for Transformer neutral earthing.	m	20										
3.1.4	25 x 3 mm GS Strip for fence earthing.	m	20										
3.2	Treated Earth pits complete with 100 dia 13 thick Cast Iron Pipe 2.5m long with disconnecting links, chamber, inspection cover, civil works, etc., as per specifications and drawings.	Nos	4										
3.3	Earth pit marker, painted metallic sheet with pedestal stand for above earth pits.	Nos	4										
	SUB TOTAL												
	GRAND TOTAL (EX-WORKS & E.T &C)												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	GRAND TOTAL												
PHYSICAL SCIENCE SUBSTATION													
	NOTE:- Supply wherever specified installation, testing as specified and commissioning of the following conforming to the specifications and drawings. All materials and workmanship shall conform to latest Standards and statutory requirement.												
	SECTION-1												
1	OIL FILLED POWER TRANSFORMER												
1.1	Supply, Installation, Testing &Commissioning of the following equipment(s) as per specifications, drawings and data sheets												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
1.1.1	1000kVA, 11/0.433kV, Outdoor type ONAN Cooled Transformer with vector group Dyn11, Z=5%, Off Load Tap Changer +5% to -10% @ 2.5%, as per specifications and Data Sheets	Nos	1										
1.1.2	Essential Spares as listed in Data Sheets (Cl. 15.0 of document PCPL-1414-4-S4-132-01, Data Sheet A1)	LS	1										
1.1.3	Recommended Spares	Lot	1										
1.1.4	Bidders to list recommended spares for 3 years trouble free operation and quote unit prices												
1.1.5	Unit rates for type testing as per specifications												
	SUB TOTAL												
	SECTION-2												
2	LT PANEL												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
2.1	Supply, Installation, Testing & Commissioning of LT Extension Panel (provision for Extension on RHS Side) as per specifications, drawings and data Sheets												
2.1.1	LT Extension Panel with One No. 1600,4P,ACB Incomer and Two Nos. of 630A, 4P, MCCB Outgoing Feeders	Set	1										
	SUB TOTAL												
	SECTION-3												
3	POWER & CONTROL CABLES												
3.1	HV POWER CABLES												
	Supply and Installation of the following Cables as per specification and drawings.												
3.1.1	11kV Earthed Grade (E), Stranded Aluminium conductor, XLPE insulated, Strip wire												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	armoured, extruded PVC inner and outer sheathed cables laid in cable trench / Cable tray / directly buried with necessary clamps and hardware, cable tags, ferrule numbers etc. and conforming to enclosed specification.												
	3C x 240 sq mm	m	15										
3.1.2	Supply and installation of indoor heat shrinkable cable termination kit including double compression brass cable glands, crimping type tinned copper lugs, GS armour binding wires, earth tags, pig tails with lugs, for 11kV Earthed Grade, armoured XLPE insulated Power Cables of following sizes:												
	3C x 240 sq mm, Al, XLPE	Nos	2										
3.2	MV POWER CABLES												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	Supply and Installation of the following Cables as per specification and drawings.												
3.2.1	1.1kV Grade, XLPE insulated, PVC innersheath, overall PVC outersheathed, Armoured cables laid in cable trays / buried in trench with necessary clamps and hardware, cable tags, ferrule numbers etc. and conforming to enclosed specification.												
	3.5C X 300 Sq.mm Al, XLPE	m	112										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
3.2.2	Supply and installation of Cable termination accessories including double compression brass cable glands, crimping type tinned copper lugs, bimetallic strips, GS armour binding wires, earth tags, pig tails with lugs, for 1.1kV grade, armoured XLPE insulated Power Cables of following sizes:												
	3.5C X 300 Sq.mm , Al, XLPE	Nos	12										
3.3	MV CONTROL CABLES												
	Supply and Installation of the following Cables as per specification and drawings.												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
3.3.1	1.1kV Grade, Stranded Copper conductor, PVC insulated, Steel Wire armoured, overall FRLS PVC outersheathed control cables laid in cable trays / wire duct with necessary clamps and hardware, cable tags, ferrule numbers etc. and conforming to enclosed specification.												
3.3.1.1	5C x 2.5 Sq.mm. CU, Armoured Cable	m	25										
3.3.1.3	12C x 2.5 Sq.mm. CU, Armoured Cable	m	25										
3.3.1.4	19C x 2.5 Sq.mm. CU, Armoured Cable	m	50										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
3.3.2	Supply and installation of Cable termination accessories including double compression brass cable glands, crimping type tinned copper lugs, bimetallic strips, GS armour binding wires, earth tags, pig tails with lugs, for 1.1kV grade, armoured PVC insulated Control Cables of following sizes:												
3.3.2.1	5C x 2.5 Sq.mm. CU, Armoured Cable	Nos	6										
3.3.2.3	12C x 2.5 Sq.mm. CU, Armoured Cable	Nos	6										
3.3.2.4	19C x 2.5 Sq.mm. CU, Armoured Cable	Nos	8										
	SUB TOTAL												
	SECTION-4												
4	CABLING SYSTEM												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
4.1	Supply and installation of RC Hume Pipe NP2 class of following sizes from buried cable to cable trench, complete with sealing of pipe ends on installation of cables.												
4.1.1	200mm dia	RM	2										
	SUB TOTAL												
	SECTION-5												
5	EARTHING												
5.1	Supply, Installation / laying and termination of the following sizes of earth flats, mats and wires, directly buried / laid in cable trays / drawn through pipe sleeves / run along structures as per specifications and drawings. All joints in the run of conductor shall be welded/ brazed/ fastened/ riveted.												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
5.1.1	50 x 10 mm GS strip for auxilary earth grid	m	15										
5.1.2	50 x 8 mm Cu strip for Transformer neutral earthing.	m	15										
5.2	Treated Earth pits complete with 100 dia 13 thick Cast Iron Pipe 2.5m long with disconnecting links, chamber, inspection cover, civil works, etc., as per specifications and drawings.	Nos	2										
5.2.1	Earth pit marker, painted metallic sheet with pedestal stand for above earth pits.	Nos	2										
	SUB TOTAL												
	GRAND TOTAL (EX-WORKS & E.T &C)												
	GRAND TOTAL												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
MUSS & 11kV CABLE ROUTING													
	NOTE: Supply wherever specified installation, testing as specified and commissioning of the following conforming to the specifications and drawings. All materials and workmanship shall conform to latest Standards and statutory requirement.												
	SECTION-1												
1	HV SWITCHGEAR												
	Supply, Installation, Testing & Commissioning of the following equipment(s) as per specifications, drawings and data sheets												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
1.1	11kV, 18.14kA 3-phase Indoor switchboard with draw out VCB Cubicle with 1250A in panel rated busbar. (1No. of Adaptor Panel + 2Nos. 630A outgoing feeder on LHS arranged as shown in the Drawing) with all relays, meters, standard accessories, including necessary control wiring etc., as per technical specification, drawings and datasheets enclosed.	Set	1										
	Cable side earthing truck with single phase PT, lamp and buzzer (if required)	UR											
	Circuit Breaker Transport trolley (if required)	UR											
1.2	11kV, 18.14kA 3-phase Indoor switchboard with draw out VCB Cubicle with 1250A in panel rated busbar (2Nos. 630A outgoing feeders	Set	1										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	on RHS of existing panel connected with busduct.) with all relays, meters, standard accessories, including necessary control wiring etc., as per technical specification, drawings and datasheets enclosed.												
	Cable side earthing truck with single phase PT, lamp and buzzer (if required)	UR											
	Circuit Breaker Transport trolley (if required)	UR											
	SUB TOTAL												
	SECTION-2												
2	POWER AND CONTROL CABLES												
2.1	HV POWER CABLES												
	Supply and Installation of the following Cables as per specification and drawings.												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
2.1.1	11kV Earthed Grade (E), Stranded Aluminium conductor, XLPE insulated, Strip wire armoured, extruded PVC inner and outer sheathed cables laid in cable trench / Cable tray / directly buried with necessary clamps and hardware, cable tags, ferrule numbers etc. and conforming to enclosed specification.												
	3C x 400 sq mm AL, Armoured Cable	m	7613										
2.1.2	Supply and installation of straight through cable joints including ferrule and other jointing materials for 11kV Earthed Grade, armoured XLPE insulated Power Cables of following sizes:												
	3C x 400 sq mm AL, Armoured Cable	Nos	16										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
2.1.3	Supply and installation of indoor heat shrinkable cable termination kit including double compression brass cable glands, crimping type tinned copper lugs, GS armour binding wires, earth tags, pig tails with lugs, for 11kV Earthed Grade, armoured XLPE insulated Power Cables of following sizes:												
	3C x 400 sq mm AL, Armoured Cable	Nos	14										
2.2	MV CONTROL CABLES												
	Supply and Installation of the following Cables as per specification and drawings.												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
2.2.1	1.1kV Grade, Stranded Copper conductor, PVC insulated, Steel Wire armoured, overall FRLS PVC outer sheathed control cables laid in cable trays / wire duct with necessary clamps and hardware, cable tags, ferrule numbers etc. and conforming to enclosed specification.												
2.2.1.1	5C x 2.5 Sq.mm. CU, Armoured Cable	m	30										
2.2.1.2	10C x 2.5 Sq.mm. CU, Armoured Cable	m	30										
2.2.1.3	12C x 2.5 Sq.mm. CU, Armoured Cable	m	30										
2.2.1.4	19C x 2.5 Sq.mm. CU, Armoured Cable	m	30										
2.2.2	Supply and installation of Cable termination accessories including double compression brass cable glands, crimping type tinned copper lugs, bimetallic strips, GS armour												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	binding wires, earth tags, pig tails with lugs, for 1.1kV grade, armoured PVC insulated Control Cables of following sizes:												
2.2.2.1	5C x 2.5 Sq.mm. CU, Armoured Cable	Nos	6										
2.2.2.2	10C x 2.5 Sq.mm. CU, Armoured Cable	Nos	6										
2.2.2.3	12C x 2.5 Sq.mm. CU, Armoured Cable	Nos	6										
2.2.2.4	19C x 2.5 Sq.mm. CU, Armoured Cable	Nos	6										
	SUB TOTAL												
	SECTION-3												
3	BUSDUCT												
3.1	Design, Supply & Installation of following Indoor & Outdoor air insulated Segregated with raychem sleeves type, Metal enclosed 11kV,1250A,3P Segregated Phase Bus												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	Duct (SPBD)												
3.1.1	Straight run Busway, for indoor installation (including length of the bends)	m	5										
3.1.2	Vertical Bend (Add on cost over and above the centre line length of the busway)	UR											
3.1.3	Horizontal Bend (Add on cost over and above the centre line length of the busway)	UR											
3.1.4	Adaptor Box, above the switchgear suitable for Bus duct Termination including making cutout in existing switchgear	Nos	2										
3.1.5	Adaptor Box, for phase cross over arrangement (if required at switchgear end after comparing the phase sequence of existing and proposed switchgear):	UR											
3.1.6	Galvanized Steel Supporting Structure	KG	450										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
3.1.7	Braided copper flexible at Switchgear end (3 Nos in each set)	Set	2										
3.1.8	50 x6 mm Copper External Earthing conductor complete with fixing arrangement.	m	7										
3.1.9	Type testing charges	UR											
3.1.10	Heat run test	UR											
3.1.11	Short Circuit Test	UR											
3.1.12	IP class Test	UR											
	Notes: 1. BIDDER to suggest the required spares and quote unit rates along with the suggested quantity. 2. Quantities mentioned above are for bidding purpose only. However, successful bidder shall have to measure the lengths at site before commencement of manufacturing. Payment shall be made based on site measurements after												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	commissioning. 3. Bidder to specify the minimum distance at which hanger supports to be provided.												
	SUB TOTAL												
	SECTION-4												
4	CABLING SYSTEM												
4.1	Supply & Installation of perforated type cable trays of following size made of 2mm thick Pregalvanised sheet complete with allbends, tees, coupler plates and associated accessories and hardware.												
4.11	300mm W x 100 mm H	m	5										
4.2	Supply and installation of RC Hume Pipe NP2 class of following sizes from buried cable to cable trench, complete with sealing of pipe ends on installation of cables.												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
4.2.1	200mm dia	RM	3										
	SUB TOTAL												
	SECTION-5												
5	EARTHING												
5.1	Supply, Installation / laying and termination of the following sizes of earth flats, mats and wires, directly buried / laid in cable trays / drawn through pipe sleeves / run along structures as per specifications and drawings. All joints in the run of conductor shall be welded/ brazed/ fastened/ riveted.												
5.1.1	50 x 10 mm GS strip for auxiliary earth grid	m	35										
	SUB TOTAL												
	SECTION-6												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
6	Battery & Battery Charger												
6.1	Dismantling and Relocating of Battery in Existing Battery Room at MUSS control Building from Present Location Facing towards North to new location facing towards west and Associated cabling work including removing the existing cable along termination and laying new cable from battery to battery charger with necessary clamps and hardware, cable tags, ferrule numbers, lugs etc. and related earthing works as per drawings	Set	1										
	SUB TOTAL												
	SECTION-7												
7	MISCELLANEOUS ITEMS												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
7.1	Supply and Installation of Safety items												
7.2	CO2 Fire Extinguishers - 4.5 kg	Nos	2										
7.3	Fire bucket with sand (3 buckets) along with steel stands	Set	2										
7.4	Danger boards as per IS 2551 (150 x 150mm)	Nos.	4										
7.5	Rubber Mats - 1500 mm (W) x 1000 mm (L) x 12 mm (T)	Nos.	5										
7.6	Obtaining statutory approval for the entire electrical works from authorities such as CAE/CEIG/ KPTCL etc., including liasoning, arranging inspection, submission of documents on behalf of IISc . The contractor is solely responsible for obtaining the approval for charging the substation. the statuatory fee paid shall be reimbursed by IISc at	Lot	1										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	actual on submission of documentary proof												
	SUB TOTAL												
	GRAND TOTAL (EX-WORKS & E.T &C)												
	GRAND TOTAL												
E -TYPE AND SS -14													
	NOTE: Supply wherever specified installation, testing as specified and commissioning of the following conforming to the specifications and drawings. All materials												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	and workmanship shall conform to latest Standards and statutory requirement.												
	SECTION-1												
1	CSS & RMU												
1.1	Supply, Installation, Testing & Commissioning of the Outdoor Compact Secondary Sub-station (CSS) as per specifications, drawings and data sheets comprising of following in three distinct compartments (E-TYPE QUARTERS)	Set	1										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
1.1.1	11kV, 630A, 20kA for 3 seconds, Non-Extensible 3 way Compact Ring Main Unit (VVV+M) comprising Vacuum circuit breaker with three position disconnector and earth switch downstream of the breaker for incomers & outgoing feeder. The circuit breakers shall be suitable for motorised operation from remote panel/SCADA. Metering module & All control, status indication, monitoring and protection devices shall be provided as per specification, drawings and datasheets												
1.1.2	1 No. of 11/0.433kV, 500kVA, Oil Filled Hermetically sealed Transformer with vector group Dyn11, Z= 4% .												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	The Tap changer shall be provided for variation of HV voltage with a tap setting of +5% to -10% , Tapping Steps at 2.5% etc.,as per specification, drawings and datasheets.												
1.1.3	1 No. of 415V, 3 Phase, 4wire, 25kA for 1sec. MV Switchgear as per specification, drawings and datasheets comprising of the following: a) 1No.1000A, 4P ACB Incomer b) 2 Nos. Of 400A, 4P MCCB Outgoing feeders c) 2 Nos. Of 250A, 4P MCCB Outgoing feeders d)1 No. Of 63A, 4P MCCB Outgoing feeder												
1.2	Supply, Installation, Testing & Commissioning of the Outdoor Ring Main Unit (RMU) as per												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	specifications, drawings and data sheets (SS -14)												
1.2.1	11kV, 630A, 20kA for 3 seconds,Extensible 3 way Ring Main Unit (VVV+M) comprising Vacuum circuit breaker with three position disconnector and earth switch downstream of the breaker for incomers & outgoing feeder. The circuit breakers shall be suitable for motorised operation from remote panel/SCADA. Metering module & All control, status indication, monitoring and protection devices shall be provided as per specification, drawings and datasheets	Set	1										
	SUB TOTAL												
	SECTION-2												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
2	POWER AND CONTROL CABLES												
2.1	HV POWER CABLES												
	Supply and Installation of the following Cables as per specification and drawings.												
2.1.1	11kV Earthed Grade (E), Stranded Aluminium conductor, XLPE insulated, Strip wire armoured, extruded PVC inner and outer sheathed cables laid in cable trench / Cable tray / directly buried with necessary clamps and hardware, cable tags, ferrule numbers etc. and conforming to enclosed specification.												
	3C x 240 sq mm	m	10										
2.1.2	Supply and installation of indoor heat shrinkable cable termination kit including double compression brass cable												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	glands, crimping type tinned copper lugs, GS armour binding wires, earth tags, pig tails with lugs, for 11kV Earthed Grade, armoured XLPE insulated Power Cables of following sizes:												
	3C x 240 sq mm, Al, XLPE	Nos	2										
2.2	MV CONTROL CABLES												
2.2.1	Supply and Installation of the following Cables as per specification and drawings.												
	1.1V Grade, Stranded Copper conductor, PVC insulated, Steel Wire armoured, overall FRLS PVC outersheathed control cables laid in cable trays / wire duct with necessary clamps and hardware, cable tags, ferrule numbers etc. and conforming to enclosed specification.												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
2.21.1	5C x 2.5 Sq.mm. CU, Armoured Cable	m	25										
22.1.3	12C x 2.5 Sq.mm. CU, Armoured Cable	m	25										
2.2.1.4	19C x 2.5 Sq.mm. CU, Armoured Cable	m	25										
2.2.2	Supply and installation of Cable termination accessories including double compression brass cable glands, crimping type tinned copper lugs, bimetallic strips, GS armour binding wires, earth tags, pig tails with lugs, for 1.1kV grade, armoured PVC insulated Control Cables of following sizes:												
2.2.2.1	5C x 2.5 Sq.mm. CU, Armoured Cable	Nos	4										
2.2.2.3	12C x 2.5 Sq.mm. CU, Armoured Cable	Nos	4										
2.2.2.4	19C x 2.5 Sq.mm. CU, Armoured Cable	Nos	4										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	SUB TOTAL												
	SECTION-3												
3	CABLING SYSTEM												
3.1	Supply and installation of RC Hume Pipe NP2 class of following sizes from buried cable to cable trench, complete with sealing of pipe ends on installation of cables.												
3.1.1	200mm dia	RM	5										
	SUB TOTAL												
	SECTION-4												
4	EARTHING												
4.1	Supply, Installation / laying and termination of the following sizes of earth flats, mats and wires, directly buried / laid in cable trays / drawn through pipe sleeves / run along												

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	structures as per specifications and drawings. All joints in the run of conductor shall be welded/ brazed/ fastened/ riveted.												
4.1.1	50 x 10 mm GS strip for main earth grid	m	28										
4.1.2	50 x 10 mm GS strip for auxilary earth grid	m	37										
4.1.3	50 x 8 mm Cu strip for Transformer neutral earthing.	m	22										
4.1.4	25 x 3 mm GS Strip for fence earthing.	m	20										
4.2	Treated Earth pits complete with 100 dia 13 thick Cast Iron Pipe 2.5m long with disconnecting links, chamber, inspection cover, civil works, etc., as per specifications and drawings.	Nos	4										
4.3	Earth pit marker, painted metallic sheet with pedestal stand for above earth pits.	Nos	4										

SL.NO.	DESCRIPTION	UNIT	QTY	SUPPLY						E.T & C			
				Unit Rate (Ex- Works)	ED (URx%ED)	TAX ((UR+ED) x %TAX)	Freight & Insurance ((UR+ED+ TAX) x %FI)	Unit F.O.R.D	TOTAL	Unit Rate (Ex- Works)	TAX (URx%TAX)	Unit Rate With TAX	Total Cost
					12.50%	14.50%	2%				14.50%		
	SUB TOTAL												
	SECTION-5												
5	Dismantling Existing LBS at SS-14 from Present Location without any damage and handing over to IISc including loading and unloading.	Set	1										
	SUB TOTAL												
	GRAND TOTAL (EX-WORKS & E.T &C)												
	GRAND TOTAL												

SL.NO.	DESCRIPTION	UNIT	QTY	UNIT RATE	AMOUNT
1	Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts complete as per specifications. Dismantling RCC M20 & M25 by manual means	Cum	5		
2	Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts complete as per specifications. Dismantling brickwork in MUSS control room	Cum	17		
3	Providing and constructing granite / trap / basalt rubble stone masonry in foundation with cement mortar 1:6 (uncoursed), bond stones at two m. apart in each course including cost of materials, labour, curing complete as per specifications.	Cum	11		
4	Providing and laying in position plain cement concrete of mix 1:4:8 with OPC cement @180kgs, with 40mm and down size graded granite metal coarse aggregates @ 0.85cum and fine aggregates @ 0.57cum machine mixed, machine mixed, concrete laid in layers not exceeding 15cms. thick, well compacted, in foundation, including cost of all materials, labour, HOM of machinery, curing complete as per specifications.	cum	19		
5	Providing and laying in position reinforced cement concrete of design mix M25 with OPC cement @ 340kgs, with 20mm and down size graded granite metal coarse aggregates @ 0.70cum and fine aggregates @ 0.47cum, with super plasticizers @ 3 liters confirming to IS 9103-1999 reafirmed-2008 at machine mixed, concrete laid in layers not exceeding 15cms thick, vibrated for all works in foundation for footings, pedestals, retaining walls, return walls, walls (any thickness) including attached pilasters, columns pillars, posts, struts, buttresses, bed blocks, anchor blocks & plinths etc., including cost of all materials, labour,	cum	56		

SL.NO.	DESCRIPTION	UNIT	QTY	UNIT RATE	AMOUNT
	HOM of machinery, curing, complete as per specifications.				
6	Providing and removing centering, shuttering, strutting, propping etc., and removal of form work for foundations, footings, bases of columns for mass concrete including cost of all materials, labour complete as per specifications.	Sqm	176		
7	Providing and Constructing burnt brick masonry with approved quality of modular bricks of standard size of class designation 5.0 Newton per sqmm (table moulded) with cement mortar 1:6 for basement and superstructure including cost of materials, labour charges, scaffolding, curing complete as per specification.	cum	17		
8	Earth work excavation for foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom , backfilling the excavation earth to the extent required and utilizing / transporting the remaining earth locally upto 1.00km lead. (Depth upto 3.00Mts)	cum	2738		
9	Refilling available earth around pipe lines, cables in layers not exceeding 20 cms in depth compacting each deposited layer by ramming after watering with lead upto 50 m and lift upto 1.5 m including cost of labour complete as per specification.	cum	1644		
10	Providing T.M.T steel reinforcement for R.C.C work including straightening, cutting, bending, hooking, placing in position, lapping and/or welding wherever required, tying with binding wire and anchoring to the adjoining members wherever necessary complete as per design (laps, hooks and wastage shall not be measured and paid) cost of materials , labour, HOM of machinery complete as per specifications.	Tonne	5.75		

SL.NO.	DESCRIPTION	UNIT	QTY	UNIT RATE	AMOUNT
11	Supplying, fabricating and fixing in position as in drawings MS curb angles, channel frames, insert plates anchor bolts ,rungs, etc., including split anchors for equipment foundations etc at all levels	Kg	630		
12	Providing 12mm thick cement plaster in single coat with cement mortar 1:4 to brick masonry including round off corners wherever required smooth rendering. Providing and removing scaffolding , including cost of materials, labour, curing complete as per specifications.	sqm	155		
13	Providing 20 mm thick cement plaster in single coat with cement mortar 1:4 to concrete surface including round off corners wherever required smooth rendering. Providing and removing scaffolding , including cost of materials, labour, curing complete as per specifications.	sqm	34		
14	Providing and fixing M.S.Block pipe of 38 mm dia of heavy guage of 14 including removing the bends, cutting the pipe & fixing the pepe in between two vertical poles (M.S. Rectangular poles) and spot welding the chain link with M.S.Block pipe including cost of all materials wastage in cutting and scaffolding wherever necessary with all lead & lift as directed by the Engineer-in charge of the worl complete including two coats of approved quality paint over one coat of shop painting.	Rm	149		
15	Supplying and fixing M.S.Rectangular poles made out of 2 equal angles 65X65X6 mm welded together and fixed in CC (1:2:4) with 2 No. s 16 mm dia hold fast rods each of length 25 cms including cost of all materials ,cutting, bending, scaffolding wherever necessary ,nicely finishing the welded joints with all leads and lifts as per the directions of the Engineer-in charge including provision of 2 coats of approved quality paint over one coat of shop painting (excluding cost of earthwork and concrete)	Rm	99		

SL.NO.	DESCRIPTION	UNIT	QTY	UNIT RATE	AMOUNT
16	`Providing chain link fencing 50 mm size of 8 gauge properly stretched between rectangular poles and fixed with suitable bolts and nuts, the free ends shall be welded to the pole and block pipe at top and bottom as required includig cost of all materials, labour, lead and lifts and as per the directions of the Engineer-in-charge of work including two coats of approved quality paint over one coat of shop paint.	Sqm	132		
17	Providing and fixing M.S. gate as per drawing using 50 mm X 50 mm 14 gauge M.S. hollow pipe frame work bent to ornamental shape as shown in the drawing and 35 mm X 6 mm and 16 mm X 16 mm square rods for verticals alternatively spaced at 4 cms c/c in two halves and 40 mm X 6 mm M.S. flats for horizontal member and at the top cast iron spikes are provided at alternate vertical members as shown in the drawing etc complete. All the steel surface should be thoroughly cleaned free of rust and painted with anti corrosive paint (shop paint) etc. complete. The work includes cost of all materials, labour charges for all items of work, hire charges for welding, cutting and grinding equipment, and electricity charges with lead and lift, loading and unloading charges etc complete as per specifications	Sqm	12		
18	Providing and filling 40 mm downgraded coarse aggregates in the transformer foundation and in the substation area	cum	4		
19	Providing and placing in position precast reinforced cement concrete waffle units, square or rectangular, as per design and shape for trench covers, poles etc., in 1:1½ :3 (1 Cement : 1½ coarse sand : 3 graded stone aggregate 10mm nominal size), including flush or deep ruled pointing at joints in cement mortar 1:2 (1 cement : 2 Fine sand), making necessary holes of required sizes for carrying through service lines etc., providing steel hooks for lifting etc, form work in precasting, handling, hoisting, centering and crection complete for all floor levels but excluding the cost of reinforcement.	cum	2.5		

SL.NO.	DESCRIPTION	UNIT	QTY	UNIT RATE	AMOUNT
20	Providing and applying two coats with oil bound washable distemper of approved brand and shade on wall surface including priming coat with distemper primer after thoroughly brooming the surface free from mortar drops and other foreign matter including preparing the surface even and sand paper smooth, cost of materials, labour, complete as per specifications.	Sqm	115		
21	Providing and applying two coats with acid resistant paint of approved brand and shade on wall surface including priming coat after throughly brooming the surface free from mortar drops and other foreign matter including preparing the surface even and sand paper smooth, cost of materials, labour, complete as per specifications.	Sqm	32		
22	Providing Ceramic tiles of approved make, shade and size for flooring, treads of steps and landings laid on a bed of 12mm thick, cement mortar 1:3 mix, flush pointing with white cement using colour pigment, including cost of materials, labour, curing complete as per specifications	Sqm	15		
23	Providing and Fixing in position Buried Cable Route Markers made up with Precast Cement Concretee block,CC 1:2:4 using 20 mm downgraded aggregates ,height 450 mm,bottom size 200X150 mm and top size 100X150 mm(Frustum of a pyramid) ,smooth finish all round with one coat of primer and two coats of synthetic enamel paint of approved make & colour including necessary markings and holes as per drawing,formwork,curing etc complete all as directed by Engineer-in charge.The markers shall be placed at about 10 m c/c as per site conditions along the alignment/route of cables.	No.	365		
24	Providing and laying 150 mm dia RCC pipe NP2 for culverts including pointing ends,fixing collars with cement mortor 1:2 including cost of all materials,labour etc complete	Rm	300		

SL.NO.	DESCRIPTION	UNIT	QTY	UNIT RATE	AMOUNT
25	Supplying and laying HDPE Pipe 160 mm external dia inside the excavated trench as per the specifications and drawing including butt welding of ends of pipes for continuity complete as directed by the Engineer-in-charge.	Rm	147		
26	Providing and filling sand in foundation upto plinth to required depth for sub soil treatment including watering rimming with all lead and lift complete as per specifications.	Cum	541		
27	Providing ,laying ,spreading and compacting stone aggregates of specific sizes to water bound macadam specifications including spreading in uniform thickness hand packing,rolling with 3 wheeled steel/vibratory roller 8-10 tonnes in stages to proper grade and camber as per specifications (Type A)as per Sl. No. 20.14.1 of KSR	Cum	16		
28	Supplying and providing precast concrete (un reinforced) covers 40 mm thick for cable protection as per IS 5820.Size of covers shall be either 300mm X 180 mm or 450 mm X 180 mm without peak	sqm	2156		
29	Construction of un reinforced cement concrete pavement with M30 concrete 150 mm thick over a prepared sub base with 25 mm down graded granite metal coarse aggregates,with superplasticiser conforming to IS 9103 ,mixed in a concrete mixer of not less than 0.6 cum capacity,and appropriate weigh batcher,as per approved mix design,laid in approved fixed side form work 9steel channel,laying and fixing of 125 micron thick polyethylene film,wedges,steel plates including levelling the formwork .Spreading the concrete with shovels,rackers compacted using needle ,screed and plate vibrator and finished in a continuous operation including provision of expansion,construction and longitudinal joints ,joint filler,separation membrane,joint sealant,admixtures as approved,curing compounds finishing to line and grades.	Cum	16		
	TOTAL				

Notes:

1. Rates quoted shall be firm and valid even if the contract is split.
2. Rates quoted shall be inclusive of all taxes and shall be as applicable at site of execution.
3. Rates and amount shall be filled in ink and shall be entered both in figures and in words.
4. The quantities of various items indicated are only approximate and payment will be made on the basis of actual quantity executed. The quantities of the individual items can vary to any extent and purchaser is at liberty to delete any item.
5. Drawing enclosed with this specification are meant only for bidding purpose and are meant only to give the bidder general idea about the nature of work various items of work involved etc., The actual execution of the work is to be done as per Released for construction (RFC) drawings to any extent. No claim is admissible in the quoted rate on this account.
6. The bidder shall quote rates for all the items.