



**NATIONAL INSTITUTE OF TECHNOLOGY
ROURKELA-769 008**

**CONSTRUCTION OF 33KV RING MAIN SYSTEM INCLUDING
33/0.433KV SUBSTATIONS AT NIT, ROURKELA**

Tender Notice No. NITR/PW/10/45 Date: 10.05.2010

Sealed tenders are invited from bonafide, experienced, resourceful and technically competent EPIC Contractors having valid registrations and licenses with State Govt./CPWD/MES/PSUs for the following work.

Sl. No.	Name of the Work	Estimated Cost (In Crore)	E.M.D. (In Lakh)	Completion Period
1.	Design engineering, manufacturing, procurement, supply, delivery, site storage, erection, testing and commissioning of 33 kV Ring Main System including 33/0.433kV substations at NIT, Rourkela	Rs. 3.5	Rs.2.00	08(Eight) months from the date of LOI

The tenders shall be submitted, in three parts (Part-I: Prequalification documents, Part-II : Techno Commercial & Part-III: Price Bid) in separate sealed envelopes, addressed to the **Registrar, NIT, Rourkela-769008**, superscribing "CONSTRUCTION OF 33KV RING MAIN SYSTEM INCLUDING 33/0.433KV SUBSTATIONS AT NIT, ROURKELA", Tender Notice No. and due date on the top of the envelope. EMD should be submitted in the form of Demand Draft from any Nationalized Bank in favour of NIT, Rourkela and payable at Rourkela.

Important Dates :

Last date of Submission of Bid : **17.06.2010** by **11.00 A.M.**

Opening of Bid : **17.06.2010** at **3.30 P.M.**

N.B. No further extension shall be there.

Tender document and other details is available in our website at <http://nitrkl.ac.in/tender.asp> The Institute reserves the right to qualify or deny tenders of any or all bidders without assigning any reason thereof.

Ph : 0661-2462021/2476773

Fax No.0661-2462022

Sd/-

REGISTRAR



**NATIONAL INSTITUTE OF TECHNOLOGY
ROURKELA-769008. ORISSA. INDIA**

1.0 Name of the Work : Engineering, Procurement, Installation and Commissioning (EPIC) of 33kV Ring Main System including 33/0.433kV Substations in NIT, Rourkela Campus, Orissa.

2.0 Salient Information (Technical)

National Institute of Technology, Rourkela, intends to set up a 33kV Ring Main System including 33/0.433 KV substations in their campus at Rourkela. Presently there is 11KV system network which will be replaced by a new 33kV Ring Main system. 33KV power will be received through a single feeder from existing WESCO substation to 33KV Main Receiving Substation (MRSS). 33KV Ring Main formation will be made through 33KV over head line (ACSR Rabbit) as well as 33KV underground cable feeders to feed 9 nos. 33/0.433 KV substations in LOOP-IN-LOOP-OUT mode.

The existing WESCO substation receives power from Rourkela grid station and Chhend grid station at 33kV. Incoming power to MRSS of NIT shall be tapped from both these incoming lines and then paralleled to bring a single feeder to the MRSS.

Main configurations of the interconnected substations are as follows:

- a. 33kV MRSS : New substation comprising of 3 nos. 33kV outdoor air insulated bays, control room, station service transformer, boundary wall.
- b. Substation-1 : 1x500kVA, 33/0.433kV substation to be built within existing boundary wall of 11kV S/S-1. The substation will feed the loads of Colony.
- c. Substation-2 : 1x500kVA, 33/0.433kV substation to be built within existing boundary wall of 11kV Pump house substation. The substation will feed the loads of Colony and Pump house.
- d. Substation-4 : 2x500kVA, 33/0.433kV substation to be built within existing boundary wall of 11kV S/S-4. The substation will feed the loads of HV Lab and Hall-6 extension.
- e. Substation-5 : New substation comprising of 2x750kVA, 33/0.433kV transformers shall be constructed adjacent to the existing Computer Science building to feed the existing loads of Computer Science and new loads of Electrical Engineering buildings.
- f. Substation-6 & 9 : Combined substation of 1x500kVA & 2x750kVA, 33/0.433kV to be built in the area adjacent to existing 11kV S/S-6 and Hall-4. The substation will feed the loads of Hall-4 extension.
- g. Substation-7 : 1x500kVA, 33/0.433kV substation to be built adjacent to existing 11kV S/S-7. The substation will feed the loads of Colony and D-Flats
- h. Substation-8 : New substation comprising of 4x750kVA, 33/0.433kV transformers shall be built adjacent to new Bio Medical building and shall feed the loads of the Mechanical Science, Golden Jubilee building, Bio Medical building and Lecture Complexes.
- i. Substation-10 : New indoor substation comprising of 2x750kVA, 33/0.433kV transformers shall be installed within the Chiller Plant building. This substation shall feed the loads of chiller plant and its auxiliaries.

Status of electrical equipment in above substations shall be monitored through Data Acquisition System (DAS). The master control station of DAS for remote monitoring shall be located in the Main Administrative Building.

3.0 Scope of Work

Design, engineering, manufacture, testing at works, procurement, supply, freight, site storage, dismantling of existing 11kV ring main system, erection, site testing and commissioning of the 33kV electrical power distribution system described above including civil construction and data acquisition system (DAS).

4.0 Salient Information (Commercial)

4.1 The tender shall be submitted in three (3) parts in strict compliance with the techno commercial stipulations laid down in the tender document.

Part-1 : Prequalification document,

Part-2 : Techno commercial,

Part-3 : Price bid.

Part-2 and 3 of the tenders shall be considered if the bidder meets the following criteria:

- a) Must have done similar nature of work.
- b) Must have worked with Govt. of India/Orissa or a Public Undertaking.
- c) Must have executed a single work of Rs. 3 crore or at least two similar works of Rs. 2 crore each in last 3 years.
- d) Must be an active contractor for last 3 years.
- e) Must have own capability of developing drawings/design for electrical and civil/structural.

4.2 Tender estimated value = Rs. 3.5 crores

4.3 Earnest money deposit = Rs. 2.00 lakhs

4.4 Nature of Contract = Item rate

4.5 Delivery time = Eight (8) months from the date of LOI.

4.6 Tender document can be downloaded using the following link and submitted with EMD.

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TENDER DOCUMENT FOR 33KV
RING MAIN SYSTEM INCLUDING
33/0.433KV SUBSTATIONS IN NIT,
ROURKELA CAMPUS

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Tender Document for 33kV Ring Main including 33/0.433kV Substation in NIT Campus	NITRKL-33KVRM-TD-01	Contents Sheet	SM	26.04.2010	1	1 of 2



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SECTION-I

NOTICE INVITING TENDER

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To

M/s

Dear Sir,

Sub: TENDER FOR "Construction of 33kV Ring Main System including 33/0.433kV substations at NIT, Rourkela campus, Orissa".

1) Sealed item rate tenders are invited in the prescribed form from bonafied contractors for execution of electrical, civil, structural, data acquisition system (DAS), internal electrification, external electrification and external services and development works for the proposed "Construction of 33kV Ring Main System including 33/0.433kV substations at NIT, Rourkela campus, Orissa" as per following details.

- a. NAME OF THE WORK : "Construction of 33kV Ring Main System including 33/0.433kV substations at NIT, Rourkela campus, Orissa".
- b. ESTIMATED COST OF THE WORK : Rs.....
- c. EARNEST MONEY DEPOSIT : Rs. 2 lakhs.
- d. PERIOD OF COMPLETION : Eight (8) Calendar Months
- e. VALIDITY OF TENDER : 90 Days
- f. DATE OF ISSUE OF TENDER : From Upto..... during office hours
- g. PRE BID MEETING WITH CONTRACTOR :at 10.30 A.M.
- h. LAST DATE OF SUBMISSION : upto 3 P.M.
- i. DATE & TIME OF OPENING OF THE TENDER : at 3.30P.M.

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- 2) Clarifications, if any, regarding this tender should get clarified from the Consultant. A prebid conference shall be arranged on in the office of Director, National Institute of Technology, Rourkela- 769008 (Orissa) to discuss the relevant points/clarification if any, "So that tenderers are well acquainted" with the details of the Tender.
- 3) Tender documents including all Bill of Quantities can be had from the office of REGISTRAR, NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA- 769008 (ORISSA).
- 4) The submission of bids by the Tenderer and opening of the same by REGISTRAR, NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA-769008 (ORISSA) will be done as per procedure enumerated below:

Envelope No.1. To contain Earnest Money in the form of Demand Draft/Pay Order favouring Nationalized Bank payable at Rourkela and Prequalification documents.

EARNEST MONEY DEPOSIT : As per clause 1.c above.

Prequalification documents : As per clause 6.0 of Section-II : Instructions for submission of tender.

Envelope No.2 To contain Unpriced Techno-commercial bid in sealed envelope.

(Unpriced Bid) : To contain technical part comprising of Unpriced and signed Schedule of Quantities, drawings, documents and catalogues as indicated in different sections of the Technical Specification (Section-VI) and Commercial terms and conditions.

Envelope No.3 To contain priced Proposal Particular Sheets in sealed envelope.

(Price Bid) : To contain the Tender with Schedule of rate duly filled in, signed and stamped on all pages. Discounts, if any, should be properly mentioned e.g. 0.531% (ZERO POINT FIVE THREE ONE PERCENT).

All the above Envelopes shall be super scribed with:

Envelope No.----

Name of the Work :

Due Date of Submission :

And to be addressed to the concerned authority as mentioned in the NIT.

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NOTE: Tenderer's are advised not to make any alteration/modification in the tender documents, items of work or in any respect whatsoever. Violation of this requirement will make the Tender Liable for rejection.

Envelope No.1. Will be opened first on the due date of opening. Upon finding satisfactory compliance of this requirement, Envelope No. 2 & 3 will be opened on the same date.

- 5) Tenders are to be submitted in one sealed envelope cover enclosing therein the Envelope No.1, 2 and Envelope No.3.
- 6) The tenderer must use only the tender forms issued for the purpose to fill in the rates.
- 7) Rates should be quoted both in figures and words in columns specified. All erasures and alterations made while initials of the tenderer must attest filling the tender. Overwriting of figures is not permitted. Failure to comply with either of these conditions will render the tender invalid and it will be the discretion of DIRECTION, NATIONAL OF TECHNOLOGY, ROURKELA-769008 (ORISSA) to accept or reject the tender. No request of any change in rate or conditions after opening of the tender will be entertained.
- 8) In the case of figures, the word 'Rs' should be written before the figures of rupees and the word 'P' written after the decimal figures e.g Rs.3.25 P. In the case of words, the word Rupee should similarly precede and the words "Paise only" should be written at the end, closely following each the percentage rate. The word "only" should not be written in the next line unless the rate quoted is in whole Rupees closely followed by the word "only": The amount should invariably be upto two decimal places.
- 9) Errors in the bill of quantities shall be dealt with in the following manner.
 - a. In the event of any discrepancy between the rates quoted in words and the rates in figures the former shall prevail.
 - b. In the event of an error occurring in the amount column of the bills of quantities as a result of the wrong extension of the unit rate and the quantity, the unit rate shall be regarded, as firm and extension shall be amended on the basis of the rates.
 - c. All the errors in totaling in the amount column and in carrying forward the totals shall be corrected.
- 10) Each of the tender documents should be signed by the person or persons submitting the tender in token of his/their having acquainted himself/themselves

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with the General and Special Conditions of Contract, Specifications etc., as laid down. Any tender with any of the documents not so signed will be subjected to rejection.

- 11) The tender submitted on behalf of a firm shall be signed by all partners of the firm or by a partner who has the necessary authority on behalf of the firm to enter the proposed contract. Otherwise the tender may be rejected by DIRECTOR, NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA-769008 (ORISSA).
- 12) No consideration will be given to a tender received after the time stipulated above and no extension will be allowed for submission of the tender. The Director shall have the right to reject any tender not conforming to prescribed procedure (or all tenders) without assigning any reason.
- 13) The time allowed for completion of works is eight (8) Calendars months (including monsoon period) for construction and the date of commencement of the work is reckoned from the fourteenth day from the date of Letter of Intent. Time shall be considered the essence of contract.
- 14) Water and electricity required for the completion of the construction shall be provided by the institute. However contractor to will have to make arrangement of pipe line for water and electric poles wires cable etc. for electricity.
- 15) Every tender shall be accompanied by earnest money of Rs 2 lakhs by way of Demand Draft/Pay order favouring NATIONAL INSTITUTE OF TECHNOLOGY AT ROURKELA- 769008 (ORISSA). Tender submitting without earnest money shall be summarily rejected.
- 16) The Earnest Money will be retained in the case of the successful tenderer as part of the security for due fulfillment of the Contract. No interest shall be paid on this deposit. Failure to enter into the contract agreement within the stipulated time of 30 days from the date of letter of Intent shall entail the forfeiture of the Earnest Money Deposit. The Earnest Money of unsuccessful tenderers will be released after issue of work order, without any interest.
- 17) The tenderer shall submit his tender after carefully examining the whole of the tender document and the terms and conditions of contract, the drawings and specifications, the schedule of quantities etc., and also after examining the site and conditions prevailing in and around site.
- 18) The notice inviting tenders, the conditions of tender and the duly completed form of tender etc., will form part of the Agreement to be executed by the successful tenderer with the owner.

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- 19) The Owner does not bind himself to accept the lowest or any tender and reserve to themselves the right of accepting the whole or any part of the tender and tenderer is bound to perform the same at the rates quoted. The owner will not be bound to accept the lowest tender and reserves the right to accept or reject any or all the tender without assigning any reasons whatsoever.
- 20) Tenders shall remain valid for a period of 90 days from the date of opening of the tender which period may be extended by mutual agreement and the tenderer shall not cancel or withdraw the tender during the initial validity period of 90 days.
- 21) The successful tenderer shall be bound to implement the Contract and mobilize and sign specified agreement within 21 days from the date of Letter of Intent.
- 22) Tenderers must include in their rates, sales tax (both CST & LST), VAT, excise duty, octroi, sales tax on works contract and any other tax & duty or other levy by the central and state government or any other tax & duty or other levy or to be levied in future by the central government or state government or local authority if applicable. No claim in respect of sales tax, excise duty, octroi, turn-over tax, sales tax on works contract or other tax, duty or levy etc., shall be accepted by the owner, if found later on to be additionally payable. Deductions in respect of sales tax or turnover levied as per government notification and /or guidelines shall be made from the contractor's interim and final bills, and deposited with the relevant authority by the owner on his behalf. Any shortfall in deposit thereof shall be made up by the contractor, before submitting his final bill.
- 23) This contract shall be an item rate contract. The Contractor shall be paid for actual quantity of work done, as measured at site including any deviation plus or minus. The rate of any non-schedule items of work shall be derived as per conditions of this contract.
- 24) The tender drawings exhibited/enclosed are preliminary drawings intended for the guidance of the contractor only. They may be subject to revision and alteration without vitiating any of the terms of the contract and the contractor shall be bound to execute the works as shown on the final drawings without claiming any extra payment.
- 25) No correspondence will be entrained in respect of this tender other than any clarifications strictly pertaining to this tender.
- 26) All the correspondence and documents shall be in English only.
- 27) The tender price quoted by a tenderer shall be kept strictly confidential and shall not be divulged to any other party even approximately before the time limit for delivery of tender. The only exception be for obtaining an insurance quotation, you may give your insurance company or agent any essential information they ask for,

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so long as it is done in strict confidence. No information about other's tender price should be obtained and no arrangement with anyone else should be made whether or not be submit the tender.

- 28)** For electrical, sanitary, water supply and drainage works, tenderers must possess respective licenses from the competent authority valid in Rourkela (Orissa), wherever applicable.
- 29)** Contractor should sign at the end of every page prior to submitting the tender.

Director,

National Institute of Technology

Rourkela- 769008 (Orissa)

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SECTION-II

INSTRUCTIONS FOR SUBMISSION OF

TENDER

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INSTRUCTIONS FOR SUBMISSION OF TENDERS

NOTE: Tenderers are requested to note that non-compliance of the following instructions is liable to render their tenders unacceptable.

1. Address at which the tender is to be submitted :

REGISTRAR,
NATIONAL INSTITUTE OF TECHNOLOGY,
ROURKELA-769008 (Orissa).

2. a. Prebid conference date
- b. Last date for receipt of tender
- c. Date of opening of tender

3. The different Schedules should be filled as follows:

- a. The "Rate" Column wherever applicable to be legibly filled in ink in both figures and words.
- b. The "Amount" Column also to be legibly filled in ink in both figures and words.
- c. All corrections to be initialed.
- d. No over writing is allowed.
- e. The figure of percentage of rate shall be legibly filled in ink in both figure and words.

4. Bank Guarantee or cheques shall not be accepted for the Earnest Money Deposit. "The Earnest Money Deposit should be in strict compliance of requirement as specified in the tender documents.

5. The tender shall be signed and dated at all places provided therein. Also all pages, drawings and corrections/alternations shall be initialed. The tender submitted on behalf of a firm shall be signed by all the partners of the firm or by a partner who has the necessary authority on behalf of the firm to enter into the proposed contract.

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6. **PREQUALIFICATION REQUIREMENT:**

Part-2 and 3 of the tenders shall be opened if the bidder meets the following criteria:

- a) Must have done similar nature of work.
- b) Must have worked with Govt. of India/Orissa or a Public Undertaking.
- c) Must have executed a single work of Rs. 3 crore or at least two similar works of Rs. 2 crore each in last 3 years.
- d) Must be an active contractor for last 3 years.
- e) Must have own capability of developing drawings/design for electrical and civil/structural.

7. **CONDITIONAL OFFER:** Any tenderer who proposes alterations to any of the conditions/specifications laid down in the tender documents or proposes any new conditions, whatsoever shall be summarily rejected.

8. **PROCEDURE FOR SUBMISSION AND OPENING OF TENDERS:**

- a. Tenders must be submitted on the tender documents issued by the Accepting Officer. Intimation of tender quoted by a letter, telegram or telex will not be accepted.
- b. Tenderers are expected not to propose any alterations to any of the conditions laid down in the tender. Stipulated conditions embodied in the tender shall be binding on the tenderers.
- c. In view of the postal and other delays the tenders should be posted sufficiently in advance of the last date and time fixed for receipt of tenders or be sent by a special messenger. Tender received late shall be rejected.
- d. The procedure for submission and opening of tenders has been set out in details in tender documents.

9. Drawings must be returned along with the tender documents duly stamped and signed. These Drawings are for reference only.

10. **VALIDITY OF TENDERS**

Tenderers should note that their tenders should remain open for consideration for a minimum period of 90 days from the last date fixed for the receipt of tenders. The validity period may, however be extended by mutual agreement. The tenderer

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shall not be allowed to cancel or withdraw the tender during the initial validity period of 90 days.

11. For Electrical, civil and structural works, Tenderers must possess respective licenses from the respective authorities valid in Rourkela for doing such works.

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SECTION-III

TENDER FORMS

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TENDER FORM

NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA- 769008 (ORISSA)

To be returned by hours on And to be opened at hours on.....

To

Registrar,
National Institute of Technology,
Rourkela- 769008 (Orissa)

TENDER FOR : CONSTRUCTION OF.....

Sir,

1. We have read and examined the following documents as received by us:
 - a. Notice Inviting Tender.
 - b. Instruction to Tenderers.
 - c. General Conditions of Contract.
 - d. Special Conditions of Contract.
 - e. Specifications.
 - f. Drawings
 - g. Schedule of Quantities.

2. We are well aware and are familiar with REC (Rural Electrification Corporation) specifications, BIS and CBIP publications and IEC code which shall apply to this contract to supplement any missing details in this contract in order of preference.

Further to the above, we have visited and examined the site of the proposed works and have acquired the requisite information relating thereto as affecting the tender invited by you.

3. We agree that any other terms or conditions of contract or any general reservation which may be printed on any correspondence emanating from us in connection with this tender or with any contract resulting from this tender shall not be applicable to this tender or to the contract.

4. We have obeyed the rules about confidentiality of tenders and will continue to do so as long as they apply.

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5. We are enclosing along with tender an earnest money being Rs. 2 Lakhs in the form of Crossed Demand Draft on Nationalised Rourkela Bank. We hereby agree that this sum shall be forfeited by DIRECTOR, NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA-769008 (ORISSA) in the event of our tender being accepted and if we fail to execute the contract when called upon to do so. We note that Earnest Money Remittance in form other than Crossed Demand Draft on Rourkela Bank shall not be accepted.
6. Subject to and in accordance with paragraphs 3 & 4 above and the terms and conditions contained or referred to in the documents listed in paragraph 1, we agree and offer to execute all the Works referred to in the said documents upon the terms and conditions contained or referred to therein and to carry out such deviations as may be ordered to be valued as per the conditions of contract.
7. We undertake to complete and deliver the whole of the works within a period as specified in the contract and further confirm that the time allowed for completion is adequate. Time allowed for completion of entire job or part job assigned shall be reckoned from the tenth day of the date of letter of intent. We shall be under the obligation to pay the sum as stated in the contract or every day that the works shall remain incomplete, damages as compensation subject to the conditions of contract relating to extension of time.
8. We hereby also agree that unless & until a formal agreement is prepared & executed in accordance with the Articles of agreements, this tender together with your acceptance thereof, shall constitute a binding contract between us.
9. The person/persons whose tender may be accepted (hereinafter called the tenderer) shall pay initial deposit of 2% (including Earnest Money) by way of Demand Draft in favour of NATIONAL INSTITUTE OF TECHNOLOGY, payable at Rourkela. This amount shall be released after virtual completion of work. We further agree for a deduction of 10% from the running bill as retention money till accumulating total security deposit.
10. Validity of the tender shall be 90 days from the date of opening of tender or it may be beyond 90 days if mutually accepted.
11. The Owner is a liberty to accept or reject any tender, without assigning any reasons whatsoever.
12. Work may be split up in the first instance. But it may be split up in more parts or parts combined if so desired by the Owner without assigning any reasons whatsoever.
13. Adherence to the pert chart shall be ensured by the contractor as the project is to be executed in a very strict time frame.

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14. In the event of our selection of award of work we agree to submit a PERT/BAR Chart based on the drawings along with the tender documents before the issue of work order. And this will form a part of the agreement.

Signed in the capacity of duly authorised to sign tenders for and on behalf of

Address..... Telephone No.....
 Telex No.....
 Fax No.....

Date: -

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SECTION-IV
GENERAL CONDITIONS OF
CONTRACT

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GENERAL CONDITIONS OF CONTRACT

DEFINITIONS & INTERPRETATION

1.1 Definitions

In the contract (as hereinafter defined) the following words and expression shall have the meanings hereby assigned to them except where the context otherwise requires:-

- a] “Owner” means the NIT, Rourkela.
- b] “Consultant” means Satcon, Kolkata.
- c] “Contractor” means the person or persons, firm or company, whose tender has been accepted by the Owner and includes the Contractors personal representatives, successors and permitted assignees.
- d] “Engineer-in-charge” means representative of NIT, Rourkela and notified in writing to the contractor to act as Engineer for the purpose of the contract.
- e] “Engineers representative” means any resident engineer or assistant of the Engineer or any clerk of works or any other employee or agent appointed from time to time by the Owner.
- f] “Work” shall mean and include all work specified or set forth and required in and by the specifications drawing and schedule here to be annexed or to be implied there from or incidental thereto or to be hereafter specified or required in such explanatory instructions and drawings.
- g] “Contract” means the Invitation to Tender, Instructions to Tenders, General Conditions of Contract, Special conditions of Contract, Specifications, Drawings, Tender Schedule showing approximate quantities, quoted rates and amount against each item, Time Schedule, Letter of intent, Tender and the Contract agreement.
- h] “Contract” Price” means the sum named in the tender subject to such additions thereto or deductions there from as may be made under the provisions of the Contract.
- i] “Constructional Plant” means all appliances or things of whatsoever, nature required in or about the execution, completion or maintenance of the Works or Temporary Works.
- j] “Temporary Works” means all temporary works of every kind required in or about the execution, completion or maintenance of the work.
- k] “Drawing” means the drawings referred to in the Specification and any modification of such drawings approved in writing by the Engineer and such other drawings as may from time to time be furnished or approved in writing by the Engineer.
- l] “Site” means the lands and other places envisaged by the Owner where the work are to be executed or carried out.
- m] “Letter of Intent” is an intimation by a letter to tenderer that tender has been accepted in accordance with the provision contained in that letter.

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n] “Approved” means approved in writing including subsequent written confirmation of previous verbal approval.

1.2 Terms “Specifications”

The term ‘Specification’ shall mean schedules, detailed designs, statements of technical data, performance characteristics and all such particulars mentioned as such in the contract. In the absence of any specific specifications issued by the Owner, the specifications issued by the B.I.S will apply.

2.0 Engineer’s Representative

The duties of the Engineer’s representative are to watch and supervise the works and to test and examine any materials to be used or workmanship employed in connection with the works. He shall have no authority to relieve the Contractor of any of his duties or obligations under the Contract nor except as expressly provided hereunder or elsewhere in the Contract to order any work involving delay or any extra payment by the Owner nor to make any variation of or in the Works. The Engineer may from time to time in writing delegate to the Engineer’s representatives any of the powers and authorities vested in the Engineer.

3.0 Assignment and Sub-Letting

The Contractor shall not assign the Contract or any part thereof or any benefit or interest therein or there under without the prior written consent of the Owner.

The Contractor shall not sublet the whole or a part of the work without prior written consent of the Owner and Sub-Contractor or Sub-Contractors are approved in writing by the Owner. Subletting 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, his agents, servants or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his agents, servants or workmen. Subletting beyond the first stage shall not be permitted.

4.0 Extent of Contract

The Contract comprises of the construction, completion and maintenance of the works & except in so far as the contract otherwise provides the provision of all labour, materials, Constructional Plant, temporary works and everything whether of a temporary or permanent nature, required for such construction, completion and maintenance.

5.0 Contract Documents

The drawings shall remain in the sole custody of the Engineer but two copies thereof shall be furnished to the Contractor free of cost.

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One copy of the drawings furnished to the Contractor as aforesaid shall be kept by the Contractor on the site and the same shall at the reasonable times be available for inspection and use by the Engineer and Engineers representative and by any other person authorized by the Engineer.

6.0 General Obligations

6.01 *Contract Agreement* : The Contractor shall enter into and execute a contract agreement in the form annexed hereto within the time specified in letter of intent and in default thereof the earnest money paid by the Contractor shall be forfeited and acceptance of his tender shall be considered as withdrawn. The cost of the stamp fee of the agreement is to be borne and paid by the contractor.

6.02 *Security Deposit* : The Contractor shall within the time specified in the letter of intent/work order deposit with the NIT Rourkela, further sum in addition to the earnest money paid with the tender to work upto a rate 2 ½ % of the value of the contract at the accepted rates as security deposit in cash or in the form of demand draft from a Nationalized Bank in favour of NIT, Rourkela.

In the event of this not being furnished within the period specified in the letter of intent/work order the earnest money shall stand forfeited and acceptance of the Contractor's tender shall stand withdrawn.

To this sum shall be added the deduction from the contractor's interim bills for work done, so as to make a total security of 10% of the value of the contract as aforesaid.

The security deposit shall remain at the entire disposal of the Owner as a security for the satisfactory execution and completion of the works in accordance with the conditions of the contract.

“When the Security Deposit exceeds Rs.1.00 lakh (Rupees one lakh only), the Contractor, if he so desires, may convert the amount in excess of Rs.1.00 lakh into a Bank Guarantee Bond of one of the Scheduled or Nationalized Banks.

On due satisfactory performance and completion of the contract in all respects, the security deposit will be returned to the Contractor without any interest on presentation of an absolute no demand certificate from the Engineer in the prescribed form after completion of maintenance period.

6.03 *Work to the satisfaction of Engineer* : The Contractor shall execute, complete and maintain the works in strict accordance with the Contract to the satisfaction of the Engineer and shall comply with and adhere strictly to the Engineer's instructions and directions on any matter. The Contractor shall take instruction and directions only from the Engineer/Engineer's representative.

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- 6.04 *Programme to be furnished* : As soon as practicable after the acceptance of his tender, the Contractor shall, if required submit the Engineer for his approval a programme showing the order of procedure and method in which he proposes to carry out the works.
- 6.05 *Contractors Superintendence* : The Contractor shall give or provide all necessary superintendence during execution of the works. The Contractor or his competent and authorized agent is to be constantly on the works and shall give his whole time to the superintendence of the same.
- 6.06 *Contractors Employees* : The Contractor shall provide and employ on the site in connection with the execution and maintenance of the Works:
- (a) Technical assistants and other staff, skilled and experienced in their respective Area who are competent to give proper supervision to the work.
 - (b) Skilled, semi-skilled and unskilled labour as is necessary for the proper and timely execution and maintenance of the works.
- 6.07 *Setting-out of the Works* : The Contractor shall be responsible for the true and proper setting out of the works and for the correctness of the positions, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliance and labour in connection therewith. The checking of any setting out or of any line or level by the Engineer or the Engineer's representative shall not in any way relieve the Contractor of his responsibility for the correctness thereof.
- 6.08 *Use of the Explosives* : Explosive shall not be used on the works by the contractor without the permission in writing of the Engineer.
- 6.09 *Watching & Lighting* : The Contractor shall in connection with the works provide and maintain at his own cost all light, guards, fencing and watching when and where necessary or required by the engineer/engineer's representative.
- 6.10 *Care of Works* : From the commencement to the completion of the works, the Contractor shall take full responsibility or the care thereof & of all the temporary works and in case any damage, loss or injury shall happen to the works or to any part thereof or to any temporary works form any cause whatsoever.
- 6.11 *Accident or injury to Workman* : The Owner shall not be liable for or in respect of any damages or compensation payable by Law in respect or in consequence of any accident or injury to any workman or other person in the employment of the Contractor or any sub-contractor save and except an accident or injury resulting from any act or default or the Owner.
- 6.12 *Workman's Compensation* : The Contractor shall at all times indemnify the Owner against all claims for compensation under the provision of the Workman's Compensation Act. or

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any other Law for the time being in force by or in respect of any workman employed by the Contractor in carrying out the contract.

- 6.13 *Giving of Notice and Payment of fees* : The Contractor shall give all notices and pay all fees required to be given or paid under any Central or State Statute, Ordinance or other Law.
- 6.14 *Compliance With Statutes Regulation etc* : The Contractor shall conform in all respects with the provision of any such Statute, Ordinance or Law as aforesaid and the rules, Regulations or Bye-Laws of any local or other duly constituted authority which may be applicable to the Works.
- 6.15 *Opportunities for other Contractors* : The Contractor shall in accordance with the requirement of the Engineer afford all reasonable opportunities for carrying out their work to any other contractors employed by the Owner and their workmen and to the workmen of the Owner & of any other duly constituted authorities who may be employed in the execution on or near the site of any work not included in the Contract.
- 6.16 *Supply of Plant Materials and Labour* : Except where otherwise specified the Contractor shall at his own expense supply and provide all the Constructional Plant, materials both for temporary and for permanent works, and labour required for the constructions completion and maintenance of the works.
- 6.17 *Site Clearance on Completion of Work* : On the completion of the work all rubbish, debris, kilns, vats tanks, materials and temporary structures of any sort or kind used for the purpose or connected with its construction are to be removed by the contractor and all pits and excavations filled up and the site handed over in a tidy and workmanlike condition.

7.0 Labour

In respect of all labour directly or indirectly employed on the works, the Contractor shall comply with all rules framed from time to time by Government (Central or State) or other local authority and legislations governing labour for the protection or health, sanitary arrangements, wages, welfare and safety of workers.

8.0 Work Materials and Plant

- 8.01 (a) All materials and workmanship shall be of the respective kinds described in the Contract and in accordance with the Engineer's instructions and shall be subjected from time to time to such tests as the Engineer may direct at the place of manufacture or fabrication or on the site. The Contractor shall provide such assistance, instruments, machines, (labour and materials as are normally required for examining, measuring and testing any work and the quality).

(b) All sample shall be supplied by the Contractor at his own cost.

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(c) The cost of making any test in performance of his works, shall be borne by the Contractor.

8.02 *Access to Site* : The Owner and / or the Engineer and any person authorized by him shall at all times have access to the works and to the site.

8.03 *Removal of improper Work and Materials* : The Engineer shall during the progress of the works have power to order in writing from time to time.

- (a) The removal from the site of any materials which in the opinion of the Engineer are not in accordance with the Contract.
- (b) The substitution of proper and suitable materials.
- (c) The removal and proper re-execution of any work which in respect of materials or workmanship, is not in the opinion of the Engineer in accordance with the contract.

9.0 Commencement Time & Delays

9.01 *Commencement of Works* : The Contractor shall commence the works on site within the period indicated in the Contract and shall proceed with the same with due expedition and without delay except as may be ordered by the Engineer.

9.02 *Time for Completion* : The whole of the works shall be completed within the time stated in the contract.

9.03 *Extension of time for Completion* : Should the amount of extra or additional work of any kind or other special circumstances of any kind whatsoever which may occur be such as fairly to entitle the Contractor to extension of time for the completion of the work the Engineer shall determine the amount of such extension.

9.04 *Rate of Progress* : The whole of the materials, plant and labour to be provided by the Contractor & the mode, manner and speed of execution and maintenance of the works are to be a kind and conducted in a manner to the satisfaction of the Engineer. Should the rate of progress of the work or any part thereof be at any time in the opinion of the Engineer too slow to ensure the completion of the works by the prescribed time or extended time for completion, the Engineer shall so notify the Contractor in writing and the Contractor shall thereupon take such steps as the Contractor may think necessary and the Engineer may approve to expedite progress so as to complete the works by the prescribed time of extended time for completion. If the work is not being carried on by day and by night and the Contractor shall request permission to work by night as well as by day.

9.05 *Liquidated Damages to Delay* : In case the Contractor fails to complete the work within the stipulated time period indicated in the contract, unless such failure is due to force majeure or due to the Owner's default, the contractor shall pay to the Owner by way of compensation for delay and not as penalty, a sum up to maximum 10% of the contract

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value. This is agreed that this is a pre-estimate of the loss/damage which will be suffered on account of delay/breach on the part of the contractor and the said amount will be payable on demand without there being any proof of the actual loss or damages caused by such delay/breach. The decisions of the Engineer/Site-in-charge in regard to the actual delay will be final and binding on the contractor.

- 9.06 *Certificate of Completion of Works* : As soon as in the opinion of the Engineer the works shall have been substantially completed & shall have satisfactorily passed any final test that may be prescribed by the contract the Engineer shall on receiving a written undertaking by the contractor to finish any outstanding work during the period of Maintenance, issue a certificate of completion in respect of the works and the period of Maintenance of the works shall commence from the date of such certificate.
- 9.07 *Definition of Period of Maintenance* : In these conditions the expression “Period of Maintenance” shall be either twelve months or any other period if specifically specified in the special conditions of this contract, and calculated from the date of completion of the works certified by the Engineer.
- 9.08 *Execution of Works of repair etc.* : To the intent that the works shall at or as soon as practicable after the expiration of the period of maintenance be delivered up to the NIT in as good & perfect a condition to the satisfaction of the Engineer as that in which they were at the commencement of the period of maintenance the Contractor shall execute all such work of repair, amendment, reconstruction, rectification and making good of defects imperfection, or other faults as may be required of the contractor in writing by the Engineer during the period of maintenance.
- 9.09 *Cost of Execution of Works of Repair etc.* : All such work shall be carried out by the contractor at his own expense if the necessity thereof shall in the opinion of the Engineer be due to the use of materials or workmanship not in accordance with the contract or to neglect or failure on the part of the contractor to comply with any obligation expressed or implied on contractor’s part under the contract.

10.0 Alternations, Additions & Omissions

- 10.01 *Variations* : The Engineer shall make any variation of the form of quantity of the works or any part thereof that may in his opinion be necessary and for that purpose or if for any other reason it shall in his opinion be desirable shall have power to order the contractor to do and the contractor shall do any of the following :
- a) Increase or decrease the quantity of any work included in the contract.
 - b) Omit any such work.
 - c) Change the character or kind of any such work.

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- d) Execute additional work of any kind necessary for the completion of the work.

10.02 *Valuation of Variation* : The Engineer shall determine the amount (if any) to be added or to be deducted from the sum named in the tender in respect of any extra or additional work done or work omitted by his order. All such work shall be valued at the rates set out in the Contract if in the opinion of the Engineer the same shall be applicable.

10.03 *Claims* : The Contractor shall send to the Engineer's representative once in every month an account giving particulars as full and detailed as possible of all claims for any additional expense to which the Contractor may consider himself entitled and of all extra or additional work order by the Engineer which he has executed during the preceding month and no claim for payment for any such work will be considered which has not been included in such particulars.

10.04 *Materials Obtained from Dismantlement and Excavation etc* :

- (1) The Contractors in the course of their works, should understand that all material obtained in the work of dismantling, excavation etc. will considered Owner's property.
- (2) All gold, silver, oil and other minerals of any description and precious stones, coins, treasures, etc. which shall be found in or upon the site shall be the property of the Owner, and the Contractor shall duly preserve the same to the satisfaction of Owner and shall from time to time, deliver the same to such person or persons as the Owner may appoint to receive the same.

11.0 Measurement

11.01 *Quantities* : The quantities set out in the tender Schedule are the estimated quantities of the work but they are not to be taken as the actual and correct quantities of the works to be executed by the Contractor in fulfillment of his obligations under the Contract.

11.02 *Works to be Measured* : The Engineer shall except as otherwise stated ascertain and determine by taking measurement of the work done in accordance with the Contract. He shall when he requires any part or part of the works to be measured give notice to the Contractor's authorized representative should forthwith attend or send a qualified agent to assist the Engineer or his representative in making such measurement and shall furnish all particulars required by them. The Contractor shall be paid for the quantities resulting from measurement of the executed work.

12.0 Provisional Payment

(a) No payment's shall ordinarily be made for works estimated to cost less than Rupees One Thousand till after the whole of the works shall have been completed but if any payment during the course of the execution of works is considered desirable in the interest of works, the Contractor may be paid at the direction of Engineer. But in the case of works

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estimated to cost more than Rupees One Thousand, mostly payments for the portion of work already done, may be made either on the basis, of measurements to be recorded by the Engineer or the Contractor shall on submitting the bill therefore be entitled to receive a monthly payment proportionate to the part there of then approved and passed by the Engineer, whose passing of the sum to be payable shall be final and conclusive against the Contractor. But all such intermediate payments shall be regarded as payments by way of advance against the final payment only.

(b) A bill shall be submitted by the Contractor each month on or before the date fixed by the Engineer for all work, executed in the previous month and the Engineer shall take or cause to be taken the requisite measurement for the purpose of having the same verified and the claim, as far as admissible, adjusted, if possible, before the expiry of ten days from the presentation of the bill. If the Contractor does not submit the bill within the time fixed as aforesaid the engineer may depute his representative to measure up the said work in the presence of the Contractor, whose countersignature to the measurement list will be sufficient warrant and the Engineer may prepare a bill from such list which shall be binding on the Contractor in all respects.

(c) As and by way of additional security from every progressive on account bill of the Contractor, 7 ½ percent of the value of the work executed, shall be deducted and kept as security deposit until the total of the amount so deducted plus the security (including the earnest money) already deposited will equal the prescribed security, which is 10 % of the value of the works.

(d) The Owner shall not be liable for any loss of securities of any description, nor for any depreciation in the value of securities while in its charge nor for any loss of interest thereon.

The Owner shall not be liable to the Contractor for any matter or thing arising out of or in connection with the contract or the execution of the works unless the contractor shall have made a claim in writing in respect there of before the giving of the Maintenance Certificate under this clause.

13.0 Remedies and Powers

13.01 *Forfeiture* : If the Contractor shall become bankrupt or have an order for appointment of any receiver made against him or shall present any petition in bankruptcy or shall make an arrangement with or assignment in favour of his creditors or shall agree to carry out the Contract under a committee of inspection of his creditors or if the Contractor shall assign the Contract within the consent in writing of the Owner first obtained or shall have an execution levied on his goods or if the Engineer shall certify in writing to the Owner that in his option the Contractor :-

(a) has abandoned the Contract, or

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- (b) without reasonable excuse has failed to commence the works or has suspended the progress of the works for 28 days after receiving from the Engineer written notice to proceed, or
- (c) has failed to remove materials from the Site or to pull down and replace work for 28 days after receiving from the Engineer written notice that the said materials or work had been condemned and rejected by the Engineer under these conditions, or
- (d) is not executing the works in accordance with Contract or is persistently or flagrantly neglecting to carry out his obligations under the Contract, or
- (e) has to the detriment of good workmanship or in defiance of the Engineer's instructions to the contrary sub-let any part of the contract, or
- (f) otherwise failed to perform his part of the contract according to the true intent & meaning thereof then the Owner may after giving 14 day's notice in writing to the Contractor, enter upon the site and the works and expel the Contractor there from without thereby avoiding the contract or releasing the Contractor from any of his obligations or liberties under the Contractor or effecting the rights & powers conferred on the Owner or the Engineer by the Contract or otherwise available under the law and may himself complete the works or may employ any other Contractor to complete the works.

13.02 *Valuation at Date of Forfeiture* : The Engineer shall as soon as may be practicable after any such entry and expulsion by the Owner fix and determine ex-parte or by or after reference to the parties or after such investigation or enquiries as he may think fit to make or institute and shall certify what amount (if any) had at the time of such entry and expulsion been reasonable earned by or would reasonable accrue to the Contractor in respect of work then actually done by him under the Contract.

13.03 *Payment after Forfeiture* : If the Owner shall enter and expel the Contractor under this clause he shall not be liable to pay to the Contractor any money on account of the Contract until the expiration of the Period of Maintenance and there after until the costs of completion and maintenance damages for delay in completion (if any) and all other expenses incurred by the Owner have been ascertained and the amount thereof certified by the Engineer. The Contractor shall then be entitled to receive only such sum or sums (if any), as the Engineer may certify would have been due to him upon due completion by him after deducting the said amount.

13.04 *Illegal Gratification and breach the terms of Contract* : The Contract may also be rescinded and the Contractor shall be liable to make good any loss or damage resulting from such cancellation.

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(a) If any bribe, gratuity, gift, loan, perquisite, reward or advantage, pecuniary or otherwise, shall either directly or indirectly be given, promised or offered by the contractor, any of his servants or agents to any public office or person in the employment of the Owner in any way relating to his office or employment or if any such officer or person shall become in any way directly or indirectly interested in the contract, or

(b) If the Contractor has committed a breach of any of the terms of the contract and in particular fair wages clause and labour regulations.

13.05 *Urgent Repairs* : If by reason of any accident or failure or other event accruing to or in connection with the works or any part thereof either during the execution of the works or during the period of Maintenances, any remedial or other work or repair shall in the opinion of the Engineer or the Engineer's representative be urgently necessary for security and the Contractor is unable or unwilling at once to do such work or repair the Owner may be his own or other workmen do such work or repair as the Engineer or the Engineer's representative may consider necessary. If the work or repair so done by the Owner is work which in the opinion of the Engineer, the Contractor was liable to do at his own expense under the Contract, all the cost and charges properly incurred by the Owner in so doing shall on demand be paid by the Contractor to the Owner or may be deducted by the Owner from any money due or which may become due to the Contractor provided always that the Engineer or the Engineer's representative (as the case may be) shall as soon after the occurrence of any such emergency as may be reasonable practicable notify the Contractor thereof in writing.

10.06 *Owner Will have full Liberty to retain and set off sums due or to Become due to Contractor* : The Owner will have full liberty to retain and set off all sums due or to become due to the Contractor (including Security Deposits and Earnest money) whether under this contract or under any other transaction or claim whatsoever, against any sum due or to the Owner under this contract or under any other transaction or claim whatsoever.

14.0 Notice

14.01 *Service of Notice on Contractor* : Any notice to be give to the Contractor under the terms of the Contract shall be served by sending the same by post to or leaving the same at the Contractor's principal place of business.

14.02 *Service of Notice on Owner* : Any notice to be given to the Owner under the terms of the contract shall be served by sending the same by post to or leaving the same at the Owner's last known address.

14.03 *Importance of Special Conditions* : The Special Conditions attached hereto where they differ from the General Condition and Specifications shall over- ride them similarly the description of work in the tender schedule where it differs from the specifications or drawings shall over-ride them.

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15.0 Miscellaneous

- 15.01 *Provision of Adequate Shoring* : The Contractor shall at his own cost, provide the material for and execute all such shoring, timbering and strutting as is necessary during the execution of work for the stability and safety of all structures, excavations and works such that no damage, injury or loss is caused or likely to be caused to any person or property.
- 15.02 *Provision of Shed, Store, Houses etc.* : The Contractor shall, at his own cost, provide such sheds or damp proof store houses as the Owner may consider necessary for storage of materials and shall also at his own cost provide Concrete Mixer, Soaking vats etc.
- 15.03 *Payment of Wages act* : The Contractor shall comply with the provisions of the Payment of Wages Act, and the Rules made there under in respect of all employees employed by him in carrying out this contract as he himself and not the Owner, is responsible under the said act for the compliance thereof.
- 15.04 *Safety* : The Contractor shall be responsible for the safety of his workmen and employees. All serious accidents to them on construction site are to be immediately reported. The Contractor shall be responsible that all such accidents, however and wherever occurring on his works, are reported with out delay to the Engineer and he should make every arrangement to give all possible assistance.
- 15.05 *Laws, Bye Laws etc. relating Works* : The Contractor shall strictly conform to the provisions, for the time being in force of any law relating to works of any regulations and byelaws made by any local authority or any water and lighting companies or any undertakings, within the limits of the jurisdiction of which it is proposed to execute the work.
- 15.06 *Change in Partnership Firm* : In the case of contract by partnership firm, any change in the constitution of the firm shall forthwith be notified by the Contractor to the Engineer.
- 15.07 *Provision for settlement of disputes* : All questions, disputes or difference of any kind whatsoever, arising out of or in connection with the contract at any time, whether during the progress of the work or after its completion or whether before or after the determination of the contract, other than questions, disputes or differences for the decision of which specific provision have been made in the foregoing clause of these conditions (hereinafter referred to as “excepted matters” and decisions on such “except matters” according to the said specific provisions shall be final and binding on the Contractor and shall not be re-opened or attempted to be re-opened on the ground of any informality; omission, delay or error in the proceeding in or about the same or on any other ground whatsoever) shall be submitted in writing by the Contractor to the Owner and the Owner shall within a reasonable time, after the submission of the same, make and notify its decision thereon in writing.

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If the Contractor be dissatisfied with the decision of the Owner on any matter in question, dispute or difference on any ground in connection with this contract or as to the withholding by the Owner of any certificate to which the contractor may claim to be entitled to, or if the Owner fails to make a decision within a reasonable time, then and in any such case but not including any of the excepted matters, or matters for which the Contractor has given no claim certificates, the Contractor may within ten days of the receipt of such decision or after the expiry of the reasonable period of time, as the case may be, demand in writing that such matter in question, dispute or difference in connection with this contract be referred to arbitration. Such demand for arbitration shall be delivered to the Owner by the Contractor shall specify the matters which are in question, dispute or difference and only such question, dispute or difference, other than any of the excepted matters, in respect of the contract of which the demand has been made and no other shall be referred to arbitration.

The further progress of any work under the contract shall, unless otherwise directed by the Engineer, continue during the arbitration proceeding, and no payment due or payable by the Owner shall be withheld on account of such proceeding, provided, however, that it shall also be opened to the arbitrator to consider and decide whether or not such work shall continue during the arbitration proceeding.

Matters in question, dispute or difference other than the excepted matters, in respect of this contract to be submitted to arbitration as foresaid shall be referred for decision to a Sole Arbitrator, who shall be the Director, NIT, Rourkela, or any person nominated by him in his behalf.

In case an arbitrator nominated by Director, NIT, Rourkela fails or neglects to arbitrate or is removed, dies or become incapable or withdraw from arbitration for any reason whatsoever, the Director, NIT, Rourkela, as the case may be, shall have the authority to nominate any other person afresh and / or supply the vacancy for the arbitration.

Such submission shall deemed to be submission to arbitration and the decision of such arbitration shall be final and conclusive and the provision of the Indian Arbitration Act of the rules there under and all statutory modifications thereof shall govern all such arbitration proceeding and shall be deemed to apply to and be incorporated in this contract.

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- 15.08 *Wages to be Paid in time* : The contractor shall ensure that their employees are paid the wage in time and can only make such deductions which are authorized under the payment of wages act and rules framed there under, that relevant records and registers required to be maintained under the said Act & Rules to be maintained by the Contractors and produced before the officers of the Institute and such other authorities under the Act for scrutiny as & when required. In case the Contractors default in making statutory payments under payment of wages Act or any other labour Act, which the Contractor is obliged to make to their employees, the Owner reserves the right to deduct any amount from the bills of the Contractors towards payment to their employees on demand from the Govt. Labour Directorate. This amount shall be made available to such authorities of the Govt. for disbursement to the employees of the contractor. They, however, will be kept informed about the same.
- 15.09 *Malpractice* : Any unauthorized removal or possession of any of the Owner's properties by the Contractor, its agents, servants and / or employees shall be deemed to be a malpractice. If the Contractor is found guilty of Malpractice in the course of carrying out the contract resulting from the acceptance of his tender, the contract will be liable to be cancelled and the security deposit forfeited without prejudice to and other action which the Owner may take under law.
- 15.10 *Black Listing* : Any Contractor found guilty of theft or in unauthorized possession of Institute's properties, is liable to be debarred from allotment of further work and the work in hand is also liable to be terminated without any notice. Further such contractors are liable to be blacklisted form allotment of work in NIT. The above action will be taken in addition to the other penal action under the relevant provisions of law which the Owner may take.

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SECTION-V

SPECIAL CONDITIONS OF

CONTRACT

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SPECIAL CONDITIONS OF CONTRACT
FOR ENGINEERING WORKS

1. The scope of contract generally covers complete electrical, civil, structural, data acquisition and communication engineering works required in connection with (i) including all ancillary works and additions to existing Works and cleaning the site etc. complete as per the approved working drawings and instructions used to contractor from time to time. The contractor shall have to take the necessary precaution to safeguard against any damage to the neighboring existing structure and underground services etc.
2. The tenderer shall visit and is deemed to have visited the site and make himself thoroughly acquainted with the nature and requirement of the job, facilities of access for materials and removal of rubbish cost of carriage, freights and other charges and shall allow in his tender for special difficulties if any in carrying out the work. He shall also include in his tender, charges for doing final surfacing to all repairs required to be done for any type of fixture, installation, etc. and for the removal of spoil arising of his contract.
3. The contract for the work is a complete one for labour, materials and workmanship including the use of construction equipments, tools and tackles. The contractor shall have to make his own arrangement for all materials required for the due performance of the contract.
4. The specifications and drawings given for execution, acceptance of construction and erection works are obligatory on the contractor for the construction works of NIT, Rourkela. If in the course of construction work, some additional problems arise, which are not covered by the given specifications, the contractor will be given proper instruction by the Engineer. Such instructions shall be observed in full by the contractor regarding specifications, drawings, method of conducting work, any other measures necessary for the fulfillment of construction. Verbal instructions be always got confirmed from the Engineers concerned, before execution by the contractor.
5. Specifications for the quality of equipment and materials as also for the quality of construction work are given in corresponding sections of these specifications and / or the working drawings. Unless otherwise specified all materials and workmanship shall conform to the specifications attached and drawings supplied. Any item not covered by these, shall conform of the latest Indian Standard specifications or relevant International standards, as applicable.
6. Work shall be carried out in such a manner as not to interfere with or affect, retard or disturb the progress of other works being executed by other agencies. The contractor's rate shall include for any losses due to likely delay in coordinating with other works and interruption on account of inherent nature of the job, and as such, no extra claim will be admissible on such account.

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7. If due to the design and other stipulations in the tender, or requirements at site, a particular sequence of overall constructional operations has to be followed due to which certain interruptions to any one or more types of work or more types of work or items of execution are inherent, no claims for such interruption are admissible.
8. For carrying out the work, the contractor will be provided with two sets of working drawings.
9. All technical documents regarding the construction of works are generally given in the metric system and all works should be carried out according to the metric system. All documents concerning the work shall also be carried out in the metric system.
10. While carrying out the works the contractors should be provided for:-
 - a) Safety of personnel engaged on the construction.
 - b) Protection and safety of works during their progress.
 - c) Sanitary and hygienic condition of working and living for his workers, as per labour regulations.
11. In respect of portions of works which are likely to be embedded or covered up by the other works, the contractors shall submit them for technical inspection and have the necessary measurement, and completion certificates duly signed by the engineer and contractor before letting such portions to be embedded or covered.
12. On completion of work, the contractor must submit to the engineer the following documents for the handing over of the works:-
 - i) The technical documents according to which the work was carried out.
 - ii) A copy of the working drawing showing thereon all additions and alterations in the process of execution.
 - iii) Completion certificates for 'embedded' and 'covered up' works.
 - iv) Manufacturer's certificates, guarantees and test certificates.
 - v) Certificates or control checking and test of materials.
13. The contractor shall submit to the engineer, in the form required by him and in the appointed time, the information regarding the progress of the work being carried out by them.
14. The power given to the representative of the contractor for signing technical certificates shall be indicated in a special letter addressed to the engineer.
15. The technical commission for the acceptance of the covered work and unfinished work should consist of a representative each of:-
 - (1) Employer
 - (2) Consultants.
 - (3) Contractor who has done the work, and

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- (4) Agency who accepts the work for continuation of the construction of the works or/ erection of equipment.
16. Contractor shall properly store all materials brought by him to the work site to prevent damage due to rain, wind direct exposure to sun etc. and also from theft, pilferage etc. The contractor shall maintain stocks of all materials required by him for the proper and speedy execution of his work.
 17. The contractor shall make his own arrangement to procure all construction plant and equipment tool and tables etc. for his works.
 18. All materials construction plants and equipments etc. once brought by the contractor within the NIT area are not to be moved from there without the written authority form the engineer. Similarly, all enabling works built by the contractor for the main construction undertaken by him, are not to be dismantled and removed without authority from the Engineer.
 19. The contractor shall at all times provide sufficient fencing, notice boards, lights, watchmen to protect and guard the works and provide all facilities and observe all the rules mentioned in the general conditions of the contract enclosed with the tender.
 20. The Contractor shall also be responsible for the overall co-ordination with internal/external agencies, project management, training of Owner's manpower, loading, unloading, handling, moving to final destination for successful erection, testing and commissioning of the substation/switchyard.
 20. (a) Concrete and mortars are generally specified by the strength or the approximate proportions by volume respectively. The contractor may quote on the basis of their proportions. The concrete that will be used in the work shall be proved to be of requisite standard as laid down in the Indian standard specification and also by other intermediate test that may be prescribed for important construction. Batching by volume may be permitted at the discussion of the Engineer.
 - (b) The quantities of all excavation, concrete, reinforcement steel work and shuttering as shown in the tender schedule are approximate. The rate quoted shall fully apply for any variations in the scope of work and the resulting quantities. The payment shall be made on actual quantities constructed and measured at site as per standard practice in conformity with I.S 1200.
 21. The aggregate to be used in the work shall be hard, strong and durable and shall be clean and free from clay films and other adherent coating. These must be machine crushed, screened before mixing. Sand must be coarse and thoroughly screened before mixing.

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22. In the areas of fill, filling shall not be done until foundations and underground work e.g. pipes cables, etc. are completed. Should the fill be done prior to such completion, the contractor shall do all excavation and protection work for doing the foundations, underground works etc. at his own cost.

23.a) The specifications prescribed various tests at specified intervals for ascertaining the quality of his work done. If the tests prove unsatisfactory, the Engineer shall have liberty to order the contractor to redo the work done, in that period, and do order such alterations and strengthening that may be necessary at the cost of the contractor. The contractor shall be bound to carry out such orders failing which the rectification, will be done by the Engineer through other agencies and cost recovered from the contractor.

(b) Structure test:- The engineer shall instruct the contractor to make a loading test on the work or any part thereof at the contractors cost, if in his opinion such a test is necessary.

(c) Charges for all tests shall be borne by the contractor.

24. The contractor shall not allow any visitors on the works except with the approval of the Engineer.

25. The tenders are required to quote rates against all the items of the attached. Tender schedule, failing which their tender may not be considered.

26. All guarantees such as for water- proofing materials for the entire work as obtained from the manufacture shall be transferred to the employer by the contractor after completion of the work.

27. The contractor shall keep a competent and qualified engineer constantly, assisted by others, who will be responsible for carrying out of the work to the satisfaction of the engineer-in –charge. Any direction or instructions given to him in writing shall be held to have been given to the contractor.

28. The following guidelines should be followed in respect of calculation of theoretical consumption of cement for civil engineering works:-

i) Theoretical consumption will be calculated on the basis of design-mix.

ii) In case of concretes and mortar specified in the contract on volumetric proportion basis, the calculation of theoretical consumption will be governed by analysis.

iii) The permissible wastage of cement over the theoretical consumption as indicated above will be upto 5%.

29. a) Item of work not covered by the specification attached shall confirm of the latest version of Indian standard Specification.

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- b) The contractor shall employ such workers who possess good antecedent reports. The contractor shall be fully responsible for the conduct of his workman and shall ensure that his work do not indulge in any criminal activities in case of any loss suffered by the NIT due to theft, damage etc. caused by the contractor's workmen, the same will be made good by suitable recovery from the contractors running bills without prejudice to other rights of the company under the contract and under the law.
30. a) The contractor should be conversant about the location & the condition of the surroundings before quoting the rates.
b) The provision for approach road for bringing the equipment and materials at the works site will be the responsibilities of the contractor at his cost.
31. The date of taking over of the works by the representative of NIT shall be taken as the date of completion of the contract. The defects of construction which are within the scope of the contract shall be recovered and signed jointly by the contractor's representative. The recorded defects will have to be attended by the contractor and it shall be the sole responsibility of the the contractor. Only after completion finalization of accounts in respect of final bill will be taken up by the department. If the recorded defects are not attended to by the contractor within 15 days, the department will at its own discretion employ anther agency at the risk and cost of the contractor to get those recorded defects attended without any further reference to the contractor.
32. The contractor shall deal with all aspect of their as well as their sub- contractors labour including industrial relations.
33. The contractor should ensure of all dues including retrenchment compensation, even if the labour is engaged by his sub-contractor.

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33KV RING MAIN SYSTEM INCLUDING 33/0.433KV SUBSTATIONS IN NIT, ROURKELA CAMPUS.

SECTION-VI : TECHNICAL SPECIFICATION AND SCOPE OF WORK

PART-I : ELECTRICAL WORKS

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E0 : General Technical specification

1.0 Introduction and Salient Information

National Institute of Technology (NIT) intends to set up a 33kV Ring Main system including 33/0.433 KV substations in their campus at Rourkela. Presently there is 11KV ring main system which will be discarded by a new 33kV system. 33KV power will be received through a single feeder from WESCO at 33KV Main Receiving Substation (MRSS). 33KV Ring Main formation will be made through 33KV over head line as well as by 33KV underground cables to feed 9 nos. 33/0.433 KV substations in LOOP-IN-LOOP-OUT mode.

Main configurations of the substations are as follows:

- a. Power tapping from WESCO substation : Power at 33kV will be tapped from existing WESCO substation shall be extended to the MRSS by cable.
- b. 33kV MRSS : New substation comprising of 3 nos. 33kV outdoor air insulated bays, control room, station service transformer, boundary wall.
- c. Substation-1 : 1x500kVA, 33/0.433kV substation to be built within existing boundary wall of 11kV substation-1. Existing 415V DB and DB room shall be reutilized. The substation will feed the loads of Colony.
- d. Substation-2 : 1x500kVA, 33/0.433kV substation to be built within existing boundary wall of 11kV Pump house substation. New DB room shall be constructed. The substation will feed the loads of Colony and Pump house.
- e. Substation-4 : 2x500kVA, 33/0.433kV substation to be built within existing boundary wall of 11kV substation-4. Existing 415V DB and DB room shall be extended. The substation will feed the loads of HV Lab and Hall-6 extension.
- f. Substation-5 : New substation comprising of 2x750kVA, 33/0.433kV transformers shall be constructed along with DB rooms, cable trench, boundary wall etc. This substation will be located in the vacant land adjacent to existing Computer Science Engineering building. The substation will feed the existing loads of Computer Science and new loads of Electrical Engineering buildings.
- g. Substation-6 & 9 : Combined substation of 1x500kVA & 2x750kVA, 33/0.433kV to be built in the area adjacent to existing 11kV substation-6

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and Hall-4. Existing 415V DB and DB room shall be extended. The substation will feed the loads of Hall-4 extension.

- h. Substation-7 : 1x500kVA, 33/0.433kV substation to be built adjacent to existing 11kV substation-7. Existing boundary wall shall be extended to accommodate the 33kV substation. New DB room shall be constructed. The substation will feed the loads of Colony and D-Flats.
- i. Substation-8 : New substation comprising of 2x750kVA, 33/0.433kV transformers shall be constructed along with DB rooms, cable trench, boundary wall etc. The substation shall be built adjacent to new Bio Medical building and shall feed the loads of the same, Lecture Complex, Mechanical engineering and Golden Jubilee buildings.
- j. Substation-10 : New substation comprising of 2x750kVA, 33/0.433kV transformers, indoor 33kV switchgears, 415V DB shall be installed within the Chiller Plant building. This substation shall feed the loads of chiller plant and its auxiliaries.

Status of electrical equipment in above substations shall be monitored through Data Acquisition System (DAS). The master control station of DAS for remote monitoring shall be located in the Main Administrative Building.

The Contractor shall follow design, engineering and manufacturing practices which meet maximum energy efficiency and follow recommendations of 'Bureau of Energy Efficiency, Ministry of Electricity, Govt of India as applicable.

2.0 Scope of Work

- 2.1 The Scope of work shall cover design, engineering, manufacture, testing at works, packing, supply, transportation, transit insurance, storage and handling at site, erection, testing and commissioning of complete power distribution equipment for formation of 33KV ring main system, 33kV MRSS, 33/0.433KV Distribution Sub-stns., control and protection systems along with associated equipment as described in the specification and handing over the system in 'Ready to switch on' condition to the Purchaser.

The broad scope of work under this specification is as follows:

- i) Tapping of power at 33kV from existing WESCO substation and laying of single feeder cable from WESCO substation to NIT MRSS.
- ii) Supply and installation of new 33KV (MRSS) switchyard with single bus

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configuration with feeders as per SLD.

- iii) Supply and installation of new 33KV over head lines on steel (beam) poles for interconnection of different 33/0.433KV substations for formation of 33KV ring main system in the NIT campus as shown in attached layout drawings.
- iv) Supply and installation of new 33KV XLPE buried cable for interconnection of different 33/0.433KV distribution substations for formation of 33KV ring main system in NIT campus as shown in attached layout drawings.
- v) Supply and installation of new 9 nos. 33/0.433KV Distribution substations including construction of 4 pole /6 pole structures, DB rooms etc. as shown in attached electrical layout drawings.
- vi) Supply and installation of Data Acquisition System (DAS) for remote monitoring of all substations.
- vii) Supply and construction of all required civil, structural and architectural material and works for installation of the 33kV ring main system and associated substations mentioned above.

2.2 The Bidder's scope shall include but not limited to the following:-

1. Design, engineering, manufacture, testing at works, packing, supply, transportation, transit insurance, storage and handling at site, erection, testing, commissioning and handing over of all electrical equipment as listed in schedule of quantities. The scope covers the following major equipment:
 - a) Modification work at existing WESCO substation for 33kV power tapping
 - i) To obtain reliable power source, 33kV will be tapped from both the incoming lines (Rourkela and Chhend) through isolators. Only one isolator will be closed at a time to prevent paralleling of two sources. The other equipment are:
 - ii) 33kV vacuum circuit breaker, CT, PI, clamps and connectors, ACSR conductor.
 - iii) Outdoor kiosk type 33kV control and relay panel in line with existing practice in WESCO substation.

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- iv) Power, control and instrumentation cables, cable termination kits etc. laying and termination of all associated power and control cables.
- v) Switchyard structures, foundations and necessary hardware.
- vi) Earthing and Lightning protection for the outdoor switchyard.
- vii) Supply and installation of 33kV XLPE cable and cable termination kits from WESCO substation to NIT 33kV MRSS.

b) 33kV MRSS

- i) 33kV switchyard equipment such as vacuum circuit breakers, Isolator, LA, CT, PT, clamps, connectors, ACSR conductor, insulators, horn gap fuse etc.
- ii) 33 kV control room with control & relay panels, ACDB, metering and protections etc.
- iii) 110V DC Battery, Battery charger, DCDB etc.
- iv) Switchyard structures and necessary hardware.
- v) Pole mounted station service transformer.
- viii) Power, control and instrumentation cables, cable termination kits etc. laying and termination of all associated power and control cables.
- viii) Complete illumination system for the outdoor switchyard and control building.
- ix) Earthing and Lightning protection for the outdoor switchyard and control building.
- x) Data acquisition system (DAS) comprising of Remote terminal units, GSM/GPRS modem etc.
- xi) Fire Fighting System for 33 kV switchyard, MRSS Control building.

c) 33kV Ring Main

- i) 33KV over head line on steel (beam) poles complete with ACSR conductors, clamps, connectors, insulators, stay wires, earthing and structural works for interconnection of different 33/0.433KV

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distribution substations in LOOP-IN-LOOP-OUT mode as shown in SLDs.

ii) 33KV XLPE cable buried directly underground supplied complete with straight through joints, termination kits, cable markers, protective tiles, excavation, sand cushioning, hume pipes at road and other service crossings, earthing etc. for interconnection of different 33/0.433KV distribution substations in LOOP-IN-LOOP-OUT mode as shown in SLDs.

d) 33/0.433kV Distribution Substations

i) 500kVA & 750kVA Distribution transformers in 33/0.433 KV substations as shown in SLDs.

ii) 4 pole/6 pole structures for LOOP-IN-LOOP-OUT arrangement of 33kV ring main.

iii) 33kV isolators, LA, clamps, connectors, ACSR conductor, insulators, horn gap fuse etc.

iv) 415V Distribution boards.

v) Power, control and instrumentation cables, cable termination kits etc. laying and termination of all associated power and control cables.

vi) Complete illumination system for the outdoor switchyard and DB room.

ix) Earthing and Lightning protection for the outdoor switchyard and DB room.

ix) Data acquisition system (DAS) comprising of Remote terminal units, GSM/GPRS modem etc.

x) Fire Fighting System for distribution substations.

xi) First filling of all consumables i.e. the initial requirement of all consumables such as transformer oil, lubricants, start-up, commissioning and performance test shall be provided.

2. Civil and architectural work for switchyard control room building comprising of control room, battery room, store, toilet, cable trenches etc. as shown in drawings.

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3. Civil and architectural work of switchyard equipment foundations, transformer foundations including rails/channels, roads, drainage, culverts, foundation for lighting poles, DB rooms etc. confirming to the specification and drawings.
4. Civil works including foundations for different kind of pole arrangements, survey, planning and finalization of route of the overhead /underground feeders for 33kV Ring Main system.
5. Substation boundary wall, anti weeding and gravel spreading of complete switchyard area etc.
6. Supply and installation of cable supporting structures (MS racks in switchyard and MS cable trays in control building) for the outdoor switchyard and control building/DB room. 33kV outgoing cables from MRSS shall be buried underground both inside and outside the MRSS area.
7. Earthing system for the outdoor switchyard, Power transformers and earthing of all power distribution equipment under the scope.
8. Measurement of soil bearing capacity and soil resistivity.

The Contractor shall submit soil test plan as per relevant standards and obtain approval from Purchaser/Consultant before starting the site measurements.

9. Dismantling of the existing 11kV ring main system and existing 11/0.433kV distribution substations in a phasewise and planned manner so that conversion time from 11kV to 33kV is minimum. The existing 415V DB & DB room in substation no. 1, 4 & 6 shall be retained and reutilized as shown in drawings. All other dismantled equipment shall be handed over to Purchaser's designated store.
10. Erection accessories and consumables.
11. Safety items like hand gloves, shock treatment charts, rubber mats, danger/caution boards etc. in sufficient quantity as per statutory norms/standards.
12. Supply of all commissioning spares as may be required during commissioning at no extra cost to the Purchaser and left out commissioning spares shall be handed over to the Purchaser after commissioning of the system.

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13. List of recommended spares for three (3) years normal operation. (List along with the unit price shall be furnished at the time of submission of offer by the Bidder).
 14. Getting approval of the various statutory authorities like electrical inspectorate etc. for the electrical installations to be carried out by the Contractor.
 15. Coordination and follow up with WESCO for obtaining 33kV power supply from WESCO as per project schedule.
- 2.3 Number of CT, PT, Relay and their ratings etc. shown in the drawing are tentative and shall be finalized during detailed engineering and no extra claim on this account will be considered.
 - 2.4 The quantities of equipment, cables, cable terminations, straight through joints, cable supporting structures, illumination, earthing / lightning and erection materials etc, as indicated in the BOQ are for guidance and tendering purpose. These materials along with civil works and DAS system shall be provided as per actual requirement in accordance with the approved detail engineering drawings. Final price for payment shall be decided on the basis of quoted unit price and quantity certified by the site engineer.
 - 2.5 At least 20% spare feeders shall be provided in each switchboards e.g. PDB, MLDB, ACDB, DCDB etc. with minimum of one (1) spare feeder for each type. At least 20% spare terminal block shall be provided in each feeder.
 - 2.6 The Bidder shall guarantee availability of spares for 10 years after commissioning for all the equipment under the scope of the Bidder.
 - 2.7 The CONTRACTOR shall extend all cooperation and coordination to other agencies for successful completion of their WORK. Timely completion of the WORK is of utmost importance. All complications with other agencies must be settled amicably and swiftly without delay in order to complete the job as per attached project schedule.
 - 2.8 The Bidder before submission of their offer must visit the site to get complete understanding of the project requirements.
 - 2.9 Materials/ components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment system shall be deemed to be included unless specifically excluded and shall be supplied without any cost implication.

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3.0 Exclusions from Scope of Work

- 3.1 Supply and laying out of LT outgoing cables (except indoor lighting cables of the substation itself) from 415V DBs in different distribution substations.
- 3.2 Civil construction of Substation no. 10 will be done by the Purchaser since the substation is an integral part of the Chiller plant building. However minor civil works including supply and installation of edge angles, insert plates, supporting steel etc. for mounting of equipment shall be in the scope of the Contractor.
- 3.3 Following final drawings shall be supplied by the Consultant during detail engineering based on the actual equipment details and other relevant input data like soil resistivity/soil bearing capacity to be provided by the Contractor :
- a) SLD of 33kV power tapping from WESCO, 33kV MRSS and 33/0.433kV distribution substations.
 - b) Electrical layout of proposed power tapping from WESCO, 33kV MRSS and 33/0.433kV substations.
 - c) Structural GA of 4/6 pole structures in distribution substations.
 - d) Structural GA of lattice type structures in outdoor switchyard of 33kV MRSS.
 - e) Civil foundation details of 1/2/4/6 pole structures for 33kV ring main and those required in substations.
 - f) Civil foundation details for lattice type structures in outdoor switchyard of 33kV MRSS.
 - g) Architectural view of Control building in MRSS.
 - h) Architectural view of 415V DB rooms in distribution substations.
 - i) Civil constructional GA of 33kV control building in MRSS and 415V DB rooms in distribution substations.
 - j) Earthing and lightning protection layout drawings.
 - k) Cable tray and trench layout drawings of different substations.
 - l) Illumination layout and SLD of different substations.
 - m) Data acquisition system (DAS) architecture and block diagram.
 - n) Power and control cable schedule and interconnection diagram for

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electrical and DAS.

o) Relay setting chart.

p) Civil construction details of road, drain and boundary wall.

4.0 Project Interface

4.1 The scope of the Contractor starts from the points of 33kV power tapping at WESCO existing substation. The Contractor shall coordinate with WESCO in consultation with Purchaser to make final arrangements for such tapping. The entire work within the WESCO substation premises will be undertaken under supervision of WESCO.

4.3 The Purchaser shall provide water and electricity at one (1) point near each substation site. Further distribution of water and electricity for construction purpose will be arranged by the Contractor.

4.4 In DB rooms of respective substations, the Contractor shall consider requisite number of cable trays in trenches and required number of pipe sleeves (with 20% spare) in wall for laying of required number of outgoing cables for evacuation of power to different buildings and facilities.

5.0 GENERAL REQUIREMENTS

5.1 Codes and Standards

5.1.1 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.

5.1.2 Equipment and materials conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

5.1.3 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

5.1.4 The electrical installation shall also meet REC standards, wherever applicable.

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5.1.5 Wherever reference to any IS, REC, IEC, IEEE or CBIP standards are made in the later chapters, the latest amended version of that specific standard will always be applicable.

5.2 Drawings & Annexure

5.2.1 All drawings and annexure appended to this specification shall form part of this specification and supplement the requirements specified herein.

5.2.2 This specification shall be read and construed in conjunction with the drawings and annexure to determine the scope of work and terminal points.

5.2.3 The quantities shown on drawings and annexure are tentative for bidding purpose only. Any variation arising during detailed engineering stage will be taken into account for adjustment of contract price based on unit rates quoted in the bid.

5.2.4 The attached drawings are conceptual in nature but indicate minimum requirements. Final drawings for construction will be forwarded during detail engineering stage.

5.3 Completeness of Supply

5.3.1 It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship.

5.3.2 Any material or accessory which may not have been specifically mentioned, but which is necessary or usual for satisfactory and trouble-free operation and maintenance of the equipment shall be furnished without any extra charge.

5.3.3 The Contractor shall supply all brand new equipment and accessories as specified herein with such modification and alteration as agreed upon in writing after mutual discussion.

5.4 Guaranteed Performance

The performance figures quoted in data sheets shall be guaranteed within the tolerance permitted by relevant standards. In case of failure of the equipment to meet the guarantee, the equipment may be liable for rejection.

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5.5 Deviation

- 5.5.1 Should the Bidder wish to deviate from this specification in any way; he shall draw specific attention to such deviation, with reference to the respective clause of the specification.
- 5.5.2 Unless such deviations are submitted with the offer, it will be taken for granted that the offer is made in conformity with this specification in all respects.

5.6 Drawing Approval

- 5.6.1 Before starting manufacture of any equipment, the Supplier shall have to take approval of relevant drawings and data from Engineer in writing.
- 5.6.2 Any manufacture done prior to the approval of drawings/data shall be rectified in accordance with the approved drawings/data by the Contractor at his own cost and the equipment shall be supplied within the stipulated period.

5.7 Quality Assurance

- 5.7.1 Contractor shall follow his standard procedures for quality assurance and control. However, said standard procedures shall be submitted to the Purchaser.
- 5.7.2 The Purchaser will inform the Contractor as to which of the inspection points and tests will be witnessed. As a minimum, a final inspection of the equipment will be made prior to shipment.
- 5.7.3 The Purchaser and/or its representative reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.
- 5.7.4 The Purchaser and/or its representative may inspect the Contractor's facilities prior to award of contract.
- 5.7.5 The Purchaser and/or its representative may witness any or all of the tests described.
- 5.7.6 The Purchaser and/or its representative may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of quality assurance and quality control while work on the specified equipment is in progress.

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5.8 Safety

- 5.8.1 All equipment shall be complete with approved safety devices wherever a potential hazard exists and with provision for safe access of personnel to and around equipment for operational and maintenance functions.
- 5.8.2 The design shall include not only those usually furnished with elements of machinery but also the additional covers, stair ways, ladders, steel structural platforms for operators control panels, hand rails, partitions etc. which are necessary for safe operation of the plant. In addition maintenance platform wherever required shall be included in the design.
- 5.8.3 All danger and caution notice boards shall be in Hindi, English and Oriya.
- 5.8.4 All safety measures as required to be adopted as per the statutory regulations and the safety rules of the plant shall be strictly followed by the Contractor during execution of the contract.
- 5.8.5 Adequate number of first aid boxes as defined in the state factory rules shall be provided and maintained at all the work sites.
- 5.8.6 When the work is carried out at night or in obscure day light adequate arrangement for flood lighting in the working area shall be made by the Contractor at his own cost and got approved by the Purchaser.
- 5.8.7 The safety postures/regulations for the prevention of accidents shall be displayed by the Bidder at appropriate places. Notices and warning signs shall be displayed for all sources of dangers.

6.0 Installation

- 6.1 For installation work at site, the Contractor shall be fully responsible for arranging the supply of required tools and tackles, welding sets, pipe bending machine, cable crimping tools, gauges, scaffoldings, ladders, temporary water and power connections and mobile cranes.

On completion of the installation but before energisation of the system, all installation shall be physically checked and properly tested. These checks and tests shall be conducted by the Contractor under the supervision of Purchaser. The Contractor shall furnish the final status and test results. Any defect observed during such check and tests shall be rectified by the Contractor free of cost within tender completion period.

All clamps brackets, bolts, nuts, screws, markers, ferrules, lugs and glands and other hardware necessary for erection work, shall be included in the

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scope of work and shall be arranged by the Contractor. Equipment shall be painted to withstand the heavily polluted and corrosive environment prevailing at site.

6.2 Contractor's license

The Contractor must possess a valid and competent Contractor's license of specified voltages issued by the electrical licensing authorities of the Govt. of Orissa for carrying out electrical installation work of the type and magnitude covered in this document, in the state of Orissa.

The Contractor shall also be required to obtain labour license from statutory authorities. Copy of the license shall be made available to the Purchaser for verifications during the execution of the contract.

All linemen, wiremen, electricians, supervisors and engineers engaged by the Contractor or his Sub Contractor shall poses necessary valid license issued by the statutory authorities and the same shall be submitted for verification, if called for.

7.0 Painting

All equipment / components / accessories which are intended to be painted shall be thoroughly cleaned of rust, scales, grease, etc. and be painted with two coats of proper undercoat. This shall be followed by two coats of finishing paint. Damage to the painting suffered during transit / erection shall be made good by the Contractor free of cost before the equipment is finally accepted by the Purchaser. All outdoor equipment colour shall be of shade 632 (dark admiralty grey) as per IS:5, while indoor equipment shall be shade 631 (light grey) of IS:5.

8.0 Tropical Protection

All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.

Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

9.0 Tests and Inspection

Routine and acceptance tests, as applicable shall be carried out on all equipment at manufacturer's works as per specification and appropriate IS/IEC codes. The Bidder shall arrange all necessary testing facilities free of cost for

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inspection and testing of the equipment by the Purchaser. Inspection and test shall be carried out at the place of manufacture as well as on receipt of the equipment at site.

9.1 Test Witness

All tests shall be performed in presence of Purchaser's representatives, if so desired by the Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when tests are to be carried out.

9.2 Test Certificate

Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Purchaser.

The equipment shall be dispatched from works only after receipt of Purchaser's written approval of the test reports.

Type test certificate on any equipment, if so desired by the Purchaser, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

9.3 Inspection and tests do not relieve the Bidder of his contractual obligations regarding performance of the equipment at site/in actual use.

9.4 Functional and Composite Testing:

Following tests shall be conducted on equipment after erection from point of view of completeness in the presence of Purchaser:

- Visual inspection of total system
- Checking of continuity of power and control cables.
- Checking of insulation resistance for inter-connected links or cables.
- Calibration of meters by secondary injection or by primary injection
- Checking of protective schemes.
- Setting of relays, and the checking of their operation with one lower and one higher setting.
- Checking of control scheme of breakers, etc. as per approved drawings and as per actual requirement
- Checking of alarm scheme by simulation of faults.

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- Checking of name plate data of complete system.
- Verification of earthing resistance.
- Checking of cable terminations and laying, dressing etc.
- Checking for safe accessibility of components.

11.0 Special Tools & Tackle

- 11.1 A set of special tools & tackles which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.
- 11.2 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

12.0 Rating plates, Name plates and Labels

- 12.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IS/IEC requirement.
- 12.2 All such nameplates, instruction plates, rating plates of transformers, CB, CT, PT, Isolators, C & R panels and Data acquisition equipment shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions can also be provided.

13.0 Guarantee and Replacements

- 13.1 The Supplier/Contractor shall guarantee that the plant/equipment shall be in strict conformity with the contract and of first class workmanship according to the latest engineering practice at the time of the award of the contract. The Contractor shall further warrant that, under normal operating condition at site and in accordance with Contractor's operation and maintenance manuals, the plant/equipment shall show no defects due to faulty design, materials, construction, and / or workmanship for a period of 12 months from the date of successful commissioning or 18 months from the date of receipt of last item at site, whichever is earlier. However, the fast wearing parts and initial fills, whose shelf life is less than the guarantee period are excluded. The Contractor / supplier's guarantee for performance shall cover individual items

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and system as a whole for their accuracy, ratings, consumptions and outputs as well as for the integrated operation of the complete plant/equipment and its auxiliaries as a whole.

The Contractor / supplier is obliged to repair and / or replace, at his own cost and expenses, the plant and equipment or any part thereof which may show any defect in workmanship or materials or deficient in performance during the guarantee period.

13.2 The Contractor / supplier shall be responsible for the due performance of the contract / Order in all respect according to the intent and meaning of the drawings, specifications, and all other documents etc. forming part of the contract / order.

13.3 Any approval which Purchaser / engineer may have given in respect of the stores, materials or other particulars and the work or the workmanship involved in the contract /supply (whether with or without test carried out by the Contractor/supplier and witnessed by the Purchaser/engineer) shall not bind the Purchaser/engineer and notwithstanding any approval or acceptance, it shall be lawful for the Purchaser/ engineer to reject the materials after arrival at site, if it is found that the materials / equipment supplied and/or supervision of erection, testing start up, commissioning and performance test are not in conformity with the term and condition of the contract / supply in all respects.

13.4 The plant / equipment must be complete in all respect to ensure the specified performance. Consequently, the Contractor / supplier shall confirm that all items of the plant / equipment and or work, whether expressly stated or not; in the contract, but are required for completion of the work for proper, efficient, safe and stable operation and maintenance of the work and / or for the fulfillment of the Contractor's guarantee, shall be supplied or provided by the Contractor / supplier without any extra charge to the Purchaser and be considered as included and covered by the contract price as though same have been expressly stated in the contract.

14.0 Drawings, Data and Documents

14.1 The Bidder shall furnish following documents/ information.

- General description of equipment offered specifying the important features, make, technical parameters, materials of construction, etc. to enable the Purchaser to have proper understanding of the equipment offered and its operation.

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- Technical literature, catalogue and publications of all major equipment, components and exclusively for numerical and communicable type relays and multifunction meters.
- Completely filled up technical data sheets as attached with this specification.
- Single line diagram.
- Typical general arrangement and foundation details.
- Type tests certificates of all major equipment like CBs, transformers, switchgear etc.

14.2 For Approval

The Contractor shall furnish following drawings/documents for approval. The drawings and documents shall be submitted in four (4) copies, two (2) copies to Purchaser and two (2) copies to Consultant :

B. Drawings

1. For Transformer

- Outline dimensional drawing showing general arrangement, space requirement, constructional features, power and control cable entry points.
- Foundation plan and loading data
- Wiring Diagram of Marshalling Box, RTCC, OLTC showing internal and external connection of different accessories
- Bill of materials
- Cable schedule and inter connection diagrams/charts
- Type Test Certificates
- Operation and maintenance manual
- Technical catalogues and leaflets/
- Any other drawings, data, manuals, write-ups, curves etc. required to operate and maintain the equipment.
- Rating and diagram plate data.

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- k) Guaranteed Technical Particulars.
2. For other equipment
 - a) Guaranteed Technical Particulars of each equipment.
 - b) General arrangement of all equipment with plan, front view, sectional views, foundation plan and other necessary details.
 - c). SLD, Schematic drawing of different feeders, control, alarm, indications, interlocking and other schematics.
 - d) Schematic and Wiring terminal plan drawings for 33kV control & relay panels with cable connections.
 3. Soil data
 - a) Soil resistivity test report as per IS 3043.
 - b) Soil bearing capacity test report.
 4. 33kV Overhead line
 - a) Overall route layout of the 33kV overhead line showing location of different kind of poles (1/2/4 poles) on the basis of thorough survey of the route to be conducted by the Contractor.
 - b) Route profile and alignment drawing.
 - c) Sag and tension chart.

14.3 For reference

- Master Drawing List.
- Static and dynamic loading of all major equipment.
- Panel/feeder wise bill of material, indicating make, type and technical parameters of various components.
- GA drawing for erection accessories like cable trays, supporting structures etc.
- Inter panel wiring and terminal block arrangement.

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- Detailed technical catalogue of all equipment.
- Installation and commissioning manuals for each equipment.
- Operation and maintenance manuals indicating trouble shooting procedure for all equipment.
- Type test certificates for all the major equipment.
- Certificates / details of test results conducted at works, for all equipment.
- Details of test results conducted at site for all equipment.
- List of recommended spares.
- Details of transport arrangement and maximum size of transportable section (weight and overall dimensions).
- Foundation/ fixing details of all the panels/ equipment, supporting structures, etc.
- Details of 2/4/6 pole structures at 33/0.433 KV S/S.
- Details of 1/2/4 pole structures along 33KV overhead lines.

14.4 As built drawings

14.4.1 Upon installation and commissioning of the equipment, the Contractor shall incorporate revisions/modifications if any in the drawings and submit 'as built' drawings for Purchaser's record. All the As built drawings shall be submitted in 2 sets of reproducibles, 4 sets of drawing prints, and 2 sets of CD/ to the Purchaser & one set of drawing prints to the Consultant.

14.4.2 Complete and comprehensive instruction manuals for operation and maintenance of the equipment with drawings. This shall include the following:

- a) Preventive maintenance schedule for each equipment.
- b) Procedure for shut down and energisation of HT equipment.
- d) Safety procedures for safe operation of equipment and complete system.

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- e) Specification of equipment installed.
- f) Test procedure for site tests.
- g) Spares list for each equipment for 3 years operation and maintenance.

15.0 General Project Information

1. Purchaser / Customer :
National Institute of Technology.
Rourkela-769008,
Orissa
2. Consultant :
SATCON
DB-90, Ground floor, Sector-I, Salt Lake, Kolkata-700064.
3. **Project Title : 33kV ring main system including 33/0.433kV substations in NIT, Rourkela campus.**
4. Project Location : NIT Campus, Rourkela, Orissa.
5. Climatic Conditions Altitude (average) -216 Meters above MSL.
Ambient Air Temperature. – Maximum.-50 C⁰ , Minimum- 2 C⁰
Climate is humid tropical climate, conducive to rust and fungus growth.
6. Relative Humidity : Maximum.-100%.
7. Wind pressure : 150 kg/m².
8. Nearest Railway station : Rourkela. The site is approx. 10 km from the station.
9. Nearest major road : NH 23

16.0 SYSTEM DATA

System Voltages : 33kV and 415/240V

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System Earthing

33 kV : Non effectively Earthed

415 V : Solidly Earthed

Voltage variations

33 kV $\pm 10\%$

415 V +10%, -15%

Rated Frequency : 50 Hz

Frequency variation : $\pm 5\%$

Combined voltage and frequency variation : 10% (absolute sum)

Control Voltage for 33kV VCB : 110VDC (from battery), $\pm 10\%$

Control Voltage for 415V ACB : 240VAC $\pm 10\%$

AC auxiliary supply : 240V AC +10% and -15%

Short time rating for equipment design

33 kV : 25kA for 3 Sec (1500MVA)

415 V : 50kA for 1 Sec.

110 VDC - 10 KA for 1 sec

17.0 System Parameters for 33kV :

1. System operating voltage : 33kV
2. Maximum operating voltage of the system (rms) : 36kV
3. No. of phases : 3
4. Rated Insulation levels
 - a) Full wave impulse withstand voltage (1.2/50 micro sec.):
 - Between line terminals and ground : 170 kVp
 - Between terminals with circuit breaker open : 170 kVp
 - Between terminals with isolator open : 180 kVp
 - b) One minute power frequency dry and wet withstand voltage (rms):

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- Between line terminals and ground : 70 kV
 - Between terminals with circuit breaker open : 70 kV
 - Between terminals with isolator open : 80 kV
5. Min. clearances (under most stringent condition)
- i) Phase to phase : 320mm
 - ii) Phase to earth : 320mm
6. Control Voltage : 110VDC, $\pm 10\%$

19.0 Training

The Contractor shall include in his scope the detailed training programme for Purchaser's personnel for safe & efficient design, operation & maintenance of equipment/systems supplied. Training period for Purchaser's personnel shall be for 5 man months at Contractor's training centers, equipment manufacturing plants and at plant site etc. The Contractor shall submit a training schedule/proposal during the offers.

20.0 Work Schedule

20.1 Time period

The entire work covering supply, erection, testing and commissioning shall be completed within eight (8) months from the date of placement of LOI/Order.

20.2 Submission of programme

The Contractor shall submit a programme in the form of Bar chart according to which they propose to execute the entire work covered by this specification.

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E1 : TECHNICAL SPECIFICATION FOR 33KV CIRCUIT BREAKERS

1.0 SCOPE

- 1.1 This specification covers 3-pole, 33 KV, 50 Hz, Vacuum Circuit Breakers for outdoor installation.
- 1.2 The Circuit Breakers offered shall be as per this specification and also complying with latest edition of IS-13118, IEC-62271-100 & IEC 60694 and other relevant specifications.
- 1.3 The Circuit Breakers are required complete with structures, operating mechanism, all associated standard accessories and auxiliaries. The supporting structure shall have suitable extension for mounting of CTs also.

2.0 DESIGN CRITERIA

- 2.1 The VCBs will be used for protection and control of incoming and outgoing feeders of 33kV MRSS of NIT, RKL.
- 2.2 The Circuit Breakers shall be VCB type manufactured under strict quality control as per IS and IEC standards mentioned above and Indian Electricity Rules.
- 2.3 The Circuit Breakers shall be used in 33kV non effectively earthed system. It shall have symmetrical breaking capacity of 25KA for 3 secs. It shall have other technical parameters as per Technical data sheet given subsequently.
- 2.4 The Breakers shall have necessary arrangement for simultaneous closing and tripping of all three poles.
- 2.5 Circuit Breakers shall be capable of making and breaking any fault current upto and including the rated fault current without any damage or undue strain to any of its component.

3.0 CONSTRUCTION

- 3.1 Each Circuit Breaker shall have three identical poles linked together electro mechanically for simultaneous operation of all the three poles.
- 3.2 Operation counter shall be provided to monitor the number of operations.

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- 3.3 The tips of the main contacts shall be of suitable design to withstand arcing.
- 3.4 Complete details of main contacts and arc quenching device with sectional drawings shall be furnished.
- 3.5 All current carrying contact surfaces shall be silver plated. Silver plating shall not be less than 25 microns in thickness.

4.0 OPERATING MECHANISM

- 4.1 The operating mechanism shall be electrically controlled spring charged.
- 4.2 The mechanism shall have anti pumping and trip free features.
- 4.3 Necessary arrangement shall be provided to operate the circuit breaker locally both electrically and mechanically.
- 4.4 There shall be mechanical ON/OFF indicators and at the local mechanism box.
- 4.5 The operating mechanism of outdoor circuit breakers shall be housed in a structure mounted, weather-proof and dust tight sheet steel (3 mm thick) cabinet (IP-55) with pad locking facilities. The cubicle shall be complete with control circuit isolating switch, lockable stay-put type local/remote selector switch, push buttons for local electrical open/close as well as manual tripping operation, ON and OFF position indicators, operation counter, necessary number of auxiliary contacts for protection, interlocking and signaling purposes suitably wired and terminated in control cable terminal block with 20% spare terminal. 240 volt, 5A, 3 pin plug socket with ON/OFF switch shall also be provided suitable space heaters shall be provided with automatic thermostatic control. The mechanism shall be suitable for remote control from the control room and electrical tripping by shunt trip coil.

5.0 INSULATORS

- 5.1 The Insulators/Bushings shall be of porcelain and mechanical strength to operate satisfactorily under various operating conditions.
- 5.2 In the heavily polluted area there shall not be any electrical discharge between bushing terminal and earth.
- 5.3 The terminal connectors shall be suitable for connection to ACSR conductor/Al tube to be used in the substation.
- 5.4 All iron parts shall be hot dip galvanized.

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6.0 MISCELLANEOUS

- 6.1 The Breaker shall be provided with 6NO + 6NC spare auxiliary contacts in addition to the auxiliary contacts required for its own operational requirements. All spare contacts shall be wired up to the terminal blocks.
- 6.2 The auxiliary contacts shall have a continuous current rating of 10A A.C and 2A D.C. The Breaking capacity shall be adequate for the circuit controlled.
- 6.3 The Circuit Breaker, its marshalling box etc. shall be provided with necessary earthing terminals as per Indian Electricity Rules.

10. TECHNICAL PARTICULARS (33KV VCB)

<u>Sl.No</u>	<u>Description</u>	<u>33kV Circuit Breaker</u>
1.0	Service	
2.0	Type	VCB
3.0	Nominal System Voltage	33kV
4.0	Rated voltage of Circuit Breaker	36kV
5.0	Rated frequency	50 Hz
6.0	Auto Reclosing	3 ph
7.0	System Earthing	Non effectively earthed
8.0	Insulation level	
	a) 1.2/50 micro-sec impulse withstand voltage (KVp)	170
	b) 1 min Power freq. withstand voltage (KV rms)	70
9.0	Rated current (Amps)	
	a) Continuous	630A
	b) Short time rating (KA) for 3 secs.	25kA
10.0	Creepage distance	25mm/kV
11.0	Breaking time (m-sec)	Not exceeding 60m sec.
12.0	Closing time (m-sec)	Not exceeding 120 m sec.
13.0	Rated operating sequence	O-0.3sec – CO - 3 min. CO
14.0	Rated line charging Breaking current	125A

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Sl.No	Description	33kV Circuit Breaker
15.0	Rated small inductive making / breaking current	Equivalent to magnetizing current of 10 MVA transformer.
16.0	Operating Mechanism	Motor operated Spring charged.
17.0	Mode of operation	3 pole.
18.0	No. of trip coils	One per pole
19.0	Trip coil & closing coil voltage	110V DC
20.0	Permissible voltage variation for closing & trip coils	85% to 110% for closing co 70% to 110% for trip coils.
21.0	Minimum clearance of live parts in air and ground (mm)	320
22.0	Phase to phase clearance of pipe bus	Bidder to indicate
23.0	First pole to clear factor	1.3
24.0	Altitude above mean sea level	Not exceeding 1000M
25.0	Terminal connectors suitable for ACSR/tube connection	ACSR DOG/1.5" Al tube as shown in S/S layout drawing.
26.0	Supply voltage for operating device	240V, 1Ph, 50Hz, AC

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E2 : TECHNICAL SPECIFICATION FOR 33KV ISOLATOR

1.0 SCOPE

- 1.1 The specification covers design, manufacture testing at manufacturers works, supply delivery, erection, testing and commissioning of 33kV, 400A, double break gang operated manually operated isolator with earth switch or without earth switch as specified in SLDs for outdoor installation.
- 1.2 The isolators shall conform to this specification as also the latest edition of IS: 9921 (part I to part V). Porcelain post insulators for the isolators shall conform to IS: 2544 as amended up to date.
- 1.3 The isolators shall be complete with porcelain insulators, main current carrying parts auxiliary contacts, operating mechanism, marshalling box, fixing arrangement, terminal connection arrangement and also with provision for electrical/mechanical interlock.

2.0 DESIGN CRITERIA

- 2.1 The Isolators shall be outdoor, triple pole, gang operated, centre post rotating, double break type. There shall be provision for mechanical operation of Isolator locally by hand. Earth switch shall be provided on one side of the isolator as shown in SLD. The earth switch shall be gang operated mechanically by hand.
- 2.2 Isolators shall be able to carry rated current continuously without exceeding the permissible temperature rise as per IS 9921. It shall also carry the rated short circuit current for the specified duration without any thermal or mechanical damage to any of its components.
- 2.3 Isolators shall be suitable for interrupting small inductive and capacitive current such as disconnecting energized lines and distribution transformers at no load.
- 2.4 Isolators shall be electrically interlocked with associated breaker and earth switch to prevent their operation when the breaker is in closed position. Necessary interlocking coil and circuitry shall be provided for the purpose.

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2.5 Earth switch wherever provided shall be electrically interlocked so that earth switch can be operated when the main isolator is open/vice versa. Necessary interlocking coil shall be provided for the purpose.

3.0 CONSTRUCTION

3.1 The Isolators shall be complete with supporting insulators, fixed and moving contacts with blades, galvanized steel bases, marshalling box etc. The switch contacts shall be high pressure, self aligning, self cleaning, adjustable type made of corrosion resistant copper alloy and silver plated. The switch blades shall be one piece corrosion resistant copper alloy. All isolators shall have provision for pad locking both in open and closed position.

3.2 The terminals of isolators shall be provided bimetallic terminal connectors suitable for connection to 'DOG' ACSR conductor or 1.5" Aluminium tube as shown in layout drawing.

3.3 All current carrying parts including earth switch shall be of electrolytic copper of maximum current density 1.75 amps per sq.mm.

3.4 The male arm and the female arm of the isolator shall be made from tube of high conductivity hard drawn electrolytic copper of required size and thickness.

3.5 The female contacts of horizontal type isolators shall consist of properly tempered loops of copper strip. The strips shall be silver-plated with minimum 20 micron thickness and shall be fixed with powerful phosphor bronze or stainless steel spring.

3.6 The design of the isolator shall be such that minimum pressure due to contact opening or closing shall be transferred to the insulator.

3.7 The insulators to be used shall be solid core type, homogeneous and properly glazed with brown colour.

3.8 All iron parts shall be hot dip galvanized.

3.9 The Earth switch and its terminals shall be able to carry the same fault current as the main blades of the isolator and shall withstand dynamic stresses.

3.10 Each isolator shall be provided with a complete galvanized steel base with holes and designed to mount on a supporting structure.

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3.11 The open and close positions of main and earthing isolators shall be indicated by an indicator made of metal and placed at a suitable height so that the same is easily visible from ground level.

3.12 All handles of isolator main blade and earth switch shall have provision for padlocking.

4.0 EARTHING

4.1 Flexible conductor of adequate cross section shall be provided at the lower end of the vertical operating shaft for connection to station earthing system. It is for earth switch only. The frame of each isolator and earthing switches shall be provided with two reliable earth terminals for connection to earth grid.

5.0 TECHNICAL PARTICULARS

- | | | | |
|-------|--|---|---|
| i. | Type of Isolators break | : | Outdoor duty, double
Centre post rotating,
horizontal type. |
| ii. | Pole | : | Three Pole |
| iii. | System voltage | : | Nominal 33kV
Maximum 36kV |
| iv. | System neutral earthing | : | Non effectively earthed |
| v. | Rated current | : | 400A |
| vi. | Short time rating | : | 25KA for 1 sec. |
| vii. | Peak short time current | : | 62.5 KA |
| viii. | Operating Mechanism | : | Manual |
| ix. | Earth Switch | : | Hand operated. |
| x. | Number of Earth switch | : | One |
| xi. | Cantilever strength of support insulator | : | 4 kN |
| xii. | Creepage distance | : | 900 mm |

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- xiii. Control voltage : 110V DC in MRSS
240V AC in distribution substations
- xiv. Auxiliary supply : 240V AC , 1Ph
- xv. Auxiliary supply for Motor : Not applicable
- xvi. Installation : Outdoor
- xvii. Auxiliary contacts : At least 6NO + 6NC spare contacts shall be provided in addition to its own requirement. All spare contacts shall be wired up to the terminal blocks.

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E3 : TECHNICAL SPECIFICATION FOR 33KV CURRENT TRANSFORMERS

1.0 DESIGN CRITERIA :

1.1 The Current Transformers and accessories covered by this specification shall comply with the requirement of the latest edition of the following standards.

IS: 2705 (Part I & IV) : Specification for Current Transformer

IS: 4201 : Application guide for Current Transformer

IS:2099 : Specification for H.V. Porcelain bushings

IS:335 : Specification for Insulation Oil for Transformers and Switchgears.

IEC: 60044 : Instrument transformers

1.2 The Current Transformers shall be of low reactance outdoor type, single phase, 50Hz, self cooled with shaded porcelain bushings, suitable for operation under the service conditions as specified elsewhere.

1.3 The Current Transformers shall have multicore/multiratio as specified. The ratio, VA rating, accuracy class etc. of Metering and Protection CTs have been specified in the attached SLD.

1.4 The exciting current of CTs shall be as low as possible. The CTs shall be capable of maintaining its rated accuracy at different burdens and within saturation limits.

1.5 C.T. Characteristic shall be such as to provide satisfactory performance for burdens ranging from 25% to 100% of rated burden in case of metering CT cores and up to knee point voltage in case of protection CT cores.

1.6 The Current Transformer to be used for metering and instruments shall have accuracy class and instrument safety factor as specified in SLD. The saturation factor of this core shall be low enough so as not to cause any damage to measuring instruments in the event of maximum short circuit current.

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- 1.7 The Current Transformer secondary to be used for protective relaying purposes shall have accuracy class as specified in SLD. The knee point voltage, resistance and magnetising current of 'PS' class CTs shall be calculated by the Contractor based on the protection model offered and shall submit for approval.
- 1.8 The design and construction of the CTs shall be such as to withstand thermal and mechanical stresses resulting from specified short circuit current for specified duration.

2.0 CONSTRUCTIONAL FEATURES:

- 2.1 The Current Transformer shall be oil immersed type provided with class 'A' insulation. It shall be hermetically sealed to prevent air and moisture ingress into it. The CT shall be dead tank type.
- 2.2 The core of the CTs shall be high grade non-ageing, laminated silicon steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and overcurrent.
- 2.3 The Current Transformer shall be complete with all accessories like primary and secondary terminals, terminal connectors, weather proof terminal box for secondary connection, lighting lugs, rating and diagram plate etc.
- 2.4 The CTs shall be suitable for upright mounting on outdoor structures. Necessary flanges, bolts, clamps fixtures etc. shall be supplied.
- 2.5 The secondary terminal box shall be full water tight construction (IP-55).
- 2.6 Secondary leads of the CT cores of all three phases shall be brought to a common CT junction box mounted on the supporting structure of the middle phase.
- 2.7 CTs shall be mounted on a common structure with 33kV CBs.

3.0 BUSHING

- 3.1 Oil filled condenser type hollow porcelain bushing conforming to latest edition of IS: 2099 shall be used for CT.
- 3.2 Oil expansion chamber and bushing clamp shall be high strength. The cantilever strength of bushing/insulator of CT must be strong enough to withstand the short circuit force on the CT terminals under all operating conditions.

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3.3 Ferrous parts shall be hot dip galvanized.

4.0 NOTE:

The bidder shall submit full data of CTs like Vk values, CT resistance, excitation current etc. and submit necessary calculations considering type of Protection etc.

5.0 TECHNICAL PARTICULARS

- i. Rated system voltage : 33kV
- ii. Highest system voltage : 36kV
- iii. Rated current/burden/accuracy : As per SLD
- iv. System neutral earthing : Non effectively earthed
- v. Installation : Outdoor
- vi. Extended current rating : 120% maxm.
- vii. Rated short time current : 25 KA for 1 sec
- viii. Peak short time current : 62.5kA
- ix. Instrument security factor : Less than 5 for metering core.
- x. Creepage distance : 900 mm

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E4 : Technical specification of 33KV potential transformers

1.0 SCOPE:

This section covers the specification of 33kV potential transformer suitable for outdoor services. Any other particulars not specifically mentioned in this specification but otherwise required for proper functioning of the equipment should be duly considered.

2.0 DESIGN CRITERIA:

2.1 The Potential transformers and accessories covered by this specification shall comply with the requirement of latest edition of the following standards unless otherwise stated in this specification:

IS 3156, IS 2099, IEC 186 etc.

IS: 3156 (Part I & IV) : Specification for Potential Transformer

IS: 4146 : Application guide for Potential Transformer

IS:2099 : Specification for H.V. Porcelain bushings

IS:335 : Specification for Insulation Oil for Transformers and Switchgears.

IEC: 60044 : Instrument transformers

2.2 Potential transformers secondaries shall be protected by HRC cartridge type fuses for all the windings.

3.0 CONSTRUCTIONAL FEATURES:

3.2 The Potential Transformer shall be oil immersed type provided with class'A' insulation. It shall be hermetically sealed to prevent air and moisture ingress into it. The PT shall be dead tank type.

3.3 The core of the PTs shall be high grade non-ageing, laminated silicon steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and overcurrent.

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- 3.4 The Potential Transformer shall be complete with all accessories like primary and secondary terminals, terminal connectors, weather proof terminal box for secondary connection, lighting lugs, rating and diagram plate oil level indicator polarity marking secondary terminal marking etc.
- 3.5 The PTs shall be suitable for upright mounting on outdoor structures. Necessary flanges, bolts, clamps fixtures etc. shall be supplied.
- 3.6 The secondary terminal box shall be full water tight construction (IP-55).
- 3.7 Secondary leads of the PT cores of all three phases shall be brought to a common PT junction box mounted on the supporting structure of the middle phase.
- 3.8 Porcelain housing shall be single piece of homogeneous, vitreous porcelain of high mechanical & dielectric strength. It will be glazed with uniform brown or dark brown colour with smooth surface finish.
- 3.9 Two earthing terminals shall be provided on the metallic tank with bolts,nuts,plain washers etc.

4.0 TECHNICAL PARTICULARS

- i. Rated system voltage : 33kV
- ii. Highest system voltage : 36kV
- iii. Rated Voltage ratio/burden/accuracy : As per SLD
- iv. System neutral earthing : Non effectively earthed
- v. Installation : Outdoor
- vi. Voltage factor : 1.9 times for 30 sec.,
1.1 times continuously
- vii. Power frequency over voltage withstand requirement for secondary winding : 2kV
- vii. Terminal suitable for : ACSR DOG
- viii. Creepage distance : 900 mm

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E5 : TECHNICAL SPECIFICATION FOR 33KV LIGHTNING ARRESTORS

1.0 DESIGN CRITERIA:

- 1.1 This specification covers Metal Oxide Lightning Arresters for use in non effectively earthed systems with nominal voltage of 33KV. The Lightning Arrestors shall be capable of discharging Lightning and switching surges and temporary power frequency over voltages. It shall be capable of withstanding Maximum Continuous Operating Voltages.
- 1.2 The Arrestor shall be capable of withstanding maximum continuous operating voltage (M.C.O.V)
- 1.3 The Arrestors shall be suitable for heavily polluted atmosphere.

2.0 APPLICABLE STANDARDS

Arrestors shall conform in general to IEC-99-4 or its latest amendment and IS/IEC as follows:

- i) IEC-60099-4 : Gapless Lightning Arrester
- ii) IS 15086 P-I : Lightning Arrestor for AC System
- iii) IS 3070 P-III : Metal oxide Surge Arrester without gaps
- iv) IS 2071 : Method of HV Testing

3.0 CONSTRUCTION:

- 2.1 Lightning Arrestors shall be self supporting type in single pole assembly for line to earth connection and suitable for mounting on structures.
- 2.2 The lightning arrester shall be of adequate pressure relief class as per IEC 99-4, fitted with suitable pressure relief devices and arc diverting ports to minimize possibilities of shattering of porcelain housing.
- 2.4 Grading Corona rings shall be provided on each complete arrester for proper stress distribution.
- 2.5 The insulator housing of the arrester shall be made of brown glazed, wet process, electrical porcelain, free from all manufacturing defects. Porcelain housing shall be so coordinated that external flash over will not occur due to

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application of any impulse or switching surge voltage upto the maximum design value for the arrester.

- 2.6 The arrestors shall be provided with outdoor type leakage current monitor and discharge counters.
- 2.7 Each single pole arrester shall be provided with suitable name plate at the base with the following data:
- i) Voltage rating.
 - ii) Nominal discharge current.
 - iii) Frequency rating
 - iv) Maximum continuous operating voltage (MCOV)
 - v) Discharge class
 - vi) Energy Discharge capability

3.0 TERMINAL ARRANGEMENT

The top metal cap and the base of the lightning arresters shall be galvanised. The line terminal shall have a built-in-clamping device which can be adjusted for both horizontal and vertical take off to suit ACSR (conductor size to be specified by the purchaser). The base of the lightning arresters shall be provided with two separate terminals distinctly marked for connection to earth.

4.0 SEALING

The arresters shall be hermetically sealed to avoid ingress of moisture. Suitable rubber gaskets with effective sealing system should be used. Manufacturers should devise a suitable routine production testing to verify the efficiency of sealing.

5.0 FITTINGS AND ACCESSORIES

- 5.1 Clamp type terminal connectors suitable for horizontal/vertical take off shall be supplied with each lightning arrestors.
- 5.2 Two ground terminal connectors suitable for GI strip (50 X 6mm) shall be provided diagonally opposite sides.

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5.3 Necessary hardware such as nuts, bolts, spring washers, etc with 5% spares shall be supplied for each units.

5.4 Necessary hardware such as nuts, bolts, spring washers, etc with 5% spares shall be supplied for each unit.

6.0 TECHNICAL PARTICULARS:

- 6.1 Nominal system voltage : 33kV
- 6.2 Highest system voltage : 36kV
- 6.3 Rated voltage of lightning arrestor : 36kV
- 6.4 Maxm. system BIL : 170 kVp
- 6.5 Nominal Discharge current : 10KA
- 6.6 System fault level : 25kA
- 6.7 Type of Arrestor : Station class heavy duty
- 6.8 Duty : Outdoor
- 6.9 Line Discharge class : Class 2
- 6.10 Minimum Energy Discharge capability (KJ/KV) : 5
- 6.11 System Neutral : Non Effectively Earthed
- 6.12 Minimum Creepage distance : 1100 mm

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E6 : Technical specification of 33KV bus bars, ACSR conductor, clamps, connectors and insulators

1.0 BUSBARS AND BUSBAR CONNECTIONS

1.1 TECHNICAL PARTICULARS OF BUSBARS:

Nominal system voltage	33 kV
Nominal current rating	As per SLD
Bus Conductor/Bay Conductor/ Dropper etc	ACSR DOG/ACSR Rabbit as shown in layout
Short time current rating for 1 second	25KA rms
The clearance in air for busbars, etc. shall not be less than the following	
- between phases	320 mm
- between one phase and earth	320 mm
- Minimum height of any busbar or live connection above ground level or platform where personnel may stand with gear alive	3700 mm
- Ground clearance from bottom of insulator	2500 mm
- Sectional clearance	2800 mm
- Center to center distance between bays	6000 mm

1.2 BUSHINGS, INSULATORS AND FITTINGS

This section is applicable to bushings, insulators and fittings which form part of breakers, insulators, lightning arrestors, CT, LPT and other such

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equipment. This is also applicable for supporting type (post / string) insulators used in the switchyard.

TECHNICAL PARTICULARS

Standards:	
Bushing Support insulator	IEC 137, IS 2099 IEC 168, IEC 273, IS 2544
Nominal System Voltage	33 kV
Highest System Voltage	36 kV
Rated frequency	50 Hz
Pollution class specified for all class of equipment	III Heavy (as per IEC71)
Insulation level-Rated lightning impulse withstand voltage	170 KV peak
Minimum creepage distance	900 mm

2.0 BAY MARSHALLING KIOSKS

One (1) 415V Bay marshalling kiosk (BMK) shall be provided for two (2) nos. 33kV bays. The BMK shall be suitable for outdoor installation (Protection class IP55) with sufficient number of stud type terminal block and cable glands for all incoming and outgoing cables.

The marshalling kiosk shall be made of 3mm thick sheet steel and weather proof construction, provided with suitable seating and gasketing to avoid entry of vermin / reptiles. It shall have canopy of suitable shape which shall not allow rain water to accumulate on top. The terminal blocks shall be suitable for connection of loop type lugs and shall be provided with shorting links.

3.0 INSULATORS

- a. The insulators for suspension and tension strings shall conform to IEC383. Insulators hardware shall conform to IS:2486.
- b. Suspension and tension insulators shall be wet process porcelain with ball and socket connection. Insulators shall be interchangeable and shall be suitable for forming either suspension or tension strings. Each insulator shall have rated strength markings on porcelain printed and applied before fining.

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- c. Porcelain used in insulator manufacture shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.
- d. All hardware shall be bolted type.

3.1 **DISC INSULATORS**

Size of insulator units (mm)	255x145
Electro mechanical strength	70 kN
Minimum Creepage distance of Each disc.	290 mm.
Minimum no. of units in complete string.	3 nos.

3.2 **BUS POST INSULATOR**

- a. The post insulators shall conform in general to latest IS:2544, IEC-168 and IEC-815.
- b. Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable.
- c. Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.
- f. Every bolt shall be provided with a steel washer under the nut so that part of the threaded portion of the bolts is within the thickness of the parts bolted together.

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Type	Solid Core.
Insulating material	70 kN
Total Creepage distance.	900mm.
Cantilever strength	2 KN.
Mounting position	Upright.

4.0 **ACSR CONDUCTOR**

The conductor shall conform to IS:398 (Part-V) – 1982 except where otherwise specified herein.

PARAMETER	DOG	RABBIT
Stranding and wire diameter	6/4.72 mm Al+7/1.57 mm steel	6Al+1/3.35 mm steel
Sectional area of aluminium	105.00mm ²	52.88 mm ²
Total sectional area	118.50mm ²	61.70 mm ²
Overall diameter	14.15mm	10.05 mm
Approximate weight	394 kg/km	214 kg/km
Calculated d.c. resistance at 20 deg C	0.2792 ohm/km	0.5524 ohm/km

4.1 **MATERIALS**

a) **ALUMINIUM**

The aluminium strands shall be hard drawn from electrolytic aluminium rods having purity not less than 99.5% and a copper content not exceeding 0.04%.

b) **STEEL**

The steel wire strands shall be drawn from high carbon steel wire rods and shall conform to the following chemical composition.

ELEMENT	%COMPOSITION
Carbon	0.50 to 0.85
Manganese	0.40 to 1.10
Phosphorous	0.05 max.
Sulphur	0.05 max.
Silicon	0.10 to 0.35

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c) ZINC

The Zinc used for galvanizing shall be electrolytic High Grade Zinc of 99.95% purity. It shall conform to and satisfy all the requirements of IS:209-1979.

4.2 Joints in Wires

a) Aluminium Wires

No joints shall, be permitted in the individual wires in the outermost layer of the finished conductor. However, joints in the 12 wire and 18 wire inner layer of the conductor shall be allowed but these joints shall be made by cold pressure but welding and shall be such that no such joints are within 15 meters of each other in the complete stranded conductor.

b) Steel Wires

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no strand splices in any length of the completed stranded steel core of the conductor.

c) Tolerances

The manufacturing tolerances to the extend of the following limits only shall be permitted in the diameter of individual aluminium and steel strands and lay-ratio of the conductor.

5.0 Tubular Bus Conductor

- a. Aluminium used shall be grade 63401 WP (range-2) conforming to IS:5082.
- b. For outside diameter (OD) & thickness of the tube there shall be no minus tolerance, other requirements being as per IS:2678 and IS:2673.
- c. The aluminium tube shall be supplied in suitable cut length to minimize wastage.

Size	1.5"IPS (Schedule 40)
Outer diameter (mm)	48.26
Thickness (mm)	3.69
Cross-sectional areas (sq.mm.)	516.13
Weight (kg./m)	1.396

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6.0 **CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS**

6.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below :

- | | | |
|----|--|--|
| a) | For connecting ACSR conductors | Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617. |
| b) | For connecting equipment terminals made of copper with ACSR conductors | Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner and all test shall conform to IS:617. |
| d) | i) Bolts, nuts & Plain, washers | i) Electro-galvanized for sizes below M12, for others hot dip galvanized. |
| | ii) Spring washers for items 'a' | ii) Electro-galvanized mild steel suitable for at least service condition-3 as per IS:1573 |

6.2 Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation.

6.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.

6.4 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body for Bi-metallic clamps.

6.5 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

6.6 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

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E7 : Technical specification of 33KV Relay and Control panel

1.0 TYPE OF PANLES

Simplex Panel

Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from rear. In case of panel having width more than 800mm, double leaf-doors shall be provided. Doors shall have handles with either built in locking facility or will be provided with pad-lock.

One 33 kV C&R panel shall be installed for incomer and one 33 kV C&R panel shall be installed for each outgoing. Each panel shall consist of energy meter, protection schemes, indication and control etc.

2.0 CONSTRUCTIONAL FEATURES

- 2.1 All Control and Relay panels shall be of simplex type design. It is the responsibility of the Contractor to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control scheme be properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in existing switchyard control rooms, should be in conformity with the space availability in the control room.
- 2.2 Panel shall be completely metal clad and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-41 in accordance with IS: 2147.
- 2.3 Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0 mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.

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- 2.4 All doors, removable covers and panels shall be gasketed all around with neoprene gaskets. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.
- 2.5 Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surface true and smooth.
- 2.6 Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti vibration strips made of shock absorbing materials that shall be supplied by the contractor, shall be placed between panel & base frame.
- 2.7 Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly.

3.0 MOUNTING

- 3.1 All equipment on and in panels shall be mounted and completely wired to the terminals blocks ready for external connections. The equipment on front of panel shall be mounted flush. No equipment shall be mounted on the doors.
- 3.2 Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.
- 3.3 Contractor shall carry out cut out, mounting and wiring of the items supplied by others, which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.
- 3.4 The centre lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel.
- 3.5 The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Like wise the top lines of all meters, relays and recorders etc. shall be matched.

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4.0 **PANEL INTERNAL WIRING**

- 4.1 Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally.
- 4.2 All wiring shall be carried out with 1100V grade, single core, stranded FRLS tinned copper conductor wires with PVC insulation. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:
- All circuits except current transformer circuits and voltage transfer circuits meant for energy metering - one no 1.5mm sq. per lead.
 - All current transformer circuits one no 2.5 sqmm per lead.
 - Voltage transformer circuit (for energy meters): Two 2.5 sqmm. Per lead.
- 4.3 All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & troughs shall be used for this purpose.
- 4.4 Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.
- 4.5 Wire termination shall be made with solderless crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule.
- 4.6 Longitudinal troughs extending throughout the full length of the panel shall be preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires.

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4.7 Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipments.

5.0 **TERMINAL BLOCKS**

5.1 All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 1100 V grade and have 10 Amps continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.

5.2 Disconnecting type terminal blocks for current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

5.3 At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

5.4 Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side

- All CT & PT circuits: minimum of two of 2.5mm Sq. copper.
- AC/DC Power Supply Circuits: One of 6mm Sq. Aluminium.
- All other circuits: minimum of one of 2.5mm Sq. Copper.

5.5 There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also the clearance between two rows of terminal blocks edges shall be minimum of 150mm.

5.6 Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the Owner's external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.

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5.7 All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. for external cables shall be included in the scope of supply.

6.0 MIMIC DIAGRAM

6.1 Coloured mimic diagram and symbols showing the exact representation of the system shall be provided in the front of control panels.

6.2 Mimic diagram shall be made preferably of anodised aluminium or plastic of approved fast colour material, which shall be screwed on to the panel and can be easily cleaned. Painted overlaid mimic is also acceptable. The mimic bus shall be 2 mm thick. The width of the mimic bus shall be 10mm for bus bars and 7 mm for other connections.

6.3 When semaphore indicators are used for equipment position they shall be so mounted in the mimic that the equipment close position shall complete the continuity of mimic.

6.4 Indicating lamp, one for each phase, for each bus shall be provided on the mimic to indicate bus charged condition.

6.5 Colour scheme for mimic diagram :

<u>KV class</u>	<u>Colour</u>	<u>Shade index as per IS 5</u>
11kV	Air craft blue	108
33kV	Brilliant green	221
132kV	Signal red	537
220kV	Light orange	557

7.0 NAME PLATES AND MARKINGS

7.1 All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel on front as well as rear side, large and bold name plates shall be provided for circuit/feeder designation.

7.2 All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the

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one shown in the panel internal wiring to facilitate easy tracing of the wiring.

7.3 Each instrument and meter shall be prominently marked with the quantity measured e.g. KV, A, MW, etc. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

7.4 Name Plates shall be made of non-rusting metal or 3 ply lamicaid. Nameplates shall be black with white engraving lettering.

7.5 All the panels shall be provided with nameplate mounted inside the panel bearing PO No & Date, Name of the Substation & feeder and reference drawing number.

8.0 MISCELLANEOUS ACCESSORIES

8.1 Plug Point:

240V, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFF switch.

8.2 Interior Lighting:

Each panel shall be provided with a fluorescent lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch.

8.3 Switches and Fuses:

Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall conform to IS :13947 . Each MCB shall be provided with one potential free contact and the same shall be wired for annunciation purpose. However voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS:13703 mounted on plug-in type fuse bases. . Fuse carrier base as well as MCBs shall have imprints of the fuse 'rating' and 'voltage'.

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8.4 Space Heater :

Each panel shall be provided with a space heater rated for 240V , single phase, 50 Hz Ac supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit .

9.0 EARTHING

9.1 All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq.mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for connection with cable armours and mounted equipment etc for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

9.2 All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green.

9.3 Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.

9.4 VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

10.0 INDICATING INSTRUMENTS

All instruments and meters shall be enclosed in dust proof, moisture resistant, black finished cases and shall be suitable for tropical use. All Bus voltage and frequency indicating instruments shall be provided with individual transducers and these shall be calibrated along with transducers to read directly the primary quantities. They shall be accurately adjusted and calibrated at works and shall have means of calibration check and adjustment at site. The supplier shall submit calibration certificates at the

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time of delivery. However no separate transducers are envisaged for digital bus voltmeters and digital frequency meters and the indicating meters provided in the synchronizing equipment.

10.1 INDICATING INSTRUMENTS

10.1.1 Unless otherwise specified, all electrical indicating instruments shall have circular 240 degree scale and with a dial of 96mm x 96mm. They shall be suitable for flush mounting.

10.1.2 Instruments dial shall be with white circular scale and black pointer and with black numerals and lettering. The dial shall be free from warping, fading, and decolouring. The dial shall also be free from parallax error.

10.1.3 Instruments shall conform to IS: 1248 and shall have accuracy class of 0.5.

10.2 TRANSDUCERS

10.2.1 Transducers (for use with Indicating Instruments) shall in general conform to IEC: 688-1.

10.2.2 The energy meter capability shall be used for measurement of active power, reactive power, voltage, current and frequency in three phase four wire unbalanced system.

10.2.3 Voltage signal (440 Volt ac L-L) for voltmeter, PF meter, frequency meter, KW meter etc to be provided in the C&R panel shall be tapped from the respective PTs through a separate / independent copper cable.

10.3 ENERGY METER

10.3.1 Static TVM energy meter shall be provided. 3 phase, 4 wire, 0.5 class energy meter shall be provided.

10.3.2 The meter shall be provided with a galvanically isolated optical communication port as per IEC-1107/PACT/ANSI, with removable cover and with locking arrangement so that it can be easily connected to data transfer.

10.3.3 The meter also shall have a separate individually sealable RS-485 communication port with Remote Terminal Unit (RTU) over Modbus protocol in multi-drop mode so that selected analog data can be communicated to central location for DAS application. The implementation detail of MODBUS protocol shall be furnished by the bidder.

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10.3.4 Reliable sealing arrangement shall be provided to make the meter tamper proof and avoid fiddling or tampering by unauthorized persons.

10.3.5 **Display:**

A real time quartz clock shall be used in the meter for maintaining time and calendar date. The maximum drift shall not exceed 5 minutes per year. The meter shall have a minimum 7 digits, 7 segments LCD or LED display with another digit for legend. The minimum character height shall be 10mm. The meter should have non-volatile memory, so that the registered parameters will not be affected by loss of power.

10.4 MULTI FUNCTION METERS

Sl. No.	Particulars	Specification
1.	Type	Digital, panel flush mounting, Conzerve type EM6400 or eqv.
2.	Construction	Sealed dust proof
3.	Size	96 x 96 mm
4.	Display	Alpha numeric bright LED display
5.	Monitoring functions	A1, A2, A3, V1, V2, V3, VN, F, PF, W, VAR, VA, WH, VARH, VAH, THD, MD
6.	Accuracy	1.0
7.	Input voltage	110V or 415V AC (L-L)
8.	Input current	5 A
9.	Aux. supply	240V AC, 1 phase
10.	Communication	RS 485 modbus RTU protocol

10.5 ANNUNCIATION SYSTEM

10.5.1 Alarm annunciation system shall be provided in the control board by means of visual and audible alarm in order to draw the attention of the operator to

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the abnormal operating conditions or the operation of some protective devices. The annunciation equipment shall be suitable for operation on the voltages specified in this specification i.e. 110 Volt DC.

- 10.5.2 The visual annunciation shall be provided by annunciation facia, mounted flush on the top of the control panels.
- 10.5.3 The annunciator facia shall be provided with translucent plastic window for alarm point with approximate size of 35mm x 50mm. The facia plates shall be engraved in black lettering with respective inscriptions. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall not be less than 5 mm.
- 10.5.4 Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. The transparency of cover plates and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (350 Lux), from the location of the operator's desk.
- 10.5.5 All Trip facia shall have red colour and all Non-trip facia shall have white colour.
- 10.5.6 The annunciation system shall work in co-ordination with the existing annunciation system (hooter or bell) in the substation. If the same is not provided, hooter shall be supplied for above purpose.
- 10.5.7 Sequence of operation of the annunciator shall be as follows:

	VISUAL	AUDIO
ON OCCURRING OF FAULT	LAMP FLASHING	ON
ON ACCEPTING	LAMP STEADY ON	OFF
ON RESET	OFF	OFF
ON TEST LAMP	FLASHING	ON

- 10.5.8 Audible annunciation for the failure of DC supply to the annunciation system shall be provided and this annunciation shall operate on 240 Volts AC supply. On failure of the DC to the annunciation system for more than 2 or 3 seconds. (adjustable setting), a bell shall sound. A separate push button shall be provided for the cancellation of this audible alarm alone but the facia window shall remain steadily lighted till the supply to annunciation system is restored.
- 10.5.9 A separate voltage check relay shall be provided to monitor the failure of supply (240V AC) to the scheme mentioned in Clause above. If the failure

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of supply exists for more than 2 to 3 seconds, this relay shall initiate visual and audible annunciation. This annunciation shall operate on Annunciation DC and buzzer shall sound.

11.0 SWITCHES

11.1 Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out.

11.2 The selection of operating handles for the different types of switches shall be as follows :

Breaker, Isolator control switches : Pistol grip, black

Selector switches : Oval or knob, black

Instrument switches : Round, knurled, black

11.3 The control switch of breaker and isolator shall be of spring return to neutral type. The switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively.

11.4 Instrument selection switches shall be of maintained contact (stay put) type. Voltmeter transfer switches for AC shall be suitable for reading all line- to-line and line-to-neutral voltages for non effectively earthed systems and for reading all line to line voltages for effectively earthed systems.

11.5 The contacts of all switches shall preferably open and close with snap action to minimize arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver or silver alloy. Springs shall not be used as current carrying parts.

The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme.

11.6 The contact rating of the switches shall be as follows :

Description	Contact rating in Amps
Continuous	110V DC, 10Amp
Make and carry	110V DC, 30 Amp

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Break for Resistive load

110V DC, 20 Amp.

12.0 INDICATING LAMPS

12.1 Indicating lamps shall be of multiple LED panel mounting type with rear terminal connections. Lamps shall have translucent lamp covers to diffuse lights coloured red, green, amber, clear white or blue as specified. The lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resisting material.

12.2 Lamps and its parts shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of supply.

12.3 The indicating lamps shall withstand 120% of rated voltage on a continuous basis.

13.0 POSITION INDICATORS

13.1 Position indicators of "SEMAPHORE" type shall be provided when specified as part of the mimic diagrams on panels for indicating the position of circuit breakers, isolating/earthing switches etc. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear. Their strips shall be of the same colour as the associated mimic.

13.2 Position indicator shall be suitable for DC Voltage as specified. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic busbars, and at right angles to them when the object is in the open position. When the supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure.

13.3 The rating of the indicator shall not exceed 2.5 W.

13.4 The position indicators shall withstand 120% of rated voltage on a continuous basis.

14.0 RELAYS

14.1 All relays shall conform to the requirements of IS:3231/IEC-60255 or other applicable standards. Relays shall be suitable for flush or semi-flush

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mounting on the front with connections from the rear. Relays could be either of electromechanical.

- 14.2 All protective relays shall be electro mechanical type in draw out or plug-in type/modular cases with proper testing facilities. Necessary test plugs/test handles shall be supplied loose and shall be included in contractor's scope of supply.
- 14.3 All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 5 amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.
- 14.4 The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme, contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.
- 14.5 All protective relays, auxiliary relays and timers except the lock out relays and interlocking relays specified shall be provided with self-reset type contacts.
- 14.6 No control relay which shall trip the power circuit breaker when the relay is de-energised shall be employed in the circuits.
- 14.7 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.
- 14.8 Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type.
- 14.9 All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

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- 14.10 The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.
- 14.11 Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection should also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the client.
- 14.12 All relays and their drawings shall have phase indications as R-Red, Y-yellow, and B-blue
- 14.13 PROTECTION:
- 14.13.1 33 kV Incoming line protection
- I. There shall be three non directional over current (IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current) and one non directional earth fault relay having a variable setting range of 10-40% in each panel.
 - II. High speed master trip hand reset lock out relay shall receive inputs from the protective relay and send command to trip coil of the circuit breaker directly.
- 14.13.2 33 kV Outgoing line protection
- I. There shall be three non directional over current (IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current) and one non directional earth fault relay having a variable setting range of 10-40% in each panel. Both over current and earth fault relay shall be with high set unit (with setting range of 250-2000% for O/C element and 100-800% for E/F element).
 - II. High speed master trip hand reset lock out relay shall receive inputs from the protective relay and send command to trip coil of the circuit breaker directly.
- 14.14 SUPERVISION RELAY
- a) Trip circuit supervision shall also be provided having adequate contacts for providing connection to alarm.

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- b) DC supply supervision shall also be provided having adequate contacts for providing connection to alarm.

15.0 CONFIGURATION OF C&R PANELS (33kV)

Each panel shall consist of, but not limited to, the following:

- | | | | |
|----|-----------------------|-------|--|
| a. | Ammeter | 1 no | for each bay |
| b. | Voltmeter | 1 no | for incoming bay |
| c. | Frequency meter | 1 no | for incoming bay |
| d. | TVM meter | 1no | for incoming bay |
| e. | MFM meter | 1no | for each outgoing bay |
| f. | CB control switch | 1no | for each breaker |
| g. | Red indicating lamp | 1 no. | for each CB ON status |
| h. | Red indicating lamp | 1 no. | for each isolator ON status |
| i. | Green indicating lamp | 1 no. | for each CB OFF status |
| j. | Green indicating lamp | 1 no. | for each isolator OFF status |
| k. | Amber indicating lamp | 1 no. | for each CB 'Auto trip' status |
| l. | Blue indicating lamp | 1 no. | for each CB 'Trip circuit unhealthy' status |
| m. | White indicating lamp | 1 no | for each feeder
(DC healthy lamp) |
| n. | Annunciation windows | 1 Set | for each feeder.
with associated annunciation
relays |

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- | | | | |
|----|--|-------|---|
| m. | Push button for alarm | 3 nos | for each control panel
Accept/reset/lamp |
| n. | Mimic to represent SLD | Lot | in all control panels |
| o. | Semaphore indicator for Earth switch | 1 no. | for all bays |
| p. | Voltmeter with selector Switch | 1 no | for incoming bay |
| q. | Trip circuit supervision | 1 set | for each CB |
| r. | DC supply Supervision relay | 1 no | As per scheme requirement |
| s. | Flag relays, aux. relays, timers, trip relays etc. | 1 Set | As per scheme requirements |

Note :

- The above list is general in nature. Additional equipment, if required, to meet the protection, metering, indication, interlock and annunciation requirements stipulated in this specification shall be supplied based on approved drawings during detail engineering.

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E8 : Technical specification of 33kV Indoor Switchboard with Load Break Switch & Fuse

1.00.00 INTENT

- 1.01.00 This specification is intended to cover design, manufacture, testing at manufacturer's works, painting delivery properly packed for rail/road transportation F.O.R. plant site of 33kV Switchboard for safe, efficient, trouble-free and successful operation and maintenance of the equipment and accessories covered under this specification. In the event of any counter stipulation elsewhere, the stipulation of this specification shall prevail.
- 1.02.00 The 33kV switchboard shall be complete in all respects and any devices not included in the specification but essential for proper operation of the equipment shall be deemed to be within the scope of the specification whether specifically mentioned in the specification or not.
- 1.03.00 It is the intention of the Purchaser to install the most up to date type of equipment conforming to modern code and practices.

2.00.00 CODES & STANDARDS

- 2.01.00 The equipment and accessories covered by this specification shall be designed manufactured and tested in accordance with the latest relevant standards and codes of practice published by BIS (Bureau of Indian Standards Institution) wherever available. In case where Indian Standard is not available, equipment and accessories shall conform to the latest publication of IEC (International Electro technical Commission). Some applicable standards are:

IS 9920, Part 1 : Specification for Switches for rated voltages above 1kV and less than 52kV.

IEC 60265, Part 1 – Specification for Switches for rated voltages above 1kV and less than 52kV.

IEC- 60282 - Specification for High voltage fuses.

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IEC-60298- Specification for H.V. metal enclosed switchgear and Control gears.

2.02.00 The equipment shall conform to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified therein for installation and operation of electrical plant and equipment.

4.00.00 SCOPE

The scope of this specification shall include supply of the following 33kV Switchboard as per SLD along with fittings and accessories in compliance with the technical specifications and ratings and requirements furnished in the subsequent clauses.

a. 33kV switchboard : 1 set.

5.00.00 DESIGN CRITERIA

5.01.00 The switchgear will be installed indoor inside Chiller plant substation no. 10.

5.02.00 The switchgear will be located in a hot, humid dusty and tropical atmosphere.

5.03.00 For continuous operation at specified ratings, temperature rise of the various switchgear components shall be limited to the permissible values stipulated in the relevant standards and/or this specification. Required derating factors shall be applied while selecting the ratings of components to meet the above criteria.

5.04.00 The switchgear and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current listed in the Annexure without any damage or deterioration of material.

5.05.00 The lowest mounting plate shall be not less than that 450mm from the bottom of the panel and the centre lines of operating handles of control/selector switches push buttons etc. shall be not less than 750 mm and not more than 1600 from the bottom of the panel.

5.06.00 Mimic Diagram

5.06.01 Mimic shall be made of 12.5 mm wide and 3mm thick enamel painted aluminum strips. It shall be fastened with pins or screws and nuts on the panel.

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5.06.02 Following colour coding shall be followed for the mimic diagram:
33 KV Signal red – shade 537 of IS: 5

6.00.00 DETAILED TECHNICAL SPECIFICATIONS

6.01.00 Construction

6.01.01 The switchboard shall be indoor sheet steel clad, floor mounted, compartmentalized, free standing type. Design and construction shall be such as to allow extension at either end.

6.01.02 The switchboard enclosure shall conform to the degree of protection IP-4X. The minimum thickness of sheet steel used shall be 2mm.

6.01.03 The switchboard assembly shall comprise a continuous, dead –front line-up of freestanding, vertical cubicles. Each cubicle shall have a front hinged door with latches and a removable back cover. All covers and doors shall be provided with neoprene gaskets.

6.01.04 Switchboard shall be assembled on base channel of structural steel of minimum height 75 mm. painted black.

6.01.05 Load break switch, instrument transformers, bus-bars cable compartment etc., shall be housed in separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units. Earthed metallic barriers shall be provided between compartments and between vertical sections.

6.01.06 All meters, switches and lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle.

6.01.07 Control cables entry shall be from the front side.

6.01.08 Screw wire mesh shall be provided in the power cable chamber.

6.02.00 Bus and Bus Taps

6.02.01 The main buses and connections shall be of high conductivity aluminum /aluminum alloy sized for specified current ratings with maximum temperature limited to 85⁰ C (i.e. 35⁰ C rise over 50⁰ C ambient)

6.02.02 All bus connections shall be silver-plated. Adequate contact pressure shall be ensured by means of two bolts connection with plain and spring washers and locknuts.

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Bimetallic connectors shall be furnished for connections between dissimilar metals.

6.02.03 Bus bars and connections shall be fully insulated for working voltage with adequate phase/ground clearances. Insulating sleeves for bus bars and cast-resin shrouds for joints shall be provided.

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

6.02.04 All buses and connections shall be supported and braced to withstand stresses due to maximum short circuit current and also to take care of any thermal expansion.

6.02.05 Bus bars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switch gear assembly.

6.02.06 The bus bar chamber shall be provided with inter panel barrier with epoxy cast seal-off bushings through which the buses will pass through so as to prevent fire from one panel to another.

6.03.00 Load Break Switch (LBS)

6.03.01 LBS shall be triple pole, air break, fault make, load break type. Other features are :

- a. Independent manual quick break type.
- b. Mechanical trip device.
- c. Mechanical ON/OFF indication with LED indication lamp.
- d. Panel mounted with pad locking facilities in ON & OFF condition.
- e. Earthing switch shall be interlocked with the LBS blades to prevent simultaneous closing of both.

6.03.02 Each LBS shall be provided with auxiliary switch with at least 4 No + 4 NC contacts.

6.03.03 Earthing switch shall be provided as shown in SLD. The rating of the ES shall be same as that of LBS.

6.03.04 Auxiliary switches shall be convertible type that is facility for changing N.O. contact to N.C. and vice-versa. Switch contact shall be rated 10A A.C. and 2A D.C. at operating voltage.

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6.04.00 HT Fuse

- 6.04.01 Load break switch shall be used in conjunction with fuse for transformer feeders to tackle high fault current and offer protection against dead short circuit. The fault clearance and isolation through this combination will be achieved in less than 5 ms through proper selection of the fuse.
- 6.04.02 Fuses shall be manufactured with silver tips/silver coated Cu.
- 6.04.03 The following parameters shall be taken into consideration for proper selection of fuse :
- Maxm. fault clearing capacity.
 - Maxm. arc energy the fuse can tackle.
 - Minimum fusing current.
 - Maxm. arc voltage it will produce while clearing the fault.
 - Should not trip for transformer magnetizing inrush current.
- 6.04.04 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the listed Short Circuit Current.
- 6.04.05 Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element.
- Visible indication shall be provided on blowing of the fuse.

6.05.00 Current Transformer

- 6.05.01. Current transformers shall be cast resin type. All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.
- Accuracy class of the Current Transformers shall be Class 1.0 and ISF <5 for metering.

6.06.00 Voltage Transformer

- 6.06.01. Voltage Transformers shall be cast-resin type and shall have an accuracy class of 1.0.
- 6.06.02. High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be

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completely disconnected and visibly grounded in fully draw-out position.

- 6.06.03. Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.

6.07.00 Meters

All meters shall be installed on the switchboard itself as indicated in the attached SLD. Following details are, however, given as guidelines for meters to be mounted for respective feeders:

- 6.07.01. Incoming Feeder of 33kV Switchboard:
- i. Digital multi function meter provided with at least KWH, KW, KVARH, PF, HZ & KVA with MDI.
 - ii. Analog type ammeter with selector switch.
 - iii. Analog type voltmeter with selector switch.

- 6.07.02. Outgoing Feeder to Transformers:
- i. Digital multi function meter provided with at least KWH, KW, KVARH, PF, HZ & KVA with MDI.
 - ii. Analog type ammeter with selector switch.

6.08.00 Secondary Wiring

- 6.08.01 The switchboard shall be fully wired at the factory to ensure proper functioning of control, protection and interlocking schemes.

- 6.08.02 Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.

- 6.08.03 Wiring shall be done with flexible, 650V grade, PVC insulated switchboard wires with standard copper conductors of 2.5mm² for control and current circuits and 1.5 mm² for voltage circuits.

- 6.08.04 Each wire, shall be identified, at both ends, with permanent markers bearing wire numbers as per Wiring Diagrams.

- 6.08.05 Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

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6.09.00 Terminal Blocks.

- 6.09.01 Terminal blocks shall be 660V grade box- clamp type with marking strips ELMEX 10mm² or equal. Terminals for C.T. Secondary leads shall have provision for shorting.
- 6.09.02 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.
- 6.09.03 Terminals blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

6.10.00 Cable Termination

- 6.10.01 Switchboard shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection.
- 6.10.02 Power cables shall be XLPE insulated, armoured, overall PVC sheathed with stranded Aluminum conductor.
Control cables shall be PVC insulated, armoured, overall PVC sheathed with stranded copper conductor.
- 6.10.03 All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates, cables supports, and crimp type tinned copper/aluminum lugs, brass compression glands with tapered washer (Power cables only) and terminal blocks.
- 6.10.04 The gland plates shall be minimum 4mm thick. The gland plate and supporting arrangement for 1/C power cables shall be such as to minimise flow of eddy current.
- 6.10.05 Sufficient space shall be providing between the power cable termination (end-boxes) and gland plate.

6.11.00 Ground Bus

- 6.11.01 A ground bus, rated to carry maximum fault current shall extend full length of the switchgear.
- 6.11.02 The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to receive 50 x 6mm M.S. flat.

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6.11.03 Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and draw out P.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.

6.12.00 Nameplates

6.12.01 Nameplates of approved design shall be furnished at each cubicle and at each instruments & device mounted on or inside the cubicle.

6.12.02 The material shall be lamicaid or approved equal. 3mm thick with white letter on black background.

6.12.03 The nameplate shall be held by self-tapping screws. Nameplate size shall be minimum 20 x 75mm for instrument/device and 40 x 150mm for panels.

6.12.04 Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

6.13.00 Space heaters and Plug sockets.

6.13.01 Each cubicle shall be provided with thermostat controlled space heaters and 5A, 3-pin plug socket.

6.13.02 Cubicle heater, Motor heater, Plug/socket circuits shall have individual switch fuse units.

6.14.00 A.C./D.C. Power Supply.

6.14.01 Isolating switch fuse units shall be provided at each switchgear for the incoming auxiliary power supplies.

6.14.02 Bus-wires of adequate capacity shall be provided to distribute the incoming auxiliary power supplies to different cubicles. Isolating switchfuse units shall be provided at each cubicle for A.C/D.C. supplies.

6.15.00 Annunciation system (To be mounted on Switchboard)

6.15.01 Alarm annunciators of back lit nameplate type with flashes and bell shall be provided on the panel for drawing attention of operators during faults of abnormal operating condition. Alarm conditions shall cover the following & any other desired by the Owner:

- a) Transformer buchholz trip - Trip alarm

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- b) Transformers buchholz alarm - Alarm
- c) Transformer winding temp trip - Trip alarm
- d) Transformer winding temp alarm - Alarm
- e) Transformer oil temp trip - Trip alarm
- f) Transformer oil temp alarm - Alarm
- g) Transformer oil level low - Alarm

Separate auxiliary relays shall be provided for trip and alarm.

6.15.02 Annunciation system shall be of solid-state type mounted on top of switchgear panel. Window engravings shall be in black on milk white, translucent cover. Each window shall have two indicating lamps. Annunciation system shall incorporate push buttons for Acknowledge, Reset and Test purposes. Operating sequence of alarm shall be as follows:

Condition	Status of	
	Visual Alarm	Audible Alarm
Normal	Off	Off
Fault occurs	Flashing	On
Acknowledge	Steady on	Off
Reset before normal	Steady on	Off
Fault cleared	Steady on	Off
Reset after normal	Off	Off

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E9 : Technical specification of Distribution Transformer & Station Service Transformer

1.00.00 INTENT

- 1.01.00 This specification is intended to cover design, manufacture, testing at manufacturer's works, painting, delivery properly packed for rail/road transportation F.O.R. plant site of distribution transformers and station service transformer as specified hereinafter and their accessories completely in line with the detailed specifications of this specification for safe, efficient, trouble-free and successful operation.
- 1.02.00 The transformer and accessories shall be complete in all respects and any devices not included in the specification but essential for proper operation of the equipment shall be deemed to be within the scope of the specification whether specifically mentioned in the specification or not.
- 1.03.00 It is the intention of the Purchaser to install the most up-to-date and energy efficient type of equipment conforming to modern code and practices.

2.00.00 CODES & STANDARDS

- 2.01.00 The equipment and accessories covered by this specification shall be designed, manufactured and tested in accordance with the following latest relevant standards and codes of practice published by BIS (Bureau of Indian Standards Institution) wherever available. In case where Indian Standard is not available, equipment and accessories shall conform to the latest publication of IEC (International Electro-technical Commission).

Sr.No.	Reference Standards/Codes	Description
1	IS:2026 (Part I to IV)	Power Transformer
2	IS: 2099	High Voltage Porcelain Bushings
3	IS: 335	Insulating Oil for transformers, switchgears
4	IS:3347	Dimensions for porcelain transformer bushings

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Sr.No.	Reference Standards/Codes	Description
5	IS:5	Colour for ready mixed paints
6	IS:13947	Degree of protection of enclosures
7	IS:3639	Fittings and accessories for power transformer
8	IS:3637	Gas operated relays
9	IS:6600	Guide for loading of oil immersed
10	IS: 5561	Electric Power connectors
11	C.B.I.P. Publication	Manual on Transformers
12	IS:6005	Code of practice for phosphating of iron and steel

2.02.00 The equipment shall conform to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified therein for installation and operation of electrical plant and equipment.

3.00.00 DESIGN CRITERIA

3.01.00 The 33/0.433kV distribution transformers are meant for distribution of power received at 33 KV and step down to 0.433KV for further distribution to different facilities of the College Campus.

3.02.00 The 33/0.433kV station service transformer is meant for distribution of power received at 33 KV and step down to 0.433KV for further distribution to station auxiliary loads of 33kV Main receiving substation (MRSS).

3.03.00 The transformer will be installed in hot, humid and tropical atmosphere, heavily polluted with dust. The transformer and accessories with wiring shall be provided with tropical finish to prevent fungus growth.

3.04.00 The transformer shall be capable of continuous operation at specified rating under the following conditions :

- a) Voltage Variation : +/- 10%
- b) Frequency Variation : +/- 5%
- c) Combined voltage frequency Variation (absolute sum) : 10%

3.05.00 The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall be such that the flux density with +10% voltage variation from rated voltage or frequency variation of -5% shall

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not exceed 1.9 Tesla. The bidder shall provide saturation curve of the core material proposed to be used satisfying this criteria.

- 3.06.00 The transformer shall be capable of withstanding the short circuit stresses due to terminal fault on one winding the full voltage being maintained at the other winding for minimum period of three (3) seconds.
- 3.07.00 The transformer shall be free from annoying hum or vibration.
- 3.08.00 All equipment shall be complete with approved safety devices wherever a potential hazard to personnel exists and with provision for safe access of personnel to and around equipment for operational and maintenance functions. The design shall include all reasonable precautions and provisions for the safety of operating and maintenance personnel.
- 3.09.00 Special care shall be taken to make enclosed equipment proof against entry of rats, lizards and other creeping reptiles, which may create electrical, short-circuits inside live equipment.
- 3.10.00 Transformers shall be energy efficient type. Minimum possible loss figures shall be offered for the transformers.

4.00.00 DETAILED TECHNICAL SPECIFICATIONS

4.01.00 Tanks

- 4.01.00 Tanks shall be of all welded construction and fabricated from good commercial grade low carbon steel of adequate thickness. All seams shall be double welded. All welding shall be stress relieved.
- 4.02.00 The tank wall shall be reinforced by stiffener to ensure rigidity so that it can withstand without any deformation (a) mechanical shock during transportation and (b) oil filling by vacuum.
- 4.03.00 All removable covers shall be provided with weatherproof, hot oil resistant, resilient gaskets. The design shall be such as to prevent any leakage of water into or oil from the tank.
- 4.04.00 The transformer tank shall be provided with one set of bi-directional flanged wheels for rolling the transformer parallel to either centre line over 1676 mm rail gauge.

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4.05.00 Jacking pads, lifting eyes and pulling lugs shall be provided to facilitate movement of the transformer. All heavy removal parts shall be provided with eyebolt for ease of handling.

4.06.00 Manholes/hand holes of sufficient size shall be provided for access to leads, windings, bottom terminals of bushings and taps.

4.02.00 Core & Coils

4.02.01 The transformer may be of core type. The core shall be built up with high grade, non-aging, low loss, high permeability, grain oriented, cold-rolled silicon steel laminations specially suitable for core material.

4.02.02 The coils shall be manufactured from electrolytic copper conductor and fully insulated for rated voltage.

4.02.03 Insulating material shall be of proven design. Coils shall be so insulated that impulse and power frequency voltage stresses are minimum.

4.02.04 Coil assembly shall be suitably supported between adjacent sections by insulating spacers and barriers. Bracing and other insulation used in assembly of the winding shall be arranged to ensure a free circulation of the oil and to reduce the hot spot of the winding.

4.02.05 All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used where practicable.

4.02.06 The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer or under short circuit stresses.

4.03.00 Tapping

4.03.01 Taps shall be provided on the high voltage side.

4.03.02 The transformer shall be capable of operation at its rated KVA on any tap provided the voltage does not vary by more than +/- 10% of the rated voltage corresponding to the tap.

4.03.03 The winding including the tapping arrangement shall be designed to maintain electromagnetic balance between primary and secondary windings at all voltage ratios.

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4.04.00 Tap Changer

4.04.01 The tap changing will be effected by a 3-phase gang operated switch. Arrangement shall be such that manual operation by operating handle can be effected at standing height from ground level.

4.04.02 The operating handle can be padlocked at any tap position. The design shall be such that the lock cannot be inserted unless the contacts are correctly engaged.

4.04.03 The mechanism shall be provided with a mechanical tap position indicator.

4.04.04 All contacts shall be silver plated and held in position under strong contact pressure to ensure low contact drop and avoid pitting.

4.05.00 Insulating Oil

4.05.01 The transformer shall be filled with mineral insulating oil suitably inhibited to prevent sludging.

4.05.02 First filling of oil along with 10% excess shall be furnished. Oil shall be supplied in non-returnable containers suitable for outdoor storage.

4.05.03 Oil preservation shall be by means of conservator tank along with the Silica gel breather and oil seal.

4.06.00 Bushing

4.06.01 Bushing rated 36 KV class and below shall be solid glazed porcelain or oil communicating type.

4.06.02 Bushings shall be provided with terminal connectors of approved type and size.

4.06.03 Bushing location shall provide adequate phase and ground clearances.

4.07.00 Terminal Arrangements

4.07.01 High voltage primary side terminals shall be brought out through top cover-mounted bushings for overhead conductor terminations.

4.07.02 Low voltage terminals shall be brought out thru' sidewall mounted bushings for connection through cables as specified.

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4.07.03 Low voltage winding neutral of 33/0.433kV transformer shall be brought out thru' sidewall/top cover mounted bushing suitable for connection with neutral earthing conductor.

4.07.04 In general, the arrangement shall be such as to permit removal of transformer without dismantling the cables.

4.08.00 Marshalling Box

4.08.01 Sheet steel, weatherproof, IPW55 marshalling box shall be provided for transformer. The box shall contain all auxiliary devices except those which must be located directly on the transformer.

4.08.02 All terminal blocks for LV aux./control cable connection shall be located in this box. The terminal blocks shall be ELMEX 10mm² or approved equal.

4.08.03 The marshalling box shall be provided with cubicle lamp with door switch, space heater with thermostat and removable cable gland plate.

4.09.00 Wiring

4.09.01 All control, alarm and indication devices provided with the transformer shall be wired up to the terminal blocks.

4.09.02 Wiring shall be done with PVC wires in conduit or PVC armoured cable. Minimum wire size shall be 2.5mm² standard copper for C.T. circuit and 1.5mm² standard copper for other circuits. Not more than two wires shall be connected to a terminal 10% spare terminals shall be provided.

4.09.03 All devices and terminals blocks within the marshalling box shall be identified by symbols corresponding to those used in applicable schematic or wiring diagram.

4.10.00 Grounding

4.10.01 Two grounding pads, located on the opposite sides of the tank, shall be provided for connection to station ground mat.

4.10.02 Grounding pad shall have clean buffed surface with two tapped holes, M10 G.I. bolts and spring washers for connection to 50 x 6 mm M.S. flat.

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4.10.03 Ground terminals shall be also provided on marshalling box to ensure its effective earthing.

5.00.00 RATINGS AND REQUIREMENTS

5.01.00 33/0.433kV, 500 KVA and 750 KVA TRANSFORMER

5.01.01	Application	: Distribution Transformer
5.01.02	Service	: Outdoor, step down
5.01.03	Type	: Oil immersed, energy efficient
5.01.04	Rated output	: 500 KVA and 750 KVA
5.01.05	Mounting	: On concrete pedestal
5.01.06	Cooling	: ONAN
5.01.07	Rated voltage (line to line)	: 33/0.433kV
5.01.08	Number of phases	: 3
5.01.09	Rated frequency	: 50 Hz
5.01.10	Temperature rise above 50 ⁰ C ambient	
	a) in oil by thermometer	: 50 ⁰ C
	b) in winding by resistance	: 55 ⁰ C
5.01.11.	Insulation level-	
	H.V.	: 170/70 KV (peak/rms)
	L.V.	: 3 KV rms
	H.V. neutral	: None
	L.V. neutral	: 3 KV rms
5.01.12	Vector Group	: Dyn11
5.01.13	Type of taps provided	: Off-load
5.01.14	Taps provided on	: H.V. winding
5.01.15	Range of Taps	: +5% to – 5% in steps of 2.5%

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- 5.01.16 Method of Tap Change control : Manual local
- 5.01.17 Percentage impedance at 75⁰ C : 500kVA = 4.75% \pm IS Tol.
750kVA = 5% \pm IS Tol.
- 5.01.18 System earthing
- H.V : Non-effectively earthed
L.V : Solidly earthed
- 5.01.19 **Terminal arrangement-**
- H.V : ACSR Rabbit
L.V : AL XLPE Cable as per SLD
L.V. Neutral : 2x50x6 GS flat
- 5.01.20 Transformer bushing-
Voltage class**
- H.V. : 36KV
L.V : 1.1 KV
L.V. Neutral : 1.1 KV
- 5.01.21 System fault level : 1500 MVA symm. at 33 KV
- 5.01.22 Auxiliary supply : 240 V +/- 10% 3Ph, N, 50Hz +/- 5%
- 5.01.23 Neutral CT : Not required
- 5.02.00 33/0.433kV, STATION SERVICE TRANSFORMER**
- 5.02.01 Application : Station ServiceTransformer
- 5.02.02 Service : Outdoor, step down
- 5.02.03 Type : Oil immersed, energy efficient
- 5.02.04 Mounting : Pedestal mounted
- 5.02.05 Rated output : 100 KVA
- 5.02.06 Cooling : ONAN

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5.02.07	Rated voltage (line to line)	: 33/0.433kV
5.02.08	Number of phases	: 3
5.02.09	Rated frequency	: 50 Hz
5.02.10	Temperature rise above 50 ⁰ C ambient	
	a) in oil by thermometer	: 50 ⁰ C
	b) in winding by resistance	: 55 ⁰ C
5.02.11.	Insulation level-	
	H.V.	: 170/70 KV (peak/rms)
	L.V.	: 3 KV rms
	H.V. neutral	: None
	L.V. neutral	: 3 KV rms
5.02.12	Vector Group	: Dyn11
5.02.13	Type of taps provided	: Off-load
5.02.14	Taps provided on	: H.V. winding
5.02.15	Range of Taps	: +5% to – 5% in steps of 2.5%
5.02.16	Method of Tap Change control	: Manual local
5.02.17	Percentage impedance at 75 ⁰ C	: As per IS : 2026
5.02.18	System earthing	
	H.V	: Non-effectively earthed
	L.V	: Solidly earthed
5.02.19	Terminal arrangement-	
	H.V	: ACSR Rabbit
	L.V	: AL XLPE Cable as per SLD
	L.V. Neutral	: 2x50x6 GS flat
5.02.20	Transformer bushing-	
	Voltage class	
	H.V.	: 36KV
	L.V	: 1.1 KV

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- L.V. Neutral : 1.1 KV
- 5.02.21 System fault level : 1500 MVA symm. at 33 KV
- 5.02.22 Auxiliary supply : 240 V +/- 10% 3Ph, N, 50Hz +/- 5%
- 5.02.23 Neutral CT : Not required

6.00.00 Transformer losses

6.01.00 The bidder shall state the transformer losses viz (i) iron (core) loss (ii) copper loss and (iii) auxiliary losses. The iron loss (no-load loss) in KW at rated voltage and at rated frequency, and load losses (copper and auxiliary losses) in KW at rated full load capacity and at rated voltage and frequency shall be guaranteed at 75 °C.

6.02.00 Transformer losses shall not exceed the following values:

	No load loss	Load Loss
1. 33/0.433kV, 500kVA :	750W	5500W
2. 33/0.433kV, 750kVA :	950W	7500W

6.03.00 No bidder shall specify any tolerance limit in respect of these losses.

6.04.00 The Purchaser reserves the right to reject the transformer if any or all actual losses after tests are found to exceed the above values.

If the test figure of losses are less than the guaranteed values no bonus will be allowed. Any changes in the figure assigned for transformer losses will not be permitted after opening of bids and bid evaluation will be carried out on the basis of information made available at the time of bid opening.

7.00.00 FITTINGS AND ACCESSORIES

The transformer shall be equipped with fittings and accessories as listed below.

- 7.01.00 Oil conservator with filter cap; drain plug and plain oil level gauge.
- 7.02.00 Air release plugs.
- 7.03.00 Pressure release devise. Explosion vent, if provided shall be double diaphragm type.

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- 7.04.00 150mm dial magnetic oil level gauge with low-level alarm contacts.
- 7.05.00 150mm dial oil temperature indicator with maximum reading pointer and electrically separate contacts for trip and alarm.
- 7.06.00 150mm dial winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip, alarm and cooler control.
- 7.07.00 Thermometer pockets.
- 7.08.00 Double float Buchholz relay with gas release cock shut-off valve on either side or separate sets of contacts for trip and alarm.
- 7.09.00 Filter valve with threaded adopter (top and bottom)
- 7.010.00 Drain valve with threaded adopter.
- 7.011.00 Sampling valve.
- 7.012.00 Necessary valves for detachable cooler units.
- 7.013.00 Jacking pads, handling and lifting lugs.
- 7.014.00 Cover lifting eyes.
- 7.015.00 Bi-directional flanged wheel/roller and skids.
- 7.016.00 Clamping device with bolts & nuts.
- 7.017.00 Hand hole of sufficient size for access to interior of the tank.
- 7.018.00 Two-grounding pads.
- 7.019.00 Ladder with safety device for access to the top of transformer tank.
- 7.020.00 Weatherproof marshalling box for housing control equipment and terminal connections.
- 7.021.00 H.V. and L.V. bushing terminal connectors.
- 7.022.00 Rating and terminal marking plates.

Note: All indication, alarm, trip contacts provided shall be rated for 0.5A at 110V DC and 5A at 240 V AC.

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E10 : TECHNICAL SPECIFICATION FOR 415V BUS DUCT

1.00.00 INTENT OF SPECIFICATION

1.01.00 This Specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport F.O.R. site of 415V BUSDUCT complete with all materials, supports and accessories for efficient and trouble-free operation.

2.00.00 SCOPE OF WORK

2.01.00 Scope of Supply

2.01.01 The following equipment shall be furnished with all accessories :-

a. 415V, 1500A Bus duct (Approx 8 meter long) : 2 Sets.

2.01.02 Galvanized steel supporting structures for Bus duct.

2.01.03 One set of special tools and tackles.

2.01.04 Spare parts for 3 years trouble free operation.

2.01.05 All relevant drawings, data and instruction manuals.

3.00.00 DESIGN CRITERIA

3.01.00 The equipment covered under this specification will be used to interconnect transformer LV side to 415V DB incomer feeder at Chiller plant substation no. 10.

3.02.00 Equipment ratings and quantities are detailed in the enclosed drawings and Annexure. Equipment shall be furnished in strict compliance with the same.

3.03.00 For continuous operation at specified ratings, the temperature rise of various equipment/components shall be limited to the permissible values stipulated in relevant standards and/or this specification.

3.04.00 All equipment and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents listed in the annexure without any damage or deterioration of the materials.

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4.00.00 SPECIFIC REQUIREMENTS

4.01.00 Construction

4.01.01 The bus ducts shall be of indoor, metal-enclosed, air insulated type.

4.01.02 The bus duct enclosure shall be dust and splash proof, conforming to a degree of protection IP-54. Minimum thickness of sheet metal used shall be 2 mm.

4.01.03 Bus duct entry to both transformer and 415V PCC shall be from top.

4.02.00 Bus and Bus Taps

4.02.01 The main buses and connections shall be of high conductivity Aluminium/Aluminium alloy, sized for specified current ratings with maximum temperature limited to 85°C (i.e., 35°C rise over 50°C ambient).

4.02.02 Bus bars and connections shall be fully insulated for working voltage with adequate phase/ground clearances. Insulating sleeves for bus bars and shrouds for joints shall be provided.

Bus insulators shall be flame retardant, track-resistant type with high creepage surface.

4.02.03 Bus bars shall be supported and braced to withstand the stresses due to maximum short circuit current and also to take care of any thermal expansion.

4.02.04 Bus bars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear when viewed from the front of the assembly.

4.03.00 Bus Duct and Bus Duct Connection

4.03.02 Each bus duct shall be installed indoor.

4.03.03 All connecting bus work shall have the same continuous current rating as per SLD and shall be fully braced for the listed short circuit current.

4.03.04 All provisions such as matching flange and other accessories shall be furnished for connection to bus duct, if supplied by others. Necessary details for this purpose will be furnished later.

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- 4.03.05 The bus duct and components shall be capable of withstanding mechanical forces and thermal stresses of short circuit current indicated in this specification without deterioration of material.
- 4.03.06 Bus duct enclosure shall have extended bellows to allow for temperature changes and usual vibrations encountered during transformer operations. Suitable inspection access shall be provided in the enclosure for inspection of support insulators, bus joints, transformer and switchgear terminals. Flexible connections shall be provided between bus sections to allow for expansion and contraction of conductor.

Each Bus duct consisting of:		
Length of the straight run portion of bus duct (Exact length to be intimated later on. However unit price per meter shall be quoted)	Approximately 8 m	
90 degree bend per bus duct	4 Nos	
Adapter box with bi-metal flexible copper connecting leads per bus duct at transformer end	1 set	
Adapter box with bi-metal flexible copper connecting leads per bus duct at switchgear end	1 set	If required
Flexible braiding per bus duct	1 set	
Phase cross-over chamber per bus duct, if required.	1 No	
Wall-mounting assembly with galvanized steel support per bus duct	1 set	

- 4.03.07 Earth continuity conductor : 2 x 50 x 6 mm GS flat to be run all along the bus duct.
- 4.03.08 Painting : Exterior of the enclosure shall be shade 631 of IS 5. Interior shall be painted black.
- 4.03.09 240V AC space heaters to be provided at suitable intervals and wired to external terminal box with heat resistant cables.
- 4.03.10 MS painted supporting structure with necessary hardware shall be included in the scope of supply.

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E11 : TECHNICAL SPECIFICATION FOR 110V BATTERY AND BATTERY CHARGERS

1.00.00 INTENT OF SPECIFICATION

1.01.00 This Specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport F.O.R. site of 110V Battery & Battery Charger complete with all materials and accessories for efficient and trouble-free operation.

2.00.00 SCOPE OF WORK

2.01.00 Scope of Supply

2.01.01 Quantity & Rating of battery & battery charger sets

110V, 75 AH : 1 set

2.01.02 Components of each set

Each battery & battery charger units shall consist of the following:

a. 110 V VRLA Battery : 1 Set

b. Float and Float-cum-Boost Charger : 1 Set.

2.01.03 The base channel frame with hardware and lifting angles.

2.01.04 One set of special tools and tackles.

2.01.05 Spare parts.

2.01.06 All relevant drawings, data and instruction manuals.

3.00.00 DESIGN CRITERIA

3.01.00 The 110 V Battery & Battery Charger system will provide D C power supply to MRSS.

3.02.00 Equipment ratings and quantities are indicated in this specification. Equipment shall be furnished in strict compliance with the same.

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3.03.00 For continuous operation at specified ratings, the temperature rise of various equipment/components shall be limited to the permissible values stipulated in relevant standards and/or this specification.

3.04.00 Under normal circumstances, the main float charger (FC) is ON and supplies the DC load as well trickle charges the battery bank. At this condition Float cum boost charger (FCBC) shall normally be in auto standby mode through auto-manual selector switch.

If the main float charger (FC) fails, Float cum boost charger (FCBC) shall automatically take over the function of main float charger (FC). Float charging function of FCBC shall also be possible in manual mode.

In case of battery deep discharge condition, the FCBC boost charges the battery bank at constant voltage mode (maxm. voltage of 2.3 VPC) while main float charger supplies the load. Boost charging as well as equalizing charge (if recommended by manufacturer) shall only be possible through manual selection. Interlock shall be provided to ensure that battery should be taken to boost mode only when main FC is healthy and running. Interlock shall be provided to ensure that the battery can be taken to boost mode only if the main float charger is healthy and running. Interlock defeat arrangement shall also be provided.

Float charging control of both chargers shall have auto as well as manual control. However, boost charging shall have only manual control.

3.05.00 All equipment and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents listed in this specification without any damage or deterioration of the materials.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 GENERAL

4.01.01 Each Battery system shall include:

- One set of 110 V VRLA Battery Bank.
- One set of automatic Float and Float-cum-Boost charger.

4.01.02 All equipment, accessories & wirings shall have adequate protection against fungus, insects & corrosion.

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- 4.01.03 Each set shall be provided with Auto-manual changeover facility.
- 4.01.04 Centre-zero ammeter shall be provided to indicate battery charge/discharge current
- 4.01.05 Each set shall be provided with Earth fault relay equivalent to Areva type CAEM21 with provision for connection of an external milliammeter to detect earth leakage current for monitoring condition of insulation of either polarity.
- 4.02.00 **BATTERY**
- 4.02.01 Application : To supply DC load to MRSS
- 4.02.02 Type : VRLA.
- 4.02.03 Applicable standard : IS 1652 with latest amendment.
- 4.02.04 Nominal Voltage : 110V
- 4.02.05 Capacity at 10Hrs discharge rate : 100 AH
- 4.02.06 Cell Voltage
- a. Nominal : 2V
- b. Float charging voltage : 2.23V
- c. Boost charging voltage : 2.30V
- d. Minimum cell voltage after 10Hrs. discharge : 1.85V
- 4.02.07 No of cells in the bank : 55
- 4.02.08 Tap cell/drooping diode : To be provided, as required.
- 4.02.09 Container : Polypropylene Co-polymer.
- 4.02.10 Connector etc. : Heavy-duty lead plated copper Connectors.
- 4.02.11 Cell No. Plates, level pad etc. : To be provided, as required.

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- 4.02.12 Terminal connection : 2/C-35 sq.mm, Al PVC Cable
- 4.02.13 Mounting : On acid resistant MS trays, self Stackable type.
- 4.02.14 Life Expectancy : 20 years.
- 4.02.15 Fittings & accessories as required
- a. Cell numbering tag with fixing arrangement.
 - b. Cable clamps with hardware.
- 4.02.16 In addition, following items are also required,
- a. Hand Gloves : 1 Pair.
 - b. Cell testing voltmeter 3-0-3 V 0-100°C : 1 No.
 - c. Cell inter connector spanner : 1 set
- 4.03.00 **BATTERY CHARGER**
- 4.03.01 Type : Float and Float-cum-Boost charger of metal clad, floor mounted. Type.
- 4.03.02 Transformer : Double wound, dry type, class B insulation.
- 4.03.03 Rectifier bridge : 3 phase, solid state, full wave, fully controlled SCR bridge.
- 4.03.04 Filter : Filter circuit at the output.
- 4.03.05 Enclosure : Sheet metal, IP-42.
- 4.03.06 AC Input : 415V \pm 10%, 50Hz, 3 Phase, 3W.
- 4.03.07 Rated DC output :
- a. Voltage Regulation : \pm 1% for \pm 10% input AC voltage

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- variation or 100% load variation
or both occurring
simultaneously.
- b. Output Ripple content : $\pm 2\%$ Maximum.
 - c. Mode of operation : Constant voltage & constant current mode.
 - d. Output setting range :
 - i) Voltage : 90-120%, stepless.
 - ii) Current : 20-100%, stepless.
 - iii) Current limit : 85-105%
- 4.03.08 Rated Capacity :
- a. Float charging : Continuous DC load of the substation (10A) plus float charging the battery.
 - b. Boost charging : Restoring fully discharged battery to fully charged condition in 10 hours with 25% margin over maximum charging current.
- 4.03.09 Measurement
- a. AC input : Voltage & Current.
 - b. DC output : Load current & Battery charging current.
- 4.03.10 Minimum Annunciation to be provided:
- a. AC supply fail
 - b. DC voltage low
 - c. DC voltage high
 - d. DC system grounded

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- e. Charger over load
- f. SCR fuse blown
- g. Filter fuse blown
- h. DC output fuse blown

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E12 : TECHNICAL SPECIFICATION FOR 415V DISTRIBUTION BOARDS

1.00.00 INTENT OF SPECIFICATION

1.01.00 This Specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport F.O.R. site of 415V DB's, complete with all materials and accessories for efficient and trouble-free operation.

2.00.00 SCOPE OF WORK

2.01.00 Scope of Supply

2.01.01 The following equipment shall be furnished with all accessories :-

- a. 415V Distribution Boards at different substations : 7 Nos.
(S/S-2, S/S-4, S/S-5, S/S-7, S/S-8, S/S-9, S/S-10)
- b. 415 V ACDB at MRSS : 1No.

2.01.02 The base channel frame with hardware and lifting bolts.

2.01.03 One set of special tools and tackles.

2.01.04 Spare parts for 3 years trouble free operation.

2.01.05 All relevant drawings, data and instruction manuals.

3.00.00 DESIGN CRITERIA

3.01.00 The equipment covered under this specification will be used to provide power, control and protection for 415 Volt A.C. system of the NIT campus in Rourkela, Orissa.

3.02.00 Equipment ratings and quantities are detailed in the enclosed drawings and Annexure. Equipment shall be furnished in strict compliance with the same.

3.03.00 For continuous operation at specified ratings, the temperature rise of various equipment/components shall be limited to the permissible values stipulated in relevant standards and/or this specification.

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3.04.00 All equipment and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents listed in the annexure without any damage or deterioration of the materials.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 Construction

4.01.01 All the DBs shall be of indoor, metal-enclosed, air insulated, compartmentalized and floor mounting type. All ACBs of different DBs shall be draw-out type and all FSU and MCCB feeders shall be fixed type. The design and construction shall be such as to allow extension at either end.

4.01.02 All DBs shall be of single front construction, unless specified otherwise.

4.01.03 The DB enclosure shall be dust and splash proof, conforming to a degree of protection IP-54. Minimum thickness of sheet metal used shall be 2 mm for load bearing members and 1.6 mm for non-load bearing members.

4.01.04 DB assembly shall comprise a continuous line up of dead front, freestanding vertical sections, housing the control modules in multitier formation.

4.01.05 The design shall be fully compartmentalized with metal/insulating partitions between compartments. The working height shall be limited within 400 mm to 1800 mm from floor level.

4.01.06 Each control module shall be housed in a separate compartment complete with an individual front access door. Each vertical section shall have a removable back cover. All doors and covers shall be gasketed.

4.01.07 All push buttons, lamps, indicating instruments shall be flush/semi-flush mounted on respective module compartment.

4.01.08 A full height vertical cable chamber with cable supports shall be provided in each section to facilitate unit wiring. The chamber shall be liberally sized to accommodate all cables and shall have removable cover at the front for access.

4.01.09 A horizontal wire way, extending the entire length, shall be provided at the top of each PCC for inter panel wiring.

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4.02.00 **Bus and Bus Taps**

4.02.01 The main buses and connections shall be of high conductivity Aluminium/Aluminium alloy, sized for specified current ratings with maximum temperature limited to 85°C (i.e., 35°C rise over 50°C ambient).

4.02.02 Bus bars and connections shall be fully insulated for working voltage with adequate phase/ground clearances. Insulating sleeves for bus bars and shrouds for joints shall be provided.

Bus insulators shall be flame retardant, track-resistant type with high creepage surface.

4.02.03 Bus bars shall be supported and braced to withstand the stresses due to maximum short circuit current and also to take care of any thermal expansion.

4.02.04 Bus bars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear when viewed from the front of the assembly.

4.03.00 **Control Modules**

4.03.01 Control Module shall house the control components for a circuit such as switch, fuse, contactors, relays, push buttons, lamps etc.

4.03.02 The equipment layout shall provide sufficient working space in between the components and subject to Owner's approval.

4.04.00 **Air Circuit Breaker**

4.04.01 Where indicated on the drawings/annexure, circuit breaker shall be provided having minimum interrupting capacity equal to the listed fault level.

4.04.02 Circuit breaker shall be four pole/three (3) pole with neutral link, single throw, air-break type with independent manual/electrical spring closing, trip-free mechanism as shown in SLD.

4.04.03 Circuit breaker shall be draw out type, having service, test & isolated position with positive indication for each position.

4.04.04 Mechanical safety interlock shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed.

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- 4.04.05 Automatic safety shutters shall be provided to cover up the stationary disconnects when the breaker is withdrawn.
- 4.04.06 Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operation counter and mechanism charge/discharge indicator.
- 4.04.07 Each circuit breaker shall be provided with the following: -
- a. Position/Cell switch with 4 NO + 4 NC contacts.
 - b. Auxiliary switch with 6 NO + 6 NC contacts.
- 4.04.08 Incomer circuit breakers from normal supply and DG source shall be interlocked both electrically and mechanically (through castle key).
- 4.04.09 ACBs other than those operated by protective relays shall be provided with built in microprocessor based S/C, O/L and E/F release units with both current and time adjustments. Communication facility and measurement functions through the release units are not mandatory.
- 4.05.00 **Moulded case Circuit Breaker (MCCB)**
- 4.05.01 Where indicated on the drawings/annexure, circuit breaker shall be provided having minimum interrupting capacity equal to the listed fault level.
- 4.05.02 Circuit breaker shall be three (3) pole with neutral link, single throw, air-break type with trip-free mechanism.
- 4.05.03 MCCBs shall be supplied with thermo-magnetic type of releases for overload and short circuit protection. Thermal and magnetic settings shall be adjustable for TPN MCCBs and magnetic element shall be fixed type for two pole MCCBs.
- 4.05.04 Utilisation category of MCCBs shall be 'A' and rated impulse withstand voltage of main circuit, $U_i = 8kV$.
- 4.05.05 All MCCBs shall be of current limiting type, i.e , in the event of a short circuit, the contacts of MCCBs open much before the peak prospective value of the short circuit current is reached thereby limiting the fault current.

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- 4.05.06 Minimum 1NO+1NC auxiliary switch and 1 NO alarm switch shall be provided with all MCCBs.
- 4.05.07 Rotary drive kit with door interlocking feature and provision for pad locking shall be provided with all MCCBs.
- 4.06.00 **Switches**
- 4.06.01 Switches shall be triple pole with neutral link, air break, AC22 heavy duty for feeders.
- 4.06.02 The switch shall have a quick-make, quick-break mechanism operated by a suitable external handle, complete with position indicator. This handle shall have provision for padlocking in ON and OFF position.
- 4.06.03 The compartment door shall be interlocked mechanically with the switch such that the door cannot be opened unless the switch is in OFF position. Means shall be provided for releasing this interlock at any time.
- 4.06.04 Switches shall be capable of withstanding the let-through fault current of back-up fuses or circuit breakers.
- 4.06.05 All outgoing feeders shall be provided with bolted disconnect link for isolation of neutral if necessary.
- 4.06.06 All switches shall be provided with 1 NO+1 NC auxiliary contacts rated 10A @ 240V AC.
- 4.07.00 **Fuses**
- 4.07.01 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the listed Short Circuit Current.
- 4.07.02 Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element.
- Visible indication shall be provided on blowing of the fuse.
- 4.08.00 **Control and Indication**
- 4.08.01 Incomer and bus coupler ACBs of DB shall provision for both local and remote operation.
- 4.08.02 One (1) LOCAL-REMOTE selector switch stay put type with pistol grip handle and key interlock for electrically operated ACBs.

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- 4.08.03 Spring return to NEUTRAL type CLOSE/TRIP control switch shall be provided for electrically operated ACBs.
- 4.08.04 All other ACBs/MCCBs shall be operated manually from local position only.
- 4.08.05 Following indication lamps shall be provided for the feeders:

ACB feeder : ON/OFF/AUTO Trip (RED/GREEN/AMBER)

MCCB feeder : ON/OFF (RED/GREEN)

Switch fuse feeder : ON/OFF

In addition phase indication lamps shall be provided at the incomer of all PCC/DBs

- 4.08.06 For control supply the Supplier shall provide 415/110V control transformers with 100% standby arrangement.

4.09.00 Relays

- 4.09.01 Relays, wherever specified in SLD, shall be of electro-magnetic draw out type with built-in testing facilities and mounted only on switchgears. Small auxiliary relays may be in non-draw out execution and mounted within the cubicle.

- 4.09.02 Relays shall be rated for operation on 110V secondary voltage and 1A secondary current. Number and rating of relay contacts shall suit the job requirements.

- 4.09.03 The Supplier shall co-ordinate all relays to suit the requirements of protection and interlock.

- 4.09.04 The protective relaying scheme shall be in line with the enclosed Single Line Diagram.

- 4.09.05 Main and auxiliary Relays shall be of Areva make only. This is to keep similarity with existing installation.

4.10.00 Meters

- 4.10.01 All indicating instruments (96 x 96 mm) shall be switchboard type, with 250° scale, anti-glare glass and accuracy class of $\pm 2\%$ full scale. Each meter shall have zero adjuster on the front.

- 4.10.02 Motor ammeter shall have an extended suppressed end-scale range to indicate starting current (6 to 8 times full load current).

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4.10.03 Multi function digital meters (MFM) shall be provided in 415V feeders as shown in SLDs. The specification of MFMs are as follows:

MULTI FUNCTION METERS

Sl. No.	Particulars	Specification
1.	Type	Digital, panel flush mounting, Conzerve type EM6400 or eqv.
2.	Construction	Sealed dust proof
3.	Size	96 x 96 mm
4.	Display	Alpha numeric bright LED display
5.	Monitoring functions	A1, A2, A3, V1, V2, V3, VN, F, PF, W, VAR, VA, WH, VARH, VAH, THD, MD
6.	Accuracy	1.0
7.	Input voltage	110V or 415V AC (L-L)
8.	Input current	5 A
9.	Aux. supply	240V AC, 1 phase
10.	Communication	RS 485 modbus RTU protocol

4.11.00 **Current Transformer**

Current Transformer, if specified, shall be cast resin type rated 15 VA, Accuracy Class 1.0 for metering and 5P20 for relaying.

4.12.00 **Secondary Wiring**

4.12.01 The PCCs/DBs shall be fully wired at the factory to ensure proper functioning of control, protection and interlocking schemes.

4.12.02 Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits.

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- 4.12.03 Wiring shall be done with flexible, 650V grade, PVC insulated switchboard wires with stranded Copper conductors of 2.5 mm² for control & current circuits and 1.5 mm² for voltage circuits.
- 4.12.04 Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per Supplier's wiring diagrams.
- 4.12.05 Wire terminations shall be made with crimping type connector with insulating sleeves. Wires shall not be spliced between terminals.
- 4.13.00 **Terminal Blocks**
- 4.13.01 Terminal blocks shall be 660V grade box-clamp type with marking strips similar to ELMEX 10 mm² or equal. Terminals for C.T. secondary leads shall have provision for shorting.
- 4.13.02 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.
- 4.14.00 **Cable Terminations**
- 4.14.01 Switchboards shall be designed for cable entry both from bottom. Sufficient space shall be provided for ease of termination and connection.
- 4.14.02 Gland plates shall be minimum 3 mm thick sheet steel. The gland plate and supporting arrangement for 1/C power cables shall be such as to prevent flow of eddy current.
- 4.15.00 **Ground Bus**
- 4.15.01 A ground bus rated to carry the maximum fault current, shall extend full length of the DBs.
- 4.15.02 The ground bus shall be provided with two-bolt drilling with G.I. bolts & nuts at each end to receive 50 x 6 mm G.I. flats.
- 4.15.03 All stationary structures shall be directly connected to the ground bus for effective grounding.
- 4.15.04 The frame of draw out module shall be ground at all times except when the power disconnects are separated by a safe distance.
- 4.16.00 **Nameplate**
- 4.16.01 Nameplate of approved design shall be provided for each control compartment and also at the top of panels.
- 4.16.02 The material of the name plate shall be lamicaid or approved equal, 3 mm thick, with white letter on black background. Nameplates shall be minimum 20 x 75 mm.

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4.17.00 **Space Heater**

4.17.01 Each vertical panel shall be furnished with thermostat controlled space heater.

4.17.02 Cubicle heater circuit shall be provided with individual switch fuse units.

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ANNEXURE-A

RATINGS & REQUIREMENTS (AS PER SLD UNLESS SPECIFIED OTHERWISE BELOW)

1.0 General

Type	:	All ACB feeders draw out, & others fixed type
Service	:	Indoor
Enclosure (Indoor)	:	IP54
Enclosure (Outdoor)	:	IP55

2.0 System

Voltage	:	415V +_ 10%
Phase	:	3
Frequency	:	50 Hz +_ 5%
System	:	Solidly grounded

3.0 Rating

Rated current of busbar & Busduct:	:	.As specified in SLD.
Rated current-ACB/Switch	:	.As per SLD
Ambient Temperature	:	.50°C
Short Circuit Current Symm.	:	25/50 KA as per SLD.
S/C Withstand Time	:	1 second.
Hipot for 1 minute	:	3 KV AC

4.0 Duty

Circuit Breaker	:	0-0.3sec-CO-3min-CO
Contactors	:	Class III - Category AC3*

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Switch for	:	
a) Feeders	:	AC22
5.0 Control/Service Voltage	:	240V \pm 10% AC 50 Hz \pm 5%
6.0 Reference drawing	:	Single line diagram as mentioned above

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ANNEXURE-B

ACB/MCCB FEEDER DETAILS

Sl No.	Feeder Rating in A	Cable Size (sq mm AL. XLPE)	Module height (mm)
1.00	25	4/C-10	200
2.00	32	4/C-16	200
3.00	63	3.5/C-35	250
4.00	80	3.5/C-50	250
5.00	100	3.5/C-70	400
6.00	160	3.5/C-240	400
7.00	250	3.5/C-300	400
8.00	400	2-3.5/C-240	600
9.00	630	2-3.5/C-300	800
10.00	800	3-3.5/C-300	800
11.00	1000	4-3.5/C-300	1200
12.00	1250	5-3.5/C-300	1200

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E13 : Technical specification of Power, Control cables, Cable Joints & Termination Accessories

1.0 SCOPE:

This specification covers, design, manufacture, testing at manufacturer's works, supply and delivery of HV & LV power and control cables, cable joints and termination accessories.

2.0 HV POWER CABLES 33KV GRADE

2.1 33KV grade (UE), 90°C rating, heavy duty XLPE HV power cable suitable for use in 33KV non-effectively earthed system conforming to following requirement and in line with IS-7098, IS 8130, IS 5831 and IS 3975.

2.2 PURPOSE 33 KV XLPE HV AL power cables will be used for incoming / outgoing feeders in MRSS and inter connector for ring main system.

2.3 CONDUCTOR Stranded and compacted circular aluminum conductor of grade H2 and class 2 for all sizes, generally conforming to IS: 8130.

2.4 CONDUCTOR SCREEN Extruded semi-conducting compound.

2.5 INSULATION Extruded cross-linked polyethylene (XLPE)

2.6 INSULATION SCREEN Extruded semi-conducting compound with a layer of non-magnetic metallic tape.

2.7 CORE IDENTIFICATION By coloured strips applied on (for three core cables) cores or by numerals.

2.8 INNER SHEATH Extruded PVC compound conforming to type ST2 of IS: 5831 for three core cables.

2.9 ARMOUR Galvanized single round steel wire armour for multicore cables.

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Non-magnetic hard drawn aluminum single round wire conforming to H4 grade for single core cables.

2.10 **OVERALL SHEATH** Extruded PVC compound conforming to type ST2 of IS:5831.

2.11 **CABLE MARKING & IDENTIFICATION**

The outer surface of the cable shall be durably marked in English language and numerals at intervals of 1 m with the following minimum information:

- a. Rated voltage
- b. Insulation Material
- c. Conductor material and size in mm²
- d. Name of manufacturer
- e. Year of manufacture

2.12 **REEL MARKING**

Cable reels/drums shall be marked in legible and indelible letters giving the following particulars:

- a. Cable voltage, number of cores and conductor size
- b. Type of cable
- c. Length and weight of cable on reel
- d. Gross weight
- e. Dimensions of reel
- f. Manufacturer's name and country of origin
- g. Purchase order/Contract number
- h. Serial number of reel
- i. Direction of rolling of reel

All markings shall appear on both sides of the reel.

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3.0 LV POWER & CONTROL CABLES

3.1 Cables shall be suitable for laying in racks, ducts, trenches and underground.

Cables shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.

The normal current rating of all PVC insulated cables shall be as per IS: 3961.

3.2 CONDUCTOR:

For 1.1kV grade power cables, conductor shall consist of stranded circular shaped plain annealed aluminium rods of high conductivity H2 grade.

For 1.1kV grade control cables, conductor shall be made from stranded circular shaped high conductivity copper rods complying with IS: 613.

The conductor shall be clean, reasonably uniform in size, shape and its surface shall be free from sharp edges.

3.3 INSULATION:

Power cables : Extruded cross-linked polyethylene (XLPE).

Control cables : The PVC insulated 1100V grade power and control cables shall be suitable for a maximum rated conductor temperature of 70°C. The Insulation shall be extruded PVC to Type-A of IS: 5831. The thickness of insulation, tolerance on thickness of insulation and insulation resistance of the material shall conform to IS: 1554 Part-I.

3.4 INNER SHEATH:

For multicore armoured cables, the inner sheath shall be of extruded PVC ST2. The inner sheath for common covering shall be of non-hygroscopic, fires retardant material and shall be softer than insulation.

The inner sheath shall be so applied that fits closely on the laid up cores. Thickness of the inner sheath shall conform to Clause 12.3 of IS: 1554 (Part-I).

3.5 ARMOURING:

Armouring shall be applied over the inner sheath in case of multicore cables. The armour shall be of galvanized round steel wires.

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Nominal diameter of round steel wires shall conform to Clause No. 13.3 of IS: 1554 (part-I).

3.6 **OUTER SHEATH:**

An outer sheath shall be provided over armouring. The outer sheath shall be applied by extrusion. The outer sheath shall be so applied that it fits closely over armouring.

The outer sheath shall be of Type ST2, PVC compounds conforming to IS: 5831. Minimum thickness of PVC outer sheath, standard colour and tolerance on thickness of armoured cables shall conform to clause 14.4.2 of IS: 1554 (Part-I).

3.7 **CABLE MARKING & IDENTIFICATION**

3.7.1 The outer surface of the cable shall be durably marked in English language and numerals at intervals of 1 m with the following minimum information:

- a. Rated voltage
- b. Insulation Material
- c. Conductor material and size in mm²
- d. Name of manufacturer
- e. Year of manufacture

3.8 **REEL MARKING**

3.8.1 Cable reels/drums shall be marked in legible and indelible letters giving the following particulars:

- a. Cable voltage, number of cores and conductor size
- b. Type of cable
- c. Length and weight of cable on reel
- d. Gross weight
- e. Dimensions of reel
- f. Manufacturer's name and country of origin
- g. Purchase order/Contract number
- h. Serial number of reel
- i. Direction of rolling of reel

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3.8.2 All markings shall appear on both sides of the reel.

4.0 CABLE JOINT/TERMINATION ACCESSORIES

4.1 The cable accessories shall include end termination kits, straight through joints and also any special tools and tackle required for making the joints/terminations.

4.2 The straight through joint/termination arrangement shall be complete with all fittings and consumables. The joint shall have electrical and mechanical withstand capability same as that of the associated cable.

4.3 The straight through joint/end termination kit shall be heat shrinkable type/push on type.

4.4 The straight through joint/end termination kit shall have the following features :

- Electrical stress control to be provided at the cable insulation shield terminus.
- An external leakage insulation to be provided between the cable conductors and ground.
- Adequate protection to be provided at the end of the cables against ingress of moisture and provision to maintain constant pressure in the cable.

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E14: Technical specification of earthing and lightning protection

1.0 EARTHING AND LIGHTNING PROTECTION - SWITCH YARD AND CONTROL BUILDING

1.1 Earthing

- a) Complete earthing of yard area including earthing of transformer neutrals, earthing of all steel structures, earthing of bodies of all equipment.
- b) Electrical equipment shall be earthed in accordance with latest IE rules, IS- 3043 and IEEE-80-2000.
- c) All earthing connections shall be of sufficient section to carry the fault current of 25 KA for 1 second.
- e) The earth resistance of yard and control building shall be less than 1.0 ohm.
- f) Touch and step potential shall be maintained in a safe value by earthing mat in accordance with IEEE-80 for a fault current of 25 KA for 1 seconds.
- h) Fencing around the yard shall be earthed.
- i) Earth electrodes for trafo neutral earthing, LA and LPT shall have facilities for measurement of resistance and watering during dry season.
- j) All structures and equipment shall be provided lightning protection as per IS 2309 (1989). The DSLP calculation shall be made as per Dr D.V. Razevig's method.
- k) Lightning pole with spike /spike mounted on four/two pole structure shall be provided as shown in electrical layout to cover zone of protection at different substations.
- l) Down conductors, from lightning poles/structure with peak shall be directly connected to earthing electrodes.

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- m) The earthmat design shall be done by the Contractor. The main earthmat shall be laid in the switchyard area in accordance with the approved design requirements.
- n) Neutral point of each transformer shall be connected directly to independent treated earth pits.
- o) LA in the switchyard shall be separately connected to a treated earth pit located below the LA. The earth pits shall be interconnected below the ground level.
- p) 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.

q) Details of Earthing System

	Size	Material
Main earthing conductor to be buried in ground	50 x 8 mm flat	Galvanized Steel
Conductor above ground & earthing leads (for equipment i.e. all yard equipment, power trafo.etc.)	50 x 8 mm flat	Galvanized Steel
Earthing of ACDB, DCDB, Battery Charger, Control panels and out door marshalling boxes, operating mechanism boxes, Junction boxes & Lighting Panels etc.	35 x 6 mm flat	Galvanized Steel
Pipe Earth Electrode (in treated pit) as per IS	40 mm dia. 3000 mm long	Galvanized Steel
Rod electrode (in untreated earth pit)	32 mm dia. 3000 mm long	Mild Steel
Cable trench earthing	50 x 6 mm flat	Galvanized Steel

The size of the earthing conductor indicated above are the minimum sizes. Pipe electrodes shall be about 4 mm thickness in one piece, provided with water filling funnels. Earth pit design shall conform to IS-3043.

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1.2 Earthing Conductor Layout

- a) Earthing conductors in outdoor areas shall be buried at least 600 mm below finished ground level unless stated otherwise. Top of the untreated earth electrode shall be buried at least 1000mm below finished ground level.
- b) Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels, railway tracks etc, it shall be laid minimum 300 mm below them and shall be re-routed in case if fouls with equipment/ structure foundation.
- d) Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500 mm away from such location.
- e) Earthing conductors crossing the road shall be laid 300 mm below road or at greater depth to suit the site conditions.

1.3 Equipment and Structure Earthing

- a) Earthing pads shall be provided for the apparatus/ equipment at accessible position. The connection between earthing pads and the earthing grid shall be made by two short earthing leads (one direct and another through the support structure) free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with Purchaser.
- b) Wherever earthing conductor crosses or runs along metallic structures such as water, steam conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.
- c) Earthing conductor shall be extended 1500 mm outside the switchyard fence. All the gates and every alternate post of the fence shall be connected to earthing grid.
- d) The stone spreading shall be restricted to switchyard fence only i.e. the stone spreading shall not be done outside switchyard fence.
- g) A continuous ground conductor of 16 SWG GI wire shall be run all along each conduit run. The conductor shall be connected to each panel ground bus. All junction boxes, receptacles, switches, lighting fixtures etc. shall be connected to this 16 SWG ground conductor.

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- h) 50 mm x 6 mm MS flat shall run on the top tier and all along the cable trenches and the same shall be welded to each of the racks. Further this flat shall be earthed at both ends and at an interval of 30M. The MS flat shall be finally painted with two coats of Red oxide primer and two coats of Post Office red enamel paint.

1.4 Jointing

- a) Earthing connections with equipment earthing pads shall be bolted type. 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 paint/ compound.
- b) Connection between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded type. For rust protection, the welds should be treated with red lead and afterwards coated with two layers bitumen compound to prevent corrosion.
- c) Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- d) All ground 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.
- f) All arc welding with large dia. Conductors shall be done with low hydrogen content electrodes.
- g) The 50X8 mm GS flat shall be clamped with the equipment support structures at 1000 mm interval.

1.5 Power Cable Earthing

Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.

1.6 Specific Requirement for Earthing Systems

- a) Each earthing lead from the neutral of the distribution/station service transformer shall be directly connected to two pipe electrode in treated

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earth pit (as per IS) which in turn, shall be buried in Cement Concrete pit with a cast iron cover hinged to a cast iron frame to have an access to the joints. Transformer body shall be directly connected to MS rod electrode which in turn shall be connected to the earthing grid.

- b) Earthing terminal of each lightning arrestor, inductive voltage transformer & tower with peak shall be directly connected to pipe earth electrode which in turn, shall be connected to station earthing grid.
- c) Auxiliary earthing mat comprising of 50X8 mm G.S. flat closely spaced (300 mm x 300 mm) conductors shall be provided at depth of 300 mm from ground level below the operating handles of the operating mechanism box of the isolators. Operating mechanism boxes shall be directly connected to the auxiliary earthing mat.

2.0 Lightning protection

- a) Direct stroke lightning protection (DSLPP) shall be provided in the HV switchyard by lightning pole with spike /spike mounted on four/two pole structure as shown in electrical layout. The final arrangement shall be decided after approval of the DSLPP calculations.
- b) Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
- c) Down conductors shall be cleated on the structures at 1000 mm interval.
- d) Connection between each down conductor and pipe electrodes shall be made via test joint (pad type compression clamp) located approximately 1500 mm above ground level. The pipe electrode shall be further joined with the main earth mat.
- e) Lightning conductors shall not pass through or run inside G.I. conduits.
- f) Lightning protection of control building shall be provided by horizontal air termination (minimum 35x6 mm GS flat) on the parapet wall of the building.
- g) Number of down conductors and spacing between air termination shall be calculated as per IS 2309. Size of down conductor shall be 50x6 mm GS flat.

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3.0 Electronic equipment earthing

- a) For electronic equipment separate earthing shall be provided which shall not be interconnected to other earthing system.
- b) 40mm dia 3000mm long G.I. pipe shall be used as earth electrode.
- c) The electrode shall be located at least 6m away from electrical earthing grid.
- d) 1/C-35 sq. mm. XLPE insulated copper cable shall be used for equipment interconnection to the earthing system.
- e) A separate earth bus (400 x 100 x 10 thick GS) shall be mounted on insulated base on wall with 10 nos. drilled M10 holes for DAS. Only insulated copper cables shall be used between earth bus and electronic equipment.

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E15: Technical specification for Illumination system and misc. equipment

1.0 Scope and System description of Illumination system

Illumination facilities for the substation shall be in the scope of the Bidder. The substation premises shall be provided with illumination facilities to achieve and maintain the specified illumination levels. Peripheral illumination shall also be provided around the buildings.

1.1 Source of Power Supply

At MRSS incoming power supply for illumination system will be received from a 33/0.433KV, 100KVA station service transformer and in all other sub stations it will be received from 415V DB located in the respective substations. Lighting system shall be supplied at 240V through 415V, 3 phase, 4 wire, 50 Hz AC Supply system. The incoming supply cables and their connection also form part of the scope of work. Source of supply shall be from SLDB for indoor illumination and OLDB for outdoor illumination. SLDB/OLDB shall be located in control building/DB room.

1.2 Lighting panel board and Control device

Lighting panel board shall be of sheet steel, dust and vermin proof, heavy duty type. Incoming feeders shall be provided with MCCB. Outgoing sub circuits shall be controlled by MCBs. Minimum rating of the MCBs shall be 16 Amps, 9 kA. All metal enclosure shall be fabricated with at least 2 mm thick steel. The incomer shall be provided with Phase indicating & ON/OFF indication lamps.

1.3 Wiring

All Wiring from lighting panel to fixtures and receptacles shall be carried out with PVC insulated CU wires in hot deep galvanized rigid steel conduits.

Wire size shall be as follows:

Point wiring starting from SLDB upto Switchboard : 1C-2.5 sq. mm CU wire
or from JB/switchboards upto lighting fixtures/
ceiling fans/exhaust fans

Point wiring starting from OLDB upto JB : 2C-6 sq. mm CU wire

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1.4 Illumination levels

The number of luminaries shall be adequate to achieve and maintain the illumination levels as indicated below:

Sl. No.	Room/Area	Average Lux
1.	Control room	300
2.	DB room	200
3.	Battery room	100
4.	Office	300
5.	Metering room	300

1.5 Type of fittings

Following type of fittings shall be used:

Sl. No	Room/area	Type of luminaires	Mounting
1.	Control room	2x36W FTL batten	Down rod
2.	DB room	2x36W FTL batten	wall
3.	Office	2x36W FTL batten	Wall
4.	Passage	1x36W FTL batten	Wall
5.	Battery room	Industrial 2x40W FTL vapour proof	Wall, ceiling
6.	Switchyard/	2x36W CFL street light	Lighting pole/ gantry structure
7.	Emergency lighting	1x40W FTL with built in battery and charger	Wall
8.	Periphery lighting	2x36W CFL street light	50mm GI pipe on building wall

All FTL luminaries shall be provided with electronic type ballast.

1.6 Lighting calculation

The following parameters shall be considered:

- 1.6.1 Reflectance factors : Ceiling = 70%, wall = 50%, floor = 20%
- 1.6.2 Maintenance factors : Indoor = 0.7, outdoor = 0.6
- 1.6.3 Working level height : control room/DB room = 0.45m, switchyard = 0.0 m
- 1.6.4 Uniformity = Min/average \geq 0.3

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1.7 Emergency Lighting

For emergency lighting, FTL fixtures with built in battery and battery charger shall be considered to achieve approximately 20% of the specified illumination level. These lights will be maintained type, ie, will remain switched on during availability of normal power.

Each of the substations & MRS shall be provided with additional portable emergency light set complete with one(1) no. 11W CFL, battery, battery charger etc. mounted on a wooden bracket at the top of exit doors.

1.8 Ceiling Fans/Exhaust Fans

1400 mm sweep ceiling fans shall be provided in control room, office cum store room and DB rooms. At least 1 no. fan shall be provided for every 10 sq. meter areas. The ceiling fan shall be complete with electronic regulator. Exhaust fans of 300 mm diameter for toilets, battery room etc. shall be provided with their control devices and louvers.

1.9 Miscellaneous Items

Items such as brackets, hangers, clamps, junction boxes, distribution boards, Piano switches, 5 A socket in boards etc. which are required to make the lighting installation complete in all respect shall be also supplied and installed. Modular type switches and switchboards shall be provided in the control room building/ DB room.

1.10 Yard Illumination

The illumination level for outdoor yard shall be 20 lux average. Lighting system shall be supplied at 240 V through 415 V 3 phase, 4 wire, 50 Hz AC supply system. Source of supply shall be from 415VACDB/DB located in control building/DB room. Necessary outdoor lighting distribution board (OLDB) with auto/manual changeover contactor circuit by time switch/photocell shall be included in the Bidder's scope of work. Number of light fittings shall be decided on the basis of specified lux level. For outdoor yard CFL type lamp shall be provided.

Periphery and switchyard lights shall be automatically switched on-off by electronic 24 hour programmable time switch. When auto/manual selector switch is selected to manual, lights can be switched on-off by push button.

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2.0 MISCELLANEOUS EQUIPMENT

2.1 Receptacles

240V, 15A, 1 phase, 3 pin industrial type receptacle shall be provided in office cum store, metering room, control room & DB room.

2.2 Small Power Utility Socket outlets

240V, 3 pin (2 pole and earth) utility socket outlets of 15 A rating with plug tops and interlocked switches in weather proof sheet steel enclosure, shall be provided in the Bay marshalling kiosk.

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E16 : Technical specification for 33KV Over Head Line

33KV RING MAIN INTERCONNECTING OVERHEAD LINES AND ACCESSORIES

1.00 GENERAL REQUIREMENTS

- 1.01 This section is intended to cover all equipment, materials and services required for supply and installation of 33kV overhead power lines for interconnecting different sub-station as indicated in enclosed electrical single line diagrams showing power supply and distribution system.
- 1.02 Overhead power lines and line materials covered under this specification, unless otherwise stated, shall be designed, erected, tested and commissioned in accordance with the relevant Indian Standard Specifications and Indian Electricity Rules with latest amendments. In case of any controversy, reference may be made to any other acceptable national standard ensuring equivalent quality of the equipment or relevant International Standard, in which case, the most stringent one shall be followed.
- 1.03 33 kV overhead line conductors.
- 1.04 Universal beam section 152mm (UB152) steel rail pole with pole structures (single/double pole structure as required) suitable for single circuit overhead lines.
- 1.05 Cross-arms, bracings, stay-sets etc. required for different pole structure.
- 1.06 Pin and disc type insulators.
- 1.07 Insulator with hardware.
- 1.08 Overhead lines-end-terminal equipment, like air break isolating switches, lightning arrestors, trifurcating cable-end boxes suitable for 33KV XLPE cable termination.
- 1.9 Necessary materials for cradle guards.

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- 1.10 All erection consumables like brick, sand, cement, stone-chip etc. for foundation of pole etc.
- 1.11 Necessary earthing materials including MS rod electrode, conductors etc. for earthing of poles and allied structures.
- 1.12 Miscellaneous items like danger plate, barbed wires, anti-climbing devices, paints.
- 1.13 Complete erection, testing and commissioning of 33kV overhead lines including commissioning spares.
- 1.14 All relevant drawings, data, test certificates, instruction manuals, manufacturer's catalogues etc
- 2.00 **SPECIFIC REQUIREMENT**
- 2.01 Overhead line conductor and conductor joints.
- a) The type of conductor shall be ACSR RABBIT.
- b) The conductor joints shall be suitable for the above conductor and shall be twisted and parallel grooved type.
- 2.02 Universal beam section 152mm (UB152) steel rail pole
- 2.03 11 Meter long steel beam 9 Meter above ground and 2 Meter below ground.
- 2.04 Single pole structure shall be used for straight run having allowable span giving due consideration to pole height, maximum sag, ground clearances permissible as per IE rules, conductor tension, strength of pole, wind load, maximum and minimum temperatures etc. but in any case the span not exceeding 75M and deviation in line alignment not exceeding 5°. For deviation in alignment between 5° and 90 ° Single poles structure may also be used with proper stay arrangement. No of stay set at angle poles shall be guided by REC Construction Standard.
- 2.05 Extension of pole height by ISMC 100X50X6 of varying length may be provided if required as per survey report for maintaining proper sag to meet up safe ground clearance.
- 2.06 Typical single pole, two pole and four pole arrangements for overhead lines are enclosed for tender purpose.

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2.07 O/H line poles shall be selected from the following types:

Position in use	Angle of deviation or	Type of insulator
Straight line	0-5 deg	Pin
Angle	5-60 deg	Tension
Angle	60-90 deg	Tension
Terminal	--	Tension

3.00 Stay set

Galvanised steel rod shall be used for stay rods. The minimum diameter and tensile strength of these rods shall not be less than 16 mm and 42Kgf/mm² respectively. Hard drawn galvanized steel stranded wire shall be used as stay wires.

Only stranded wires shall be used for stay wires. The minimum diameter and tensile strength of these wires shall not be less than 7/12 and 70Kgf/ mm² respectively. Stay set with accessories shall be provided for each angle pole and terminal pole.

3.01 Insulator and Insulator Hardware

3.02 The insulator shall be of highest grade porcelain free from defects, thoroughly vitrified, smoothly glazed completely non absorbent. Following types of insulator shall be provided:

- a) Pin type : This shall be used mainly for straight run and angle points below 5° and jumper support. However, conductor size, tension etc. shall be duly consider while deciding on suitability of pin type insulator.
- b) Disc type : This shall be used mainly at turning points (above 5°) and termination each points.

4.00 Spindles for Pin Insulator

These shall have an ultimate strength to suit requirement of application as working load with 2.5 factor of safety and shall be hot dip galvanized. The forged pins shall be of steel complying with class 2 of IS 2000 (1962) and nuts shall be of steel class 4.8 of IS: 1367 (1967)

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5.00 Strain clamps for disc insulator

Disc type insulators shall have strain clamps for conductor. The bolted types are recommended. It is essential that the slip strength of the strain clamp must be a little over the maximum working tension of the conductor and at least 40% more than the rated ultimate strength of the conductor. The bolted type clamps shall be of malleable iron hot dip galvanized complete with aluminium liner.

6.00 Insulator Binding Material

Aluminium armour rod is preferred for binding ACSR conductor with insulator.

7.00 Gang operated air-break isolating switches

The isolators shall be 400Amp 33kV triple-pole, off load, outdoor, vertical mounted type air break isolator with earthing switch and complete with mounting channels and hardware. Mechanical interlock shall be provided between main and earthing switch.

8.00 Lightning Arrestors

The lightning arrestors shall be ZnO type single pole and shall be suitable rated for 33kV system voltage as applicable.

9.00 Earthing of Overhead line

All metal poles shall be permanently and efficiently earthed. For this purpose each and every pole shall be earthed. All stay wires shall be effectively earthed. The cross sectional area of the earth conductor connecting pole structure with earth pits shall not be less than 4 SWG GI wire.

32mm dia. 3000mm long MS rod shall be used as earth electrode in untreated pit as shown in attached GA drawings of pole structures.

10.00 Erection

10.01 The erection of 33kV overhead power lines covered under this specification shall essentially consist of the following major activities which, unless specifically stated hereunder, shall be performed as per the code of practice stipulated in IS with due considerations of I.E. rules and other regulations prevailing at the place of activities:

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- 10.01 The route should be of the shortest practicable distance. However, attention should be kept on the possibility of taking the line as close as possible to the road for easy maintenance and approach during emergency.
- 10.02 It should be located at a safe distance from buildings and from possible fire, proximity to traffic and other hazards.
- 10.03 A detailed route survey for the line has to be made. Alignment and route profile drawing of the line should be submitted to the concerned authority for approval before excavation of pits are started. Approval should also be obtained for the location of all poles crossings, tree cuttings or trimmings and guying locations.
- 10.04 Anchoring and providing one or more guys shall have to be provided for all supports where there is an unbalanced strain acting on the support which may result in tilting/uprooting or breaking of the support. Guys shall be provided to the supports at angle locations, dead end locations, tee-Off points & steep gradient locations.
- 10.05 Guy insulators should be placed to prevent the lower part of the guy from becoming electrically energized by a contact of the upper part of the guy when the conductors snap and fall on them or due to leakage. No guy insulator shall be located less than 2.6 mtrs from the ground.
- 11.00 Excavation for foundation of poles
- a) The foundation shall be excavated in the direction of the overhead line.
 - b) Based on the soil condition and the height and type of pole, the size of excavated hole shall be determined and during excavation, care shall be taken to avoid over sizing of holes.
 - c) Before the above excavation, positioning of stay anchor shall be determined considering its distance from the foot of the pole to be not less than $\frac{1}{4}$ th of the height of support from the ground to the point of attachment of stay.

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12.00 Filling up of excavated holes

After the foundation concrete is fully matured and shuttering removed, the excavated area around the foundations shall be properly back filled with earth.

13.00 Cement concrete works for pole/stay foundations

For cement concrete works, sand, cement, stone-chips of approval quality shall be mixed in desired proportion approved by the purchaser. The purchaser, if required, may supply cement at issue rate from the available stock. Proportioning and mixing shall be properly done. The purchaser may at his discretion take sample of the mix and test the compressive strength of the cube.

14.00 Setting of Stay

The angle between the pole and stay shall be normally 45° but where it is not possible, the minimum angle of 30° must be maintained. It is important to ensure that when the stay is set the same must have correct inclination relative to the ground and the whole screwed portion of stay rod shall protrude 127 mm above the ground.

At the determined position, the stay rod shall be given correct inclination and the stay with anchor shall be embedded in concrete foundation.

15.00 Erection of Stay

- a) Box type clamp for stay shall be fitted to the region of the center of conductors loading, which normally shall be 0.61 meter below from the pole top.
- b) It is important to ensure that when the stay is finally tightened up prior to stringing and pulling up line conductor, the pole to which the stay attached shall be leaning slightly towards the stay. In staying terminal or heavy angle poles, the stays shall be fitted one above the other, such that they shall be in parallel to each other. REC construction standard G-1 may be referred to for Guy assembly.

16.00 Cross-arms General Arrangement

- a) At all intermediate positions except at strain points 'V' bracket having triangular configuration shall be employed and the positions other than stated above, horizontal cross-arms may be

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employed. For heavy loads and different crossings, corners longer or double cross-arms shall be provided.

- b) It is important that at the strain positions, cross-arms shall be so fixed that the pulling shall draw the arm to the pole and not away from it.

17.00 Insulator binding arrangement

The binding of conductor to insulator shall be sufficiently firm and tight to ensure that no intermittent contacts develop. The ends of binding wire shall be tightly twisted in a close speed spiral around the conductor to ensure good electrical contact to strengthen the conductor.

The conductor shall be given a helical layer of round section of armour rod at the point of attachment to insulators and binding in with aluminium binding wire.

18.00 Safety Devices

a) Cradle Guards for power line

To conform to regulations at road crossings and other crossing, the span lengths shall have to be provided with cradle guards, as per requirement. The same shall be erected and fitted between the supporting structures.

b) Anti-climbing devices on lines

To guard against unauthorized climbing barbed wire having 4 barbed per 76 mm of 12.4kg/m wrapped helically spaced 76 mm around the limb of supports, bracings, stays etc. shall be provided.

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RATINGS AND REQUIREMENTS

1.0 33kV Single Circuit Overhead Line

1.1 General

- Type : O/H Line on rail pole
Single circuit vertical/Horizontal
disposed Overhead line system.
- Voltage : 33000V (\pm) 10%
- Phase : 3
- Frequency : 50Hz (\pm) 5%
- System Ground : Effectively grounded
- 1.2 Short Circuit Rating : 25kA sym
- 1.3 Insulation level kV peak/kV rms : 170/70 for 33kV
- 1.4 Conductor
- Type : ACSR
- Size : RABBIT
- 1.5 Electrical Clearances : As per IE rules, REC
construction standard.

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E17 : TECHNICAL SPECIFICATION FOR ERECTION, TESTING & COMMISSIONING

1.0 SPECIAL INSTRUCTIONS TO THE CONTRACTOR

1.1 Supply Items

- 1.1.1 The equipment and materials to be supplied by the Contractor shall be brand new and of good quality.
- 1.1.2 Galvanizing of steel structures and support shall be carried out as per BIS-2629 and BIS-2633
- 1.1.3 Steel supplied by the Contractor, shall be galvanized and free from any defect. When painted it shall be done with one coat of primer and two coats of final paint of approved shade.

1.2 Contractor's Obligation

- 1.2.1 The Contractor shall be fully and finally responsible for proper erection, safe and satisfactory operation of plant and equipment under his scope of work to the entire satisfaction of the Engineer.
- 1.2.2 The work shall be executed in accordance with the directions, instructions, drawings and specifications that shall be supplied to the Contractor by the Engineer from time to time.
- 1.2.3 If in the opinion of the Contractor any work is insufficiently specified or require modification, the Contractor shall refer the same in writing to the Engineer and obtain his instruction/approval before proceeding with the work.
- 1.2.4 If the Contractor fails to refer such instances any excuse for the faulty erection, poor workmanship or delay in completion shall not be entertained.
- 1.2.5 Equipment and material that are wrongly installed shall be removed and reinstalled to comply with the design requirement at the Contractor's expenses to the satisfaction of the Engineer.

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1.3 Supervision by Purchaser's Engineer.

- 1.3.1 The Purchaser's Engineer shall have the overall responsibility for co-ordination of Contractor's work and his direction shall be final.
- 1.3.2 Such direction and supervision, however, shall not relieve the Contractor of his responsibility of correctness and quality of workmanship and of other obligation under the contract.

1.4 Drawings

- 1.4.1 Drawings and schedules enclosed with this specification are for general guidance to assess the type and volume of work involved.
- 1.4.2 These drawings and schedules may be revised to suit the actual requirement in related systems. Additional drawings and schedules will also be furnished to Contractor if/ when necessary.
- 1.4.3 Any revisions, correction additions to drawings and schedules shall not be considered to change the scope of work.
- 1.4.4 The Contractor shall mark in red on one (1) set of drawings all deviations/alterations, not shown on drawings but carried out at field. After completion of work the Contractor shall furnish a set of marked up prints of "As Built "drawings to the Purchaser.

1.5 Extra Work

- 1.5.1 The Contractor shall, when requested by the Engineer, perform extra work and furnish extra materials not covered under his scope of work at unit rate quoted or where rates are not quoted at mutually agreed terms and rates.
- 1.5.2 The decision of the Engineer for such extra payment will be final and binding.

1.6 Methods and Workmanship

- 1.6.1 All work shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.
- 1.6.2 Competent supervisors holding relevant supervisory license from the Government shall supervise the erection work.
- 1.6.3 All details on installation shall be electrically and mechanically correct.

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1.6.4 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

1.7 Protection of Work

The Contractor shall effectively protect his work, equipment and materials under his custody from theft, damage or tampering.

1.7.1 Finished work where required shall be suitably covered to keep it clean and free from defacement or injury.

1.7.2 For protection of his work if required Contractor shall provide fencing and lighting arrangement, as necessary or directed by the Engineer.

1.7.3 Contractor shall be held responsible for any loss or damage to equipment and material issued to him until the same is taken over by the Purchaser according to contract.

1.8 Safety Measures

1.8.1 The Contractor shall take all necessary precautions as per established practice for such work to prevent accidents to his own workmen and others and shall strictly adopt safety measures as per safety rules and codes and/or as directed by the Engineer. All safety rules and codes as applicable to work shall be followed without exception.

1.8.2 All safety appliance and protective devices including belts, hand gloves, aprons, helmets, shields, goggles etc. shall be provided by the Contractor for his personnel.

1.8.3 The Contractor shall provide guards and prominently display caution notices if access to any equipment/area is considered unsafe and hazardous.

1.9 Co-Operation

1.9.1 The Contractor shall at all times work in close coordination with the Purchaser's/Purchaser's supervising personnel and afford them every facility to become familiar with erection and maintenance of the equipment.

1.9.2 In case of any difference between Contractors, the decision of the Engineer shall be final and binding on all parties concerned.

1.9.3 Statutory requirements like electrical inspector clearance etc. are to be arranged by the Contractor.

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1.10 Erection Programme and Progress

- 1.10.1 The Contractor shall submit at such times and in such forms as may be requested by the Engineer, schedule showing the programme and the order in which the Contractor proposes to carry out the work with dates and estimated completion time for various parts of the work.
- 1.10.2 Such schedules shall be approved by the Engineer prior to starting the erection. The Contractor shall adhere to this approved programme for all practical purposes. If for any reason the work is held up, the Contractor shall bring it to the attention of the Engineer in writing without any delay.
- 1.10.3 During the progress of work the Contractor shall submit monthly progress report and such other reports on erection work and organization as the Engineer may direct.
- 1.10.4 If in the opinion of the Engineer the progress of erection work by the Contractor at any stage needs expediting so as to ensure completion of work within stipulated time, the Engineer shall have the right to instruct the Contractor to increase Contractor's manpower in appropriate categories and/or the working hours per day and/or erection tools and tackles and the Contractor shall comply with such instruction forthwith.

1.11 Erection Tools & Tackles

- 1.11.1 The Contractor shall provide all tools, tackle, implements, scaffolding, ladders, etc., which are required for handling and erection of the equipment and materials.
- 1.11.2 Purchaser's tools and equipment if and when available, may be made hired by Contractor on payment of charges.

1.12 Testing Equipment

The major testing equipment that are required to be provided by the Contractor are listed below:

- a) Power operated Meggar of 5000 and 1000V grade for Insulation testing.
- b) Hand operated Meggar of 1000V grade for Insulation testing.
- c) Hand driven earth resistance Meggar of range 0-1/3/30 ohms
- d) Tong testers of suitable ranges.
- e) High potential test set suitable for 33 kV grade cables and equipment.
- f) Torque wrench of various sizes.

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- g) Current transformer primary injection set.
- h) Multimeters, test lamp, buzzer, spirit level, different gauges, oil testing set etc.
- i) Transformer oil testing set.
- j) Phase sequence tester

Other testing equipment as required shall also be arranged by the contractor.

2.0 DETAILED ERECTION PROCEDURE

2.1 Taking Delivery

2.1.1 The Contractor shall arrange to store materials supplied by him in his own stores and shall take delivery of these materials from this store and the equipment and materials to be supplied by the Purchaser from the Purchaser's stores. The Contractor shall take all reasonable precautions for safe handling of all materials and equipment right from the issue from the Purchaser's stores till handing over after successful commissioning.

2.1.2 Materials shall be brought to the erection site, stored or erected as necessary.

2.2 Opening of Cases and Packages

2.2.1 All packing cases and packages shall be opened in presence of Engineer or his authorized representatives.

2.2.2 Packing cases shall be opened carefully to avoid damage to timber. Nails and strips shall be collected separately in boxes and not to be thrown away at random.

2.2.3 All packing materials, timbers, nails and strips shall become property of the Purchaser and shall be delivered to the Purchaser or disposed of as directed by the Engineer.

2.3 Checking and Cleaning of Part

2.3.1 All equipment, accessories and materials shall be carefully inspected and checked with packing list and identified with the erection drawings.

2.3.2 Any discrepancy shall be reported forthwith in writing to the Engineer and repair carried out as described hereinbefore.

2.3.3 All parts shall be thoroughly cleaned, all rust removed and surface polished as required.

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2.3.4 Cleaned and polished parts shall be coated with anticorrosive paints where necessary and stored with care ready for erection.

2.4 Wastage

The Contractor shall make every effort to minimize wastage during erection work.

2.5 Foundation & Civil works

2.5.1 All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts, sills, inserts and fastening devices shall be carried out by the Contractor including minor modification of civil work as may be required for erection.

2.5.2 Any cutting of masonry/concrete work, which is necessary, shall be done by the Contractor at his own cost and shall be made good to match the original work. The Contractor shall obtain approval of the Engineer before proceeding with any cutting of masonry/concrete work.

2.6 Quality of Erection Work

2.6.1 Installation work shall be carried out in accordance with good engineering practices and also manufacturer instructions/recommendations where the same is available.

2.6.2 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, and square and properly aligned and oriented.

2.7 Condition of Equipment prior to Erection

2.7.1 The equipment will be furnished in a dis-assembled condition as received at site. The Contractor shall assemble all these parts, mount and wire-up loose equipment, fittings and accessories and complete with all connections.

2.7.2 Any internal wiring of the equipment, which has been left incomplete because of shipping, split or which requires minor modifications shall be carried out by the Contractor.

2.7.3 Equipment and accessories shall be installed, leveled, plumbed, squared and properly aligned and oriented. Tolerance shall be as established in manufacturer's drawings or as stipulated by the Purchaser. No equipment shall be permanently bolted down to foundation or structure until the alignment has been checked and found acceptable by the Engineer.

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3.0 Cable Trays, Racks

3.1 Cable tray

3.1.1 The Contractor shall supply & install all cable trays, racks, risers & supports in accordance with drawings and documents to be supplied to him and or as directed by the Engineer.

3.1.2 Cable trays either inside or outside buildings shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the drawings.

3.1.5 The cable trays shall be supported in general at a span of 1.5 meters horizontally and at a distance or 1.0 meter vertically. Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing and maintaining the cables.

3.2 Conduit and Accessories

3.1.1 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.

3.1.2 The Contractor shall furnish all conduits complete with accessories as required.

3.3 Cables: Storage and Handling

3.3.1 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e. with flange horizontal.

3.3.2 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending.

3.4 Cable Laying

3.4.1 The Contractor shall install, terminate and connect up all cables, conduits and accessories as per drawings, cable schedules and stipulations furnished elsewhere in this specification.

3.4.2 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.

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- 3.4.3 Before commencement of work the Contractor shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.
- 3.4.4 During the erection period the Contractor shall furnish a monthly report on cable position.
- 3.4.5 Cables laid on trays and risers shall be neatly dressed and clamped at an interval of 1500mm and 1000mm for horizontal and vertical cable runs.
- 3.4.6 All multi core power cables shall be clamped with 25X3mm aluminum flats. All power cables shall be clamped individually and control cables shall be clamped in group of three or four cables.
- 3.4.7 In outdoor areas where buried cables are laid these shall be covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.
- 3.4.8 When buried cables cross road/railway track, additional protection shall be provided in the form of hume/galvanized iron pipes. After completion of installation and prior to connection, all cables shall be subjected to High Potential Tests.
- 3.4.9 Separate trays shall be used for HT power cable, LT power cables and controls cables.
- 3.4.10 33KV buried cable shall be laid 1000mm below finished G.L through temporary brick duct. Minimum 8nos. bricks per meter shall be provided in the under ground cable duct. Separate cable duct shall be provided for each HT power cables.

3.5 Cables Tags & Markers

- 3.5.1 Each cable run shall be tagged with numbers that appear in the cable schedules. Cables shall be tagged at their entrance, every 30 M and exit from any equipment, junction box.
- 3.5.2 The Contractor shall furnish and install all tags and markers stated above.
- 3.5.3 For buried cable, the marker shall project 750mm above ground and shall be spaced at an interval of 30 meters and at every change of direction.

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3.6 Cable Termination and Connection

- 3.6.1 The termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the Engineer.
- 3.6.2 The work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be of Contractor's procurement under this specification.
- 3.6.3 Furnishing of all consumable materials such as soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.
- 3.6.4 Contractor shall supply Cable joint kits for all cables under this specification. Responsibility for proper termination shall lie on the Contractor. Guarantee for termination shall also have to be given by Contractor.
- 3.6.5 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.
- 3.6.6 The Contractor shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.
- 3.6.7 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the Contractor at the discretion of Engineer shall carry the same out.
- 3.6.8 Control cable cores entering control panel/switchgear / kiosks/DBs/marshalling boxes etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.
- 3.6.9 The Contractor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type.
- 3.6.10 Cable glands shall preferably be tinned brass gland, double compression type complete with necessary armour clamp and tapered washer etc.

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4.0 INSPECTION AND TESTING

4.2 Tests at Manufacturer's works

Routine test on all equipment shall be conducted at manufacturer works as per latest IS. Tests shall also conform to International Standards IEC/VDE/DIN/BS (in case corresponding test are not mentioned in IS).

All the equipment shall also be tested at site to know their condition and to prove suitability for required performance. The site tests and acceptance tests to be performed by contractor are detailed below.

The contractor shall be responsible for satisfactory working of complete integrated system and guaranteed performance at site.

4.3 SITE TESTS AND CHECKS

4.3.1 General

All the equipment shall be tested at site to know their condition and to prove suitability for required performance. The list of tests indicated to be conducted, and all required equipment/instrument shall have to be arranged by the contractor. Any other test which is considered necessary by the manufacturer of the equipment, contractor or mentioned in commissioning manual shall have to be conducted at site. In addition to the tests on individual equipment, some tests / checks are to be conducted / observed from overall system point of view to develop confidence for charging of the system / equipment. Such checks are highlighted under miscellaneous tests but these shall not be limited to as indicated, and shall be finalized with consultation of client before charging of the system. All checks and tests shall be conducted in the presence of client's representative and test results shall be submitted in three copies to client and one copy to Electrical Inspector. Test results shall be filled in proper Performa. After clearance from Electrical Inspector system / equipment shall be charged in step by step method. Based on the test results clear cut observation shall be indicated by testing engineer with regard to suitability for charging of the equipment or reasons for not charging are to be brought out by the contractor.

4.3.2 HT Equipment

1. IR test
3. Measurement of contact resistance for HT breakers
5. Testing of relays as per supplier's commissioning manual.

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6. Testing and calibration of all meters.
7. Operation of all relays by secondary injection method. Stability Test of differential CTs and relays.
8. Testing of CT polarities and CT ratio by primary injection test.]
9. Measurement of knee point voltage and secondary resistance for CTs used for differential protection.
10. IR and voltage ratio test for PTs
11. Functional test of all circuit components for each panel/feeder.
12. Test to prove closing/tripping operation at minimum and maximum specified voltage in test and service position.
13. Check for drawout test and service position of breakers for all feeders.
14. Check for covering of all openings in the panel - check for continuity and operation of aux. contacts of breaker.
15. HV test on vacuum interrupters (for VCBs).
16. HT Isolator and Breaker Operation.
17. All interlocks checking among Isolator ,Earth Switch and breaker .
18. Overall Integrated Testing of Switchyard and MRS Equipment.
19. Earth Resistance checking of switchyard and MRS on stand alone basis.

4.3.3 TRANSFORMER

1. IR test P.I value on each winding to ground, and between windings.
2. Turns ratio test on each tap.
3. Polarity and vector group test.
4. Measurement of winding resistance by Kelvin bridge.

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5. Checking of earthing wrt transformer tank (flexible from top cover to tank) other parts, neutrals and tank to electrodes of LAs (for LAs located near the transformer).
6. For bushing CTs, tests applicable shall be as for current transformers (where applicable).
7. Setting of oil/winding temperature indicators, level gauge and checking of alarm/trip circuits.
9. Checking of insulators for cracks.
10. Measurement of magnetizing current and magnetic balance test.
12. Checking of other points given in the manufacturer's commissioning manual.
14. BDV test of transformer oil after filtration & drying.
15. Transformer tan delta test.

4.3.4 BATTERY

1. Checking for completion of civil requirement of battery room, if applicable.
2. Checking of adequacy of charger output/ requirement w.r.t current required for battery charging as per the manual.
3. Checking for availability of safety devices, water and first aid box.
4. Checking the polarity of connections between battery and charger.
5. Visual inspection test for level and leakages.
6. Checking of layout as per approved drawing.
8. Checking of tightness of connectors on each cell.

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4.3.5 BATTERY CHARGER

1. IR test.
2. HV test.
3. Checking the voltage ratio of boost and float mode transformers.
4. Checking for charging mode of batteries, constant current and constant voltage mode.
5. Load test on chargers by running of DC drives (if there) and by liquid resistance system.
6. Checking of tightness of earthing connections.
7. Checking for all alarm conditions.
8. Checking and calibration of all indicating meters.
9. Check for functional operation of charger, auto/ manual change over from float to boost and boost to float etc.
10. Checking and setting of all relays.
11. Checking for AC ripple in boost and float mode after charging.
12. Checking for polarity of cables connected to battery.

4.3.6 MISCELLANEOUS

1. Checking of continuity of the system.
2. Checking of phase sequence from overhead line to consumer end.
3. Checking for safe accessibility of all operating points.
4. Check for availability of emergency lighting.
5. Check for availability of control/aux. supply.
6. Ensure availability of first aid box, fire fighting equipments, earth discharge rods, rubber mats, rubber glove.
7. Check for filling of gravels in yard and in transformer pits.

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8. Check for safe movement of operators from yard to control room/switchgear basement/tunnel etc. w.r.t proper illumination, uncovered openings, provision of hand railings in stairs etc.
9. Check for proper covering of cable channels.
10. Placement of shock treatment chart, danger boards, provision of boards indicating 'Man on Work, Do not switch ON', 'Do not switch OFF', 'EARTHED' etc.
11. Provision of route map at tunnel/basement entry points for indication of escape.
12. Check for proper dressing of cables, mechanical protection of cables, placement of cable markers.
13. Check for sealing of all cable openings including conduit opening with fire resistance material.
14. Check for sealing of all openings at bottom of electrical panels.
15. Phase sequence, continuity, I.R and H.V. tests of power cables (HT<) and control cables as applicable after installation at plant site.

4.3.8 Test Certificates

- i. Certified copies of all tests carried out at site shall be furnished in six (6) copies for approval of the Purchaser.
- ii. The equipment shall be dispatched from works only after receipt of Purchaser's written approval of shop test reports. This is applicable only for supply item.
- iii. Type test certificates on any equipment, if so desired by the Purchaser, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design. This is applicable only for supply item.

5.0 TAKING OVER OF INSTALLATION

- 5.1 On successful testing, commissioning and trial run, the Contractor shall request Engineer in writing for taking over the installation.

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- 5.2 The Engineer, on receipt of the request, shall arrange to take over the installation either wholly or in part as the case may be after a final inspection.
- 5.3 Till such taking over, the responsibility of the whole installation against theft or damage of any kind shall remain with the Contractor.

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33KV RING MAIN SYSTEM INCLUDING 33/0.433KV SUBSTATIONS IN NIT, ROURKELA CAMPUS.

SECTION-VI : TECHNICAL SPECIFICATION AND SCOPE OF WORK

PART-II : CIVIL WORKS

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TECHNICAL SPECIFICATION NO. GCS

FOR

GENERAL CIVIL SPECIFICATION

1.00.00 INTENT OF SPECIFICATION

1.01.00 The intent of this specification is to specify the minimum standard of work and to indicate the extent of work under the scope of this specification for the power supply of National Institute of Technology (NIT), Rourkella.

1.02.00 The work covered under this specification broadly is the construction of

- I. Modification of Wesco Substation comprising of new foundation and structures for two isolators, one breaker and one CT, Post Insulators/ Cable Termination (three sets) and cable trenches.
- II. Main Receiving Substation (MRS) comprising of Foundation & Structure of Cable Terminals, PI, LA, Isolators, PT, Latticed Towers & Beam for Bus Gantry, Station Transformers, Control Room Building & Foundation, Foundation for Beakers and Trenches.
- III. Structures (1 pole, 2 Pole, 4 pole) and Foundations for overhead transmission.
- IV. 33 kV/ 415 V Substations comprising of structures and foundations for incoming line & bus (4 pole structures and beams; Isolators and Cable Terminals will be mounted on beams). Foundations for Power Transformers (1 No. at 3 locations, 3 Nos. at 2 locations, 2 Nos. at 2 locations), Control/ Distribution Building & Foundations, Cable Trenches.
- V. Chain Link Fencing/ Boundary Walls with Barbed Wire Fencing & Gates.
- VI. Approach Roads

1.03.00 Any other building, structure or service of similar nature may be added and/or any of the above work under 1.02.00 may be taken out of the scope of this package at the discretion of the Engineer.

1.04.00 Hot weather occurs in the region and method of concreting (including additives) shall be suitable for such condition.

2.00.00 SCOPE OF WORK

The scope of work shall include but not be limited to :

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- 2.01.00 All Civil Structural and Architectural work including finishing and grounding work.
- 2.02.00 Incidental and Related Work
- 2.02.01 All incidental and temporary work including setting out, protection of adjacent foundations and structures, dewatering, staging, approach roads, the Contractor's office, stores etc. shall be within the scope of the Contractor.
- 2.02.02 All materials, labour, supervision, construction plant, equipment, tools, tackles, fuel, electricity, compressed air, water shall be provided by the Contractor.
- 2.02.03 All testing and commissioning work shall be done by the Contractor and necessary testing equipment shall be provided by the Contractor except that cube tests for concrete work shall be done by the Owner.
- 2.02.04 Any other work not specifically mentioned but reasonably implied or necessary for the proper completion, maintenance and handing over the work shall be done by the Contractor.
- 2.02.05 No separate payment shall be made for above (2.02.01 through 2.02.04).
- 2.03.00 Exclusion
- 2.03.01 The following work except for construction purposes are excluded from the scope of this contract :

i) Electrical work.

3.00.00 WORK TO BE PROVIDED FOR BY OTHERS

No work under this specification will be provided for by any agency other than the Contractor, unless specifically mentioned elsewhere in the Contract.

4.00.00 LAYOUT

The layout and levels of all the work shall be made by the Contractor at his own cost from two reference grids of the plot and one bench marks. The Contractor shall check the perpendicularity of the two axes and shall report to the Engineer error, if any. The Contractor shall give all help in instruments, materials and men to the Engineer for checking the detailed layout and correctness of the layout and levels. The approval of the Engineer shall not be deemed to imply any warranty and shall not relieve the Contractor of his sole responsibility in connection with carrying out the work correctly. The Contractor shall also verify the layout and location of the existing work before starting his construction.

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Making bench mark pillars and reference line pillars, etc. and maintaining them upto the completion of the work shall be the responsibility of the Contractor. No extra payment shall be made on this account. The layout may be required to be modified due to site conditions and the Engineer's instructions shall be followed in such cases.

5.00.00 TIME OF COMPLETION (Not applicable)

~~All work within the scope of this specification shall be completed within six (6) months from the date of issue of Letter of Intent.~~

6.00.00 SPECIFICATION FOR ITEM OF WORK

6.01.00 General

6.01.01 All work including all materials, equipment shall be done strictly as per the approved drawings, specification and instructions of the Engineer.

6.01.02 All work shall be done by skilled experienced personnel, holding trade licence in their respective trades. Welding shall be done by qualified and experienced welders only.

6.01.03 Materials approved by the Engineer only shall be used. The Contractor shall submit free samples to the Engineer for approval.

6.01.04 Work involving bought-out items (painting, waterproofing etc.) shall be done as per Manufacturer's instruction and their supervision, if required.

6.01.05 Scaffolding, ladders staging shall be as per IS 3696 (Part I & II).

6.02.00 Standards

All work unless specified otherwise, shall be carried out as per latest Indian Standards. In case any particular aspect of work is specifically not covered any other standard practice as may be specified by the Engineer shall be followed or the work shall be carried as per the instruction of the Engineer.

6.03.00 Roof Waterproof Treatment

The surface on which roof treatment is to be laid shall be cleaned of all oil, grease, laitance, loose particles and other deleterious materials. Gradient as per drawing shall be provided in structural concrete itself. Any unevenness shall be corrected to the proper gradient with depression filled with 1: 2 mortar under saturated surface dry condition, cured for 7 days and all projections rubbed off. Roof surface shall then be saturated with water and two coats of polymer modified flexible waterproof cement slurry as SIKA Topseal shall be applied under saturated surface dry condition as

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per manufacturer's instruction. Coarse sand shall be lightly sprinkled while the film is still green and then 50 mm of waterproof concrete (1: 2: 4) with 6mm down stone chips and Plastocrete Plus (or equivalent) @ 0.2% by weight of cement and polyurethane fibers @ 3 % shall be laid and trowelled for a smooth finish. Concrete shall be laid very carefully so as not to disturb the film below. The slurry shall be applied on sides and on walls as well. Roof tiles shall be placed on top concrete if specified in drawing or finish schedule.

6.04.00 Fencing & Gates

Fencing (2.5 m high) shall be of galvanized steel chain link fence or masonry wall with barbed wire. Chain link fabric shall be 6g wire with 75x 75 mm mesh size and shall conform to IS 2721. The fabric will be fixed to the angle posts (spaced @ 3.0 m) and top rails with staplers by stapler gun or by self drilling screws. The spacing of staplers shall be 450 mm maximum. Fencing shall be taut, without any kink, true to line and levels.

Gates shall be of MS construction with a well arranged framework to insure stiffness and rigidity combined with light weight as per drawing It shall be leaved openable type hung from RCC pillars. The gate shall run on a track at ground level. The gate shall be operated manually. The tracks and hinges shall of such construction as will allow smooth and rattle free travel.

Barbed wires shall be galvanized 3 ply wires of 10g wire with 2 point barbs @ 600 mm. The fixing arrangement shall be similar to that of fixing chain link fabric.

Rates shall be inclusive of fixing and tensioning arrangement. Angle posts and rails shall be separately paid for.

6.05.00 Approach Roads

Road shall be constructed as per specifications of Ministry Of Shipping and Transport (MOST)

6.06.00 Architectural Items

Architectural items not covered in this specification shall be of best quality and workmanship. West Bengal PWD specifications shall be followed unless mentioned otherwise.

6.05.00 List of Specification

The following technical specifications are annexed with this tender specification and shall form a part of it :

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- CS-1 Earthwork in Excavation and Backfilling
- CS-2 Cement Concrete - Plain and Reinforced
- CS-3 Fabrication of Structural Steel Work
- CS-3/1 Erection of Structural Steel Work
- A-1 Masonry and Allied Work
- A-2 Finish to Masonry and Concrete
- A-3 Metal Doors Windows Ventilators

In case of conflict, this general specifications shall have precedence over the technical specifications listed above.

7.00.00 PROGRAM AND METHOD OF EXECUTION

7.01.00 Information to be submitted with Tender

The Tenderer shall give details of construction machineries and testing facilities, key technical personnel to be deployed at site, detail program of work, etc. as per NIT, conditions of Tendering, General and Special Conditions so as to complete the work as per specifications within the completion time. The Tenderer shall visit the site and collect all necessary information. Due consideration shall be given to the site condition, weather and climatic condition, high flood level of the area and other natural conditions, work to be done in co-ordination with other contractor.

7.02.00 Information to be submitted after Award of Work

The Contractor shall submit within one fortnight of acceptance of his tender, the detailed description and schedules of mobilisation of construction machineries, workshop equipment, testing facilities, key technical personnel as well as establishment of site office, stores, fabrication shop, etc. for the approval of the Engineer. The program of work shall be submitted alongwith the above information. The Contractor shall prepare the net-work drawing showing all the activities. The above may be shown in the form of a bar chart connecting the activities

8.00.00 DEFECT LIABILITY PERIOD

The defect liability period shall be 1 year except for roof water proof treatment, the defect liability period for which will be 10 years.

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SCHEDULE OF ITEMS

SCHEDULE OF ITEMS FOR STRUCTURAL AND CIVIL WORK

NOTES :

1. Details of the items under this Schedule shall be read in conjunction with corresponding specifications, drawings and other tender documents.
2. The work shall be carried out as per drawings, specifications, the description of the items in this schedule and/or instructions by the Engineer.
3. Items of work provided in this Schedule but not covered in the Specification shall be executed strictly as per instructions of the Engineer.
4. Unless specifically mentioned otherwise in the contract, the Tenderer shall quote for the finished items and shall provide for the complete cost towards labour, materials, erection and dismantling of necessary scaffolding, levies, taxes, transport, storage, repairs, rectifications, maintenance till handing over, revenue expenses, contingencies, overheads, profits and all incidental items not specifically mentioned but reasonably implied and necessary to complete the works according to the contract.
5. Rates shall be quoted both in figures and in words in clear legible writing. No over writing is allowed. All scoring and cancellations should be countersigned by the Tenderer. In case of illegibility, the interpretation of the Engineer shall be final. All entries shall be in English Language.
6. In case of discrepancy in the Schedule of Items, Specifications & Drawings the order of preference shall be as follows for the purpose of tendering:
 - a) Description of work in the Schedule of Items.
 - b) Specifications
 - c) Drawings
7. Rates shall be firm for any variation in quantities of individual items subject to a variation of total price of $\pm 25\%$.

.....
Signature of the Tenderer

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TECHNICAL SPECIFICATION NO CS-1

FOR

EARTHWORK IN EXCAVATION AND BACKFILLING

1.0.0 SCOPE

This specification covers excavation in all types of soil, soft and decomposed rock not requiring blasting and rocks requiring blasting, shoring, dewatering, filling around foundations and to grade, compaction of fills and approaches, protective fencing, lighting, etc. relevant to structures and locations covered under the scope of this contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless specified otherwise, shall include but not be limited to the following :

- a) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, fencing, lighting etc. required for the work.
- b) To carry out sampling and testing and submit to the Engineer, results of soil compaction tests if required by the Engineer to assess the degree of compaction.

2.2.0 Work to be provided for by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract.

2.3.0 Codes and Standards

All works under this specification, unless specified otherwise, shall conform to the latest revision and/or replacement of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not covered specifically by Indian Standard Specification any other standard practice as may be specified by the Engineer shall be followed :-

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- IS: 2720 : Determination of Moisture Content (Part-II)
- IS: 2720 : Determination of Moisture content / Dry Density Relation (Part-VII) using Light Compaction.
- IS: 2720 : Determination of Density Index (Relative Density) (Part-xiv) of cohesionless soils.
- IS: 2720 : Determination of Dry Density, in place, by core cutter method. (Part-xxix)
- IS: 2720 : Determination of Dry Density of soils, in place, (Part-xxviii) by sand replacement methods.
- IS: 3764 : Safety code for Excavation work.
- IS: 4081 : Blasting and Related Drilling Operations

2.4.0 **Conformity with Designs**

The Contractor is to carry out the work as required to carry out foundation and substructure work. Drawings for earthwork including dewatering scheme, if required, shall be prepared by the Contractor and approved by the Engineer.

2.5.0 **Materials to be used**

2.5.1 **General**

All materials required for the work shall be of best commercial variety and approved by the Engineer.

2.5.2 **Borrow Material**

Borrow material arranged by the contractor and approved by the Engineer shall be free from roots, vegetation, decayed organic matter, harmful salts and chemicals and free from lumps and clods. If specified, clean graded sand free from harmful and deleterious material from approved quarries, shall be used as fill material.

2.6.0 **Quality Control**

The Contractor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work :-

a) Lines, Levels and Grades :

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- i) Periodic surveys
 - ii) Establishment of markers, boards etc.
- b) Back-filling :
 - i) Checking the quality of fill material
 - ii) Checking moisture content of the backfill
 - iii) Checking the degree of compaction

3.0.0 EXECUTION

3.1.0 Setting Out

The Contractor will set out the work from the control points furnished to him and fix permanent points and markers for ease of future checking. These permanent points and markers will be fixed at intervals, which shall be approved and certified by the Engineer. Engineer shall be provided with necessary men, material, tools and instruments for such checking. It should be noted that this checking by the Engineer prior to start of the work will in no way absolve the Contractor of his responsibility of carrying out the work to true lines, levels and grades.

3.2.0 Initial Levels

The Contractor shall take initial levels to be verified by the Engineer for future reference and measurements.

3.3.0 Classification

All earthwork shall be classified under the following categories as specified in the relevant IS Code:

- a) Ordinary Soil
- b) Hard Soil
- c) Soft and Decomposed Rock
- d) Hard Rock

3.4.0 Excavation for Foundations and Trenches

3.4.1 General

All excavations shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer shall be obtained by the Contractor, in each individual case, for the method he proposes to adopt for the excavations including dimension, side slopes, shoring, dewatering, disposal, etc. This approval, however,

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shall not in any way make the Engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner.

All excavation in open cuts shall be made true to line, slopes and grades shown on the drawing. No material shall project within the dimension of minimum excavation lines marked. Boulders projecting out of the excavated surfaces shall be removed, if in the opinion of the Engineer they are likely to be a hindrance to the workers.

Method of excavation shall be in every case subject to the approval of the Engineer and the Contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works.

The Contractor shall have full responsibility of the stability of the excavation and safety of the workmen. If any slip occurs, the Contractor shall remove all slipped material from the excavated pit.

All loose boulders, semi-detached rocks, not directly in excavation but so close to the area to be excavated as to be liable, in the opinion of the Engineer, to fall or otherwise endanger the workmen, equipment or the work, etc., shall be stripped off and removed away from the areas of excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion, which was originally sound and safe. Any materials not requiring removal as contemplated in the work, but which, in the opinion of the Engineer, is later to become loose or unstable shall also be promptly and satisfactorily removed as directed by the Engineer.

The rough excavation may be carried upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Engineer, soft and undesirable spots shall be removed even below the final level and filled up with 1:4:8 ordinary concrete or as directed by the Engineer.

In formation of rock requiring blasting, those overcuts which are unavoidable will be made up by ordinary cement concrete 1:2:4

3.4.2 **Excavation in Ordinary Soil, Hard Soil and Soft and Decomposed Rock**

The excavation in ordinary soil, hard soil, soft and decomposed rock will be carried out as per the approved proposal. In certain cases, where deterioration of the ground, upheaval, slips, etc. are expected, the Engineer may order to suspend the work at any stage and instruct the

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Contractor to carry out the balance work just before the foundation work of the structure can be started.

3.4.3 **Excavation in Hard Rock**

Excavation of hard rock, as described under (d), shall be carried out by chiseling, wedging and using sledge hammers as far as possible. But, if it requires blasting the same shall be executed with special care. Controlled blasting with proper muffling shall be done so that no splinter goes out of the plant boundary .

Personnel deployed for rock excavations shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is such that it is not stable against sliding, necessary supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock/boulder falling from the excavated surfaces deeper than 2 metres, steel mesh anchored to the lower edge of excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained.

3.4.4 **Blasting**

Storage, handling and use of explosives shall be governed by the current explosive rules laid down by the Central and the State Governments. The Contractor shall ensure that these rules are strictly adhered to.

3.4.5 **Disposal**

The excavated spoils will be disposed of in any or all the following manners :-

- a) By using it for backfilling straightway.
- b) By stacking it temporarily for use in backfilling at a later date during execution of the Contract.
- c)
 - i) By either spreading, or
 - ii) Spreading and compacting at designated filling areas.
- d) By selecting the useful material and stacking it neatly in areas designated by the Engineer for use in backfilling by some other agency.

3.5.6 **Disposal of Surplus Material**

All surplus material from excavation shall be carried away by the contractor and disposed of outside the plant boundary, if directed by

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the Engineer. The disposal area shall be arranged by the Contractor at his own cost.

3.4.7 **Protection**

The Engineer shall be notified by the Contractor as soon as the excavation is expected to be completed within a day so that it may be inspected by him at the earliest. Immediately after approval of the Engineer, the excavation must be covered up in the shortest possible time. Excavated material shall be placed beyond 1.5 metres from the edge of the pit or trench or the depth of the pit or trench whichever is more.

Excavation shall not be carried out below the foundation level of structure close by until required precautions have been taken. Adequate fencing is to be made enclosing the excavation.

The Contractor shall protect all under-ground services exposed by excavation. The Contractor shall also divert all surface drains, etc. affected by the excavation to maintain the working area neat and clean.

3.4.8 **Dealing with surface water**

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

No works shall commence until surface water streams have been properly intercepted, redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems at his own cost to drain surface water from working areas.

3.4.9 **Dewatering**

All excavations shall be kept free of water and slush. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The Contractor shall remove by pumping or other means approved by the Engineer any water inclusive of rain water and subsoil water accumulated in excavation and keep the trench dewatered until the construction of foundation structure and backfilling are complete in all respects. Sumps made for de-watering must be kept clear of the foundations. Method of pumping shall be approved by the Engineer but in any case, the pumping arrangement

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shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping.

3.4.10 **Timber Shoring**

Timber Shoring made out of approved quality of timber shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

a) **Close Timbering**

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 250 x 40 mm sections as directed by the Engineer. The boards shall generally be placed in position vertically in pairs, one board on each side of cutting, and shall be kept apart by horizontal walers of strong wood at maximum 1.2 metres spacing, cross strutted with ballies. The length of the bally struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical walers, which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed, so that the earth is not liable to slip.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit/trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber.

b) **Open Timbering**

In the case of open timbering, the entire surface of the side of trench pit is not required to be covered. The vertical board of minimum 250 mm width and minimum 40 mm depth shall be spaced sufficiently apart to leave unsupported strips of maximum 500 mm average width. The detailed arrangement, sizes of the timber and the distances apart shall be subject to the approval of the Engineer. In all other respects, specification for close timbering shall apply to open timbering.

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3.5.0 **Back-filling**

3.5.1 **General**

The material used for backfilling shall consist of material, approved by the Engineer obtained directly from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits arranged by Contractor and approved by the Engineer. The material shall be free from lumps and clods, roots & vegetations, harmful salts & chemicals, organic materials, etc.

In certain locations, the Engineer may direct sand fillings. The sand should be clean, well graded and be of quality normally acceptable for use in concrete.

3.5.2 **Filling and Compaction in Pits and Trenches around Structures**

As soon as the work in foundations has been accepted the spaces around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings, etc., and filled with earth in layers not exceeding 250 mm in loose thickness each layer being watered, rammed and properly compacted to achieve a dry density of not less than 90% of proctor's dry density at optimum moisture content. For back filling with sand having little or no silt, each layer shall be compacted to a relative density of 75%. The final surface shall be trimmed and leveled to proper profile as per drawing.

Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections done to optimise the moisture content.

3.5.3 **Plinth Filling**

The plinth shall be filled with earth in layers not exceeding 250 mm in loose thickness, watered and compacted as stated under clause no. 3.7.2 with approved compaction machine or manually, if specifically permitted by the Engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slope intended for the floor.

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3.6.0 Approaches and Fencing

The Contractor should provide and maintain proper approaches for workmen and for inspection. The roads and approaches around the excavated pits should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the project. Sturdy fencing is to be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

3.7.0 Lighting

Full fledged area lighting is to be provided if night work is permitted or directed by the Engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Excavation

On completion of excavation, the dimensions of the pits will be checked as per the drawings after the pits are completely dewatered the work will be accepted after all undercuts have been set right and all over excavations filled back to required lines, levels and grades by placing ordinary concrete of 1:4:8 proportion and/or richer and/or by compacted earth at the Contractor's cost. Over excavation of the sides will be made good free of cost by the Contractor while carrying out the backfilling. The excavation work will be accepted after the above requirements are fulfilled and all temporary approaches encroaching inside the required dimension of the excavation have been removed.

4.2.0 Backfilling

The degree of compaction shall be sufficient to achieve a dry density of not less than 90% of proctor's dry density at optimum moisture content as per IS-2720 (Part - vii) or a relative density of 75% as per IS-2720 (Part-xiv) as applicable depending on the nature of backfilling material. The work of backfilling will be accepted after the Engineer is satisfied with the degree of compaction achieved.

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5.0.0 Rates and Measurements

The rates shall include cost of all items and work as mentioned under 2.1.0. Measurements shall be made as per IS-1200 unless otherwise mentioned in the Specifications and/or Schedule of Items.

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TECHNICAL SPECIFICATION NO. CS-2

FOR

CEMENT CONCRETE (PLAIN OR REINFORCED)

1.0 SCOPE

- 1.1 This specification covers all the requirements for general use of plain and reinforced concrete (cast-in-situ or precast)
- 1.2 IS: 456 and codes and standards referred therein shall form a part of this specification and shall be applicable unless specified otherwise. For any particular aspect not covered by these codes, appropriate IS codes or standards or any other international standard, as may be specified by the Engineer, shall be followed. All codes and standards shall conform to their latest revisions

2.0 GENERAL

2.1 Work to be Provided for by the Contractor

The work to be provided by the Contractor shall include but not be limited to the following:-

- a) Furnish all labour, supervision, services including facilities, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportation, etc. as required for work.
- b) Drawings for temporary work and supports, if required by the Engineer.
- c) Submit for approval, if required by the Engineer, detailed schemes of all operations e.g. material handling, concrete mixing, placement of concrete, compaction, curing, services, approaches etc.
- d) Furnish samples and test results of materials used in and for the work, for approval
- e) Submit for approval concrete mix design.

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- f) Provide all incidental items not shown or specified in particular, but reasonably implied for the successful completion of the work.

2.2 Work by Others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned in the contract.

2.3 Conformity with Design

The Contractor will prepare check lists in approved form which will be called 'Pour Cards'. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all help and assistance to the Engineer for checking. Details of all instructions and observations of the Engineer, records of compliance by the Contractor and other relevant information will be written on the accompanying sheets. These pour cards will again be reviewed, after the forms are removed, curing is completed and concrete test results are obtained, by the Engineer and signed.

2.4 Materials

2.4.1 General

All materials whether to be incorporated in the work or used temporarily for construction shall conform to relevant IS specifications unless stated otherwise and be of best quality, approved by the Engineer.

2.4.2 Cement

Generally cement shall be 43 grade ordinary Portland cement conforming to IS: 8112 or Portland slag cement conforming to IS: 455 of approved brand. In special cases other types of cement may be permitted or directed to be used by the Engineer.

2.4.3 Aggregates

Coarse aggregates shall be natural gravel or crushed rock. Fine aggregates shall be natural sand. Aggregates shall comply with the requirements of IS: 383. Aggregates shall be rounded or cubical and free from deleterious

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material. Sand shall be preferably of zone II. Tests for alkali reactivity may have to be made if directed by the Engineer.

2.4.4 Water

Water for mixing and curing concrete shall be clean and free from injurious oils, acids alkalis, organic matters, salts, silts or other impurities and shall meet the requirements of IS: 456.

2.4.5 Admixture

Only admixture of approved brand and type shall be used when directed or permitted by the Engineer

2.4.6 Reinforcement

Reinforcement shall be high strength deformed bars ($f_y = 415 \text{ N/mm}^2$) as per IS 1786 or as mentioned in drawings. All bars shall be of tested quality and from approved source.

2.5 Storage of materials

All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Storage of materials shall be as per IS: 4082

2.6 Quality Control

Contractor shall establish and maintain quality control for different items of work and materials. A form for quality control shall be developed by the Contractor and approved by the Engineer. The quality control operation shall include but not be limited to the following:

- a) Admixture: Type, quality, manufacturers' certificate and instructions
- b) Aggregate: Physical and mineralogical qualities, grading, moisture content, impurities
- c) Water: Impurities
- d) Cement: Tests to satisfy relevant IS specifications
- e) Formwork: Materials, shapes, dimensions, lines, plumb, elevations, surface finish, leak tightness, adequacy of forms, props, ties, bracing, shoring and coating

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- f) Reinforcement: Shapes, dimensions and sizes, cover, location and length of splices, clearances, ties and supports, quality of welded splice
- g) Grades of concrete: Usage and mix design, testing of all properties
- h) Batching: Types and capacity of plant, concrete mixers, equipment for transportation, proportioning, calibration of weighing instruments measuring tanks and measuring boxes (if permitted), mixing time and uniformity of mix
- i) Workability: Slump test
- j) Joints: Location and treatment of joints, water stops and their splicings, sealants
- k) Embedded items: Material, shape, location, setting, anchor, welding
- l) Placing: Preparation, rate of pouring, time interval between mixing and placing and between two successive placing, prevention of cold joints, covering over dry or wet surface, cleaning and preparation of surfaces on which concrete is to be placed, types of chutes or conveyers
- m) Compaction: Number of vibrators, their capacity and performance, duration of vibration, rodding and tamping
- n) Concrete finish: Repair of surface defects, screeding, floating, steel trowelling and brooming, special finishes
- o) Curing: Method and length of time

3.0 INSTALLATIONS

3.1 Washing and Screening of Aggregates

Washing and screening of coarse aggregates shall be carried out to remove fines, dirt or other deleterious materials, when directed by the Engineer. Fine aggregates shall be screened to remove dirt or other deleterious materials and shall not be washed.

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3.2 Proportioning and Work Control

3.2.1 General

It shall be the responsibility of the Contractor to produce concrete mix which shall be transported, placed and compacted without segregation to produce concrete of required strength, durability and surface finish.

3.2.2 Minimum Cement Content

The minimum cement for different grades of concrete shall be as follows

Grade	Minimum Cement Content
M-20	300 kg/m ³
M-25	325 kg/m ³
M-30	350 kg/m ³

Higher cement content shall be used to meet the requirement of strength and workability as required.

3.2.3 Workability

The degree of workability necessary to allow the concrete to be well compacted and to be worked into corners of formwork and around the reinforcements and embedments and to give the required finish shall depend on the type and nature of structure, type of compacting equipment and shall be based on experience and tests. IS: 456 shall be referred for guidance.

The workability and consistency of concrete mix shall be checked at frequent intervals by slump tests or by compaction factor.

3.2.4 Design Mix

Before any concreting, the Contractor shall design mix for each grade of concrete and for different workability and shall get these approved by the Engineer. The Engineer shall be given full access to the tests, test results and records before approval.

3.3 Mixing Conveying and Compaction

3.3.1 General

Mixing, conveying, placing and compaction shall be done as per IS: 456 and as stipulated below. When concreting is to be done in hot weather (above 35° C) IS: 7861 shall be also followed.

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3.3.2 Mixing

Concrete shall be mixed in a mechanical mixer. Hand mixing will be permitted for 1: 4: 8 nominal concrete for small jobs and shall be done as per direction of the Engineer.

Concrete shall be weigh batched. Volume batching may be permitted if the following conditions are satisfied.

- i) Water shall be added from a calibrated tank.
- ii) Cement of whole bag is used in each batch. Bags shall be in-tact without any loss of cement.
- iii) Other conditions as per IS: 456 are satisfied.

The first batch of mix shall have 10% extra cement to compensate for the loss in drums.

Water cement ratio shall be maintained as per design mix. For this, frequent determination of moisture content of aggregates shall be made and water content shall be adjusted.

3.3.3 Conveying

Concrete mix shall be conveyed, placed and compacted before the initial setting starts. Concrete shall be conveyed in an approved manner as will prevent segregation or loss of ingredients.

3.3.4 Placing

Concrete shall be always placed under saturated surface dry condition. Old construction joints shall be roughened by wire brushing, chipping or sand blasting and all loose particles shall be removed.. All cuttings, dirt, oil, foreign material, laitance etc. are to be removed by air water jetting and shall be thoroughly washed.

Concrete shall be placed without segregation and shall be spread, if necessary and thoroughly compacted by approved mechanical vibration and thoroughly worked around shape. The depth of placing shall not be more than the needle depth. Vibrators shall not be used for pushing concrete into adjoining areas. Over vibration and segregation shall be avoided. In thin congested members, the Contractor shall use form vibrators conforming to IS:

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4656. For slabs and other similar structures, the Contractor shall additionally employ screed vibrators as per IS: 2506.

The rate of pouring and sequence of pouring shall be planned in advance such that no cold joint is formed. To prevent cold joint, controlled periodic re-vibration may be permitted before concrete is set to prevent its setting. If a cold joint is formed, concrete shall be raked or cut to the required depth and removed as directed by the Engineer.

No concrete shall be placed in open during rains. The Contractor shall keep sufficient arrangements to the satisfaction of the Engineer for protection to freshly laid concrete against damage.

3.4 Construction Joint

Location and details of construction joints shall be planned and as approved by the Engineer. Treatment of joints shall be as per IS: 456. A layer of mortar of thick creamy consistency of same proportion as the concrete mix but without coarse fraction shall be applied, if directed by the Engineer. Vertical construction joints shall be made with rigid stop board having slots for reinforcement and an epoxy bond maker shall be applied.

3.5 Repair

All concrete work shall be inspected immediately after the forms are removed. If defect occurs, the entire work may be rejected by the Engineer or he may ask the Contractor to repair the work as per his instructions. For minor defects, repair shall be done by sack rubbing with mortar and stoning with caborundum stone.

For honeycombs, defective concrete shall be cut away to the required depth and cut square. Epoxy bonding agent shall be applied and repair shall be done by any of the following means, as directed by the Engineer, with or without additives:

- a) Packing mortar of the same proportion as the mix but without coarse fraction and of a thick creamy consistency.
- b) Concreting
- c) Placing and compacting concrete and injecting grout

Grouting may be done with:

- a) With cement sand slurry of 1: 1 mix

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- b) With non-shrink ready mix grout
- c) With resin or polymer modified mortar.

3.6 Finishing of Floors

Wherever a non integral floor or roof finish is specified, the surface of concrete shall be struck off at the required level and slope and shall be finished by a wooden float fairly smooth removing all laitance. For roofs, gradients shall always be provided in the structural concrete itself.

Where integral finish is specified, concrete shall be compacted and struck off at the specified level and slope with a screed, preferably vibrating type and then with a wooden float. Steel trowelling shall then be started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hardened enough to prevent proper finishing of aberrations, so as to produce a dense surface free from blemishes, ripples and trowel marks. Cement shall be sprinkled @ 2 kg/m² on surface during floating when neat cement is specified.

3.7 Protection and Curing of Concrete

Newly placed concrete shall be protected from rain, damage, abrasion, contamination and aggressive condition. Curing shall be done by approved means as per IS: 456. Curing shall be done at least for 7 days. During this period concrete shall be kept moist and temperature kept between 5° C and 35° C.

3.8 Reinforcement

3.8.1 Cleaning

All reinforcement shall be free from loose scales, loose concrete/mortar, oil, grease, paint or other harmful matters before placing the concrete.

3.8.2 Cutting and Bending

Reinforcing steel shall be bent as per IS: 2502. No reinforcement shall be bent when already in position, except without the approval of the Engineer. Bars shall not be straightened that will injure the material. Rebending can be done only with the approval of the Engineer. Jogging shall be done to clear reinforcement/pockets, if directed by the Engineer.

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3.8.3 Placing

All reinforcement shall be accurately fixed in position by adequate and approved means like chairs, cover blocks, spacer bars, staging. Location and length of laps shall be as approved by the Engineer. Cover blocks shall be of same mix as concrete but without coarse fraction. Bars at crossings shall be securely tied together at all such points by No. 20 G annealed soft iron wire. Binders shall tightly embrace with which they are intended to be in contact and shall be securely held. Welding shall be done as and when directed by the Engineer

3.9 Formwork

3.9.1 General

Formwork inclusive of the supports and centering shall be capable of withstanding the load, considering working load, load due to fluidized concrete, effect of vibration and other effects and loads, and shall remain undistorted throughout the period it is left in service. Where props are placed on ground, they shall be tight resting on adequate base plates. All slabs and beams shall be crowned to compensate for any deflection of the formwork and gradient shall be provided as per drawing. The joints in the formwork shall be snug fitted and tight to prevent any leakage of slurry and mortar. The formwork shall lap and be secured sufficiently at the lift joints to prevent leakage, bulging or offsets.

To achieve desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must not in anyway impair the strength of concrete or cause stains, rusting or marks on concrete., Where sleeves are used, the annulus of the conduits shall be filled with expanding mortar. Specially designed sleeves/tie bolts are to be used for water retaining structure.

3.9.2 Cleaning and Treatment of Forms

All parts of forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them. Reuse of forms shall be subject to the approval of the Engineer. All rubbish, loose concrete, chippings, shavings etc. shall be scrupulously removed from the interior of the forms before concrete is placed, by vacuum cleaners and/or compressed air jet.. The inside surface of the formwork shall be treated with approved non-staining shutter releasing agent like 'Separol' of Sika. Care shall be taken so that oil or other compound does not come in contact with reinforcements or construction joint surfaces.

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3.9.3 Removal of Forms

Before removing any formwork, the Contractor shall notify the Engineer well in advance, to enable him to inspect the concrete. The Contractor shall be fully responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or for any other reason, shall be rejected and entirely reconstructed. Forms, under no circumstances, shall be removed before the time specified in IS: 456.

3.10 Anchor Bolts & Misc. Embedded Fixtures

The Contractor shall embed bolts and other fixture true to line and level. Necessary templates, jigs, fixtures, supports etc. shall be used as may be required.

Tolerance for fixing anchor bolts shall be ± 2 mm.

3.11 Joint Sealing Strips & Water Stops

Joint sealing strips and water stops shall be provided at all construction, expansion and isolation joints for water retaining structures. These shall be best quality PVC or rubber water stops approved by the Engineer. Sealing strips shall not have any longitudinal joint and all joint sealing materials shall be procured in largest practicable lengths having a minimum number of transverse joints. The jointing procedure shall be as specified by the manufacturer and approved by the Engineer. Water stops shall be so installed that these are not bent, displaced or distorted during concreting. Necessary details shall be developed and provided by the Contractor and the cost is to be included in the rates of water stops.

3.12 Precast Concrete

The specification for precast concrete is similar as for cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for this purpose.

The yard shall be dry, properly leveled and having a hard and even as well as well drained surface to prevent excessive settlement due to softening of soil during casting and curing. If the ground is used as a soffit former of the units, it shall be paved with concrete and provided with a layer of mortar (1: 2) with smooth finish. Where directed by the Engineer, casting shall be done on smooth vibrating table.

The Contractor is responsible for the safe removal from the moulds and erection of the precast units and these shall be handled without causing any damage to these.

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Lifting hooks if provided, shall be embedded in correct position. These shall be burnt off and finished after erection, if not shown on the drawings. For symmetrical sections, units shall be marked to indicate top surface. After erection and alignment, the joints shall be filled with grout if directed by the Engineer.

4.0 SAMPLING TESTING AND ACCEPTANCE CRITERIA

4.1 General

The Contractor shall carry out all sampling and testing in accordance with relevant Indian Standards except for materials supplied by the Owner. For bought out items manufacturers' certificate may be accepted provided that the Engineer shall be given full access to the tests, test results and test records.

4.2 Concrete

The sampling of concrete, making test specimens, curing shall be in accordance with IS: 516 and IS: 1199 and test specimens shall be submitted by the Contractor to the Owner for testing. Sampling procedure, sampling frequency and test specimens shall conform to clause 15 of IS: 456.

To control the consistency of concrete, slump tests in accordance with IS: 1149 shall be carried out every two hours or more frequently as directed by the Engineer. Slumps corresponding to test specimens shall be recorded for reference.

The acceptance criteria of concrete shall be in accordance with clause 16 of IS: 456. Standard deviation shall be based on test results and determination of standard deviation shall be made at the early stage and constantly upgraded as per IS: 456.

Concrete work found unsuitable for acceptance shall be dismantled and replacement as per specifications, shall be done by the Contractor.

5.0 RATES AND MEASUREMENTS

The rates shall be for complete item and shall include cost of all the works and items mentioned in clause 2.1 of this specification.

Measurements shall be made as per IS:1200 and where the provision of IS:1200 is not clear, standard practice followed by Orissa PWD shall be followed, unless mentioned otherwise in this specification or Schedule of

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Items. Jigs, templates, supports, jack bars for slipform work, shall not be measured or paid for.

6.0 LIST OF INDIAN STANDARDS

All work, as mentioned in 1.2 shall be carried out as per relevant Indian Standards unless mentioned otherwise. Following is a partial list of relevant Indian Standards:

(Note: When a clause no. is mentioned, IS specification shall refer to that edition which was in force at the time of award, otherwise it shall mean the latest standard,)

- IS: 269 - Indian Standard Specification for 33 Grade Ordinary Portland Cement
- IS: 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
- IS: 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement
- IS: 455 - Indian Standard Specification for Portland Slag Cement
- IS: 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete
- IS: 516 - Indian Standard Specification for Methods of Test for Strength of Concrete
- IS: 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete
- IS: 1200 – Indian Standard Specification for Method of Measurement of Cement Concrete Work (Part – II)
- IS: 1200 - Indian Standard Specification for Method of Measurement of Formwork (Part – V)
- IS: 1489 - Indian Standard Specification for Portland Pozzolana Cement – Part 1 & 2
- IS: 1566 - Indian Standard Specification for Hard Drawn Steel Wire Fabric for Concrete Reinforcement

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- IS: 1786 - Indian Standard Specification for High Strength Deformed Bars & Wires for Concrete Reinforcement
- IS: 1791 - Indian Standard Specification for Batch Type Concrete Mixers
- IS: 1834 - Indian Standard Specification for Hot Applied Sealing Compound for Joint in Concrete
- IS: 2062 - Steel for General Structural Purpose
- IS: 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete –Part I to VIII
- IS: 2430 - Indian Standard Specification for Method of Sampling of Aggregates for Concrete
- IS: 2502 - Indian Standard Specification for Bending and Fixing of Bars for Concrete Reinforcement
- IS:2505 - Indian Standard Specification for Concrete Vibrators Immersion Type
- IS: 2506 - Indian Standard Specification for Screed Board Concrete Vibrators
- IS: 2514 - Indian Standard Specification for Concrete Vibrating Tables
- IS: 2645 - Integral Cement Water Proofing Compound
- IS: 2722 - Indian Standard Specification for Portable Swing Weigh Batchers for Concrete (Single and Double Bucket Type)
- IS: 2751 - Code of Practice for Welding of Mild Steel Bars Used for Reinforced Concrete Construction
- IS: 3025 - Indian Standard Specification for Methods of Sampling and Test (Physical and Chemical) for Water and Waste Water
- IS: 3414 - Code of Practice for Design and Installation of Joints in Buildings
- IS: 3350 - Indian Standard Specification for Method of Test for Routine Control for Water Used in Industry

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- IS: 3558 - Code of Practice for Use of Immersion Vibrators for Consolidating Concrete
- IS: 4082 - Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at Site
- IS: 4656 - Indian Standard Specification for Form Vibrators for Concrete
- IS: 4990 - Indian Standard Specification for Plywood for Concrete Shuttering Work
- IS: 7242 - Indian Standard Specification for Concrete Spreaders
- IS: 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete
- IS: 7251 - Indian Standard Specification for Concrete Finishers
- IS: 7320 - Indian Standard Specification for Concrete Slump Test Apparatus
- IS: 7861 - Indian Standard Specification for Recommended Practice for Hot and Cold Weather Concreting (Part I & II)
- IS: 7969 - Safety Code for Storage and Handling of Building Materials
- IS: 8041 - Indian Standard Specification for Rapid Hardening Portland Cement
- IS: 8112 - Indian Standard Specification for 43 Grade Ordinary Portland Cement
- IS: 8142 - Indian Standard Specification for Determining Setting Time of Concrete by Penetration Resistance
- IS: 9013 - Indian Standard Specification for Method of Making, Curing and Determination of Accelerated – Cured Concrete Test Specimens
- IS: 9103 - Indian Standard Specification for Admixtures for Concrete
- IS: 9417 - Recommendation for Welding Cold Worked Bars for Reinforced Concrete Construction
- IS: 10262 - Recommended Guideline for Concrete Mix Design

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IS: 12269 - Indian Standard Specification for 53 Grade Ordinary Portland Cement

IS: 12600 - Indian Standard Specification for Low Heat Portland Cement

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TECHNICAL SPECIFICATIO NO. CS-3

FOR

FABRICATION OF STRUCTURAL STEELWORK

1.0.0 SCOPE

This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork in general covered under the scope of the contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following;

- a) To furnish necessary test certificates of all raw materials supplied by the Contractor for the project.
- b) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary bolts, nuts, washers, tie rods and welding electrodes for field connections.
- c) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.
- d) Insure, pack, load and transport all fabricated steelwork and field connection materials to site with proper marking. Item d) shall be applicable if fabrication is not done at site.

2.2.0 Work by Others

No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract.

2.3.0 Codes and Standards

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All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard Specification, any other standard practice, as may be specified by the Engineer shall be followed:

- IS : 800 - Code of practice for general construction in steel
- IS : 801 - Code of practice for use of cold formed light gauge steel structural members in general building construction.
- IS : 806 - Code of practice for use of steel tubes in general building construction.
- IS : 808 - Dimensions for rolled steel beams, channels and angle sections.
- IS : 812 - Glossary of terms relating to welding & cutting of metals.
- IS : 813 - Scheme of symbols for welding.
- IS : 814 - Covered electrodes for metal arc welding of carbon and carbon manganese steel.
- IS : 815 - Classification coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.
- IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel.
- IS : 817 - Code of practice for training & testing metal arc welders.
- IS : 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations.
- IS : 819 - Code of practice for resistance spot welding for light assemblies in mild steel.

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- IS : 822 - Code of practice for inspection of welds.
- IS : 919 - Recommendations for limits and fits for engineering.
- (Part - 1&2)
- IS : 1161 - Steel Tubes for structural purposes.
- IS : 1182 - Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
- IS : 1200 - Method of measurement of steel work and iron (Part - 8) work
- IS : 1239 - Mild steel tubes, tubular & other wrought steel (Part - 1&2) fittings
- IS : 1363 - Hexagon head bolts, screws & nuts of product (Part - 1 to 3) grade C
- IS : 1364 - Hexagon head bolts, screws and nuts of product (Part - 1 to 5) grade A & B
- IS : 1365 - Slotted counter sunk head screws (dia. 1.6 to 20 mm)
- IS : 1367 - Technical supply conditions for threaded (Part - 1 to 18) steel fasteners.
- IS : 1608 - Method for tensile testing of steel products.
- IS : 1730 - Dimensions for steel plate, sheet and strip for structural and general engineering purposes.
- IS : 1852 - Rolling and cutting tolerances for hot-rolled steel product.
- IS : 1977 - Structural steel (Ordinary quality)
- IS : 2016 - Plain washer

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- IS : 2062 - Steel for general structural purposes.
- IS : 2629 - Recommended practice for hot-dip galvanising of iron and steel.
- IS : 2633 - Method for testing uniformity of coating on zinc coated articles.
- IS : 3644 - Code of practice for ultrasonic pulse echo testing by contact and immersion method.
- IS : 3757 - High strength structural Bolt
- IS : 4000 - High strength bolts in steel structure
- IS : 4759 - Specifications for hot-dip zinc coatings on structural steel and other allied products.
- IS : 4923 - Hollow steel sections for structural use.
- IS : 5334 - Code of practice for magnetic particle flaw detection of weld.
- IS : 5369 - General requirements for plain washers and lock washer.
- IS : 6005 - Code of practice for phosphating of iron and steel.
- IS : 6649 - Specification for hardened and tempered washers for high strength structural bolts and nuts.
- IS : 6623 - Specification for high strength structural nuts.
- IS: 7215 - Tolerances for fabrication of steel structures.
- IS : 7280 - Bare wire electrode for submerged arc welding
- S : 8629 - Code of practice for protection of iron steel & structures from atmospheric corrosion.

(Part - I to III)

- IS : 9595 - Recommendation for metal arc welding of carbon manganese steels.

PAINTING

- IS : 117 - Specification for ready mixed paint, brushing, finishing, exterior, semi-gloss, for general purposes.

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- IS : 128 - Specification for ready mixed paint, brushing, finishing, semi-gloss for general purposes, black.
- IS : 1477 - Code of practice for painting of ferrous metal in building
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- IS : 2074 - Ready mixed paint, air-drying red-oxide zinc chrome priming.
- IS : 2339 - Specification for aluminium paints for general purposes in dual container.
- IS : 2932 - Specification for enamel, synthetic exterior type- I.
- IS : 2933 - Specification for enamel, synthetic exterior type- II.

2.4.0 Materials to be Used

2.4.1 General

All steel materials shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant.

Test Certificates of materials supplied by the contractor in respect of each consignment shall be submitted in triplicate.

The arc welding electrodes shall conform to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.

2.4.2 Steel

All steel materials to be used in construction within the purview of this specification shall comply with Indian Standard Specifications as may be applicable. Section properties shall be as per Indian Standards or as per British Standards as manufactured by Jindal Steel

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2.4.3 Electrodes

All electrodes to be used under the Contract shall comply with the Indian Standard Specifications as may be applicable.

2.4.4 Bolts and Nuts

All bolts and nuts shall be of grade 5.6 HRH and shall conform to the requirements of IS 6639 and IS 1367. Spring washers or lock nuts shall be used with all bolts.

2.4.5 Paints

Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS: 2074 - Ready mixed Paint, Air Drying, Red Oxide - Zinc Chromate Priming.

2.5.0 Storage of Material

2.5.1 General

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately and replaced, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract should be stacked separately with easily identifiable marks.

2.5.2 Steel

The steel to be used in fabrication shall be stored in separate stacks off the ground sectionwise and lengthwise so that they can be easily inspected, at any time. If required by the Engineer, the materials may have to be stored under cover and suitably protected against weather.

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2.5.3 Electrodes

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

2.5.4 Bolts, Nuts and Washers

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length and quality. Before installation, oil shall be removed.

2.5.5 Paints

Paints shall be stored under cover in airtight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened. All safety precautions shall be observed in storage and handling of paints.

2.6.0 Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall cooperate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work :

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- a) Steel : Quality, manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used. Tests shall be carried out in client's laboratory
- b) Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, Washers material testing
- c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.
- d) Welders : Qualifying Tests
- e) Welding sets : Performance Tests
- f) Welds : Inspection, X-ray, dye penetration tests, weld size, ultrasonic tests, surface preparation.
- g) Fabrication : Cutting, drilling, grinding, dimensional checks, lack of fit
- h) Paints : Manufacturer's certificate, physical inspection reports, thickness of coating
- i) Galvanizing : Tests in accordance with IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot- Dip Zinc coatings on Structural Steel and other allied products.

2.7.0 Standard Dimensions, Forms and Weights

The dimensions, forms, weights and tolerances of all rolled shapes, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.

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2.8.0 Drawings

The Contractor shall verify all drawings supplied to him by actual layout, templates and jigs. Knock-out drawing, if required shall be prepared by the Contractor.

3.0.0 WORKMANSHIP

3.1.0 Fabrication

3.1.1 General

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS: 800 - Code of Practice for use of Structural Steel in General Building Construction and other relevant Indian Standards or equivalent.

3.1.2 Straightening Material

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification IS:1852 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600 °C.

3.1.3 Cutting

Cutting shall be effected by shearing, cropping or sawing. Use of a mechanically controlled gas cutting torch will be permitted for mild steel. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.

3.1.4 Planing of Edges

Planing or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the

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drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.1.5 Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end, but where, for practical reasons, greater clearance is necessary, suitably designed cleats shall be provided.

3.2.0 Bolted Construction

3.2.1 Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of H8 as specified in IS:919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thickness in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for bolts shall not be formed by gas cutting process.

3.2.2 Assembly

Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged

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to admit the bolts shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be so assembled that they are neither twisted nor otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Bolted construction shall be permitted only in case of field connections if called for on the drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if directed by the Engineer.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer, one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating.

3.3.0 Welded Construction

3.3.1 General

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS: 817.

3.3.2 Preparation of Material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch.

3.3.3 Assembling

Parts to be fillet welded shall be brought in as close contact as practicable and in no event shall be separated by more than 3 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3

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mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two (2) degrees.

The work shall be positioned for flat welding whenever practicable.

3.4.0 Shop Erection

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchangeability.

3.5.0 Shop Painting

3.5.1 General

Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted after cleaning as per relevant codes

3.5.2 Inaccessible Parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.5.3 Finished Surfaces

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

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3.5.4 Surfaces Adjacent to Field Welds

Unless otherwise provided for, surfaces within 50 mm of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.6.0 Galvanizing

Structural steelwork for switchyard or other structures as may be specified in the Contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS : 2629 - Recommended practice for Hot-Dip Galvanising of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

4.0.0. INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.1.0 Inspection

Unless specified otherwise, inspection to all work shall be made by the Engineer or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract.

4.2.0 Testing and Acceptance Criteria

4.2.1 General

The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost, unless otherwise specified in the Contract. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within three days after completion of the test.

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4.2.2 Steel

All steel supplied by the Contractor shall conform to the relevant Indian Standards. Except otherwise mentioned in the Contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 MT or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be borne by the Contractor.

All material shall be free from all imperfections, loose mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance.

4.2.3 Testing Criteria for Checking Lamination in Raw Steel Plates

All raw steel plate of thickness more than 20 mm supplied by the Contractor shall be checked against lamination before procurement & prior to commencement of fabrication work in the following ways as directed by the Engineer :

- a) Ultrasonic testing along the edge of specified points of the plates shall be carried out to delete lamination in the plates, if any.
- b) If the results of the tests in (a) are not satisfactory, the whole area of the plates shall be checked by ultrasonic testing at specified nodal points formed at equidistant grid locations. The spacing of the grids shall be determined from tests in (a) or as directed by the Engineer.

If the results of the above tests are not satisfactory, the plates shall not be taken up for fabrication work. Even after fabrication at shop, if the Engineer requires any ultrasonic testing to detect lamination of plates, the same shall be carried out by the Contractor. If the plates in the fabricated item is found to be laminated, the component will be rejected.

4.2.4 Welding

All electrodes shall be procured from reliable manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall only be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards and as supplemented in this specification. The cost of such test shall be borne by the Contractor. In cases of the test results showing deficiency, the Engineer shall have option to reject

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or instruct any remedial measures to be taken free of charge to the Owner.

4.2.5 Bolts, Nuts and Washers

All bolts, nuts and washers shall be procured from reputed manufacturer approved by the Engineer and shall conform to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor.

4.2.6 Shop Painting

All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.

4.2.7 Galvanizing

All galvanizing shall be uniform and of standard quality when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

4.3.0 Tolerance

The tolerances on the dimensions of individual rolled steel components shall be as specified in IS:1852 - specification for Rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) and thin walled construction (like box girders) shall be as specified in IS:7215 - Tolerances for Fabrication of Steel Structures.

4.4.0 Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this Specification, the same shall be liable to rejection. No structure or part of the structure, once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable.

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When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue a provisional certificate, only for the purpose of partial payment. Where the contract is for fabrication only, procedure as mentioned in the General Specification shall be followed.

4.5.0 Delivery of Materials

Where required, the Contractor shall mark, pack and ship fabricated material as per the direction of the Engineer.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

The Tenderer shall give a list of his major equipment, manpower, testing facilities that will be available for the work. If, the fabrication work is proposed to be carried out in his shop, details of the same shall also be furnished.

5.2.0 After Award

After award of the Contract the successful Tenderer is to submit the following:

- a) Monthly Progress Report as per requirement of this contract
- b) Results of any test as and when conducted and as required by the Engineer.
- c) Manufacturer's mill test report in respect of steel materials, bolts, nuts and electrodes as may be applicable.

6.0.0 RATES AND MEASUREMENTS

The rates shall be for complete items including all cost as per 2.1.0 of this specification and all incidental and related items. Where applicable, the rates shall also include erection of steelwork. Measurement shall be made as per IS: 1200 unless otherwise mentioned in the Contract.

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TECHNICAL SPECIFICATION NO. CS3/1
FOR
ERECTION OF STRUCTURAL STEELWORK

1.0.0 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:

- a) The Contractor shall provide all construction and transport equipment, tools, tackles, consumables, materials, labour and supervision required for the erection of the structural steelwork.
- b) Receiving, unloading, checking and moving to storage yard at Site as per the provisions of the contract if the fabrication is not done at site.
- c) Transportation of all fabricated structural steel materials from site storage yard/the Contractor's shop, handling, rigging, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials.
- d) Checking center lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets.
- e) Aligning, plumbing, leveling, bolting, welding and securely fixing the fabricated steel structures in accordance with the Drawings or as directed by the Engineer.
- f) Painting of the erected steel structures as required by the Contract.

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2.2.0 Work by Others

No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the Contract.

2.3.0 Codes and Standards

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice or equivalent:-

IS-800	:	Code of Practice for general construction in steel
IS-456	:	Code of Practice for plain or reinforced concrete
IS-7205	:	Safety Code for erection of Structural Steel work
IS-12843	:	Tolerance for erection of Steel Structures

2.4.0 Conformity with Designs

The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the design criteria detailed in the approved erection drawings and/or other stated document. All work shall conform to the provisions of the relevant Indian Standard Specifications and/or the instructions of the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specification and /or the instructions of the Engineer.

2.5.0 Material

2.5.1 General

All fabricated steel structures and connection materials shall be supplied by the Contractor. All field connection materials like bolts, nuts, washers & electrodes, consumables like oxygen and acetylene gas, paints, fuels, lubricants, oil, grease, cement, sand, aggregates and any other material that may be required for the execution of the works in accordance with the contract shall be supplied by the contractor for erection work and shall be deemed to have been included in these rates.

2.5.2 Materials to Conform to Indian Standards

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All materials required to be supplied by the Contractor under this Contract shall conform to the relevant Indian Standard Specifications.

2.6.0 Storage of Materials

2.6.1 General

All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the Engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the Contractor's dues.

2.6.2 Yard

The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other materials. The yard shall have proper facilities like, drainage, lighting, suitable access for large cranes, trailers and other heavy equipment.

The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved program of work.

2.6.3 Covered Store

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor.

2.7.0 Quality control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the following items of work :

- a) Erection : Lines, levels, grades, plumbs, joint characteristics

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- b) Grouting : Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency and strength of grout.
- c) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats, thickness of coats.
- d) Bolting : Tightening of bolts , provision of washers.
- e) Welding : Quality of welds

3.0.0 WORKMANSHIP

3.1.0 Erection

3.1.1 Plant and equipment

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.

3.1.2 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the Engineer. The Erection shall arrange for most economical method and sequence available to him consistent with the Drawings and Specifications and such information as may be furnished to him prior to the execution of the Contract.

3.1.3 Temporary bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, free of cost to the Owner, temporary guys and bracings where needed to secure the framing against loads such as wind comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

3.1.4 Temporary floors for buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or by-laws of state, Municipal or other local authorities.

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3.1.5 Setting out

Positioning and leveling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. For heavy columns, etc. the Contractor shall set proper screed bars as required.

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance allowable under this Specification.

No permanent field connections by bolting or welding shall be carried out until proper alignment and plumbing has been attained.

3.1.6 Field bolting

All relevant portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following :

Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into good contact with each other. "Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation

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specified in Table-1 with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

TABLE-1

Bolt length not exceeding 8Xdia. Or 200mm.	Bolt length exceeding 8Xdia. Or 200 mm.	Remarks
½ turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation -3 degrees over or under

Bolts tightened by the turn-of-nut method may have the outer face of the nut match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torque specified in TABLE - II. Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE – II

Nominal Bolt Diameter (mm)	Torque to be applied (Nm) for bolt class 8.8 of IS : 1367
20	599.4
22	816.3
24	1037.3

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The above torque values are approximate for providing tensions of 147 kN for 20 mm dia., 182 kN for 22 mm dia; and 212 kN for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular torque wrench.

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds.

Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause.

3.1.7 Field Welding

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints. The sequence of welding shall be such that no stress is induced on welds or members.

3.1.8 Holes, Cutting and Fitting

No cutting of sections, flanges, webs, cleats, bolts, welds etc. shall be done unless specifically approved and / or instructed by the Engineer. The erector shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The Contractor shall not be entitled for any payment on account of any such work..

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3.2.0 Drifting

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work, which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers, shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

3.3.0 Grouting of Stanchion Bases and Bearings of Beams and Girders on Concrete

The grouting shall be done with non-shrink high strength free flow cementitious grout (ready mixed) like "Sika grout - 214", or "Anchor NSG" or approved equivalent.

No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, leveled and plumbed and sufficient floor beams are tied in position.

The grouting operation shall not be carried out until the steelwork has been finally leveled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.

3.4.0 Painting after Erection

Field painting, if required to be done by the erection Contractor, shall only be done after the structure is erected, leveled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. However, touch up paintings, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the erection Contractor. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable for the project.

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Painting shall not be done in rainy or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field bolts, welds and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces which will be in contact after site assembling shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface, which will be inaccessible after field assembly, shall receive the full specified protective treatment before assembly. Bolts and fabricated steel members, which are galvanized or otherwise treated and steel members to be encased in concrete, shall not be painted.

The specification for paint and workmanship shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable to the project. The number of coats and the shades to be used shall be as specified or as directed by the Engineer.

3.5.0 Final Cleaning Up

Upon completion of erection and before final acceptance of the work by the Engineer, the Contractor shall remove free of cost all false work, rubbish and all temporary works resulting in connection with the performance of his work.

3.6.0 Safety Measures during Erection

The safety measures to workmen and supervisors during all types of erection work (e.g., use of lifting appliances, slinging, welding, gas cutting, etc.) should be taken as per IS : 7205. When any statutory provisions exist, the same shall be complied with in addition to the provisions contained in the above code.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 General

Loading tests shall be carried out on erected structures, if required by the Contract, to check adequacy of fabrication and/or erection.

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4.2.0 Tolerances

Some variation is to allowed in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steelwork applicable to this Project and as specified below:

Component	Description	Variation Allowed
Main columns	a) Shifting to column axis at foundation level with respect to building line I) In longitudinal direction II) In lateral direction	i) ± 3.0 mm ii) ± 3.0 mm
	b) Deviation of both major column axis from vertical between foundation and other member connection levels: i) For a column up to including 10M height ii) For a column greater than 10M but less than 40M height	i) ± 3.5 mm. From true vertical. ii) ± 3.5 mm. From true vertical for any 10M length measured between connections levels, but not more than ± 7.0 mm. Per 30M length.
	C) For adjacent pairs of columns across the width of the building prior to placing of truss.	± 9.0 mm. On true span
	d) For any individual column deviation of any bearing or resting level from level shown on drawings.	± 3.0 mm
	e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating level supposed to be at the same level.	± 3.0 mm
Trusses	a) Deviation at centre of span of upper chord member from vertical plane running through centre.	1/1500 of the span but not greater than 10mm of bottom chord.

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Component	Description	Variation Allowed
	b) Lateral displacement of top chord at centre of span from vertical plane running through centre of supports.	1/250mm of depth of truss or 20mm. Whichever is the least.
Crane Girders & Tracks	a) Difference in levels of crane rail measured between adjacent columns	2.0mm
	b) Deviation to crane rail gauge	± 3.0mm
	c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermit welding.	1.0mm.
	d) Deviation of crane rail axis from centre line of web.	± 3.5mm
Expansion Gaps	At the time of setting of the expansion gaps, due to regard shall be taken of the ambient temperature above or below 30 Deg Celsius. The coefficient of expansion or contraction shall be taken as 0.000012 per Deg.C per unit length.	

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

4.3.0 Acceptance

Structures and members which conform to all requirements specified in the applicable provisions of this Specification and are within the limits of tolerances specified in Sub-clause 4.2.0 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this Contract.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 Before Tender

Along with the Tenders the tenderer will be required to submit the following information:

5.1.1 Constructional Plant and Equipment

A detailed list of all Constructional Plant & Equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer, which he will be able to employ on the job to maintain the

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progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.1.2 Erection Yard

A site plan showing the layout and location of the erection yard proposed to be established by the Tenderer shall be attached with the Tender indicating the storage space for fabricated steel materials, site-fabrication shop, covered stores, offices, locations of erection equipment and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.

5.2.0 After award of the Contract

After award of the contract, the Contractor shall submit the following :

5.2.1 Detailed Program

The Contractor shall submit a detailed erection program within a month of the award of the Contract for completion of the work in time in accordance with the Contract. This will show the target program, with details of erection proposed to be carried out in each fortnight, details of major equipment required and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.

5.2.2 Fortnightly Progress Report

The Contractor shall submit fortnightly progress reports in triplicate to the Engineer details of actual achievements against the target program specified in Sub- clause 5.2.1 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.

6.0.0 RATES AND MEASUREMENTS

The rates shall be for complete item and shall include all cost as per 2.1.0 of this specification including cost of all related and incidental items. Measurements shall be made as per IS: 1200 unless mentioned otherwise in the tender document. The rates shall also include fabrication if required as per Schedule of Items.

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TECHNICAL SPECIFICATION NO. A-1

FOR

MASONRY & ALLIED WORKS

1.00.00 SCOPE

This specification covers furnishing, properties, storage & handling of common building materials unless otherwise mentioned in the specification, installation, repairing, finishing, curing, protection, maintenance and handing over of masonry and allied works for use in structures and locations covered under the scope of the Contract.

2.00.00 MATERIALS

a) Brick

Bricks for general masonry work shall be 5 N/mm² crushing strength quality, well burnt, of uniform size, shape and colour free from cracks, flaws or nodules of free lime and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, lumps holes etc. Compressive strength shall be 5 N/mm² minimum for common bricks. Water absorption after 24 hours immersion shall not exceed 20% by weight for common bricks. Dimensional tolerance shall not exceed 8% of the size shown in drawings for common bricks. All bricks shall have rectangular faces and sharp straight edges. The bricks shall show no efflorescence after soaking in water and drying in shade.

b) Cement

Cement used shall be Ordinary Portland Cement or Portland Slag Cement or Portland Pozzolana Cement conforming to IS Codes and shall be fresh when delivered. In special cases, Rapid Hardening Portland Cement, Low Heat Cement etc. may be permitted or directed to be used by the Engineer. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If the cement is procured by the Owner and issued to the Contractor, the Contractor shall satisfy himself at the time of taking delivery that the quality, quantity and freshness of cement are upto the specified standards. No complain later on regarding the cement supplied by the Owner shall be entertained and all rectification work on this account shall be done by the Contractor at his own expense. If at any time, the Engineer feels that the cement being used is not upto specification, he may stop the work and send the samples of the

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cement to a testing laboratory for standard tests and The Contractor shall have no claim for this type of suspension of work.

c) Coarse Aggregates

Coarse aggregates shall be as per IS:383 latest editions, consisting of hard, strong and durable pieces of crushed stone and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles etc. and any other material liable to affect the strength, durability or appearance of concrete.

Aggregates other than crushed stone conforming to the provision of specification may be used if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by the Engineer.

Grading of coarse aggregates shall generally conform to IS:383 and shall be such as to produce a dense concrete of the specified proportions and strength and of consistence that will work readily into position without segregation.

d) Sand

Sand shall be hard, durable, clean and free from adherent coatings or organic matter and shall not contain clay balls or pellet. The sand shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosion to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded. Unless otherwise directed by the Engineer, all sand shall pass through IS Sieve No. 240 and 15 to 35% of sand for masonry mortar and 5 to 50% of sand for plaster shall pass through IS Sieve No. 30. Sand for concrete shall conform to IS:383.

e) Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances, which may cause corrosion, discolouration, efflorescence etc.

3.00.00 INSTALLATION

3.01.00 Brick Edging

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

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.3.02.00 Masonry

3.02.01 General

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings. The concrete surface against which masonry work is to be laid shall be hacked and cleaned. Masonry work shall always be placed against saturated surface dry condition.

3.02.02 Mortar

Mix for mortar shall be specified in the Drawing.

For cement sand mortar, cement and sand in requisite proportions shall be mixed dry in a mechanical mixer and then water added and mixed further. Minimum quantity of water shall be added to achieve working consistency.

Surplus mortar droppings from masonry if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar that has stood for more than half an hour shall be used.

3.02.03 Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upward over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar. Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing. Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickwork of two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

3.02.04 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings and approved by the Engineer. Expansion joints shall be as shown on drawings and specified in the Schedule of Items. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

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Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

3.02.05 Mouldings, Cornices, Drip Course

These shall be made as shown on drawings. Bricks shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with carborandum stone.

3.02.06 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be kept wet by ponding.

3.02.07 Embedding of Fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

3.03.00 Damp Proof Course

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1:1-1/2:3 cement sand stone-chips (10 mm down) with admixture of a water proofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by ponding for seven days.

4.00.0 RATES AND MEASUREMENTS

The rates shall be for the complete item including all related and incidental expenses. Measurements shall be as per IS- 1200.

5.00.00 I.S. CODES

Some of the important relevant codes for this section are :

IS:1127 : Recommendations for dimensions and workmanship of natural building stones for masonry work.

IS:2212 : Code of Practice for Brickwork.

IS:2250 : Code of Practice for preparation and use of Masonry Mortar.

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TECHNICAL SPECIFICATION NO. A-2

FOR

FINISH TO MASONRY & CONCRETE

1.0.0 SCOPE

This Specification covers supply of all materials, labour, tools & tackles and furnishing, installation, repairing, finishing, curing, testing, protection, and maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimise damage by other work. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.0.0 INSTALLATION

2.1.0 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be brushed down with stiff wire brush to remove all loose dust from joints and thoroughly washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval or the Engineer shall be taken as to the acceptability of the base.

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2.2.0 Plastering

2.2.1 Mortar

Mortar for plastering shall be as specified in the drawings/schedule of Items and approved by the Engineer.

For sand cement plaster, sand and cement in the specified proportion shall be mixed dry on a watertight platform and minimum water added to achieve working consistency.

For lime gauged plaster, lime putty or hydrated lime and sand in the required proportion shall be mixed on a watertight platform with necessary addition of water and thoroughly ground in mortar mill. This mix shall then be transferred to a mechanical mixer to which the required quantity of cement is added and mixed for at least 3 minutes.

No plaster, which has stood for more than half an hour, shall be used. Plaster that shows tendency to become dry before this time shall have water added to it.

2.2.2 Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats - a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat, the overall thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster. All vertical edges of brick pillars, doorjambes etc. shall be chamfered or rounded off. All drips, grooves, mouldings and cornices shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

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2.2.3 Finish

Generally, the standard finish shall be used unless otherwise shown on approved drawing or directed by the Engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the Engineer regarding the texture, colour & finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough. Otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of minimum 2.2 kg per M² and rubbed smooth with a trowel to an uniform finished thickness of 3 mm only.

c) Coloured Plaster Finish

This shall be done in the same way as specified in Clause 2.2.2 but using coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the top coat only shall be made with coloured cement.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.2.2. While the mortar is still plastic small pebbles or crushed stone of size generally from 10 mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-Cast Finish

A wet plastic mix of 3 parts coloured cement, 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 mm as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) Scraped Finish

Ordinary plaster as described under Clause 2.2.2 after being leveled and allowed to stiffen for a few hours, shall be scraped with a steel straight

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edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) Textured Finish

Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2. Ornamental treatments in the form of horizontal or vertical rib texture; fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

2.2.4 Curing

All plastered surfaces after laying, shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried, before applying the next coat.

2.3.0 Pointing to Masonry

All joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finished with suitable tools to shape as shown on the drawings. Any surplus mortar shall be scraped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.4.0 Plaster with Metal Lath

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 BG thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two layers. The mortar for plastering shall consist of 1 part cement, 1/2 part lime and 4 parts sand by volume, or 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.2.1. The application, finish etc. shall be as specified under relevant clause above.

2.5.0 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained & aged and mixed

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with 1 part clean, washed, sieved fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and not more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punning shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.6.0 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. area and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.7.0 Stone Facing

Stone facing where specified shall be done as per design and detail drawings approved by the Engineer. The stone shall be as specified on drawings and/or schedule of items. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on approved drawings. They shall be fastened to wall with suitable noncorrodable anchorage as shown in the drawings. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanised (weight of zinc coating shall not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer. The completed surface shall be neat, of uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings and/or Schedule of Items.

3.0.0 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

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4.0.0 RATES AND MEASUREMENTS

The rates shall be for complete item and all incidental and related costs and cost of all items mentioned in 1.0.0 of this specification shall be included. Measurements shall be made as per IS- 1200 unless otherwise mentioned in the Tender Document.

5.0.0 I.S. CODES

Important relevant codes for this Section are

- a) IS : 1661 : Code of practice for cement and cement-lime plaster finish on walls & ceilings.
- b) IS : 4101 : Code of practice for external facings and veneers.

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TECHNICAL SPECIFICATION NO. A-3

FOR

METAL DOORS, WINDOWS, VENTILATORS

1.0.0 SCOPE

The work in general shall consist of supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. as shown on drawings with all materials complete. The scope of work shall also include the assembly and erection of all doors, windows, louvres, glazed partitions, etc. for which fabricated materials shall be supplied by the Owner from the store at site. Supplying and/or fixing of all door and window accessories and hardware is also included in the scope.

2.0.0 INSTALLATION

2.1.0 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified in drawing and schedules.

Steel sheets for frames, shutters, louvre blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS: 1948 & 1949 or as manufactured by Indian Aluminium Company Limited or approved equivalent. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified in "Schedule of Fixtures" and the best quality from approved manufacturers shall only be used. The Tenderer shall specifically state the particular manufacturer's materials he proposes to use. "Schedule of Fixtures" is for the purpose of stating the minimum requirement and improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closures shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated in schedule. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the closer replaced free of charge.

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Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance requirements and endurance test stated in IS: 3564 - Appendix A.

The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards the end for incorporation in the job.

The mastic for caulking shall be of best quality from a manufacturer approved by the Engineer. In general, the mastic for fixing of metal frames shall be as per IS: 1081 and/or as approved by the Engineer.

2.1.0 Fabrication

2.1.1 Steel Doors, Windows, Ventilators

a) Door Frames

Frames shall be fabricated from 16 g sheets. They shall be mortised, reinforced, drilled and tapped for hinges and lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitred corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be supplied. Frames shall be brought to site with floor ties/weather bars installed in place.

b) Double Plate Flush Door Shutters

Door shutters shall be 55 mm. thick, completely flush design and shall comprise of two outer sheets 1.5mm thick steel sheets rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centres. Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting-stile edges bevelled or rebated. Where shown on drawing, or called for in the schedule of items, the doors shall be sound- deadened by filling the inside voids with mineral wool or other suitable approved materials.

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Doors shall be mortised, reinforced, drilled and tapped in shop for hinges, locks and bolts. They shall also be reinforced for closers, push-plates and other surface hardwares where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown on drawing, provision shall be made for fixing glazing, vision panels, louvres etc. glazing moldings shall be of 16 G steel or extruded aluminium sections with profiles shown on drawing and suitable for fixing 6 mm glass. Louvres blades shall be V or Z shaped and made out of 16 G sheets.

c) Single Sheet Door Shutters

Single sheet doors shall be made from best quality 16 G mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other furniture. The frames shall be made from best quality 16 G mild steel sheets. Wherever required as shown on drawings, provisions for fixing glass panes, louvres etc. shall be made.

The manufacturing shall be done as specified in 2.2.1.b. "Double Plate Flush Door Shutters".

d) Fire resistant door.

Fire proof door shall conform to I.S.3614 (part I & II) and shall have fire rating as indicated in schedule of item and where TAC approval will be required fire door shall also conform to TAC regulations. Door shall be double or single leaf and shall of fully metal insulated box section frame and fully insulated shutter faced with steel sheet on both faces. Door shall be procured from manufacturer specialised in fire door manufacturing.

e) Door Threshold

Door threshold shall be provided as shown on drawing. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, Ventilators etc.

These shall conform in all respects to IS: 1038 and IS: 1361 latest editions and as shown on drawings. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, pivot arrangements for ventilators, etc. or as shown on drawings or called for in the Schedule of Items.

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All welds shall be dressed flush on all exposed and contact surfaces.

Where composite unit openings are shown on drawings, the individual window units shall be joined together with requisite transoms and mullions as shown on drawings. All windows shall be outside glazed, fixed with putty or metal glazing beads as shown on the drawings and/or specified under Schedule of Items. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Indal Section No. 2209) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.

2.1.2 Aluminium Door, Windows and Frames

Extruded sections shall have a minimum 3 mm wall thickness unless otherwise approved in samples by the Engineer. All sections shall be approved by the Engineer before fabrication is taken up. Doors, frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating of minimum 0.6 mm thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent coating shall be applied to the sections before shipment from the factory. Unless otherwise specified all aluminium doors and windows shall be anodised with 20 micron thick

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce an uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing or as specified in schedule of items. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.2.0 Shop Coat of Paint

The shop paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. which will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

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Where called for in the Schedule of Items, all steel doors, windows, etc. shall be hot dip galvanised to give a coating weight of 500-600 gms. per m². One coat zinc chromate primer coat shall then be applied as shop paint. Portions of aluminium frame which come in contact with masonry construction, shall, before shipment from workshop, be protected with a heavy coat of alkali paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.3.0 Handling & Storage of Fabricated Material

All metal doors, windows, etc. shall be packed and crated properly before despatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are upto the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer. All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.4.0 Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvres, etc. shall conform to IS:1081 and as shown on drawings. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvres, etc. including transoms and mullions for composite units in respective places as shown on drawing, keeping proper lines and levels, and in approved workmanlike manner, to give trouble free and leak-proof installations. The installation shall be done according to the instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take every precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good with the same quality of paint used. All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the mastic cement in original sealed containers of manufacturer and shall apply it as per the instructions. For all frames supplied by either the Owner or the Contractor, mastic shall be supplied by

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the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one metre from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

2.5.0 Glazing

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvres, miscellaneous glazing and partitions, unless otherwise stated from approved manufacturer having uniform refractive index and free from flaws, specks and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site. Glass shall meet the specification below as mentioned in Drawing/ Schedule of Items.

- a) Glare reducing or heat absorbing glass shall be of approved manufacturer and special care shall be taken to grind smooth and round off the edges before fixing.
- b) Glass shall be float glass of required thickness and shall be clear or tinted as indicated in schedule of item.
- c) Wired glass shall be thick rolled glass with centrally embedded 42g wire mesh of Georgian type. This may be of clear or coloured glass, as shown on drawings or schedules.
- d) Obscure glass shall have a cast surface in one side.
- e) Coloured and figured glass shall be as per approved sample.
- f) In general, the putty shall conform to IS : 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing. Quick setting putty glass is used where it shall be non-setting type.
- g) EPDM gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.

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All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes where six or more clips shall be used as per Engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by the Contractor.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where moulding or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where glass will be supplied by Owner, the Contractor shall cut it to size and fix them in the same as specified above.

Necessary glazing clips, putty, mastic cement etc. shall be supplied by the Contractor. The Contractor shall be responsible for damage of glass supplied by the Owner, during handling, transportation, fixing etc. Maximum wastage allowance shall be 5%.

After completion of glazing work, the Contractor shall remove all dirt stains, excess putty etc. clean the glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the Contractor's own cost.

3.0.0 ACCEPTANCE CRITERIA

3.1.0 Fabricated Items

- a) Overall dimensions shall be within +1.5 mm of the size shown on drawings.
- b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.
- c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 1.5 mm.

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- d) Door leaves shall be undercut where shown on drawings.
- e) Doors, windows, frames, etc. shall be on true planes, free from warp/buckle.
- f) All welds shall be dressed flush on exposed and contact surfaces.
- g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures.
- h) Provision for hardware and fixtures to be installed at site.
- i) Glazing beads shall be cut with mitred corners.
- j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.
- k) Shop coats shall be properly applied.
- l) Exposed aluminium surfaces shall be free from scratches, stains and discolouration. Anodised surfaces shall present a uniform and pleasing look.

3.2.0 Installed Items

- a) Installations shall be at correct location, elevation and in general, on a true vertical plane.
- b) Fixing details shall be strictly as shown on drawings.
- c) Assembly of composite units shall be strictly as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete.
- d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.
- e) All openable section shall operate smoothly without jamming.
- f) Locks, fasteners etc. shall engage positively. Keys shall be non-interchangeable.
- g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.
- h) Aluminium doors, windows, etc. shall be free from scratches stain or discolouration.

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3.3.0 Glazing

- a) All installation shall be free from cracked, broken or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked or underground edges.
- b) Glazing shall be carefully done to avoid direct contact with metal frames.
- c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak proof installation.
- d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

4.0.0 RATES

Rates shall be unit rates for items described in "Schedule of Items".

5.0.0 METHOD OF MEASUREMENT

- a) Supply and installation including painting of doors shall be measured in m². The types shall be as per drawings and described in Schedule of Items.
- b) Supply & installation including painting of windows shall be measured in m².
- c) Supply and installation including painting of louvres shall be measured for area of opening in which the louvre is to be installed.
- d) Supply of mullions and transoms shall not be measured and to be included in the rates for doors/windows..
- e) Vision panels, louvres to doors and insulation between door faces shall be measured for actual area and paid separately over the basic rate doors unless mentioned otherwise.
- f) Glazing beads, weather stripping, fixing devices etc. shall not be measured separately but shall be included in the supply rate of respective items.

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- g) Curing of grouting to concrete and masonry or welding and drilling to steel required for installation shall be included in the installation rate. No separate payment shall be made for caulking and jamming of frames or making good to concrete or masonry.
- h) Glass and glazing shall be measured in m² and paid under relevant items.
- i) Door and window fixtures, locks, door closers etc. shall be measured in actual numbers use unless mentioned otherwise in the schedule of items.

6.0.0 I.S. CODES

Following are some of the important I.S. Codes as relevant to this specification:

- IS: 1038 - Steel doors, windows and ventilators
- IS: 1083 - Code of practice for fixing and glazing metal doors, windows & ventilators.
- IS: 1361 - Steel windows for industrial buildings
- IS: 1948 - Aluminium doors windows and ventilators
- IS: 1949 - Aluminium windows for industrial buildings
- IS: 4351 - Steel door frames
- IS: 1081 - Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators
- IS: 3548 - Code of practice for glazing in building.

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33KV RING MAIN SYSTEM INCLUDING 33/0.433KV SUBSTATIONS IN NIT, ROURKELA CAMPUS.

SECTION-VI : TECHNICAL SPECIFICATION AND SCOPE OF WORK

PART-I : DATA ACQUISITION SYSTEM (DAS)

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DATA ACQUISITION SYSTEM SPECIFICATION

1.00.00 INTENT OF SPECIFICATION

- 1.00.01 This specification is intended to cover the Supply, Install, Testing, Connect and Commission Data Acquisition System (DAS) comprising Remote Terminal Unit (RTU) GSM and GPRS Modems devices for electrical substations at NIT Rourkella, Orissa and subsequent interfacing the proposed DAS System to the existing NIT Server. The system under this tender shall be complete with all materials and accessories for efficient and trouble-free operation in NIT, Rourkella.
- 1.00.02 All the equipment specifications given in this Tender are minimum required specifications and bidders should supply the equipments that meet the data collection needs.
- 1.00.03 The bidder shall supply and install all the modems/ AMR devices with data-call enabled SIM cards of service providers for local area. The bidder shall provide NIT Rourkella a list of all SIM card numbers along with service provider's name for each of the install points. This should be submitted along with modem commissioning report. The bidder should also maintain a complete comprehensive list at all times during the contract period.
- 1.00.04 Usage of GPRS for all types of end-points is preferred subject to confirmation by service provide for that specific area. This confirmation should be taken by the bidder from the service provider. Bidder should decide most cost effective connection plan and quote the prices accordingly. The feasibility for the type of connection available at site shall be done by the bidder in coordination with the service provider
- 1.00.05 All the GSM/ GPRS connections shall be procured in the name of NIT Rourkella and the billing and payment for all recurring charges shall be done directly between the service provider and the NIT Rourkella.
- 1.00.06 After successful, commissioning of any DAS System, during the Warrantee and AMC period of this contract, if a data reading failure is encountered on account of remote end-point works performed by the bidder, non-availability of GSM or GPRS connection, the bidder shall, at its own cost, arrange to read the data using suitable alternative method.
- 1.00.07 The Bidder shall be responsible for the technical soundness of the equipment and service(s) rendered by them. In the event of any deficiency in installation, performance etc., the Bidder shall modify the same at no extra cost to Owner within such time as may be reasonably necessary for the purpose.

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- 1.00.08 Any additional equipment, material, services which are not specifically mentioned here, but are required to make the system complete in every respect in accordance with the intent and technical specification and for safe operation and guaranteed performance, shall be deemed to be covered under the scope of this specification
- 1.00.09 The Bidder shall have to interact with other agencies regarding successful execution of the project. All assistances to the Bidder in this regard shall be provided.

2.00.00 SCOPE OF WORK

2.01.00 SCOPE OF SUPPLY

- 2.01.01 The equipment and materials shall include but not be limited to one lot of DAS for AMR System comprising:

DATA ACQUISITION SYSTEM (DAS)

- a) DAS Server system in Hot Stand By mode with all monitor, keyboard, mouse, cables and accessories.
- b) Metering Data Server System in Hot Stand By mode with all monitor, keyboard, mouse, cables and accessories.
- c) Engineering Work Station/Operator Work Station with mouse, keyboard and 19" Monitor, complete with all accessories.
- d) Managed Ethernet Switch.
- e) A3 Size Laser Jet Printer with connecting cable and other accessories
- f) DAS Software for data collection from meters connected locally or that are located in remote locations, through modem communication and local retrieval and access from the existing Server etc, as per the tender requirement
- g) Base Computer Software for collection of metering data viz. voltage, frequency, current, PF, watt, watt hour, var, volt ampere, var hour, volt ampere hour, THD, maximum demand.
- h) Remote Terminal Unit (RTU) complete with DI, DO, AI, AO modules and communication ports viz. RS485, RS232 and complete with all necessary software for configuration and reporting facility at the Server, as per the tender requirement
- i) GSM/GPRS modem with optical cord, RS232 serial cable, Antenna and RF Coaxial cable.

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- j) Uninterrupted Power Supply with two hours back up for server and each RTU
- k) Firewall system between DAS Server and existing NIT Server
- l) Portable Configuration and Maintenance Tool for RTU
- m) Shielded 2 core twisted pair cable for connecting the MFM/TVM to Modem
- n) Earthing of the Proposed System (main Server, all modems and associated equipment) as per manufacturer standard along with all cables and other necessary items.
- o) Guarantee for spares supply for a period of at least 5 years items and providing any software up gradation free of cost in future to be provided. Bidder shall submit written compliance from OEM in this regard.
- p) Supply of required commissioning spare to complete the system in all respect shall be in the scope of the Bidder. A list of the commissioning spares shall be furnished.
- q) Required hard ware and soft ware to complete the system in all respects
- r) The items not mentioned but required for successful completion of the project including modification, addition in existing system shall be in the scope of the Bidder.
- s) All relevant drawings, data and instruction manual. Bidder shall as a mandatory measure, furnish documents and datasheets for the systems and equipment, quoted in the offer.

2.02.00 SCOPE OF SERVICE

2.02.01 Installation ,Testing and Commissioning of the overall DAS System viz. RTU, GPRS/GSM Modem, DAS Server, UPS etc and interfacing with NIT Rourkella Server and access by web client to DAS System. All technical inputs and supports to the DAS Vendor shall be provided and arranged by the NIT Rourkella.

2.02.02 The termination of cables and its testing as required in the aforesaid areas shall be under scope of this Package. Necessary interfacing with other agencies viz. Manufacturers of relays etc, NIT Rourkella, Service Providers as described in other parts of this Tender and attached documents and deemed necessary later shall be undertaken by the Bidder.

2.02.03 Installation, Testing and Commissioning of the DAS Software and interfacing with the existing NIT shall also be under the scope of this

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package. Further, Contractor shall supply and install the necessary interconnecting cables, conduits and other accessories as required.

- 2.02.04 Bidder will, during the time of detail engineering and installation of the quoted system, interact and coordinate with any other agency regarding collection/retrieval of inputs/information/data and all such works shall be under the scope of this Vendor. If necessary, the Bidder shall contact the Owner before submission of their quotation.
- 2.02.05 Training to be provided to Owner's personnel for maintenance.
- 2.02.06 Three (3) years Post Warranty Annual Comprehensive Maintenance service for maintenance of the DAS System shall be provided by the Bidder as per terms and conditions , which the exact terms and conditions shall be worked out in detail afterwards with the successful Bidder.
- 2.02.07 Bidder has to provide the services required for completeness of the system irrespective of whether it is mentioned in the specification or not.
- 2.03.00 **EXCLUSION FROM SCOPE OF WORK**
 - a) Major civil, structural and masonry works.
 - b) Illumination
 - c) Furniture
 - d) Raw LT AC power

3.00.00 GENERAL REQUIREMENTS

3.01.00 GUARANTEED PERFORMANCE

- 3.01.01 The Systems / Equipment to be supplied under this specification shall meet the guaranteed performance specified in the enclosed data sheet, specification sheet and technical attachment sheet when operating at the rated / specified conditions. The acceptance of the System / Equipment shall be subject to satisfying these parameters during shop test at Contractor's works and / or at site installation in complete assembled condition.
- 3.01.02 Performance figures quoted by Bidder shall be guaranteed for a period of three (3) years from the date of handing over the Telephone System to the Owner within the tolerance permitted by relevant standards. In case the Bidder fails to achieve the Performance Guarantee parameters during the PG Test at site, Bidder shall make necessary modifications or replace the plant / any part / system within reasonable time to be decided by the owner. If even after the rectification the DAS system is not able to achieve the guarantee parameters, the Owner shall have the right to reject the DAS System. In such case, the Bidder shall pay back the total amount paid to

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him against this contract / order with all taxes and duties as applicable to the owner.

3.02.00 DEVIATION

3.02.01 Should the Bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation.

3.02.02 All such deviations shall be clearly mentioned on the Deviation sheet enclosed, with reference to the respective clause of the specification.

3.02.03 Unless such deviations are recorded in the Deviation sheets and submitted with the offer, it shall be taken for granted that the offer is made in conformity with this specification in all respects.

4.00.00 DESIGN CRITERIA

4.01.00 DESIGN CRITERIA

4.01.01 The objective of the DAS is to collect the data from the Substations and store it to the Master Control Server at the controller location which shall be located at the Administrative building. The data shall be stored in the Server which shall be interfaced with the existing Server of NIT Rourkella. The interfacing between DAS Server and the existing System Server shall allow the specified user group in the existing system to access the given set of data of the DAS System. The access shall also be web enabled wherein the permitted user group shall monitor the data of the DAS from Internet web terminals.

4.01.02 The Data Acquisition System (DAS) shall be suitable for monitoring of the complete substation and shall have the capability for modular expansion and augmentation including future extensions.

4.01.03 The systems shall comprise the latest range of product and suitable for operation under high ambient electromagnetic noise electrical environment present in High Voltage substations, follow the latest engineering practice, ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff.

4.01.04 Maintenance, modification or extension of components and alteration of parameters may not require shutdown of the whole DAS system. Self-monitoring of components, modules and communication system shall be incorporated to increase the availability and the reliability of the equipment and minimize routine maintenance.

4.01.05 The main equipment shall be designed and shall demonstrate the following features:

? Robustness and reliability in a hot, humid, coastal marine environment

? Maintainability

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The design shall be based upon standard equipment that is already proven in the Electrical Substation.

5.00.00 SYSTEM ARCHITECTURE

5.01.00 The DAS shall be based on a functionally decentralized architecture and on a concept of bay-oriented, distributed intelligence operational system. There shall be nine (9) Substations in the campus and the grouping of RTU and Substation shall be done in the following manner.

Sub Station-1 (SS1)		RTU-1
Sub Station-2 (SS2)		RTU-2
Administration Building		RTU-3
Sub Station-4 (SS4)		RTU-4
Sub Station-5 (SS5)		RTU-5
Sub Station-6&9 (SS6)		RTU-6
Sub Station-7 (SS7)		RTU-7
Sub Station-8 (SS8)		RTU-8
Sub Station-10 (SS10)		RTU-9
MRSS		RTU-10

5.02.00 At Sub Station level, the Multi Function Meter shall provide all functions regarding metering, monitoring and inputs for status indication. The inputs

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of Breakers shall be taken directly which will have binary inputs. The binary inputs shall be used to update the events of all breakers. The indication of Breakers shall be taken through hard wiring from the Breaker Panels and through RTU, it shall update the status of Circuit Breakers.

- 5.03.00 The objective of the DAS is to collect the data from the Substations and store it to the Master Control Server at Administration Building location. The data shall be stored in the Server which shall be interfaced with the existing NIT Server. The interfacing between DAS Server and the existing System Server shall allow the specified user group in the existing system to access the given set of data of the DAS System. The access shall also be web enabled wherein the permitted user group shall monitor the data of the DAS from Internet web terminals.
- 5.04.00 All the Feeder meters installed in the sub station will be having RS 485 ports to loop these Meters through Rs485 ports, using 2 core-shielded cables. The MFMs shall be connected through daisy chain link through RS485 ports over Modbus protocol and finally connected to their Station RTU.
- 5.05.00 The RTU at Administration Building shall be configured as Master RTU (RTU-3). It shall acquire all data sent by RTU at other Sub Stations. The Master RTU shall have its own HMI which shall be used for monitoring the data of all Sub Stations and diagnostic checking and software configuration of the RTU and its parameters. The Server and the RTU shall be connected to a LAN network through an Ethernet switch which shall also be connected to the Router /Gateway so that NIT Server and other web based client can access DAS System.
- 5.06.00 The RTU at each Sub station shall be connected to the GPRS/GSM Modem (complete with antenna). The GPRS/GSM Modem shall be connected to the DAS Server through GSM network, in operation over the area. DAS Software shall collect all data from the substation RTU and store the same in the Server for subsequent retrieval, as defined in the other part of the document.
- 5.07.00 The communication between RTUs at Substation and Master at Administration Building shall take place over IEC 60870-5-104. The communication protocol and the interfacing between DAS Server and NIT Server shall be based on industry standard open protocol viz. MODBUS, OPC
- 5.08.00 The Input/Output details of RTU at each Sub Station are contained in the Annexure-A,. The SLD showing protection and metering scheme of sub stations are also attached for reference. The overall system architecture of the DAS System is enclosed herewith for necessary study. The Plot Plan of the plant is also enclosed herewith for a general idea about the topography amongst the Sub Stations.

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6.00.00 TECHNICAL SPECIFICATION

6.01.00 REMOTE TERMINAL UNIT

- 6.01.01 The Remote Terminal Unit (RTU) shall be installed at Substations to acquire data from Multifunction Meters (MFMs),. and device status signals The RTUs shall be interfaced with the GSM/GPRS Modem equipment, power supply distribution boards; for which all the interface cables, TBs, wires, lugs, glands etc. shall be supplied, installed & terminated by the Contractor.
- 6.01.02 RTU shall monitor the Substation. This monitoring shall be possible in the RTU by providing a hardwired connection to Breakers and through data collection from MFMs and TVM.
- 6.01.03 This data is then transferred to the higher-level i.e. Master DAS Server at Sub Station07. The control system will act on this data and monitor the data on the EWS/OWS HMI.
- 6.01.04 The RTU shall have requisite number of I/O boards /modules to interface with the direct I/Os from the breakers. The RTU shall also collect data fro MFM and TVM through RS485 interface. which shall be looped in “Daisy Chain” mode. The reading of the meters shall be in MODBUS protocol.
- 6.01.05 All functional capability described herein shall be provided by the contractor even if a function is not initially implemented. As a minimum, the RTU shall be capable of performing the following functions:
- (a) Acquiring analog values from CT/PT circuits & OLTC using suitable multifunction & OLTC transducers and the status inputs of devices from the substation, processing and transmitting to Master stations.
 - (b) Supporting data transmission rates
 - (c) Use of IEC 60870-5-104 protocol to communicate with the Master station(s)
 - (d) Use of MODBUS Protocol over RS485 interface to communicate with the MFM in Multi-Drop mode.
 - (f) Have required number of communication ports for simultaneous communication with Master station(s),MFM and RTU configuration & maintenance tool.
 - (g) RTU shall have the capability of automatic start-up and initialization following restoration of power after an outage without need of manual intervention. All restarts shall be reported to the connected master stations.

Further it should be possible to have following capabilities in the RTU by way of addition of required hardware at later date:

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(i) Capable of acting as data concentrator.

(j) RTU shall be capable of acquiring analog having output as 4-20 mA, 0-10 mA, 0-+10 mA using analog input modules.

6.01.06 The RTUs shall have following communication ports to communicate with master station, Multi Function Meters and Tri Vector Meter.

- TCP/IP Ethernet port
- RS485 port
- RS232 port

It shall be possible to increase the number of communication ports in the RTU by addition of cards, if required in future.

6.01.07 Analog Inputs

The real time values like Active power, Reactive Power, Current, Voltage and frequency, power factor will be acquired periodically (initially set to 2 seconds x number of MFMs in a group) by RTU from MFMs. However, the kWh and kVARh readings will be acquired at a rate configurable from 5 to 60 minutes in a step of 5

minutes with initial setting as 15 minutes. The RTU shall also support acquisition of stored energy values of 15 min./1 hour blocks of the day from MFMs.

6.01.08 Status Input RTU shall be capable of accepting isolated dry (potential free)

contact status inputs. The RTU shall provide necessary sensing voltage, current, optical isolation and de-bounce filtering independently for each status input. The sensing voltage shall not exceed 48 V DC. All status inputs shall be scanned by the RTU from the field at 1 Millisecond periodicity.

6.01.09 Diagnostic Software shall be provided to continuously monitor operation of the RTU and report RTU hardware errors to the connected master stations. The software shall check for memory, processor, and input/output ports errors and failures of other functional areas defined in the specification of the The internal RTU time base shall have a stability of 100 ppm. The RTU shall be synchronized through synchronization message from master station at every 5 minutes (configurable from 5 minutes to 60 minutes) over IEC 60870-5-104.

6.01.10 The RTU shall be operable from 230Volt, 50 Hz , AC and have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the RTU internal logic from being damaged and becoming unstable causing mal-operation.

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6.01.11 TECHNICAL PARTICULARS OF RTU

Sl no.	Item Description	Value	Remarks
1.	Data transmission rate	300 to 9600 bps for Serial ports for MODBUS	Configurable
2.	Communication ports	RS232,RS485,RJ45 Ethernet	
3.	Communication protocol with Master station	IEC 60870-5-104	GSM/GPRS Modem Interface
4.	Communication protocol with MFM	MODBUS	
5.	Analog/Status data transfer to Master station	By exception	Shall support periodic polling & on demand
6.	Analog Input Channel	4	
7.	Digital Input	8	
8.	Digital Output	4	
9.	Real Time Clock stability	10ppm	R
10.	Temperature	-20 Deg C to +70 Deg C	

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6.01.12 SCADA FUNCTION

The following SCADA functions are envisaged under this specification.

- a) Data Acquisition from RTUs
- c) Data exchange
- d) Data Processing
- e) Real-time data storage and playback
- f) Sequence of event processing

All input data and parameters collected automatically, shall be checked for reasonability and rejected if they are unreasonable.

6.02.00 GSM/GPRS MODEM

- 6.02.01 GSM modem shall be of standard GSM 900/1800/1900MHz having auto bauding facility and complaint with ETSI (European Telecommunications Standards Institute). GSM Phase 2+ standard shall be operated at Class 4 (2W) @ 900 MHz and Class 1(1W) @ 1800/1900MHz with suitable memory of minimum 4 GB and further having facility of error correction 40 characters command buffer, Non-Transparent data transmission at 1200/2400/4800/9600 bps and auto dial feature.
- 6.02.02 The modem shall support Short Messaging Service Feature, Point to Point transmission and Cell Broadcast features, GSM data feature – CSD Asynchronous non transparent up to 9.6kbps and HSCSD(High speed circuit switched data) (2+1) up to 28.8kbps, serial binary and asynchronous data format for data transfer
- 6.02.03 The data enabled SIM cards will be provided by NIT Rourkella. However, all necessary coordination and arrangement for issuance of the cards b y the Service Provider shall be undertaken by Bidder at their own responsibility.
- 6.02.04 A SMA (Sub Miniature version -A for connectors and coaxial RF connectors) interface shall be provided on the GSM modem to which either a fixed removable or wired Dual Band Antenna with gain of 5.5 dB can be connected.

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6.02.05

General Constructional Requirements

- a) **Modem Enclosure:-**The modem should be made of tough grade ABS/Metallic casing which should be compliant to degree of protection IP 50 as per IS12063 or IEC 529. Enclosure that should be able to withstand shock and vibration should not break upon falling. It should be able to shield the internal power as well as communication circuitry from any external electromagnetic radiation. The outer body of the Modem should be corrosion resistant and should withstand any effect of chemical solvents like acids corrosive alkalies etc. The body should also be EMI/EMC compliant as per IS for meter i.e. IS 13779 and its latest amendments and CBIP 88. The body should result in attenuation of only about 1 to 2 dB of GSM signal VGFVVI. The modem shall be made of fire retardant material and also should be shock proof.
- b) **SIM Card Holder:-**The SIM card holder should be provided inside the modem and modem should be seal able from the outer body. The SIM card should easily slide into the SIM card holder or could be inside the GSM modem with easy access for replacement. Any arrangement in which the SIM card holder is inside the modem body or any other constructional arrangement in which for replacement of SIM card the body of the modem needs to be opened should be supported with easiness of access for replacement of SIM card.
- c) **Antenna:-**The Antenna provided should be High gain type of 5.5 dB. The Antenna should be able to function in weak signal areas where signal strength is week, etc. The mechanical strength of antenna should be high and it should function independent of heat, radiation, or any other higher frequencies in the area.
- d) **LED:-** As an added feature modem can have LED for Tx/Rx and power.

6.02.06

General Technical requirements

- a) The modem shall operate on GSM operating band. It should support EGSM/900/1800/1900 MHz and should be operational in GSM Band made available in future and comprising 384 KB EEPROM and further 4 MB Non volatile memory for additional data storage, EIARS 232-C data interface.
- b) The modem shall be Data/ GPRS/GSM compliant.

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- c) Interface offered shall have RS 232 port with a D type 9 pin connector or RJ 11 connector.
- d) GSM engine should not get affected under heat, electromagnetic fields, electrostatic fields, magnetic fields, electromagnetic induction etc. The GSM engine should be of Wavecom, Siemens, Sony Ericsson, Nokia, Simcom and Motorola. If any other make of GSM engine is being used then it should get prior approval from NIT Rourkella.
- e) It should be able to get remote controlled through AT commands.
- f) Modem should have a Real time Clock (RTC) as an integral part and should be demonstrated if demanded.
- g) Modem shall follow open software platform.
- h) Protocols for communication with Server ETSI GSM Phase 2+, GPRS Enabled, DOTA 3 Enabled.
- i) The Baud rate for data transfer shall be at 9600 kbps programmable. The modem should be flexi speed in nature that means they should be able to operate at different baud rate without any hindrance in their communication properties.
- j) The modem shall configure at any baud rate up to a maximum of 9600 baud rate through the terminals of desktop/laptop using Windows Operating System. No proprietary software should be used for configuration of modem at the desired baud rate.
- k) For determining the health of device an LED shall be provided on the modem, which shall depict the current functioning status (registered /unregistered/communicating)
- l) The GSM modem shall meet the following EMI/EMC specification:
 - Electrostatic Discharge :IEC61000-4-2
 - Fast Transient Burst :IEC61000-4-4 19
 - Surges Immunity, under Line to Earth and Line to Line Coupling: IEC61000-4-5
 - Conducted Emission: IEC61000-3-2/CISPER22
 - Radiated Emission :CISPR22
 - Radiated Immunity IEC61000-4-3
- m) The modem should have outbound dialing facility to a particular GSM number (server) at specified time (daily/weekly/monthly, etc) for the purpose of meter data. This configuration of the modem shall be made available to the user through the vendor provided software.

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If modem could not establish connection to modem placed at central station at specified time then it shall retry the same as configured

n) The Intelligent modem shall have sufficient memory up to 256 KB + 32KB to store resident software and separate memory up to 4MB Flash for data storage. The modem memory shall be non-volatile so that the registered parameters and stored data are not affected by loss of power. The non-volatile memory shall have a minimum retention time of 10 years.

o) Data Features:

- Modem should use standard AT Command set (GSM 07.05 ,GSM07.07) for settings of the modem
- Full GSM or GSM/GPRS software stack
- Data circuit asynchronous, transparent and non transparent
- Max. Baud Rate : for GSM Operation – 9600 bits/sec for GPRS operation -14400 bits/sec

GPRS packet data features:

- GPRS Class2 or class 10 support of PBCCH/PCCCH Coding Schemes: CS1 to CS4

p) GPRS Class 10 with Coding Schemes: CS1 to CS4

q) Power : Maximum Power Output should be 2 W at 900 MHz and 1W at 1800 MHz & The RF functionalities should The RF functionalities should comply with the phase II EGSM 900/GSM 1800 recommendation. VA Burden of the Modem should not exceed 3.5 VA during data communication.

r) The GPRS module in the modem shall have a real time clock and calendar with a battery backup totally independent of power supply. The meter time or GPRS time shall be synchronized in both the modem and central server to take care of RTC drift variations.

p) Modem should be capable of continuous working for 24 hours every day under field conditions, even when enclosed in Metering Cubicles at Consumer Sites

q) Environmental Specifications:The Modem shall meet the following environmental specifications :-

Temperature :- -10 degrees to +55 degree celcius

Humidity :- 95% RH(Non – Condensing)

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6.03.00 Specification For Switch (At Control Room, Administration Building)

6.03.01 The Ethernet switch shall be an industrially hardened, fully managed Ethernet switch providing six ports of Gigabit Ethernet. An additional two gigabit fiber or copper can be added. An operating temperature range of -10°C to +60°C shall be applicable for the device. The embedded Operating System with self healing and process restart shall provide advanced networking features such as Enhanced Rapid Spanning Tree (eRSTPTM), Port Rate Limiting and a full array of intelligent functionality for high network availability and manageability and advanced layer 2 and layer 3 networking functions, and advanced cyber security features.

6.03.02 Ethernet Ports

- _.6 - 10/100/1000BaseTX Triple Speed Copper Ports Standard
- _.Optional 2 additional 1000LX SFP Pluggable Gigabit Fiber
- _.2 - 10/100/1000BaseTX copper ports

6.03.03 Cyber Security Features

- _.Multi-level user passwords
- _.SSH/SSL encryption
- _.Enable/disable ports, MAC based port security
- _.Port based network access control (802.1x)
- _.VLAN (802.1Q) to segregate and secure network traffic
- _.RADIUS centralized password management
- _.SNMPv3 encrypted authentication and access security

6.04.00 SERVER/WEBSERVER

Sl no.	Item Description	Specification
1.	Make Manufacture	by ISO 9000 and 14000 manufacturing unit HP/COMPAQ/IBM ONLY
2.	Processor	Intel Xeon 3.0 GHz or higher

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Sl no.	Item Description	Specification
3.	MB L2 Cache memory, Front Side Bus	800 Mhz
4.	Rack Mountable	Rack Mountable Server with rack (19" x 42 U Rack)
5.	No. of Processors	Dual Core / Core 2 Duo Processor
6.	Memory	2 GB DDR RAM/ Scalable to 8 GB max ECC DDR RAM memory (200 MHz)
7.	Error Correction	Multibit Error Correction capability using ind std ECC DIMM
8.	Bays Available 8 bays	six hot swap disk bays, (1) diskette, (1) CDROM
9.	HDD	HDD 4 * 73 GBGB (hot plug) Ultra 160 SCSI disks, 10 K RPM
10.	Controller	Controller Dual Channel Ultra 320 SCSI Controller
11.	Raid controller	Raid Dual Channel Ultra 320 Raid controller with 128 MB battery backed ECC cache
12.	Networking	2 x 10/100/1000 MBPS Ethernet controller
13.	Ports	Two USB ports and 1 serial
14.	System Management	Dedicated Service Processor with LAN connectivity to provide for remote console and

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Sl no.	Item Description	Specification
		management / diagnostics independent of the hardware and OS
15.	DVD Writer	48 x speed or better EIDE CD ROM
16.	Floppy drive	1.44 MB 3.5"
17.	Fans System	fans for cooling for power supply and processor
18.	Power supply	Redundant Hot pluggable power supply
19.	Software	Software Installation and configuration utilities, System Administration Software. Web based server management software for monitoring system health, environment, alert notification, critical event action
20.	Operating System	Win 2003 Enterprise Edition, with media and manual, Antivirus for Win 2003 Enterprise Edition Antivirus should provide comprehensive Virus protection for Windows based network. It must provide Virus protection at the Gateway for all inbound and Outbound HTTP, SMTP, & FTP Traffic across the network (with Firewall for Web Server). It should Detect and remove viruses hidden in email attachments, prevent it from spreading through Microsoft Exchange Environment, Lotus Notes. Efficiently safeguard Multiple Servers

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Sl no.	Item Description	Specification
		and Domains from Virus attacks Provide centralized, Web based, real-time desktop virus protection for Enterprise Desktops with integrated server based deployment and control Manage virus protection across the enterprise network, through single console
21.	Backup Device	VXA -1, 33/66 GB with 3/6 MBPS transfer rate /DAT drive 33/66 GB with 2 cartridge/media or Better. 23. Audited TPC-C throughput Must have audited TPMC rating Certificate must be attached or Better
22.	Mouse	PS/2 type Microsoft or equivalent scroll mouse
23.	Monitor	21" Color Monitor, Max. pixel rate of 110 Mhz,0.28 MM Dot Pitch with capability to support resolutions of 1024x768 or more Monitor should be able to support Horizontal frequency of upto 69kHz. and vertical frequency of upto 120Hz. Should be MPR-II compliant/FCC Class B

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6.05.00 UNINTERRUPTED POWER SUPPLY

Sl no.	. Item Description	Specification
1.	Make Manufacture	APC/ TVSE / EMERSON Only
2.	Capacity	2 KVA True Online for all locations except at Master RTU location, 3 KVA True Online for Master RTU location
3.	Technology	Microprocessor Based High Frequency Switching
4.	Input Voltage	190 V AC to 260 V AC or better on full load
5.	Input Frequency	50 Hz + / - 5 %
6.	Input Power Factor	0.6 to 1
7.	Output Voltage	230 Volts +/- 2%
8.	Output Frequency	50 Hz Sync to mains supply User settable 50 Hz +/- 0.15% when on battery
9.	Total Harmonic Distortion	Less than 5.0% and sinusoidal waveform on linear load
10.	Load Power Factor	0.6
11.	Efficiency	>85%

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12.	Communication	RS 232 for UPS Monitoring Software Monitoring
13.	Back-up Time	30 mins
14.	Battery Type	Sealed Maintenance Free
15.	Alarm / Indications	LCD screen and LED display for UPS status, Alarm messages & settings for user settable parameters
16.	Audible Noise	45 dba
17.	Feature	Hot Standby Static Bypass with Automatic Transfer
18.	Protections	Circuit breaker at I/P, Fuse for Battery, Fuse for I/P, Electronic short circuit protection , Electronic overload protection

6.06.00 BASE COMPUTER SOFTWARE:

6.06.01 The Base Computer Software shall comply with Common Frame Work standard specification of software published by Metering Inter-Operable Standard (MIOS) under IEEMA, the purpose of the same is as given below:

- Read meters of various manufacturers
- Convert data into common format (XML)
- View data

To read efficient and speedy recovery of multiple manufacturer make meters using manufacturer specific API's (Read & Convert as per IEEMA MIOS 13 standard) & view, a Base Computer Software (BCS) shall have to be supplied having the following features:

- The BCS software shall be windows based user friendly.
- It could also collect data from the meters with modem.

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- The data transfer shall be highly reliable and fraud proof.
- These data may be used for viewing and monitoring with the help of BCS.
- Gives logical view of all the meter reading data according to various parameters.
- Base Computer software shall give all details adequate for analysis and abnormal event data & load surveys parameters as provided by the meter manufacturer APIs.
- New user(s) with their level of access rights could be defined and / manage by supervisor based upon their usage.
- The software shall have the facility to convert all the consolidated information / data of selectable parameters into XML format. EDP department of NIT RKL can generate its own DBF (data base files) to download all the required information into it.
- System shall retain the individuality of meter manufacturers embedded software design (API).
- System shall protect the optimizations in performance, quality, throughout and security issues.
- Software shall provide universally acceptable translation platform (i.e. XML) as per MIOS standard to which all meter manufacturers must provide data.

6.06.02 **Platform**

The BCS shall be executable on MS WINDOWS XP or higher operating system. The BCS shall be suitable to run on IBM PC or compatible hardware platform.

6.06.03 **Support Display:**

There shall be "user friendly" approach for viewing meter data for the reading collected now or for the reading collected in the past. All information about a particular reading shall be sorted out and available at one place so that locating any meter specific past data is easy. The metering data shall be accessible from the Metering Server monitor (Web enabled) as well as from any authorized web client of NIT Rourkella.

6.06.04 **Print Facility :**

It shall be possible to have selective printing out of all available data of the meter. Print out shall not include anything and everything available with the BCS. BCS shall have facility to export data to XML format for integrating with the any third party system.

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6.06.05 Security:

The BCS shall have provision of user name and password to protect unauthorized access of system.

6.06.06 Data Security:

The system shall provide an integrated security system with Administrators to create users and grant permissions to seek required data, tamper conditions etc.

Access to the system must be authorized by and authenticated ID and Password security.

There shall be provision to store up to 12 months of meter data in the SQL database in the Server

6.06.07 Reporting Requirements

The system shall be able to generate various exceptional reports on tamper events and energy data and acquire real time instantaneous data like voltage, current, frequency, power factor, active power, reactive power, etc. at the specified regular intervals as defined by the NIT RKL

On-line data shall be presented in tabular format and data shall be available in the user defined formats viz. Viewing of historical parameters in graphic format.

Facility to acknowledge one or multiple alarms at a time and also facility to save the alarm shall be provided.

It shall show and transfer data in case of change in meters.. An indication of meter changed shall be available and separate record shall be maintained to avoid any confusion.

The software shall provide detailed report on quantum of energy supplied from each feeder and number of hours for which energy is supplied.

6.06.08 Software Licenses

All supplied software such as OS for central server, RDBMS etc. shall be suitably licensed. All software including BCS shall be transferred to NIT RKL at the time of handing over the system to NIT RKL.

6.07.00 PRINTERS

Colour Laser Printer (A3 Size Paper)

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Sl no.	Item Description	Specification
1.	Make Manufacture	Manufactured by ISO 9001 & 14001
2.	Model	Must be specified. All the relevant product brochures and manuals must be submitted.
3.	Paper Size	A3, A4, Letter, Executive, Legal
4.	Print Speed	27 ppm (letter)/28 ppm (A4) black & colour
5.	Resolution	600 x 600 dpi
6.	Memory	64 MB Standard Up-gradable to 256 MB
7.	Paper Type	Plain paper, transparencies, thick stock (120 GSM), labels and envelopes
8.	Paper Handling	Input Tray-500 sheet tray, 100 sheet multipurpose tray Output Tray- 250 sheet face down bin
9.	Duplex Printing	Automatic two sided printing
10.	Color Matching	Automatic -document, photographic, graphics
11.	Interface	1 Bidirectional IEEE-1284-C parallel port, 1 USB 1.1 port
12.	Network Interface	10/100 Mbps Ethernet interface with UTP port
13.	Printer Server S/W	Standard Print Server Software
14.	Compatibility	Windows 98, 2000, XP, NT, Server

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Sl no.	Item Description	Specification
		2003
15.	Duty Cycle	120000 pages per month

6.08.00 GROUNDING / EARTHING

- a) All metal enclosures, conduits, junction/pull boxes shall be grounded in compliance with I.E. rules.
- b) Contractor shall provide required number of earthing pits and shall run # 8 SWG G.1. wires from these pits for grounding.
- c) Earthing of all sheet metallic parts of enclosures of all equipment covered in this specification, which are non-current carrying, shall be bonded to an earth bus provided in the equipment. Contractor shall ensure that two (2) nos. earthing terminals are provided in each equipment. Equipment earthing shall be done by 8 SWG GI wire. The supply and installation of all earthing wires, earthing plates and other materials for the entire telephone system shall be under the scope of Contractor. Contractor shall properly earth the system so that there is no hum/noise in the communication system due to power frequency interference.

7.00.00 INSTALLATION AND COMMISSIONING OF GSM MODEM and RTU.

7.01.00 The required material shall be shifted by the Vendor for installation from NIT Rourkella stores to the work site.

- Installation of RTU and GSM modem in Meter mounting box at suitable place in location is under the scope of this work.
- UPS and Power cables will be used for connections
- All material required for complete installation such as Lugs, Mounting Clamps and cable holding clamps etc. shall also be provided by the Vendor.
- All joints/ terminations will be carried out by using of suitable size of lugs by the Vendor.

8.00.00 TESTS

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8.01.00 **Type Test:** These tests shall be carried out by the vendor on any one modem of the total lot of PO either in house or through any other Govt. approved Lab / Approved Lab of NIT Rourkella. The test specified are as under:

8.01.01 **Shock Test:-** the test in this case shall be carried out as per IS 9000 (Part 7) under following conditions:

- ? Modem without packing
- ? Half sine pulse
- ? Peak acceleration (40g i.e. 400m/s²)
- ? Duration of pulse 18 msec
- ? No. of Shock: two in both direction of three mutual perpendicular axes (Total of 12 shocks)

After the test modem shall show no damage and no change in it's communication properties.

8.01.02 **Vibration Test:-** The test shall be carried out as per IS 9000 (part 8) under following conditions:

- ? Modem without packing 7
- ? Frequency range: 10-150-10 Hz
- ? Transition frequency 60 Hz
- ? F<60 Hz constant amplitude of movement 0.15 mm
- ? F> 60 Hz constant acceleration 2g (1g = 9.8 m/s²)
- ? Single point control
- ? Number of sweep cycles per axis : 10 After the test modem shall show no damage and no change in it's communication or power circuitry.

8.01.03 **Spring hammer test:** The mechanical strength of the modem cover shall be tested with a spring hammer (IEC 600068-2-75(1997) environmental testing part 2-75---test Eh: Hammer Test). The modem body shall be mounted in its normal working position and the spring hammer shall be act on the outer surface of the modem with a kinetic energy of 0.22 Nm+/- Nm. The result of the test shall be deemed to be satisfactory if the modem body does not sustain damage which could affect the function of modem slight damage which doesn't impair the protection against indirect contact or the penetration of solid objects, dust and water is acceptable.

8.01.04 **Test for protection against penetration of dust and water:** The test shall be carried out as per IS 12063 under the following:

Protection against penetration of dust::

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- Modem in non operating condition mounted on an artificial wall.
 - First characteristic digit: 1 (IP 5X)
 - Any ingress of dust only be in quantity not impairing the functioning of modem protection against ingress of water:
 - Modem in non operating condition
 - Second characteristic digit: 1 (IP X 1)
 - Any ingress of water should be in a quantity that does not impair the functioning of modem.
- 8.01.05 **Dry Heat Test:** This test shall be carried out as per relevant IS 9000 (Part 3/Sec 1 to 5). The following condition shall be maintained:-
- Modem in non operating condition
 - Temperature +55 +/-2 C
 - Duration of test 72 hrs.
- 8.01.06 **7.1.6 Cold Heat Test:** This test shall be carried out according to the relevant IS 9000 (Part 2/ sec 1 to 4) under the following condition:
- Modem in non operating condition
 - Temperature -10 +/-2 C
 - Duration of test 72 hrs.
- 8.01.07 **Damp Heat Cycle Test:** This test shall be carried out in accordance of relevant section of IS 9000 (Part 5/ Sec 1 and 2) under the following conditions:
- Modem in operating condition
 - Voltage in power circuit
 - Upper temperature: 40 C +/-2C 8
 - No special precaution for removal of moisture
 - Duration of test 6 cycles
- After the test modem shall show no damage or change in it's communication or power circuitry.
- 8.01.08 **Impulse Voltage Test:** An impulse of 6 KV is applied ten times with one polarity and then applied ten times with one polarity then repeated with the other polarity. The min. time between the impulses shall be 3 sec. The waveform of the generator characteristics shall be as per IEC 61000-4-5 (1995-02).
- 8.01.09 **AC voltage test:** A test voltage of 4 KV (substantially sinusoidal) having a frequency between 45 to 55 Hz and applied for one min. The power

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source shall be capable of carrying this test. During the test no flash over, disruptive discharge or puncture shall occur.

8.01.10 **Test for immunity to Electrostatic discharge:** The test shall be carried out in accordance with IEC 61000-4-2 (1995-02). The test shall be carried out in following test conditions:

- Contact discharge
- Test voltage: 8KV
- No. of discharge: 10
- Test jequirity level; 4
- Power and communication circuit energized

After the test modem shall show no damage or change in it's communication or power circuitry.

8.01.11 **Test for immunity to Electromagnetic HF fields:-** The test shall be carried out in accordance with IEC 61000-4-3 (1995-02)"Following conditions shall be ensured during the test:

- Power and communication circuit energized.
- Frequency Band 80 MHz to 1000 MHz
- Test Field Strength: 10 V/m
- Test Security Level: 4

After the test the modem shall show no damage or change in communication or power circuitry.

8.01.12 **Fast transient burst test: -** The test shall be carried out in accordance with IEC 61000 4-4 (1995-02)"Following conditions shall be ensured during the test:

- Power and communication circuit energized.
- Test Voltage 4 KV
- Test Security Level: 3
- Duration of test: min 60 sec.

8.01.13 **Radio Interference Measurement:-** The test for radio interference shall be carried out for frequencies from 0.15 MHz to 30 MHz and for the frequencies from 30 MHz to 300 MHz as per IS 6842 the modem should be powered on and off and also the communication of the modem shall be checked. The reports for these tests are to be sent to NIT in advance before applying 9 for MDCC. Tests should be carried out in a laboratory

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recognized internationally/nationally. The calibration certificates for all the lab instruments should be submitted with the test-reports.

- 8.01.14 **Routine Test:** The following test shall be carried out on each and every modem before dispatch:-
- 8.01.15 **Insulation resistance test:** Insulation resistance shall be more than 200 M ohm. The ambient conditions unless specified shall be:-
- Ambient temperature:- 20 to 35 C
 - Relative Humidity: 45 to 95%
 - Atmospheric pressure 86 to 106 kPa
- 8.01.16 **Power loss in circuit:** - The power loss in circuit shall not be more than 3.0 VA in stand alone condition and shall not exceed 6VA in communication mode.
- 8.01.17 **Supply voltage test:** - The modem shall be tested for supply voltage test for specified input voltages
- 8.01.18 **Supply voltage variation test:-** The modem shall remain operational from voltage range from 63.5 to 370 volts.
- 8.01.19 **Communication test:** -The modem shall be able to communicate:
- Test for communication of modem with PC
 - Test for service indicating LED
 - Test for communication GSM to GSM
 - Test for communication through electrical port of meter.
- 8.01.20 **Visual Inspection:** - **Visual inspection for blinking of LED's should be done.**

9.00.00 DRAWINGS, DATA AND MANUALS

9.01.00 TO BE SUBMITTED WITH THE BID

01. List of deviations, if any
02. List of exclusions, if any
03. Proposed System schematic diagram.
04. Write up on architecture and operation of proposed system
05. BILL OF MATERIALS with make and model no. of equipment.
06. Power requirement. (capacity of UPS and SMF battery)

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07. Manufacturer's product catalogues.
08. The Bidder shall include in his scope of supply system/ component/ accessories and software required to make the equipment and system complete in all respects even though every individual item may not have been mentioned specifically in the specification.
09. The Bidder shall submit detailed specification of all the equipment hardware/software).

9.02.00 TO BE SUBMITTED AFTER AWARD OF CONTRACT.

9.02.01 Schematic Diagram and Configuration of The Offered System

- a) Bill of materials including make & model and specification.
- b) Quality Assurance Plan for equipment & cables as per format enclosed.
- c) Wiring Diagram Of RTU ,Ethernet Switch and GSM/GPRS Modem
- d) Wiring Diagram Of Panel
- e) Details of Panel and Installation.
- f) List of Components in Panels.
- g) List of Components in RTU and GSM/GPRS Modem.
- h) Erection /Installation Drawing of RTU and GSM/GPRS Modem
- i) Equipment Layout Drawing in buildings/locations
- j) Cable Route Layout Drawing
- k) Cable Schedule of RTU and GSM/GPRS Modem
- l) Operation & Maintenance Manuals
- m) External connection diagrams.
- n) Specification data sheets for equipment and cables.
- o) Panel general view.
- p) As-Built Drawings.

10.00.0 SPARES

10.01.00 GENERAL REQUIREMENT OF SPARES

- 10.01.01 All spares required for operation / maintenance by Owner shall be delivered in unused new condition.

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- 10.01.02 Spares shall be interchangeable with the parts for which they are intended for replacement.
- 10.01.03 Supplier shall indicate the service expectancy period for spares under normal operating conditions after which replacement will be necessary.
- 10.01.04 Spares shall be properly packed for long storage under the prevailing site condition.
- 10.01.05 Spares cards/modules, components etc shall be offered for 10% of total nos. used in the system or minimum 1 (one) no. whichever is more.
- 10.02.00 MANDATORY SPARES**
- 10.02.01 Mandatory spares shall be supplied as per Annexure-A. Although the list is given with an indicative requirement, Vendor may quote the essential cards and modules like power supply, processor card, line cards, external interface ports, power amplifier module etc whichever they deem necessary for each type of equipment-
- 10.03.00 RECOMMENDED SPARES**
- 10.03.01 The supply of Spare parts as necessary and recommended by the manufacturer for ten (10) years' reliable operation and maintenance of the equipment shall be under the scope of this specification.
- 10.04.00 START-UP AND COMMISSIONING SPARES**
- 10.04.01 Spares, which may be required during tests, trial and commissioning, shall be arranged separately. Supplier shall replace spares, which will be used for this purpose, within reasonable period of time.

11.00.00 PERFORMANCE WARRANTY:-

- 11.01.00 The Hardware and Software supplied by the firm shall be under warranty for a period of 36 Months from the date of Installation. During the warranty period, the firm shall be liable to replace/rectify all the equipment found defective and shall also attend all the software problems intimated to them.

12.00.00 TRAINING

- 12.01.00 Bidder shall consider training at manufacture works/authorized training centers for the IOCL personnel. The Bidder shall arrange for training of purchaser's personnel in operation, maintenance & fault identification/rectification of the system at purchaser's premises. Training shall include supply of sets of course material/handouts. The training schedule/ details shall be mutually worked out. The nature, standard and

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duration of such training package shall be discussed and decided during the Technical Disc

13.00.00 SHIPMENT

- 13.01.00 Contractor shall be responsible for ensuring that all equipment are carefully and/or suitably packed for shipment, so that they arrive at site in good condition and remain so during storage at site. Before despatch, all exposed surface shall be protected by applying anti rust primer (two coats) and suitable cover shall be provided for the equipment to be supplied.
- 13.02.00 Contractor will be responsible for all damages due to improper preparation of the goods for shipment

14.00.00 I/O LIST

Following points shall be supervised through DAS :

<u>Substation</u>	<u>Supervised points</u>
WESCO tapping	RKL Isolator ON RKL Isolator OFF Chhend Isolator ON Chhend Isolator OFF 33kV VCB ON 33kV VCB OFF 33kV VCB Trip ckt faulty Master trip relay (86) operated Line current Line voltage
MRSS	33KV IC Isolator (29A) ON 33KV IC Isolator (29A) OFF 33KV IC Isolator (29L) ON 33KV IC Isolator (29L) OFF 33kV IC VCB ON 33kV IC VCB OFF 33kV IC VCB Trip ckt faulty

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33kV IC Master trip relay (86) operated

33KV IC Line current
33KV IC Line voltage

33KV OG1 Isolator (29A) ON
33KV OG1 Isolator (29A) OFF

33KV OG1 Isolator (29L) ON
33KV OG1 Isolator (29L) OFF

33kV OG1 VCB ON
33kV OG1 VCB OFF
33kV OG1 VCB Trip ckt faulty
33kV OG1 Master trip relay (86) operated

33KV OG1 Line current

33KV OG2 Isolator (29A) ON
33KV OG2 Isolator (29A) OFF

33KV OG2 Isolator (29L) ON
33KV OG2 Isolator (29L) OFF

33kV OG2 VCB ON
33kV OG2 VCB OFF
33kV OG2 VCB Trip ckt faulty
33kV OG2 Master trip relay (86) operated

33KV OG2 Line current

Station service trafo trouble

Battery charger trouble

UPS trouble

S/S-1,2,5,7,9

33KV Bus Isolator-1 (29A) ON
33KV Bus Isolator-1 (29A) OFF

33KV Bus Isolator-2 (29B) ON
33KV Bus Isolator-2 (29B) OFF

Trafo Isolator (29T) ON (For each trafo.)
Trafo Isolator (29T) OFF (For each trafo.)

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Transformer alarm (BA, WTA, OTA, MOLGA) (For each trafo.)

Transformer trip (BT, WTT, OTT) (For each trafo.)

415V DB IC ACB ON (For each incomer)

415V DB IC ACB OFF (-- do --)

415V DB OG A, V, PF, W, VAR (For each OG except lighting feeders)

UPS trouble

S/S-4

33KV Bus Isolator-1 (29A) ON

33KV Bus Isolator-1 (29A) OFF

33KV Bus Isolator-2 (29B) ON

33KV Bus Isolator-2 (29B) OFF

Trafo Isolator (29T) ON (For each trafo.)

Trafo Isolator (29T) OFF (For each trafo.)

Transformer alarm (BA, WTA, OTA, MOLGA) (For each trafo.)

Transformer trip (BT, WTT, OTT) (For each trafo.)

415V DB IC ACB ON (For each incomer)

415V DB IC ACB OFF (-- do --)

415V DB OG A, V, PF, W, VAR (For each OG except lighting feeders)

415V Existing DB IC A, V, PF, W, VAR

UPS trouble

S/S-6

415V Existing DB IC A, V, PF, W, VAR

S/S-8

33KV Bus Isolator-1 (29A) ON

33KV Bus Isolator-1 (29A) OFF

33KV Bus Isolator-2 (29B) ON

33KV Bus Isolator-2 (29B) OFF

33KV Bus section Isolator (29BS) ON

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33KV Bus section Isolator (29BS) OFF

Trafo Isolator (29T) ON (For each trafo.)
Trafo Isolator (29T) OFF (For each trafo.)

Transformer alarm (BA, WTA, OTA, MOLGA) (For each trafo.)
Transformer trip (BT, WTT, OTT) (For each trafo.)

415V DB IC ACB ON (For each incomer)
415V DB IC ACB OFF (-- do --)

415V DB OG A, V, PF, W, VAR (For each OG except lighting feeders)

UPS trouble

S/S-10

33KV LBS-1 ON
33KV LBS-1 OFF

33KV LBS-2 ON
33KV LBS-2 OFF

33KV LBS-3 ON
33KV LBS-3 OFF

33KV LBS-4 ON
33KV LBS-4 OFF

Transformer alarm (BA, WTA, OTA, MOLGA) (For each trafo.)
Transformer trip (BT, WTT, OTT) (For each trafo.)

415V DB IC ACB ON (For each incomer)
415V DB IC ACB OFF (-- do --)

415V DB OG A, V, PF, W, VAR (For each OG except lighting feeders)

UPS trouble

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SECTION-VII

TENDER DRAWINGS

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TENDER DRAWINGS

Sl. No.	Description	Drawing no
1.	SLD – Proposed power tapping arrangement from WESCO	NIT-RKL-E-SLD-001
2.	Overall SLD – 33KV Ring Main	NIT-RKL-E-SLD-002 Sht 1 of 10
3.	SLD – 33KV MRSS	-Do- Sht 2 of 10
4.	SLD – S/S-1	-Do- Sht 3 of 10
5.	SLD – S/S-2	-Do- Sht 4 of 10
6.	SLD – S/S-4	-Do- Sht 5 of 10
7.	SLD – S/S-7	-Do- Sht 6 of 10
8.	SLD – S/S-5	-Do- Sht 7 of 10
9.	SLD – S/S-6& 9	-Do- Sht 8 of 10
10.	SLD – S/S-8	-Do- Sht 9 of 10
11.	SLD – S/S-10	-Do- Sht 10 of 10
12.	Layout of proposed power tapping arrangement from WESCO S/S to NIT MRSS.	NIT-RKL-E-LAY-001
13.	Proposed route of 33KV ring main and location of 33/0.433KV substations.	NIT-RKL-E-LAY-002
14.	Electrical layout of S/S-1	NIT-RKL-E-LAY-003
15.	Electrical layout of S/S-2	NIT-RKL-E-LAY-004
16.	Electrical layout of S/S-4	NIT-RKL-E-LAY-005
17.	Electrical layout of S/S-5	NIT-RKL-E-LAY-006
18.	Electrical layout of S/S-6 & 9	NIT-RKL-E-LAY-007
19.	Electrical layout of S/S-7	NIT-RKL-E-LAY-008
20.	Electrical layout of S/S-8	NIT-RKL-E-LAY-009
21.	Electrical layout of MRSS	NIT-RKL-E-LAY-010
22.	Electrical layout of S/S-10	NIT-RKL-E-LAY-011
23.	GA of 33KV Single pole structure	NIT-RKL-E-GA-001
24.	-Do- Double pole structure	NIT-RKL-E-GA-002
25.	-Do- Four pole structure for line tapping	NIT-RKL-E-GA-003
26.	GA of cradle guard	NIT-RKL-E-GA-004
27.	Architectural layout of MRSS control building.	NIT-RKL-A-ARC-001
28.	-DO- of 415V DB room.	NIT-RKL-A-ARC-002
29.	Data acquisition system (DAS) block diagram.	NIT-RKL-E-DAS-001
30.	Typical Detail of cable tray, cable trench and buried cable	NIT-RKL-E-DET-001, 4 SHTS.

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SECTION-VIII

LIST OF APPROVED MAKES

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LIST OF APPROVED MAKES

Sl.No.	Equipment	Approved makes
1.	33KV OUTDOOR VCB	AREVA/SIEMENS/ABB
2.	33kV CT, PT	CGL/LAXMI ENGG/ PRAGATI/MEHRU/TELK
3.	33KV ISOLATOR (HCDB)	G NANDY/ ABB/S&S/SIEMENS/ HIVELM
4.	30KV LA	ABB/AREVA/BHEL/CGL/OBLUM
5.	HT insulator & bushing	JAYSHREE/WSI/MODERN/OBLUM/BHEL
6.	Transformer	AREVA/CGL/KEC/Marsons, Agra/PETE, Hyderabad/AEG, Kolkata
7.	C & R Panels	ECC/PCE PROJECTS/SYSTEM CONTROL & AUTOMATION/ELECTRO ALLIED PRODUCTS
8.	Relays	AREVA
9.	Ammeter, Voltmeter	AE/IMP
10.	Multifunction meter	CONZERVE/SATEC/SECURE/SCHNEIDER
11.	Tri vector meter	CONZERVE/SATEC/SECURE/SCHNEIDER
12.	Annunciator	MINILEC/PROCON
13.	T-N-C & L-R Switch	AREVA/KAYCEE
14.	Auxiliary relays	AREVA
15.	Master trip relay	AREVA
16.	Air Circuit breaker (draw out type)	ABB/SCHNEIDER/SIEMENS
17.	MCCB	ABB/SCHNEIDER/SIEMENS
18.	ACDB/LDB/Fabricated panels	ECC/PCE PROJECTS/SYSTEM CONTROL & AUTOMATION/ELECTRO ALLIED PRODUCTS/ALFA AUTOMATION
19.	Battery, Battery charger	EXIDE/HBL/AMCO/CALDYNE
20.	MCB, DB 10KA	ABB/SIEMENS/LEGRAND/SCHNEIDER
21.	Switch, Fuse, Contactor, Bimetalic overload relay	ABB/SIEMENS/SCHNEIDER
22.	HT Power cable	CCI/ GLOSTER/HAVELLS/NICCO/POLYCAB/ UNIVERSAL
23.	LT Power and Control cables	CCI/ GLOSTER/HAVELLS/NICCO/POLYCAB/ UNIVERSAL/FINOLEX/ASIAN
24.	Cable gland	DOWELS/ELECTRO WERKE/CCI
25.	Cable lug	DOWELS/JAINSON/ISMAL
26.	Terminal block	CONNECT WALL/ELMEX/WAGO
27.	Cable termination, jointing kit	CCI/RAYCHEM/M-SEAL
28.	Lighting luminaires with lamps	BAJAJ/CGL/PHILIPS
29.	Emergency lighting	PROLITE

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Sl.No.	Equipment	Approved makes
	luminaire with built in battery and charger	
30.	Welding receptacle (Metal clad)	BCH/CGL/GE/ANCHOR/
31.	Clamps, connectors for switchyard	RASTRA UDYOG/INDUSTRIAL SPARE PRODUCT/ELECTROMECH & TRANSTEC
32.	ACSR conductor	CABCON/LUMINO
33.	RTU	ABB/AREVA/GE/HONEYWELL/SIEMENS
34.	Transducers	ABB/AREVA/SCHNEIDER/SIEMENS
35.	Ethernet switch	NORTEL/CISCO/HP
36.	GSM/GPRS modem	GEOTECH SYSTEMS/SV TEL/RAVIRAJ TECHLOGIES
37.	Any other material	As approved by NIT/Consultant.

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