



No. EII/327/4/2003

GOVERNMENT OF INDIA
MINISTRY OF EXTERNAL AFFAIRS
(Development Partnership Administration III)

**TENDER FOR CONSTRUCTION OF NEPAL BHARAT
MAITRI POLYTECHNIC BUILDING
AT HETAUDA, NEPAL**

Project Management Consultant

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INVITATION FOR BIDS,
INSTRUCTIONS TO BIDDERS,
FORMS & FORMATS,
GENERAL CONDITIONS OF CONTRACT
SPECIAL CONDITIONS OF CONTRACT

To

.....

Bid Document Number:

I.	NAME OF WORK	Construction of Nepal Bharat Maitri Polytechnic at Hetauda, Nepal
II	BID SECURITY (EMD)	Rs. 50,00,000.00 (Rupees Fifty Lacs only)
III	COMPLETION PERIOD/ CONTRACT PERIOD	As mentioned in the Special Conditions of Contract of bidding document
IV	DATE, TIME AND VENUE OF PRE-BID MEETING	27 June 2016 at 1530 hrs at Ministry of External Affairs, Jawaharlal Nehru Bhavan, 23-D, Janpath, New Delhi
V	SALE OF BID DOCUMENT	From 10 th Jun 2016
VI	LAST DATE & TIME FOR BID SUBMISSION	upto 28 July 2016, 1400 hrs (IST)
VII	TECHNICAL BID OPENING DATE & TIME	28 July 2016 at 1500 hrs. (IST)
VIII	VENUE OF BID OPENING	Ministry of External Affairs, Jawaharlal Nehru Bhavan, 23-D, Janpath, New Delhi
IX	TENDER DOCUMENT FEE	Rs. 10,000.00 (Rupees Ten Thousand only)
If any of the days specified above happens to be a holiday in Ministry of External Affairs, the next working day shall be implied.		

X ELIGIBILITY CIRTERIA:

<u>S.NO</u>	<u>QUALIFICATION CRITERIA</u>	<u>DOCUMENTS REQUIRED</u>
1	The bidder must be company registered under Indian Companies Act 1956 of Individual /Partnership Firm registered with appropriate authorities.	The bidder shall submit proof of date of incorporation/ registration along with the bid.

2	The bidder should have at least 7 years experience in the field of construction with experience of executing 01 similar work of Rs 31.95 crores or 02 similar work of Rs 19.97 Crores value or 03 similar works of 15.98 Crores value in five years.	Successful completion certificates for such projects needs to be submitted in this regard
3	The bidder must have annual turnover for the last three years shall not be less than 38.53 Crores and the bidder should not have suffered loss in any of the previous 03 financial years.	Certificates/related documents to be submitted along with the bid.
4	The solvency of the bidding company should be Rs 12 Crores.	

The Ministry of External affairs reserves the right to counter check any of the supporting documents directly from the respective client for their authenticity.

- 1.0 Ministry of External Affairs, Govt. of India invites bids (2 bid system) from eligible bidders meeting the Bid Evaluation Criteria (refer Instructions to Bidders (ITB) of tender document) specified in this tender document, for Construction of Nepal Bharat Maitri Polytechnic at Hetauda, Nepal, in complete accordance with this IFB. The bidders or their designated representatives, who intend to bid are invited to attend the pre bid meeting at the date and time mentioned in this IFB. Corrigendum, if any, to the tender document, shall be hosted on the website subsequent to the pre-bid meet.
- 2.0 Bids should be submitted through sealed envelope before the bid due date and time specified, along with Earnest Money Deposit/ Bid Bond. Similarly, **Tender Fee/Bidding Document Fee** in the form of DD/BC **payable in the name of Pay & Account Officer , Ministry of External Affairs**, and **should be submitted along with the technical bid.** The bids submitted without tender fee shall not be opened and considered.
- 3.0 Bids complete in all respect should be submitted in sealed envelope on or before the BID DUE DATE AND TIME.
- 4.0 Bidder(s) are advised to quote strictly as per terms and conditions of the tender documents and not to stipulate any deviations/exceptions. Once quoted, the Bidder shall not make any subsequent price change after due date and time of submission of bid. Price changes through any other mode shall render the offer liable for rejection.
- 5.0 This Invitation for Bids (IFB) is an integral and inseparable part of the enclosed Bid Document.
- 6.0 MEA reserves the right to accept or reject any or all offers without assigning any reason, whatsoever.
- 7.0 The bid document can be obtained from SO (DPA-III), Room No: 3119, Jawaharlal Nehru Bhavan, 23-D, Janpath, New Delhi-110011 on payment of the Tender Fee (Payable in the form of Demand Draft in the name of Pay and Account Officer, Ministry of External Affairs, Payable at Delhi) from the date of publishing of this NIT till one day before the date of bid submission. The tender document can also be downloaded from MEA website www.mea.gov.in or Central Public Procurement Portal www.eprocure.gov.in or from the website of Embassy of India, Kathmandu

at www.indianembassy.org.np The downloaded tender documents completed in all respects should be submitted along with the requisite tender fees in the form of Demand Draft in the name of Pay and Account Officer, Ministry of External Affairs, Payable at Delhi.

- 8.0 Tenders completed in all respects may be submitted at Room No: 3119, Jawaharlal Nehru Bhavan, 23-D, Janpath, New Delhi-110011 before last date and time of submission of bids. Bids submitted at any other place will not be considered. The bids shall be opened at the Meeting Room, Jawaharlal Nehru Bhawan, 23-D, Janpath, New Delhi.
- 9.0 Further information regarding amendments, corrigendum, extension of date, etc., if any, shall be posted on MEA website <http://www.mea.gov.in> , www.indianembassy.org.np and Central Procurement Portal <http://eprocure.gov.in>.

GENERAL CONDITIONS OF CONTRACT

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General Conditions of Contract

SECTION- I DEFINITIONS

- 1. Definition of Terms:** 1.1 In this CONTRACT (as here-in-after defined) the following words and expressions shall have the meanings hereby assigned to them except where the context otherwise required.

1.1.1The EMPLOYER/COMPANY/MEA means Ministry of External Affairs, Government of India and includes its successors and assigns.

1.1.2The "CONTRACTOR" means the person or the persons, firm or Company or corporation whose tender has been accepted by the EMPLOYER and includes the CONTRACTOR's legal Representatives his successors and permitted assigns.

1.1.3The ENGINEER/ENGINEER-IN-CHARGE" shall mean the person designated from time to time by the MEA and shall include those who are expressly authorized by him to act for and on his behalf

for operation of this CONTRACT.

1.1.4The "WORK" shall mean and include all items and things to be supplied/ done and services and activities to be performed by the CONTRACTOR in pursuant to and in accordance with CONTRACT or part thereof as the case may be and shall include all extra, additional, altered or substituted works as required for purpose of the CONTRACT.

1.1.5The "PERMANENT WORK" means and includes works which will be incorporated in and form a part of the work to be handed over to the EMPLOYER by the CONTRACTOR on completion of the CONTRACT.

1.1.6"CONSTRUCTION EQUIPMENT" means all appliances/equipment and things whatsoever nature for the use in or for the execution, completion, operation, or maintenance of the work or temporary works (as hereinafter defined) but does not include materials or other things intended to form or to be incorporated into the WORK, or camping facilities.

1.1.7 "CONTRACT DOCUMENTS" means collectively the Tender Documents, Designs, Drawings, Specification, Schedule of Quantities and Rates, Letter of Acceptance and agreed variations if any, and such other documents constituting the tender and acceptance thereof.

1.1.8 CONSULTANT: means M/s Nirman Consultants Pvt. Ltd. who are the consulting engineer to the Employer for this project and having registered office at E-135, Okhla Industrial Estate, Phase III, New Delhi – 110020.

1.1.9The "SUB-CONTRACTOR" means any person or firm or Company (other than the CONTRACTOR) to whom any part of the work has been entrusted by the CONTRACTOR, with the written consent of the ENGINEER-IN-CHARGE, and the legal representatives, successors and permitted assigns of such person, firm or company.

1.1.10 The "CONTRACT" shall mean the Agreement between the EMPLOYER and the CONTRACTOR for the execution of the works including therein all contract documents.

1.1.11 The "SPECIFICATION" shall mean all directions the various technical specifications, provisions attached and referred to the Tender Documents which pertain to the method and manner of performing the work or works to the quantities and qualities of the work or works and the materials to be furnished under the CONTRACT for the work or works, as may be amplified or modified by the MEA or ENGINEER-IN-CHARGE during the performance of CONTRACT in order to provide the unforeseen conditions or in the best interests of the work or works. It shall also include the latest edition of relevant Standard Specifications including all addenda/corrigenda published before entering into CONTRACT.

1.1.12 The "DRAWINGS" shall include maps, plans and tracings or prints or sketches thereof with any modifications approved in writing by the ENGINEER- IN-CHARGE and such other drawing as may, from time to time, be furnished or approved in writing by the ENGINEER-IN-CHARGE.

1.1.13 The "TENDER" means the proposal along with supporting documents submitted by the CONTRACTOR for consideration by the EMPLOYER.

1.1.14The "CHANGE ORDER" means an order given in writing by the ENGINEER-IN-CHARGE to effect additions to or deletion from and alteration in the works.

1.1.15The "COMPLETION CERTIFICATE" shall mean the certificate to be issued by the ENGINEER-IN-CHARGE when the works have been completed entirely in accordance with CONTRACT DOCUMENT to his satisfaction.

1.1.16 The "FINAL CERTIFICATE" in relation to a work means the certificate regarding the satisfactory compliance of various provision of the CONTRACT by the CONTRACTOR issued by the ENGINEER-

IN-CHARGE/EMPLOYER after the period of liability is over.

1.1.17 "DEFECT LIABILITY PERIOD" in relation to a work means the specified period **ONE YEAR** from the date of COMPLETION CERTIFICATE upto the date of issue of FINAL CERTIFICATE during which the CONTRACTOR stands responsible for rectifying all defects that may appear in the works executed by the CONTRACTOR in pursuance of the CONTRACT and includes warranties against Manufacturing/Fabrication/ Erection/Construction defects covering all materials plants, equipment, components, and the like supplied by the CONTRACTOR, works executed against workmanship defects.

1.1.18 The "APPOINTING AUTHORITY" for the purpose of arbitration shall be a person so designated by the EMPLOYER.

1.1.19 "TEMPORARY WORKS" shall mean all temporary works of every kind required in or about the execution, completion or maintenance of works.

1.1.20 "PLANS" shall mean all maps, sketches and layouts as are incorporated in the CONTRACT in order to define broadly the scope and specifications of the work or works, and all reproductions thereof.

1.1.21 "SITE" shall mean the lands and other places on, under, in or through which the permanent works are to be carried out and any other lands or places provided by the EMPLOYER for the purpose of the CONTRACT.

1.1.22 "NOTICE IN WRITING OR WRITTEN NOTICE" shall mean a notice in written, typed or printed characters sent (unless delivered personally or otherwise proved to have been received by the addressee) by registered post to the latest known private or business address or registered office of the addressee and shall be deemed to have been received in the ordinary course of post it would have been delivered.

1.1.23 "APPROVED" shall mean approved in writing including subsequent written confirmation of previous verbal approval and "APPROVAL" means approval in writing including as aforesaid.

1.1.24 "LETTER OF INTENT/FAX OF INTENT" shall mean intimation by a Fax/Letter to Tenderer(s) that the tender has been accepted in accordance with the provisions contained in the letter.

1.1.25 "DAY" means a day of 24 hours from midnight to midnight irrespective of the number of hours worked in that day.

1.1.26 "WORKING DAY" means any day which is not declared to be holiday or rest day by the EMPLOYER.

1.1.27 "WEEK" means a period of any consecutive seven days.

1.1.28 "METRIC SYSTEM" - All technical documents regarding the construction of works are given in the metric system and all work in the project should be carried out according to the metric system. All documents concerning the work shall also be maintained in the metric system.

1.1.29 "VALUE OF CONTRACT" or "TOTAL CONTRACT PRICE" shall mean the sum accepted or the sum calculated in accordance with the prices accepted in tender and/or the CONTRACT rates as payable to the CONTRACTOR for the entire execution and full completion of the work, including change order.

1.1.30 "LANGUAGE FOR DRAWINGS AND INSTRUCTION" All the drawings, titles, notes, instruction, dimensions, etc. shall be in English Language.

1.1.31 "MOBILIZATION" shall mean establishment of sufficiently adequate infrastructure by the

CONTRACTOR at "SITE" comprising of construction equipments, aids, tools tackles including setting of site offices with facilities such as power, water, communication etc. establishing manpower organization comprising of Resident Engineers, Supervising personnel and an adequate strength of skilled, semi-skilled and un-skilled workers, who with the so established infrastructure shall be in a position to commence execution of work at site(s), in accordance with the agreed Time Schedule of Completion of Work. "MOBILISATION" shall be considered to have been achieved, if the CONTRACTOR is able to establish infrastructure as per Time Schedule, where so warranted in accordance with agreed schedule of work implementation to the satisfaction of ENGINEER-IN-CHARGE/ EMPLOYER.

1.1.32 "COMMISSIONING" shall mean pressing into service of the system including the plant(s), equipment(s), vessel(s), pipeline, machinery(ies), or any other section or sub-section of installation(s) pertaining to the work of the CONTRACTOR after successful testing and trial runs of the same. "COMMISSIONING" can be either for a completed system or a part of system of a combination of systems or sub-systems and can be performed in any sequence as desired by EMPLOYER and in a manner established to be made suited according to availability of pre-requisites. Any such readjustments made by EMPLOYER in performance of "COMMISSIONING" activity will not be construed to be violating CONTRACT provisions and CONTRACTOR shall be deemed to have provided for the same.

SECTION-II GENERAL INFORMATION

2. General Information

2.1 a) Location of Site: The proposed location of Project site is defined in the Special Conditions of Contract.

b) Access by Road: CONTRACTOR, if necessary, shall build other temporary access roads to the actual site of construction for his own work at his own cost. The CONTRACTOR shall be required to permit the use of the roads so constructed by him for vehicles of any other parties who may be engaged on the project site. The CONTRACTOR shall also facilitate the construction of the permanent roads should the construction there of start while he is engaged on this work. He shall make allowance in his tender for any inconvenience he anticipates on such account. Non-availability of access roads, railway siding and railway wagons for the use of the CONTRACTOR shall in no case condone any delay in the execution of WORK nor be the cause for any claim for compensation against the EMPLOYER.

2.2 Scope of Work: The scope of WORK is defined in the Technical Part of the tender document. The CONTRACTOR shall provide all necessary materials, equipment, labour etc. for the execution and maintenance of the WORK till completion unless otherwise mentioned in the Tender Document.

2.3 Water Supply: Contractor will have to make his own arrangements for supply of water to his labour camps and for works. All pumping installations, pipe net work and distribution system will have to be carried out by the Contractor at his own risk and cost.

Alternatively the Employer at his discretion may endeavour to provide water to the Contractor at the Employer's source of supply provided the Contractor makes his own arrangement for the water meter which shall be in custody of the Employer and other pipe net works from source of supply and such distribution pipe network shall have prior approval of the Engineer-in-Charge so as not to interfere with the layout and progress of the other construction works. In such case, the rate for water shall be deducted from the running account bills. However, the Employer does not guarantee the supply of water and this does not relieve the Contractor of his responsibility in making his own arrangement and for the timely completion of the various works as stipulated.

2.4 Power Supply:

2.4.1 Subject to availability, EMPLOYER will supply power at 400/440 V at only one point at the

nearest sub-station, from where the CONTRACTOR will make his own arrangement for temporary distribution. The point of supply will not be more than 500 m away from the CONTRACTOR'S premises. All the works will be done as per the applicable regulations and passed by the ENGINEER-IN-CHARGE. The temporary line will be removed forthwith after the completion of work or if there is any hindrance caused to the other works due to the alignment of these lines, the CONTRACTOR will re-route or remove the temporary lines at his own cost. The CONTRACTOR at his cost will also provide suitable electric meters, fuses, switches, etc. for purposes of payment to the EMPLOYER which should be in the custody and control of the EMPLOYER. The cost of power supply shall be payable to the EMPLOYER every month for Construction Works power which would be deducted from the running account bills. The EMPLOYER shall not, however, guarantee the supply of electricity nor have any liability in respect thereof. No claim for compensation for any failure or short supply of electricity will be admissible.

2.4.2 It shall be the responsibility of the CONTRACTOR to provide and maintain the complete installation on the load side of the supply with due regard to safety requirement at site. All cabling, equipment, installations etc. shall comply in all respects with the latest statutory requirements and safety provisions i.e., as per the Central/State Electricity Acts and Rules etc. The CONTRACTOR will ensure that his equipment and Electrical Wiring etc., are installed, modified, maintained by a licensed Electrician/Supervisor. A test certificate is to be produced to the ENGINEER-IN-CHARGE for his approval, before power is made available.

2.4.3 At all times, IEA regulations shall be followed failing which the EMPLOYER has a right to disconnect the power supply without any reference to the CONTRACTOR. No claim shall be entertained for such disconnection by the ENGINEER-IN-CHARGE. Power supply will be reconnected only after production of fresh certificate from authorized electrical supervisors.

2.4.1 The EMPLOYER is not liable for any loss or damage to the CONTRACTOR's equipment as a result of variation in voltage or frequency or interruption in power supply or other loss to the CONTRACTOR arising there from.

2.4.2 The CONTRACTOR shall ensure that the Electrical equipment installed by him are such that average power factors does not fall below 0.90 at his premises. In case power factor falls below 0.90 in any month, he will reimburse to the EMPLOYER at the penal rate determined by the EMPLOYER for all units consumed during the month.

2.4.3 The power supply required for CONTRACTOR's colony near the plant site will be determined by the EMPLOYER and shall be as per State Electricity Board's Rules and other statutory provisions applicable for such installations from time to time. In case of power supply to CONTRACTOR's colony, the power will be made available at a single point and the CONTRACTOR shall make his own arrangement at his own cost for distribution to the occupants of the colony as per Electricity Rules and Acts. The site and colony shall be sufficiently illuminated to avoid accidents.

2.4.4 The CONTRACTOR will have to provide and install his own lights and power meters which will be governed as per Central/State Government Electricity Rules. The metres shall be sealed by the EMPLOYER.

2.4.8 In case of damage of any of the EMPLOYER's equipment on account of fault, intentional or unintentional on the part of the CONTRACTOR, the EMPLOYER reserves the right to recover the cost of such damage from the CONTRACTOR's bill. Cost of HRC Fuses replaced at the EMPLOYER's terminals due to any fault in the CONTRACTOR's installation shall be to CONTRACTOR's account at the rates decided by the ENGINEER-IN-CHARGE.

2.4.9 Only motors upto 3 HP will be allowed to be started direct on line. For motors above 3 HP and upto 100 HP a suitable Starting device approved by the ENGINEER- IN-CHARGE shall be provided by the CONTRACTOR. For motors above 100 HP slipring induction motors with suitable starting devices as approved by the ENGINEER- IN-CHARGE shall be provided by the CONTRACTOR.

2.4.10 The CONTRACTOR shall ensure at his cost that all electrical lines and equipment and all installations are approved by the State Electricity Inspector before power can be supplied to the EMPLOYER.

2.4.11 The total requirement of power shall be indicated by the tenderer alongwith his tender.

2.5 Land for Contractor's Field Office, Godown and Workshop:

The EMPLOYER will, at his own discretion and convenience and for the duration of the execution of the work make available near the site, land for construction of CONTRACTOR's Temporary Field Office, godowns workshops and assembly yard required for the execution of the CONTRACT. The CONTRACTOR shall at his own cost construct all these temporary buildings and provide suitable water supply and sanitary arrangement and get the same approved by the ENGINEER-IN-CHARGE. On completion of the works undertaken by the CONTRACTOR, he shall remove all temporary works erected by him and have the SITE cleaned as directed by ENGINEER-IN-CHARGE. If the CONTRACTOR shall fail to comply with these requirements, the ENGINEER-IN-CHARGE may at he expenses of the CONTRACTOR remove such surplus, and rubbish materials and dispose off the same as he deems fit and get the site cleared as aforesaid; and CONTRACTOR shall forthwith pay the amount of all expenses so incurred and shall have no claim in respect of any such surplus materials disposed off as aforesaid. But the EMPLOYER reserves the right to ask the CONTRACTOR any time during the pendency of the CONTRACT to vacate the land by giving 7 days notice on security reasons or on national interest or otherwise. Rent may be charged for the land so occupied from contractor by the Employer. The CONTRACTOR shall put up temporary structures as required by them for their office, fabrication shop and construction stores only in the area allocated to them on the project site by the EMPLOYER or his authorised representative. No tea stalls/canteens should be put up or allowed to be put up by any CONTRACTOR in the allotted land or complex area without written permission of the EMPLOYER. No unauthorised buildings, constructions or structures should be put up by the CONTRACTOR anywhere on the project site. For uninterrupted fabrication work, the CONTRACTOR shall put up temporary covered structures at his cost within Area in the location allocated to them in the project site by the EMPLOYER or his authorised representative. No person except for authorised watchman shall be allowed to stay in the plant area/CONTRACTOR's area after completion of the day's job without prior written permission from ENGINEER-IN-CHARGE.

2.6 Land for Residential Accommodation:-:No Land shall be made available for residential accommodation for staff and labour of CONTRACTOR.

SECTION-III GENERAL INSTRUCTIONS TO TENDERERS

3. Submission of Tender:

3.1 TENDER must be submitted without making any additions, alterations, and as per details given in other clauses hereunder. The requisite details shall be filled in by the TENDERER at space provided under "Submission of Tender at the beginning of GCC of Tender Document. The rate shall be filled only in the schedule given in this Tender Document.

3.2 Addenda/Corrigenda to this Tender Document, if issued, must be signed, submitted along with the Tender Document. the tenderer should write clearly the revised quantities in Schedule of Rates of Tender Document and should price the WORK based on revised quantities when amendments of quantities are issued in addenda.

3.3 Covering letter along with its enclosures accompanying the Tender Document and all further correspondence shall be submitted in duplicate.

3.4 Tenderers are advised to submit quotations based strictly on the terms and conditions and specifications contained in the Tender Documents and not to stipulate any deviations.

3.5 Tenders should always be placed in double sealed covers, super scribing ["QUOTATION DO NOT OPEN" Tender for NEPAL BHARAT MAITRI POLYTECHNIC, HETAUDA, NEPAL Project of Ministry of External Affairs, Government of India due for opening on _____]. The *Full Name, Address and Telegraphic Address, Fax No. of the Tenderers* shall be written on the bottom left hand corner of the sealed cover.

4. Documents:

4.1 General:

The tenders as submitted will consist of the following:

- i) Complete set of Tender Documents (Original) as sold duly filled in and signed by the tenderer as prescribed in different clauses of the Tender Documents.
- ii) Earnest money in the manner specified in Clause 6 hereof.
- iii) Power of Attorney or a true copy thereof duly attested by a Gazetted Officer in case an authorised representative has signed the tender, as required by Clause 14 hereof.
- iv) Information regarding tenderers in the proforma enclosed.
- v) Details of work of similar type and magnitude carried out by the Tenderer in the proforma provided in the tender document.
- vi) Organisation chart giving details of field management at site, the tenderer proposes to have for this job.
- vii) Details of construction plant and equipments available with the tenderer for using in this work.
- viii) Solvency Certificate from Scheduled Bank to prove the financial ability to carry out the work tendered for.
- ix) Latest Balance Sheet and Profit & Loss Account duly audited.
- x) Details of present commitment as per proforma enclosed to tender.
- xi) Data required regarding SUB-CONTRACTOR(s)/ Supplier/ Manufacturers and other technical information's the tenderer wish to furnish.
- xii) Provident fund registration certificate
- xiii) List showing all enclosures to tender.

4.2 All pages are to be Initialed: All signatures in Tender Documents shall be dated, as well as, all the pages of all sections of Tender Documents shall be initialed at the lower right hand corner and signed wherever required in the tender papers by the TENDERER or by a person holding power of attorney authorising him to sign on behalf of the tenderer before submission of tender.

4.3 Rates to be in Figures and Words: The tender should quote in English both in figures as well as in words the rates and amounts tendered by him in the Schedule of Rates of Tender submitted by the CONTRACTOR for each item and in such a way that interpolation is not possible. The amount for each item should be worked out and entered and requisite total given of all items, both in figures and in words. The tendered amount for the work shall be entered in the tender and duly signed by the Tenderer. If some discrepancies are found between the RATES in FIGURES and WORDS or the AMOUNT shown in the tender, the following procedure shall be followed:

- a) When there is difference between the rates in figures and words, the rate which corresponds to the amount worked out by the tenderer shall be taken as correct.
- b) When the rate quoted by the tenderer in figures and words tally but the amount is incorrect the rate quoted by the tenderer shall be taken as correct.
- c) When it is not possible to ascertain the correct rate by either of above methods, the rate quoted in words shall be taken as correct.

4.4 Corrections and Erasures: All correction(s) and alteration(s) in the entries of tender paper shall be signed in full by the TENDERER with date. No erasure or over writing is permissible.

4.5 Signature of Tenderer:

4.5.1 The TENDERER shall contain the name, residence and place of business of person or persons making the tender and shall be signed by the TENDERER with his usual signature. Partnership firms shall furnish the full names of all partners in the tender. It should be signed in the partnership's name by all the partners or by duly authorised representatives followed by the name and designation of the person signing. Tender by a corporation shall be signed by an authorised representative, and a Power of Attorney in that behalf shall accompany the tender. A copy of the constitution of the firm with names of all partners shall be furnished.

4.5.2 When a tenderer signs a tender in a language other than English, the total amount tendered should, in addition, be written in the same language. The signature should be attested by at least one witness.

4.6 Witness: Witness and sureties shall be persons of status and property and their names, occupation and address shall be stated below their signature.

4.7 Details of Experience: The tenderer should furnish, alongwith his tender, details of previous experience in having successfully completed in the recent past works of this nature, together with the names of Employers, location of sites and value of contract, date of commencement and completion of work, delays if any, reasons of delay and other details alongwith documentary evidence(s).

5. Transfer of Tender Documents:

5.1 Transfer of Tender Documents purchased by one intending tenderer to another is not permissible.

6. Earnest Money:

6.1 The bidder must pay Earnest Money as given in the letter /notice inviting tenders and attach the official receipt with the tender failing which the tender is liable to be rejected and representatives of such tenderers will not be allowed to attend the tender opening. Earnest Money can be paid in Demand Drafts or Bank Guarantee or Banker's Cheque or Letter of Credit from any Indian scheduled bank or a branch of an International bank situated in India and registered with Reserve Bank of India as scheduled foreign bank. However, other than the Nationalised Indian Banks, the banks whose BGs are furnished, must be commercial banks having net worth in excess of Rs. 100 crores and a declaration to this effect should be made by such commercial bank either in the bank guarantee itself or separately on a letter head. The bid guarantee shall be submitted in the prescribed format.

Note: The Bank Guarantee so furnished by the tenderer shall be in the proforma prescribed by the EMPLOYER. No interest shall be paid by the EMPLOYER on the Earnest Money deposited by the tenderer. The Bank Guarantee furnished in lieu of Earnest Money shall be kept valid for a period of "SIX MONTHS" from the date of opening of tender.(TWO MONTHS beyond the bid validity). The Earnest Money deposited by successful tenderer shall be forfeited if the Contractor fails to furnish the requisite Contract Performance Security as per clause 24 hereof and /or fails to start work within a period of 15 days or fails to execute the AGREEMENT within 15 days of the receipt by him of the Notification of Acceptance of Tender.

Note: The Earnest Money of the unsuccessful bidder will be returned by EMPLOYER/CONSULTANT, directly to the tenderer (s), within a reasonable period of time but not later than 30 days after the expiration of the period of bid validity prescribed by EMPLOYER.

7 Validity:

7.1 Tender submitted by tenderers shall remain valid for acceptance for a period of "6 MONTHS"(180 days) from the date of opening of the tender. The tenderers shall not be entitled during the said period of 6 months, without the consent in writing of the EMPLOYER, to revoke or cancel his tender or to vary the tender given or any term thereof. In case of tender revoking or canceling his tender or varying any term in regard thereof without the consent of EMPLOYER in writing, the EMPLOYER shall forfeit Earnest Money paid by him along with tender.

8 Addenda/Corrigenda

8.1 Addenda/ Corrigenda to the Tender Documents will be issued in duplicate prior to the date of opening of the tenders to clarify documents or to reflect modification in design or CONTRACT terms.

8.2 Each addenda/ corrigendum issued will be issued in duplicate to each person or organisation to whom set of Tender Documents has been issued. Recipient will retain tenderer's copy of each Addendum/Corrigendum and attach original copy duly signed along with his offer. All Addenda/Corrigenda issued shall become part of Tender Documents.

9 Right of Employer to Accept or Reject Tender:

9.1 The right to accept the tender will rest with the EMPLOYER. The EMPLOYER, however, does not bind himself to accept the lowest tender, and reserves to itself the authority to reject any or all the tenders received without assigning any reason whatsoever. At the option of the Employer, the work for which the tender had been invited, may be awarded to one Contractor or split between more than one bidders, in which case the award will be made for only that part of the work, in respect of which the bid has been accepted. The quoted rates should hold good for such eventualities. Tenders in which any of the particulars and prescribed information are missing or are incomplete in any respect and/or the prescribed conditions are not fulfilled are liable to be rejected. The Tender containing uncalled for remarks or any additional conditions are liable to be rejected. Canvassing in connection with tenders is strictly prohibited and tenders submitted by the Tenderers who resort to canvassing will be liable to rejection.

10 Time Schedule

10.1 The WORK shall be executed strictly as per the TIME SCHEDULE(**24 MONTHS**) specified in TENDER/CONTRACT Document. The period of construction given in Time Schedule includes the time required for mobilisation as well as testing, rectifications if any, retesting and completion in all respects to the entire satisfaction of the ENGINEER-IN- CHARGE.

10.2 A joint programme of execution of the WORK will be prepared by the ENGINEER-IN-CHARGE and CONTRACTOR based on priority requirement of this project. This programme will take into account the time of completion mentioned in 10.1 above and the time allowed for the priority works by

the ENGINEER-IN-CHARGE.

10.3 Monthly/Weekly construction programme will; be drawn up by the ENGINEER-IN-CHARGE jointly with the CONTRACTOR, based on availability of work fronts and the joint construction programme as per 10.2 above. The CONTRACTOR shall scrupulously adhere to these targets /programmes by deploying adequate personnel, construction tools and tackles and he shall also supply himself all materials of his scope of supply in good time to achieve the targets/programmes. In all matters concerning the extent of targets set out in the weekly and monthly programmes and the degree of achievements the decision of the ENGINEER-IN-CHARGE will be final and binding on the CONTRACTOR.

11 Tenderer's Responsibility

11.1 The intending tenderers shall be deemed to have visited the SITE and familiarised submitting the tender. Non-familiarity with the site conditions will not be considered a reason either for extra claims or for not carrying out the works in strict conformity with the DRAWINGS and SPECIFICATIONS or for any delay in performance.

12 Retired Government or Company Officers

12.1 No Engineer of Gazetted rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the States/ Central Government or of the EMPLOYER is allowed to work as a CONTRACTOR for a period of two years after his retirement from Government Service, or from the employment of the EMPLOYER without the previous permission of the EMPLOYER. The CONTRACT, if awarded, is liable to be cancelled if either the CONTRACTOR or any of his employees is found at any time to be such a person, who has not obtained the permission of the State/Central Government or of the EMPLOYER as aforesaid before submission of tender, or engagement in the CONTRACTOR'S service as the case may be.

13 Signing of the Contract:

13.1 The successful tenderer shall be required to execute an AGREEMENT in the proforma attached with TENDER DOCUMENT within 15 days of the receipt by him of the Notification of Acceptance of Tender. In the event of failure on the part of the successful tenderer to sign the AGREEMENT within the above stipulated period, the Earnest Money or his initial deposit will be forfeited and the acceptance of the tender shall be considered as cancelled.

14 Field Management & Controlling/Coordinating Authority:

14.1 The field management will be the responsibility of the ENGINEER-IN-CHARGE, who will be nominated by the EMPLOYER. The ENGINEER-IN-CHARGE may also authorize his representatives to assist in performing his duties and functions.

14.2 The ENGINEER-IN-CHARGE shall coordinate the works of various agencies engaged at site to ensure minimum disruption of work carried out by different agencies. It shall be the responsibility of the CONTRACTOR to plan and execute the work strictly in accordance with site instructions to avoid hindrance to the work being executed by other agencies.

15 Note to Schedule of Rates:

15.1 The Schedule of Rates should be read in conjunction with all the other sections of the tender.

15.2 The tenderer shall be deemed to have studied the DRAWINGS, SPECIFICATIONS and details of work to be done within TIME SCHEDULE and to have acquainted himself of the condition prevailing at site.

15.3 Rates must be filled in the Schedule of Rates of original Tender Documents. If quoted in separate

typed sheets no variation in item description or specification shall be accepted. Any exceptions taken by the tenderer to the Schedule of Rates shall be brought out in the terms and conditions of the offer.

15.4 The quantities shown against the various items are only approximate. Any increase or decrease in the quantities shall not form the basis of alteration of the rates quoted and accepted.

15.5 The EMPLOYER reserves the right to interpolate the rates for such items of work falling between similar items of lower and higher magnitude.

16 Policy for Tenders Under Consideration:

16.1 Only Those Tenders which are complete in all respects and are strictly in accordance with the Terms and Conditions and Technical Specifications of Tender Document, shall be considered for evaluation. Such Tenders shall be deemed to be under consideration immediately after opening of Tender and until such time an official intimation of acceptance /rejection of Tender is made by MEA to the Bidder.

16.2 Zero Deviation: Bidders to note that this is a ZERO DEVIATION TENDER. MEA will appreciate submission of offer based on the terms and conditions in the enclosed General Conditions of Contract (GCC), Special Conditions of Contract (SCC), Instructions to Bidders (ITB), Scope of Work, technical specifications etc. to avoid wastage of time and money in seeking clarifications on technical/commercial aspects of the offer. Bidder may note that no technical and commercial clarifications will be sought for after the receipt of the bids. In case of any deviation/nonconformity observed in the bid, it will be liable for rejection.

17 Award of Contract:

17.1 The Acceptance of Tender will be intimated to the successful Tenderer by MEA either by Telex/Telegram/ Fax or by Letter or like means-defined as LETTER OF ACCEPTANCE OF TENDER.

17.2 MEA will be the sole judge in the matter of award of CONTRACT and the decision of MEA shall be final and binding.

18 Clarification of Tender Document:

18.1 The Tender is required to carefully examine the Technical Specifications, Conditions of Contract, Drawings and other details relating to WORK and given in Tender Document and fully inform himself as to all conditions and matters which may in any way affect the WORK or the cost thereof. In case the Tenderer is in doubt about the completeness or correctness of any of the contents of the Tender Documents he should request in writing for an interpretation/clarification to MEA in triplicate. MEA will then issue interpretation/clarification to Tenderer in writing. Such clarifications and or interpretations shall form part of the Specifications and Documents and shall accompany the tender which shall be submitted by tenderer within time and date as specified in invitations to tender.

18.2 Verbal clarification and information given by MEA or its employee(s) or its representatives shall not in any way be binding on MEA.

19 Local Conditions:

19.1 It will be imperative on each tenderer to inform himself of all local conditions and factors which may have any effect on the execution of WORK covered under the Tender Document. In their own interest, the tenderer are requested to familiarise themselves with the Indian Income Tax Act 1961, Indian Companies Act 1956, and Indian Customs Act 1962 and other related Acts and Laws and Regulations of India with their latest amendments, as applicable MEA shall not entertain any requests for clarifications from the tenderer regarding such local conditions.

19.2 It must be understood and agreed that such factors have properly been investigated and considered while submitting the tender. No claim for financial or any other adjustments to VALUE OF CONTRACT, on lack of clarity of such factors shall be entertained.

20 Abnormal Rates:

20.1 The tenderer is expected to quote rate for each item after careful analysis of cost involved for the performance of the completed item considering all specifications and Conditions of Contract. This will avoid loss of profit or gain in case of curtailment or change of specification for any item. In case it is noticed that the rates quoted by the tenderer for any item are unusually high or unusually low, it will be sufficient cause for the rejection of the tender unless the EMPLOYER is convinced about the reasonableness after scrutiny of the analysis for such rate(s) to be furnished by the tenderer (on demand).

SECTION-IV GENERAL OBLIGATIONS

21 Priority of Contract Documents

21.1 Except if and the extent otherwise provided by the Contract, the provisions of the General Conditions of Contract and Special Conditions shall prevail over those of any other documents forming part of the CONTRACT. Several documents forming the CONTRACT are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies the same shall be explained and adjusted by the ENGINEER-IN-CHARGE who shall thereupon issue to the Contractor instructions thereon and in such event, unless otherwise provided in the Contract, the priority of the documents forming the Contract shall be as follows :

- 1) The Contract Agreement ;
- 2) The Letter of Acceptance;
- 3) The (Instructions to Bidders)ITB;
- 4) Special Conditions of Contract (SCC);
- 5) General Conditions of Contract (GCC)
- 6) Any other document forming part of the Contract.

Works shown in the DRAWING but not mentioned in the SPECIFICATIONS OR described in the SPECIFICATIONS without being shown in the DRAWINGS shall nevertheless be deemed to be included in the same manner as if they had been specifically shown upon the DRAWINGS and described in the SPECIFICATIONS.

21.2 Headings and Marginal Notes: All headings and marginal notes to the clauses of these General Conditions of Contract or to the SPECIFICATIONS or to any other Tender Document are solely for the purpose of giving a concise indication and not a summary of the contents thereof, and they shall never be deemed to be part thereof or be used in the interpretation or construction thereof the CONTRACT.

21.3 Singular and Plural: In CONTRACT DOCUMENTS unless otherwise stated specifically, the singular shall include the plural and vice versa wherever the context so requires.

21.4 Interpretation: Words implying 'Persons' shall include relevant Corporate Companies / Registered Associations/ Body of Individuals/ Firm of Partnership' as the case may be.

22 Special Conditions of Contract:

22.1 Special Conditions of Contract shall be read in conjunction with the General Conditions of Contract, specification of Work, Drawings and any other documents forming part of this CONTRACT wherever the context so requires.

22.2 Notwithstanding the sub-division of the documents into these separate sections and volumes every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the CONTRACT so far as it may be practicable to do so.

22.3 Where any portion of the General Condition of Contract is repugnant to or at variance with any provisions of the Special Conditions of Contract, unless a different intention appears the provisions of the Special Conditions of Contract shall be deemed to over-ride the provisions of the General Conditions of Contract and shall to the extent of such repugnancy, or variations, prevail.

22.4 Wherever it is mentioned in the specifications that the CONTRACTOR shall perform certain WORK or provide certain facilities, it is understood that the CONTRACTOR shall do so at his cost and the VALUE OF CONTRACT shall be deemed to have included cost of such performance and provisions, so mentioned.

22.5 The materials, design and workmanship shall satisfy the relevant INDIAN STANDARDS, the JOB SPECIFICATIONS contained herein and CODES referred to. Where the job specification stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.

23 Contractor to obtain his own Information:

23.1 The CONTRACTOR in fixing his rate shall for all purpose whatsoever reason may be, deemed to have himself independently obtained all necessary information for the purpose of preparing his tender and his tender as accepted shall be deemed to have taken into account all contingencies as may arise due to such information or lack of same. The correctness of the details, given in the Tender Document to help the CONTRACTOR to make up the tender is not guaranteed. The CONTRACTOR shall be deemed to have examined the CONTRACT DOCUMENTS, to have generally obtained his own information in all matters whatsoever that might affect the carrying out of the works at the schedules rates and to have satisfied himself to the sufficiency of his tender. Any error in description of quantity or omission therefrom shall not vitiate the CONTRACT or release the CONTRACTOR from executing the work comprised in the CONTRACT according to DRAWINGS and SPECIFICATIONS at the scheduled rates. He is deemed to have known the scope, nature and magnitude of the WORKS and the requirements of materials and labour involved etc., and as to what all works he has to complete in accordance with the CONTRACT documents whatever be the defects, omissions or errors that may be found in the DOCUMENTS. The CONTRACTOR shall be deemed to have visited surroundings, to have satisfied himself to the nature of all existing structures, if any, and also as to the nature and the conditions of the Railways, Roads, Bridges and Culverts, means of transport and communication, whether by land, water or air, and as to possible interruptions thereto and the access and egress from the site, to have made enquiries, examined and satisfied himself as to the sites for obtaining sand, stones, bricks and other materials, the sites for disposal of surplus materials, the available accommodation as to whatever required, depots and such other buildings as may be necessary for executing and completing the works, to have made local independent enquiries as to the sub-soil, subsoil water and variations thereof, storms, prevailing winds, climatic conditions and all other similar matters effecting these works. He is deemed to have acquainted himself as to his liability of payment of Government Taxes, Customs duty and other charges, levies etc. Any neglect or omission or failure on the part of the CONTRACTOR in obtaining necessary and reliable information upon the foregoing or any other matters affecting the CONTRACT shall not relieve him from any risks or liabilities or the entire responsibility from completion of the works at the scheduled rates and times in strict accordance with the CONTRACT. It is, therefore, expected that should the CONTRACTOR have any doubt as to the meaning of any portion of the CONTRACT DOCUMENT he shall set forth the particulars thereof in writing to EMPLOYER in duplicate, before submission of tender. The EMPLOYER may provide such clarification as may be necessary in writing to CONTRACT, such clarifications as provided by EMPLOYER shall form part of CONTRACT DOCUMENTS. No verbal agreement or inference from conversation with any effect or employee of the EMPLOYER either before, during or after the execution of the CONTRACT agreement shall in any way affect or modify and of the terms or obligations herein contained. Any change in layout due to site conditions or technological requirement shall be binding on the CONTRACTOR and no extra claim on this account shall be entertained.

24 Contract Performance Security:

24.1 The CONTRACTOR shall furnish to the EMPLOYER, within 15 days from the date of notification of award, a security in the sum of 5% of the accepted value of the tender or the actual value of work to be done whichever is applicable due to any additional work or any other reasons, in the form of a Bank draft/Banker's cheque or Bank Guarantee or irrevocable Letter of credit (as per proforma enclosed) as Contract Performance Security with the EMPLOYER which will be refunded after the expiry of DEFECTS LIABILITY PERIOD. **(Defect Liability period is one year from date of completion work)**

24.2 CONTRACTOR can furnish the Contract Performance Security in the form of Demand Draft or through a Bank Guarantee or through an irrevocable Letter of Credit from any Indian scheduled bank

or a branch of an International bank situated in India and registered with Reserve Bank of India as scheduled foreign bank. However, other than the Nationalised Indian Banks, the banks whose BGs are furnished, must be commercial banks having net worth in excess of Rs. 100 crores and a declaration to this effect should be made by such commercial bank either in the bank guarantee itself or separately on a letter head. The bank guarantee or the Letter of Credit shall be submitted in the prescribed format.

24.3 If the CONTRACTOR/SUB-CONTRACTOR or their employees or the CONTRACTOR's agents and representatives shall damage, break, deface or destroy any property belonging to the EMPLOYER or others during the execution of the CONTRACT, the same shall be made good by the CONTRACTOR at his own expenses and in default thereof, the ENGINEER-IN-CHARGE may cause the same to be made good by other agencies and recover expenses from the CONTRACTOR (for which the certificate of the ENGINEER- IN-CHARGE shall be final).

24.4 All compensation or other sums of money payable by the CONTRACTOR to the EMPLOYER under terms of this CONTRACT may be deducted from or paid by the encashment or sale of a sufficient part of his Contract Performance Security or from any sums which may be due or may become due to the CONTRACTOR by the EMPLOYER of any account whatsoever and in the event of his Contract Performance Security being reduced by reasons of any such deductions or sale of aforesaid, the CONTRACTOR shall within ten days thereafter make good in cash, bank drafts as aforesaid any sum or sums which may have been deducted from or realised by sale of his Contract Performance Security, or any part thereof. No interest shall be payable by the EMPLOYER for sum deposited as Contract Performance Security.

24.5 Failure of the successful bidder to comply with the requirements of this Clause shall constitute sufficient grounds for the annulment of the award and the forfeiture of bid security.

25 Time of Performance:

25.1 Time for Mobilisation The work covered by this CONTRACT shall be commenced within fifteen (15) days, the date of letter/Fax of Intent and be completed in stages on or before the dates as mentioned in the TIME SCHEDULE OF COMPLETION OF WORK. The CONTRACTOR should bear in mind that time is the essence of this agreement. Request for revision of construction time after tenders are opened will not receive consideration. The above period of fifteen (15) days is included within the overall COMPLETION SCHEDULE, not over and above the completion time to any additional work or any other reasons.

25.2 Time Schedule of Construction:

25.2.1 The general Time Schedule of construction is given in the TENDER DOCUMENT. CONTRACTOR should prepare a detailed monthly or weekly construction program jointly with the ENGINEER-IN-CHARGE within 15 days of receipt of LETTER/FAX OF INTENT or ACCEPTANCE OF TENDER. The WORK shall be executed strictly as per the Time Schedule given in the CONTRACT DOCUMENT. The period of construction given includes the time required for mobilisation testing, rectifications, if any, retesting and completion in all respects in accordance with CONTRACT DOCUMENT to the entire satisfaction of the ENGINEER-IN-CHARGE.

25.2.2 The CONTRACTOR shall submit a detailed PERT network within the time frame agreed above consisting of adequate number of activities covering various key phases of the WORK such as design, procurement, manufacturing, shipment and field erection activities within fifteen (15) days from the date of LETTER/FAX OF INTENT. This network shall also indicate the interface facilities to be provided by the EMPLOYER and the dates by which such facilities are needed.

25.2.3 CONTRACTOR shall discuss the network so submitted with the EMPLOYER and the agreed network which may be in the form as submitted with the EMPLOYER or in revised form in line with the outcome of discussions shall form part of the CONTRACT, to be signed within fifteen (15) days from the date of LETTER OF ACCEPTANCE OF TENDER. During the performance of the CONTRACT, if

in the opinion of the EMPLOYER proper progress is not maintained suitable changes shall be made in the CONTRACTOR's operation to ensure proper progress. The above PERT network shall be reviewed periodically and reports shall be submitted by the CONTRACTOR as directed by EMPLOYER.

26 Force Majeure:

26.1 CONDITIONS FOR FORCE MAJEURE In the event of either party being rendered unable by Force Majeure to perform any obligations required to be performed by them under the CONTRACT the relative obligation of the party affected by such Force Majeures shall upon notification to the other party be suspended for the period during which Force Majeures event lasts. The cost and loss sustained by the either party shall be borne by the respective parties. The term "Force Majeures" as employed herein shall mean acts of God, earthquake, war (declared or undeclared), revolts, riots, fires, floods, rebellions, explosions, hurricane, sabotage, civil commotions and acts and regulations of respective Government of the two parties, namely the EMPLOYER and the CONTRACTOR. Upon the occurrence of such cause(s) and upon its termination, the party alleging that it has been rendered unable as aforesaid thereby, shall notify the other party in writing immediately but not later than 72 (Seventy-two) hours of the alleged beginning and ending thereof giving full particulars and satisfactory evidence in support of its claim. Time for performance of the relative obligation suspended by the Force Majeures shall then stand extended by the period for which such cause lasts. If deliveries of bought out items and/or works to be executed by the CONTRACTOR are suspended by Force Majeure conditions lasting for more than 2 (two) months the EMPLOYER shall have the option to terminate the CONTRACT or re-negotiate the contract provisions.

26.2 OUTBREAK OF WAR

26.2.1 If during the currency of the CONTRACT there shall be an out-break of war whether declared or not, in that part of the World which whether financially or otherwise materially affect the execution of the WORK the CONTRACTOR shall unless and until the CONTRACT is terminated under the provisions in this clause continue to use his best endeavour to complete the execution of the WORK, provided always that the EMPLOYER shall be entitled, at any time after such out-break of war to terminate or re-negotiate the CONTRACT by giving notice in writing to the CONTRACTOR and upon such notice being given the CONTRACT shall, save as to the rights of the parties under this clause and to the operation of the clauses entitled settlement of Disputes and Arbitration hereof, be terminated but without prejudice to the right of either party in respect of any antecedent breach thereof.

26.2.2 If the CONTRACT shall be terminated under the provisions of the above clause, the CONTRACTOR shall with all reasonable diligence remove from the SITE all the CONTRACTOR's equipment and shall give similar facilities to his SUB-CONTRACTORS to do so.

27 Price reduction schedule:

27.1 Time is the essence of the CONTRACT. In case the CONTRACTOR fails to complete the WORK within the stipulated period, then, unless such failure is due to Force Majeure as defined in Clause 26 here above or due to EMPLOYER's defaults, the Total Contract price shall be reduced by $\frac{1}{2}$ % of the total Contract Price per complete week of delay or part thereof subject to a maximum of 5 % of the Total Contract Price, by way of reduction in price for delay and not as penalty. The said amount will be recovered from amount due to the Contractor/ Contractor's Contract Performance Security payable on demand. The decision of the ENGINEER-IN-CHARGE in regard to applicability of Price Reduction Schedule shall be final and binding on the CONTRACTOR.

27.2 All sums payable under this clause is the reduction in price due to delay in completion period at the above agreed rate.

27.3 Bonus For Early Completion (*)

If the Contractor achieves completion of Works in all respect prior to the time schedule stipulated in the SCC, the Employer shall pay to the Contractor the relevant sum, if mentioned specifically in SCC, as bonus for early completion. The bonus for early completion, if provided specifically in SCC, shall be payable to the maximum ceiling of 2 ½ % of the total contract price.

(*) Partial earlier completion may not always produce net benefits to the Employer, for example where utilization of the completed Works requires (a) the fulfillment of all parts of the Contract (e.g. the training of personnel); or

(b) the completion of all Sections (e.g. in pipeline laying, where early completion of the laying of pipeline would not be useful if the compressor is still under installation); or (c) certain seasonal effects to take place (e.g. onset of the rainy season, for impounding a reservoir); or (d) other circumstances. Also a more rapid drawdown of budgeted funds may be required. All such factors should be considered prior to the inclusion of a bonus clause in the Contract.

28 Rights of the employer to forfeit contract performance security:

28.1 Whenever any claim against the CONTRACTOR for the payment of a sum of money arises out or under the CONTRACT, the EMPLOYER shall be entitled to recover such sum by appropriating in part or whole the Contract Performance Security of the CONTRACTOR. In the event of the security being insufficient or if no security has been taken from the CONTRACTOR, then the balance or the total sum recoverable, as the case may be shall be deducted from any sum then due or which at any time thereafter may become due to the CONTRACTOR. The CONTRACTOR shall pay to the EMPLOYER on demand any balance remaining due.

29 Failure by the contractor to comply with the provisions of the contract:

29.1 If the CONTRACTOR refuses or fails to execute the WORK or any separate part thereof with such diligence as will ensure its completion within the time specified in the CONTRACT or extension thereof or fails to perform any of his obligation under the CONTRACT or in any manner commits a breach of any of the provisions of the CONTRACT it shall be open to the EMPLOYER at its option by written notice to the CONTRACTOR:

a) TO DETERMINE THE CONTRACT in which event the CONTRACT shall stand terminated and shall cease to be in force and effect on and from the date appointed by the EMPLOYER on that behalf, whereupon the CONTRACTOR shall stop forthwith any of the CONTRACTOR's work then in progress, except such WORK as the EMPLOYER may, in writing, require to be done to safeguard any property or WORK, or installations from damage, and the EMPLOYER, for its part, may take over the work remaining unfinished by the CONTRACTOR and complete the same through a fresh contractor or by other means, at the risk and cost of the CONTRACTOR, and any of his sureties if any, shall be liable to the EMPLOYER for any excess cost occasioned by such work having to be so taken over and completed by the EMPLOYER over and above the cost at the rates specified in the schedule of quantities and rate/prices.

b) WITHOUT DETERMINING THE CONTRACT to take over the work of the CONTRACTOR or any part thereof and complete the same through a fresh contractor or by other means at the risk and cost of the CONTRACTOR. The CONTRACTOR and any of his sureties are liable to the EMPLOYER for any excess cost over and above the cost at the rates specified in the Schedule of Quantities/ rates, occasioned by such works having been taken over and completed by the EMPLOYER.

29.2 In such events of Clause 29.1(a) or (b) above.

a) The whole or part of the Contract Performance Security furnished by the CONTRACTOR is liable to be forfeited without prejudice to the right of the EMPLOYER to recover from the CONTRACTOR the excess cost referred to in the sub-clause aforesaid, the EMPLOYER shall also have the right of taking possession and utilising in completing the works or any part thereof, such as materials equipment and plants available at work site belonging to the CONTRACTOR as may be necessary and the CONTRACTOR shall not be entitled for any compensation for use or damage to such materials,

equipment and plant.

b) The amount that may have become due to the CONTRACTOR on account of work already executed by him shall not be payable to him until after the expiry of Six (6) calendar months reckoned from the date of termination of CONTRACT or from the taking over of the WORK or part thereof by the EMPLOYER as the case may be, during which period the responsibility for faulty materials or workmanship in respect of such work shall, under the CONTRACT, rest exclusively with the CONTRACTOR. This amount shall be subject to deduction of any amounts due from the CONTRACT to the EMPLOYER under the terms of the CONTRACT authorised or required to be reserved or retained by the EMPLOYER.

29.3 Before determining the CONTRACT as per Clause 29.1(a) or (b) provided in the judgement of the EMPLOYER, the default or defaults committed by the CONTRACTOR is/are curable and can be cured by the CONTRACTOR if an opportunity given to him, then the EMPLOYER may issue Notice in writing calling the CONTRACTOR to cure the default within such time specified in the Notice.

29.4 The EMPLOYER shall also have the right to proceed or take action as per 29.1(a) or (b) above, in the event that the CONTRACTOR becomes bankrupt, insolvent, compounds with his creditors, assigns the CONTRACT in favour of his creditors or any other person or persons, or being a company or a corporation goes into voluntary liquidation, provided that in the said events it shall not be necessary for the EMPLOYER to give any prior notice to the CONTRACTOR.

29.5 Termination of the CONTRACT as provided in sub- clause 29.1(a) above shall not prejudice or affect their rights of the EMPLOYER which may have accrued upto the date of such termination.

30 Contractor remains liable to pay compensation if

30.1 In any case in which any of the powers conferred upon the EMPLOYER BY CLAUSE 29.0 thereof shall have become **action not taken under clause 29:** exercisable and the same had not been exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any further case of default by the CONTRACTOR for which by any clause or clauses hereof he is declared liable to pay compensation amounting to the whole of his Contract Performance Security, and the liability of the CONTRACTOR for past and future compensation shall remain unaffected. In the event of the EMPLOYER putting in force the power under above sub -clause (a), (b) or (c) vested in him under the preceding clause he may, if he so desired, take possession of all or any tools, and plants, materials and stores in or upon the works or the site thereof belonging to the CONTRACTOR or procured by him and intended to be used for the execution of the WORK or any part thereof paying or allowing for the same in account at the CONTRACT rates or in case of these not being applicable at current market rates to be certified by the ENGINEER-IN-CHARGE whose certificate thereof shall be final, otherwise the ENGINEER-IN- CHARGE may give notice in writing to the CONTRACTOR or his clerk of the works, foreman or other authorised agent, requiring him to remove such tools, plant, materials or stores from the premises (within a time to be specified in such notice), and in the event of the CONTRACTOR failing to comply with any such requisition, the ENGINEER-IN-CHARGE may remove them at the CONTRACTOR's expense or sell them by auction or private sale on account of the CONTRACTOR and at his risk in all respects without any further notice as to the date, time or place of sale and the certificate of the ENGINEER-IN-CHARGE as to the expenses of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the CONTRACTOR.

31 Change in constitution:

31.1 Where the CONTRACTOR is a partnership firm, the prior approval of the EMPLOYER shall be obtained in writing, before any change is made in the constitution of the firm. Where the CONTRACTOR is an individual or a Hindu undivided family business concern, such approval as aforesaid shall, likewise be obtained before such CONTRACTOR enters into any agreement with other parties, where under, the reconstituted firm would have the right to carry out the work hereby

undertaken by the CONTRACTOR. In either case if prior approval as aforesaid is not obtained, the CONTRACT shall be deemed to have been allotted in contravention of clause 37 hereof and the same action may be taken and the same consequence shall ensure as provided in the said clause.

32 Termination of contract

32(A) TERMINATION OF CONTRACT FOR DEATH: If the CONTRACTOR is an individual or a proprietary concern and the individual or the proprietor dies or if the CONTRACTOR is a partnership concern and one of the partner dies then unless, the EMPLOYER is satisfied that the legal representative of the individual or the proprietary concern or the surviving partners are capable of carrying out and completing CONTRACT, he (the EMPLOYER) is entitled to cancel the CONTRACT for the uncompleted part without being in any way liable for any compensation payment to the estate of the deceased CONTRACTOR and/or to the surviving partners of the CONTRACTOR'S firm on account of the cancellation of CONTRACT. The decision of the EMPLOYER in such assessment shall be final and binding on the parties. In the event of such cancellation, the EMPLOYER shall not hold the estate of the deceased CONTRACTOR and/or the surviving partners of the CONTRACTOR'S firm liable for any damages for non-completion of CONTRACT.

32(B) TERMINATION OF CONTRACT IN CASE OF LIQUIDATION/ BANKRUPTCY ETC.

If the Contractor shall dissolve or become bankrupt or insolvent or cause or suffer any receiver to be appointed of his business or any assets thereof compound with his Creditors, or being a corporation commence to be wound up, not being a member's voluntary winding up for the purpose of amalgamation or reconstruction, or carry on its business under a Receiver for the benefits of its Creditors any of them, EMPLOYER shall be at liberty :- To terminate the contract forthwith upon coming to know of the happening of any such event as aforesaid by notice in writing to the Contractor or to give the Receiver or liquidator or other person, the option of carrying out the contract subject to his providing a guarantee upto an amount to be agreed upon by EMPLOYER for due and faithful performance of the contract.

32 (C) TERMINATION OF CONTRACT FOR NON-PERFORMANCE AND SUBSEQUENTLY PUTTING THE CONTRACTOR ON HOLIDAY:

In case of termination of CONTRACT herein set forth (under clause 29.0) except under conditions of Force Majeure and termination after expiry of contract, the CONTRACTOR shall be put under holiday [i.e. neither any enquiry will be issued to the party by MEA against any type of tender nor their offer will be considered by MEA against any ongoing tender (s) where contract between MEA and that particular CONTRACTOR (as a bidder) has not been finalized] for three years from the date of termination by MEA (India) Ltd. to such CONTRACTOR.

33 Members of the employer not individually liable:

33.1 No Director, or official or employee of the EMPLOYER/ CONSULTANT shall in any way be personally bound or liable for the acts or obligations of the EMPLOYER under the CONTRACT or answerable for any default or omission in the observance or performance of any of the acts, matters or things which are herein contained.

34 Employer not bound by personal representations:

34.1 The CONTRACTOR shall not be entitled to any increase on the scheduled rates or any other right or claim whatsoever by reason of any representation, explanation statement or alleged representation, promise or guarantees given or alleged to have been given to him by any person.

35 Contractor's office at site:

35.1 The CONTRACTOR shall provide and maintain an office at the site for the accommodation of his agent and staff and such office shall be open at all reasonable hours to receive instructions, notice or other communications. The CONTRACTOR at all time shall maintain a site instruction book and

compliance of these shall be communicated to the ENGINEER-IN CHARGE from time to time and the whole document to be preserved and handed over after completion of works.

36 Contractor's subordinate staff and their conduct

36.1 The CONTRACTOR, on or after award of the WORK shall name and depute a qualified engineer having sufficient experience in carrying out work of similar nature, to whom the equipments, materials, if any, shall be issued and instructions for works given. The CONTRACTOR shall also provide to the satisfaction of the ENGINEER-IN- CHARGE sufficient and qualified staff to superintend the execution of the WORK, competent sub-agents, foremen and leading hands including those specially qualified by previous experience to supervise the types of works comprised in the CONTRACT in such manner as will ensure work of the best quality, expeditious working. Whenever in the opinion of the ENGINEER-IN- CHARGE additional properly qualified supervisory staff is considered necessary, they shall be employed by the CONTRACTOR without additional charge on accounts thereof. The CONTRACTOR shall ensure to the satisfaction of the ENGINEER-IN-CHARGE that SUB-CONTRACTORS, if any, shall provide competent and efficient supervision, over the work entrusted to them.

36.2 If and whenever any of the CONTRACTOR's or SUB- CONTRACTOR'S agents, sub-agents, assistants, foremen, or other employees shall in the opinion of ENGINEER-IN- CHARGE be guilty of any misconduct or be incompetent or insufficiently qualified or negligent in the performance of their duties of that in the opinion of the EMPLOYER or the ENGINEER-IN-CHARGE, it is undesirable for administrative or any other reason for such person or persons to be employed in the works, the CONTRACTOR, is so directed by the ENGINEER-IN-CHARGE, shall at once remove such person or persons from employment thereon. Any person or persons so removed from the works shall not again be employed in connection with the WORKS without the written permission of the ENGINEER-IN-CHARGE. Any person so removed from the WORK shall be immediately re-placed at the expense of the CONTRACTOR by a qualified and competent substitute. Should the CONTRACTOR be requested to repatriate any person removed from the works he shall do so and shall bear all costs in connection herewith.

36.3 The CONTRACTOR shall be responsible for the proper behaviour of all the staff, foremen, workmen, and others, and shall exercise a proper degree of control over them and in particular and without prejudice to the said generality, the CONTRACTOR shall be bound to prohibit and prevent any employees from trespassing or acting in any way detrimental or prejudicial to the interest of the community or of the properties or occupiers of land and properties in the neighborhood and in the event of such employee so trespassing, the CONTRACTOR shall be responsible therefore and relieve the EMPLOYER of all consequent claims or actions for damages or injury or any other grounds whatsoever. The decision of the ENGINEER-IN-CHARGE upon any matter arising under this clause shall be final. The CONTRACTOR shall be liable for any liability to EMPLOYER on account of deployment of CONTRACTOR's staff etc. or incidental or arising out of the execution of CONTRACT. The CONTRACTOR shall be liable for all acts or omissions on the part of his staff, Foremen and Workmen and others in his employment, including misfeasance or negligence of whatever kind in the course of their work or during their employment, which are connected directly or indirectly with the CONTRACT.

36.4 If and when required by the EMPLOYER and CONTRACTOR's personnel entering upon the EMPLOYER's premises shall be properly identified by badges of a type acceptable to the EMPLOYER which must be worn at all times on EMPLOYER's premises. CONTRACTOR may be required to obtain daily entry passes for his staff/employees from EMPLOYER to work within operating areas. These being safety requirements, no relaxations on this account shall be given to CONTRACTOR.

37 Sub-letting of works:

37.1 No part of the CONTRACT nor any share or interest therein shall in any manner or degree be transferred, assigned or sublet by the CONTRACTOR directly or indirectly to any person, firm or corporation whatsoever without the consent in writing, of the ENGINEER/EMPLOYER except as

provided for in the succeeding sub-clause.

i) SUB-CONTRACTS FOR TEMPORARY WORKS ETC.:

The EMPLOYER may give written consent to Sub- contract for the execution of any part of the WORK at the site, being entered in to by CONTRACTOR provided each individual Sub- contract is submitted to the ENGINEER-IN-CHARGE before being entered into and is approved by him.

ii) LIST OF SUB-CONTRACTORS TO BE SUPPLIED:

At the commencement of every month the CONTRACTOR shall furnish to the ENGINEER-IN-CHARGE list of all SUB-CONTRACTORS or other persons or firms engaged by the CONTRACTOR and working at the SITE during the previous month with particulars of the general nature of the Subcontract or works done by them.

iii) CONTRACTOR'S LIABILITY NOT LIMITED BY SUB- CONTRACTORS:

Notwithstanding any sub-letting with such approval as aforesaid and notwithstanding that the ENGINEER-IN-CHARGE shall have received copies of any Subcontracts, the contractor shall be and shall remain solely responsible for the quality, proper and expeditious execution of the Contract in all respects as if such sub-letting or Subcontracting had not taken place, and as if such work had been done directly by the CONTRACTOR. The CONTRACTOR shall bear all responsibility for any act or omission on the part of sub-contractors in regard to work to be performed under the CONTRACT.

iv) EMPLOYER MAY TERMINATE SUB-CONTRACTS:

If any SUB-CONTRACTOR engaged upon the works at the site executes any works which in the opinion of the ENGINEER-IN-CHARGE is not in accordance with the CONTRACT documents, the EMPLOYER may by written notice to the CONTRACTOR request him to terminate such subcontract and the CONTRACTOR upon the receipt of such notice shall terminate such Subcontract and dismiss the SUB-CONTRACTOR(S) and the later shall forthwith leave the works, failing which the EMPLOYER shall have the right to remove such SUB-CONTRACTOR(S) from the site.

v) NO REMEDY FOR ACTION TAKEN UNDER THIS CLAUSE:

No action taken by the EMPLOYER under the clause shall relieve the CONTRACTOR of any of his liabilities under the CONTRACT or give rise to any right or compensation, extension of time or otherwise failing which the EMPLOYER shall have the right to remove such SUB-CONTRACTOR(S) from the site.

38 Power of entry:

38.1 If the CONTRACTOR shall not commence the WORK in the manner previously described in the CONTRACT documents or if he shall at any time in the opinion of the ENGINEER-IN-CHARGE.

- i) fail to carry out the WORK in conformity with the CONTRACT documents, or
- ii) fail to carry out the WORK in accordance with the Time Schedule, or
- iii) substantially suspend work or the WORK for a period of fourteen days without authority from the ENGINEER-IN-CHARGE, or
- iv) fail to carry out and execute the WORK to the satisfaction of the ENGINEER-IN-CHARGE, or
- v) fail to supply sufficient or suitable construction plant, temporary works, labour, materials or things, or
- vi) Commit, suffer, or permit any other breach of any of the provisions of the CONTRACT on his part to be performed or observed or persist in any of the above mentioned breaches of the CONTRACT for fourteen days, after notice in writing shall have been given to the CONTRACTOR by the ENGINEER-IN-CHARGE requiring such breach to be remedied, or
- vii) if the CONTRACTOR shall abandon the WORK , or
- viii) If the CONTRACTOR during the continuance of the CONTRACT shall become bankrupt, make any arrangement or composition with his creditors, or permit any execution to be levied or go into liquidation whether compulsory or voluntary not being merely a voluntary liquidation for the purpose of amalgamation or reconstruction

then in any such case, the EMPLOYER shall have the power to enter upon the WORK and take possession thereof and of the materials, temporary WORK, construction plant, and stock thereon, and

to revoke the CONTRACTOR's licence to use the same, and to complete the WORK by his agents, other CONTRACTORS or workmen or to relate the same upon any terms and to such other person, firm or corporation as the EMPLOYER in his absolute discretion may think proper to employ and for the purpose aforesaid to use or authorise the use of any materials, temporary work, CONSTRUCTION PLANT, and stock as aforesaid, without making payment or allowance to the CONTRACTOR for the said materials other than such as may be certified in writing by the ENGINEER-IN-CHARGE to be reasonable, and without making any payment or allowance to the CONTRACTOR for the use of the temporary said works, construction plant and stock or being liable for any loss or damage thereto, and if the EMPLOYER shall by reason of his taking possession of the WORK or of the WORK being completed by other CONTRACTOR (due account being taken of any such extra work or works which may or be omitted) then the amount of such excess as certified by the ENGINEER-IN-CHARGE shall be deducted from any money which may be due for work done by the CONTRACTOR under the CONTRACT and not paid for. Any deficiency shall forthwith be made good and paid to the EMPLOYER by the CONTRACTOR and the EMPLOYER shall have power to sell in such manner and for such price as he may think fit all or any of the construction plant, materials etc. constructed by or belonging to and to recoup and retain the said deficiency or any part thereof out of proceeds of the sale.

39 Contractor's responsibility with the mechanical, electrical, intercommunication system, airconditioning contractors and other agencies:

39.1 Without repugnance of any other condition, it shall be the responsibility of the CONTRACTOR executing the work of civil construction, to work in close cooperation and coordinate the WORK with the Mechanical, Electrical, Air-conditioning and Intercommunication Contractor's and other agencies or their authorised representatives, in providing the necessary grooves, recesses, cuts and opening etc., in wall, slabs beams and columns etc. and making good the same to the desired finish as per specification, for the placement of electrical, intercommunication cables, conduits, air-conditioning inlets and outlets grills and other equipments etc. where required. For the above said requirements in the false ceiling and other partitions, the CONTRACTOR before starting-up the work shall in consultation with the Electrical, Mechanical, Intercommunication, Air-conditioning contractor and other agencies prepare and put-up a joint scheme, showing the necessary openings, grooves, recesses, cuts, the methods of fixing required for the WORK of the aforesaid, and the finishes therein, to the ENGINEER-IN-CHARGE and get the approval. The CONTRACTOR before finally submitting the scheme to the ENGINEER-IN-CHARGE, shall have the written agreement of the other agencies. The ENGINEER-IN-CHARGE, before communicating his approval to the scheme, with any required modification, shall get the final agreement of all the agencies, which shall be binding. No claim shall be entertained on account of the above. The CONTRACTOR shall confirm in all respects with provision of any statutory regulations, ordinances or byelaws of any local or duly constituted authorities or public bodies which may be applicable from time to time to the WORK or any temporary works. The CONTRACTOR shall keep the EMPLOYER indemnified against all penalties and liabilities of every kind, arising out of non-adherence to such stains, ordinances, laws, rules, regulations, etc.

40 Other agencies at site:

40.1 The CONTRACTOR shall have to execute the WORK in such place and conditions where other agencies will also be engaged for other works such as site grading, filling, and levelling, electrical and mechanical engineering works, etc. No claim shall be entertained due to WORK being executed in the above circumstances.

41 Notice:

41.1 TO THE CONTRACTOR:

Any notice hereunder may be served on the CONTRACTOR or his duly authorised representative at the job site or may be served by registered mail direct to the address furnished by the CONTRACTOR. Proof of issue of any such notice could be conclusive of the CONTRACTOR having been duly informed of all contents therein.

41.2 TO THE EMPLOYER:

Any notice to be given to the EMPLOYER under the terms of the CONTRACTOR shall be served by sending the same by Registered mail to or delivering the same at the respective site offices of MEA addressed to the HEAD/SITE-IN-CHARGE.

42 Right of various interests:

42.1 i) The EMPLOYER reserves the right to distribute the work between more than one agency(ies). The CONTRACTOR shall cooperate and afford other agency(ies) reasonable opportunity for access to the WORK for the carriage and storage of materials and execution of their works.

ii) Wherever the work being done by any department of the EMPLOYER or by other agency(ies) employed by the EMPLOYER is contingent upon WORK covered by this CONTRACT, the respective rights of the various interests involved shall be determined by the ENGINEER-IN-CHARGE to secure the completion of the various portions of the work in general harmony.

43 Patents and royalties:

43.1 The CONTRACTOR, if licensed under any patent covering equipment, machinery, materials or compositions of matter to be used or supplied or methods and process to be practised or employed in the performance of this CONTRACT, agrees to pay all royalties and licence fees which may be due with respect thereto. If any equipment, machinery, materials, composition of matters, be used or supplied or methods and processes to be practised or employed in the performance of this CONTRACT, is covered by a patent under which the CONTRACTOR is not licensed then the CONTRACTOR before supplying or using the equipment, machinery materials, composition method or processes shall obtain such licences and pay such royalties and licence fees as may be necessary for performance of this CONTRACT. In the event the CONTRACTOR fails to pay any such royalty or obtain any such licence, any suit for infringement of such patents which is brought against the CONTRACTOR or the EMPLOYER as a result such failure will be defended by the CONTRACTOR at his own expense and the CONTRACTOR will pay any damages and costs awarded in such suit. The CONTRACTOR shall promptly notify the EMPLOYER if the CONTRACTOR has acquired the knowledge of any plant under which a suit for infringement could be reasonably brought because of the use by the EMPLOYER of any equipment, machinery, materials, process, methods to be supplied hereunder. The CONTRACTOR agrees to and does hereby grant to EMPLOYER, together with the right to extend the same to any of the subsidiaries of the EMPLOYER as irrevocable, royalty free licence to use in any country, any invention made by the CONTRACTOR or his employee in or as result of the performance of the WORK under the CONTRACT.

43.2 All charges on account of royalty, tollage, rent, octroi terminal or sales tax and/or other duties or any other levy on materials obtained for the work or temporary work or part thereof (excluding materials provided by the EMPLOYER) shall be borne by the CONTRACTOR.

43.3 The CONTRACTOR shall not sell or otherwise dispose of or remove except for the purpose of this CONTRACT, the sand, stone, clay, ballast, earth, rock or other substances, or materials obtained from any excavation made for the purpose of the WORK or any building or produce upon the site at the time of delivery of the possession thereof, but all such substances, materials, buildings and produce shall be the property of the EMPLOYER provided that the CONTRACTOR may with the permission of the ENGINEER-IN-CHARGE, use the same for the purpose of the work by payment of cost of the same at such a rate as may be determined by the ENGINEER-IN-CHARGE.

43.4 The EMPLOYER shall indemnify and save harmless the CONTRACTOR from any loss on account of claims against CONTRACTOR for the contributory infringement of patent rights arising out and based upon the claim that the use of the EMPLOYER of the process included in the design prepared by the EMPLOYER and used in the operation of the plant infringes on any patent right. With respect to any subcontract entered into by CONTRACTOR pursuant to the provisions of the relevant clause hereof, the CONTRACTOR shall obtain from the SUB-CONTRACTOR an undertaking to

provide the EMPLOYER with the same patent protection that CONTRACTOR is required to provide under the provisions of this clause.

44 Liens:

44.1 If, at any time there should be evidence or any lien or claim for which the EMPLOYER might have become liable and which is chargeable to the CONTRACTOR, the EMPLOYER shall have the right to retain out of any payment then due or thereafter to become due an amount sufficient to completely indemnify the EMPLOYER against such lien or claim and if such lien or claim be valid, the EMPLOYER may pay and discharge the same and deduct the amount so paid from any money which may be or may become due and payable to the CONTRACTOR. If any lien or claim remain unsettled after all payments are made, the CONTRACTOR shall refund or pay to the EMPLOYER all money that the latter may be compelled to pay in discharging such lien or claim including all costs and reasonable expenses. EMPLOYER reserves the right to do the same.

44.2 The EMPLOYER shall have lien on all materials, equipments including those brought by the CONTRACTOR for the purpose of erection, testing and commissioning of the WORK.

44.3 The final payment shall not become due until the CONTRACTOR delivers to the ENGINEER-IN-CHARGE a complete release or waiver of all liens arising or which may arise out of his agreement or receipt in full or certification by the CONTRACTOR in a form approved by ENGINEER-IN-CHARGE that all invoices for labour, materials, services have been paid in lien thereof and if required by the ENGINEER-IN-CHARGE in any case an affidavit that so far as the CONTRACTOR has knowledge or information the releases and receipts include all the labour and material for which a lien could be filled.

44.4 CONTRACTOR will indemnify and hold the EMPLOYER harmless, for a period of two years after the issue of FINAL CERTIFICATE, from all liens and other encumbrances against the EMPLOYER on account of debts or claims alleged to be due from the CONTRACTOR or his SUB-CONTRACTOR to any person including SUB-CONTRACTOR and on behalf of EMPLOYER will defend at his own expense, any claim or litigation brought against the EMPLOYER or the CONTRACTOR in connection therewith. CONTRACTOR shall defend or contest at his own expense any fresh claim or litigation by any person including his SUB-CONTRACTOR, till its satisfactory settlement even after the expiry of two years from the date of issue of FINAL CERTIFICATE.

45 Delays by employer or his authorized agents:

45.1 In case the CONTRACTOR's performance is delayed due to any act or omission on the part of the EMPLOYER or his authorised agents, then the CONTRACTOR shall be given due extension of time for the completion of the WORK, to the extent such omission on the part of the EMPLOYER has caused delay in the CONTRACTOR's performance of his WORK.

45.2 No adjustment in CONTRACT PRICE shall be allowed for reasons of such delays and extensions granted except as provided in TENDER DOCUMENT, where the EMPLOYER reserves the right to seek indulgence of CONTRACTOR to maintain the agreed Time Schedule of Completion. In such an event the CONTRACTOR shall be obliged for working by CONTRACTOR's personnel for additional time beyond stipulated working hours as also Sundays and Holidays and achieve the completion date/interim targets.

46 Payment if the contract is terminated:

46.1 If the CONTRACT shall be terminated as per Tender pursuant to Clause no. 29 of GCC, the CONTRACTOR shall be paid by the EMPLOYER in so far as such amounts or items shall not have already been covered by payments of amounts made to the CONTRACTOR for the WORK executed and accepted by ENGINEER-IN-CHARGE prior to the date of termination at the rates and prices provided for in the CONTRACT and in addition to the following:

a) The amount payable in respect of any preliminary items, so far as the Work or service comprised therein has been carried out or performed and an appropriate portion as certified by ENGINEER-IN-

CHARGE of any such items or service comprised in which has been partially carried out or performed.
b) Any other expenses which the CONTRACTOR has expended for performing the WORK under the CONTRACT subject to being duly recommended by ENGINEER-IN-CHARGE and approved by EMPLOYER for payment, based on documentary evidence of his having incurred such expenses.

46.2 The CONTRACTOR will be further required to transfer the title and provide the following in the manner and as directed by the EMPLOYER.

a) Any and all completed works.

b) Such partially completed WORK including drawings, informations and CONTRACT rights as the CONTRACTOR has specially performed, produced or acquired for the performance of the CONTRACTOR.

47 No waiver of rights:

47.1 Neither the inspection by the EMPLOYER or any of their officials, employees, or agents nor any order by the EMPLOYER for payment of money or any payment for or acceptance of the whole or any part of the Work by the EMPLOYER nor any extension of time, nor any possession taken by EMPLOYER shall operate as a waiver of any provision of the CONTRACT, or of any power herein reserved to the EMPLOYER, or any right to damages herein provided, nor shall any waiver of any breach in the CONTRACT be held to be a waiver of any other subsequent breach.

48 Certificate not to affect right of employer and liability of contractor:

48.1 No interim payment certificate(s) issued by the Engineer-in-Charge of the EMPLOYER, nor any sum paid on account by the EMPLOYER, nor any extension of time for execution of the work granted by EMPLOYER shall affect or prejudice the rights of the Employer against the CONTRACTOR or relieve the CONTRACTOR of his obligations for the due performance of the CONTRACT, or be interpreted as approval of the WORK done or of the equipment supplied and no certificate shall create liability for the EMPLOYER to pay for alterations, amendments, variations or additional works not ordered, in writing, by EMPLOYER or discharge the liability of the CONTRACTOR for the payment of damages whether due, ascertained, or certified or not or any sum against the payment of which he is bound to indemnify the EMPLOYER.

49 Language and measures:

49.1 All documents pertaining to the CONTRACT including Specifications, Schedules, Notices, Correspondence, operating and maintenance Instructions, DRAWINGS, or any other writing shall be written in English language. The Metric System of measurement shall be used in the CONTRACT unless otherwise specified.

50 Transfer of title:

50.1 The title of Ownership of supplies furnished by the CONTRACTOR shall not pass on to the EMPLOYER for all Supplies till the same are finally accepted by the EMPLOYER after the successful completion of PERFORMANCE TEST and GUARANTEE TEST and issue of FINAL CERTIFICATE.

50.2 However, the EMPLOYER shall have the lien on all such works performed as soon as any advance or progressive payment is made by the EMPLOYER to the CONTRACTOR and the CONTRACTOR shall not subject these works for use other than those intended under this CONTRACT.

51 Release of information:

51.1 The CONTRACTOR shall not communicate or use in advertising, publicity, sales releases or in any other medium, photographs, or other reproduction of the Work under this CONTRACT or description of the site dimensions, quantity, quality or other information, concerning the Work unless prior written permission has been obtained from the EMPLOYER.

52 Brand names:

52.1 The specific reference in the SPECIFICATIONS and documents to any material by trade name, make or catalogue number shall be construed as establishing standard or quality and performance and not as limited competition. However, TENDERER may offer other similar equipments provided it meets the specified standard design and performance requirements.

53 Completion of contract:

53.1 Unless otherwise terminated under the provisions of any other relevant clause, this CONTRACT shall be deemed to have been completed at the expiration of the PERIOD OF LIABILITY as provided for under the CONTRACT.

54 Spares:

54.1 The CONTRACTOR shall furnish to the EMPLOYER all spares required for COMMISSIONING of the plants, recommendatory and/or mandatory spares, which are required essential by the manufacturer/supplier. The same shall be delivered at SITE, 3(Three) months before COMMISSIONING. Also the CONTRACTOR should furnish the manufacturing drawings for fast wearing spares.

54.2 The CONTRACTOR guarantees the EMPLOYER that before the manufacturers of the equipments, plants and machineries go out of production of spare parts for the equipment furnished and erected by him, he shall give at least twelve (12) months' advance notice to the EMPLOYER, so that the latter may order his requirement of spares in one lot, if he so desires.

SECTION-V PERFORMANCE OF WORK

55 Execution of work:

55.1 All the Works shall be executed in strict conformity with the provisions of the CONTRACT Documents and with such explanatory detailed drawings, specification and instructions as may be furnished from time to time to the CONTRACTOR by the ENGINEER-IN-CHARGE whether mentioned in the CONTRACT or not. The CONTRACTOR shall be responsible for ensuring that works throughout are executed in the most substantial, proper and workmanlike manner with the quality of material and workmanship in strict accordance with the SPECIFICATIONS and to the entire satisfaction of the ENGINEER-IN-CHARGE. The CONTRACTOR shall provide all necessary materials equipment labour etc. for execution and maintenance of WORK till completion unless otherwise mentioned in the CONTRACT.

56 Co-ordination and inspection of work:

56.1 The coordination and inspection of the day-to-day work under the CONTRACT shall be the responsibility of the ENGINEER-IN-CHARGE. The written instruction regarding any particular job will normally be passed by the ENGINEER-IN-CHARGE or his authorised representative. A work order book will be maintained by the CONTRACTOR for each sector in which the aforesaid written instructions will be entered. These will be signed by the CONTRACTOR or his authorised representative by way of acknowledgement within 12 hours.

57 Work in monsoon and dewatering:

57.1 Unless otherwise specified elsewhere in the tender, the execution of the WORK may entail working in the monsoon also. The CONTRACTOR must maintain a minimum labour force as may be required for the job and plan and execute the construction and erection according to the prescribed schedule. No extra rate will be considered for such work in monsoon.

57.2 During monsoon and other period, it shall be the responsibility of the CONTRACTOR to keep the construction work site free from water at his own cost.

58 Work on Sundays and Holidays:

58.1 For carrying out Work on Sundays, and Holidays, the CONTRACTOR will approach the ENGINEER-IN-CHARGE or his representative at least two days in advance and obtain permission in writing. The CONTRACTOR shall observe all labour laws and other statutory rules and regulations in force. In case of any violations of such laws, rules and regulations, consequence if any, including the cost thereto shall be exclusively borne by the CONTRACTOR and the EMPLOYER shall have no liability whatsoever on this account.

59 General conditions for construction and erection work:

59.1 The working time at the site of work is 48 hours per week. Overtime work is permitted in cases of need and the EMPLOYER will not compensate the same. Shift working at 2 or 3 shifts per day will become necessary and the CONTRACTOR should take this aspect into consideration for formulating his rates for quotation. No extra claims will be entertained by the EMPLOYER on this account. For carrying out work beyond working hours the CONTRACTOR will approach the ENGINEER-IN-CHARGE or his authorized representative and obtain his prior written permission.

59.2 The CONTRACTOR must arrange for the placement of workers in such a way that the delayed completion of the WORK or any part thereof for any reason whatsoever will not affect their proper employment. The EMPLOYER will not entertain any claim for idle time payment whatsoever.

59.3 The CONTRACTOR shall submit to the EMPLOYER/ENGINEER-IN-CHARGE reports at regular

intervals regarding the state and progress of WORK. The details and proforma of the report will mutually be agreed after the award of CONTRACT. The CONTRACTOR shall provide display boards showing progress and labour strengths at worksite, as directed by the ENGINEER-IN-CHARGE.

60 Alterations in specifications, design and extra works:

60.1 The WORK covered under this CONTRACT having to be executed by the CONTRACTOR on a lumpsum firm price/item rate quoted by him, the EMPLOYER will not accept any proposals for changes in VALUE OF CONTRACT or extension in time on account of any such changes which may arise to the CONTRACTOR's scope of WORK as a result of detailed Engineering and thereafter during the execution of WORK. The only exception to this will be a case where the EMPLOYER requests in writing to the CONTRACTOR to upgrade the SPECIFICATIONS or the size of any major pieces of equipments, plant or machinery beyond what is normally required to meet the scope of WORK as defined in the CONTRACT DOCUMENT. In such cases, a change order will be initialled by the CONTRACTOR at the appropriate time for the EMPLOYER's prior approval giving the full back-up data for their review and for final settlement of any impact on price within 30 (thirty) days thereafter.

60.2 The ENGINEER-IN-CHARGE shall have to make any alterations in, omission from, additions to or substitutions for, the Schedule of Rates, the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the WORK and the CONTRACTOR shall be bound to carry out the such altered/ extra/ new items of WORK in accordance with any instructions which may be given to him in writing signed by the ENGINEER-IN-CHARGE, and such alterations, omissions, additions or substitutions shall not invalidate the CONTRACT and any altered, additional or substituted work which the CONTRACTOR may be directed to do in the manner above specified as part of the WORK shall be carried out by the CONTRACTOR on the same conditions in all respects on which he agreed to do the main WORK. The time of completion of WORK may be extended for the part of the particular job at the discretion of the ENGINEER-IN-CHARGE, for only such alterations, additions or substitutions of the WORK, as he may consider as just and reasonable. The rates for such additional, altered or substituted WORK under this clause shall be worked out in accordance with the following provisions:-

I. For Item Rate Contract

a) If the rates for the additional, altered or substituted WORK are specified in the CONTRACT for the WORK, the CONTRACTOR is bound to carry on the additional, altered or substituted WORK at the same rates as are specified in the CONTRACT.

b) If the rates for the additional, altered or substituted WORK are not specifically provided in the CONTRACT for the WORK, the rates will be derived from the rates for similar class of WORK as are specified in the CONTRACT for the WORK. The opinion of the ENGINEER-IN-CHARGE, as to whether or not the rates can be reasonably so derived from the items in this CONTRACT will be final and binding on the CONTRACTOR.

c) If the rates for the altered, additional or substituted WORK cannot be determined in the manner specified in sub-clause(s) and (b) above, then the CONTRACTOR shall, within 7 days of the date of receipt of order to carry out the WORK, inform the ENGINEER-IN-CHARGE of the rates which it is his intention to charge for such class of WORK, supported by analysis of the rate or rates claimed, and the ENGINEER-IN-CHARGE shall determine the rate or rates on the basis of the prevailing market rates, labour cost at schedule of labour rates plus 10% to cover contractor's supervision, overheads and profit and pay the CONTRACTOR accordingly. The opinion of the ENGINEER-IN-CHARGE as to current market rates of materials and the quantum of labour involved per unit of measurement will be final and binding on the CONTRACTOR.

d) Where the item of work will be executed through nominated specialist agency as approved by the ENGINEER-IN-CHARGE, then the actual amount paid to such nominated agency supported by documentary evidence and as certified by ENGINEER-IN-CHARGE shall be considered plus 10% (ten percent) to cover all contingencies, overhead, profits to arrive at the rates

e) Provisions contained in the Sub-clause (a) & (d) above shall, however, not apply for the following:- Where the value of additions of new items together with the value of alterations, additions/deletions or substitutions does not exceed by or is not less than plus/minus (+/-) 25% of the VALUE OF CONTRACT. The item rates in the Schedule of Rates shall hold good for all such variations between the above mentioned limits, irrespective of any increase/decrease of quantities in the individual items of Schedule of Rates. Where the value of addition of new items together with the value of alterations, additions/deletions or substitutions reduces more than 25% of the contract value but is within the following limits the tenderer shall be paid compensation for decrease in the value of work, as follows:

S.No. Range of Variation Percentage compensation for decrease in the value of work in the respective range.

a) Beyond (+) 25% No increase and/or upto & inclusive of decrease shall be (+) 50% applicable for the Schedule of Rates

(The rates quoted for this increase shall be valid).

b) Beyond (-) 25% upto & For reduction beyond inclusive of (-) 50% 25% contractor shall be compensated by an amount equivalent to 10% of the reduction in value of the contract as awarded. For example if the actual contract value is 70% of awarded value then compensation shall be 10% of (75-70) i.e. 0.5% of awarded contract value.

II. For Lumpsum Contracts

CONTRACTOR shall, within 7 days of the date of receipt of order to carry out the WORK, inform the ENGINEER-IN- CHARGE of the rates which it is his intention to charge for such class of WORK, supported by analysis of the rate or rates claimed, and the ENGINEER-IN-CHARGE shall determine the rate or rates on the basis of the prevailing market rates, labour cost at schedule of labour rates plus 10% to cover contractor's supervision, overheads and profit and pay the CONTRACTOR accordingly. The opinion of the ENGINEER- IN-CHARGE as to current market rates of materials and the quantum of labour involved per unit of measurement will be final and binding on the CONTRACTOR.

61 Drawings to be supplied by the employer

61.1 The drawings attached with tender are only for the general guidance to the CONTRACTOR to enable him to visualize the type of work contemplated and scope of work involved. The CONTRACTOR will be deemed to have studied the DRAWINGS and formed an idea about the WORK involved.

61.2 Detailed working drawings on the basis of which actual execution of the WORK is to proceed, will be furnished from time to time during the progress of the work. The CONTRACTOR shall be deemed to have gone through the DRAWINGS supplied to him thoroughly and carefully and in conjunction with all other connected drawings and bring to the notice of the ENGINEER-IN-CHARGE discrepancies, if any, therein before actually carrying out the Work.

61.3 Copies of all detailed working drawings relating to the WORK shall be kept at the CONTRACTOR's office on the site and shall be made available to the ENGINEER-IN- CHARGE at any time during the CONTRACT. The drawings and other documents issued by the EMPLOYER shall be returned to the EMPLOYER on completion of the WORK.

62 Drawings to be supplied by the contractor:

62.1 The drawings/date which are to be furnished by the CONTRACTOR are enumerated in the special conditions of contract, and shall be furnished within the specified time.

62.2 Where approval/review of drawings before manufacture/ construction/fabrication has been specified, it shall be CONTRACTOR's responsibility to have these drawings prepared as per the

directions of ENGINEER-IN-CHARGE and got approved before proceeding with manufacture/construction/fabrication as the case may be. Any change that may have become necessary in these drawings during the execution of the work shall have to be carried out by the CONTRACTOR to the satisfaction of ENGINEER-IN-CHARGE at no extra cost. All final drawings shall bear the certification stamp as indicated below duly signed by both the CONTRACTOR and ENGINEER-IN-CHARGE.

(ENGINEER-IN-CHARGE)

"Certified true for _____
(Name of Work)
Agreement No. _____
Signed: _____

(CONTRACTOR)

62.3 The DRAWINGS submitted by the CONTRACTOR shall be reviewed by the ENGINEER-IN-CHARGE as far as practicable within 3 (Three) weeks and shall be modified by the CONTRACTOR, if any modifications and/or corrections are required by the ENGINEER-IN-CHARGE. The CONTRACTOR shall incorporate such modifications and/or corrections and submit the final drawings for approval. Any delays arising out of failure by the CONTRACTOR to rectify the drawing in good time shall not alter the Contract Completion Time.

62.4 As built drawings showing all corrections, adjustments etc. shall be furnished by the CONTRACTOR in six copies and one transparent for record purposed to the EMPLOYER.

63 Setting out works:

63.1 The ENGINEER-IN-CHARGE shall furnish the CONTRACTOR with only the four corners of the Works site and a level bench mark and the CONTRACTOR shall set out the Works and shall provide an efficient staff for the purpose and shall be solely responsible for the accuracy of such setting out.

63.2 The CONTRACTOR shall provide, fix and be responsible for the maintenance of all stakes, templates, level marks, profiles and other similar things and shall take all necessary precautions to prevent their removal or disturbance and shall be responsible for the consequence of such removal or disturbance should the same take place and for their efficient and timely reinstatement. The CONTRACTOR shall also be responsible for the maintenance of all existing survey marks, boundary marks, distance marks and center line marks, either existing or supplied and fixed by the CONTRACTOR. The work shall be set out to the satisfaction of the ENGINEER-IN-CHARGE. The approval there of joining with the CONTRACTOR by the ENGINEER-IN-CHARGE in setting out the work, shall not relieve the CONTRACTOR of any of his responsibility.

63.3 Before beginning the Works, the CONTRACTOR shall at his own cost, provide all necessary reference and level posts, pegs, bamboos, flags, ranging rods, strings and other materials for proper layout of the works in accordance with the schemes for bearing marks acceptable to the ENGINEER-IN-CHARGE. The center, longitudinal or face lines and cross lines shall be marked by means of small masonry pillars. Each pillar shall have distinct mark at the centre to enable theodolite to be set over it. No work shall be started until all these points are checked and approved by the ENGINEER-IN-CHARGE in writing but such approval shall not relieve the CONTRACTOR of any of his responsibilities. The CONTRACTOR shall also provide all labour, material and other facilities, as necessary, for the proper checking of layout and inspection of the points during construction.

63.4 Pillars bearing geodetic marks located at the sites of units of WORKS under construction should be protected and fenced by the CONTRACTOR.

63.5 On completion of WORK, the CONTRACTOR must submit the geodetic documents according to

which the WORK was carried out.

64 Responsibility for level and alignment:

64.1 The CONTRACTOR shall be entirely and exclusively responsible for the horizontal and vertical alignment, the levels and correctness of every part of the WORK and shall rectify effectively any errors or imperfections therein, such rectifications shall be carried out by the CONTRACTOR, at his own cost, when instructions are issued to that effect by the ENGINEER- IN-CHARGE.

65 Materials to be supplied by contractor:

65.1 The CONTRACTOR shall procure and provide within the VALUE OF CONTRACT the whole of the materials required for the construction including steels, cement and other building materials, tools, tackles, construction plant and equipment for the completion and maintenance of the WORK except the materials which will be issued by the EMPLOYER and shall make his own arrangement for procuring such materials and for the transport thereof. The EMPLOYER may give necessary recommendation to the respective authority if so desired by the CONTRACTOR but assumes no further responsibility of any nature. The EMPLOYER will insist on the procurement of materials which bear ISI stamp and/or which are supplied by reputed suppliers.

65.2 The CONTRACTOR shall properly store all materials either issued to him or brought by him to the SITE to prevent damages due to rain, wind, direct exposure to sun, etc. as also from theft, pilferage, etc. for proper and speedy execution of his works. The CONTRACTOR shall maintain sufficient stocks of all materials required by him.

65.3 No material shall be despatched from the CONTRACTOR's stores before obtaining the approval in writing of the ENGINEER-IN-CHARGE.

66 Stores supplied by the employer:

66.1 If the SPECIFICATION of the WORK provides for the use of any material of special description to be supplied from the EMPLOYER's stores or it is required that the CONTRACTOR shall use certain stores to be provided by the ENGINEER-IN-CHARGE, such materials and stores, and price to be charged there for as hereinafter mentioned being so far as practicable for the convenience of the CONTRACTOR, but not so as in any way to control the meaning or effect of the CONTRACT, the CONTRACTOR shall be bound to purchase and shall be supplied such materials and stores as are from time to time required to be used by him for the purpose of the CONTRACT only. The sums due from the CONTRACTOR for the value of materials supplied by the EMPLOYER will be recovered from the running account bill on the basis of the actual consumption of materials in the works covered and for which the running account bill has been prepared. After the completion of the WORK, however, the CONTRACTOR has to account for the full quantity of materials supplied to him as per relevant clauses in this document.

66.2 The value of the stores/materials as may be supplied to the CONTRACTOR by the EMPLOYER will be debited to the CONTRACTOR's account at the rates shown in the schedule of materials and if they are not entered in the schedule, they will be debited at cost price, which for the purpose of the CONTRACT shall include the cost of carriage and all other expenses whatsoever such as normal storage supervision charges which shall have been incurred in obtaining the same at the EMPLOYER's stores. All materials so supplied to the CONTRACTOR shall remain the absolute property of the EMPLOYER and shall not be removed on any account from the SITE of the WORK, and shall be at all times open for inspection to the ENGINEER-IN-CHARGE. Any such materials remaining unused at the time of the completion or termination of the CONTRACT shall be returned to the EMPLOYER's stores or at a place as directed by the ENGINEER-IN-CHARGE in perfectly good condition at CONTRACTOR's cost.

67 Conditions for issue of materials:

- 67.1 i) Materials specified as to be issued by the EMPLOYER will be supplied to the CONTRACTOR by the EMPLOYER from his stores. It shall be responsibility of the CONTRACTOR to take delivery of the materials and arrange for its loading, transport and unloading at the SITE of WORK at his own cost. The materials shall be issued between the working hours and as per the rules of the EMPLOYER as framed from time to time.
- ii) The CONTRACTOR shall bear all incidental charges for the storage and safe custody of materials at site after these have been issued to him.
- iii) Materials specified as to be issued by the EMPLOYER shall be issued in standard sizes as obtained from the manufacturers.
- iv) The CONTRACTOR shall construct suitable Godowns at the SITE of WORK for storing the materials safe against damage by rain, dampness, fire, theft etc. He shall also employ necessary watch and ward establishment for the purpose.
- v) It shall be duty of the CONTRACTOR to inspect the materials supplied to him at the time of taking delivery and satisfy himself that they are in good condition. After the materials have been delivered by the EMPLOYER, it shall be the responsibility of the CONTRACTOR to keep them in good condition and if the materials are damaged or lost, at any time, they shall be repaired and/or replaced by him at his own cost according to the instructions of the ENGINEER-IN-CHARGE.
- vi) The EMPLOYER shall not be liable for delay in supply or non-supply of any materials which the EMPLOYER has undertaken to supply where such failure or delay is due to natural calamities, act of enemies, transport and procurement difficulties and any circumstances beyond the control of the EMPLOYER. In no case, the CONTRACTOR shall be entitled to claim any compensation or loss suffered by him on this account.
- vii) It shall be responsibility of the CONTRACTOR to arrange in time all materials required for the WORK other than those to be supplied by the EMPLOYER. If, however, in the opinion of the ENGINEER-IN-CHARGE the execution of the WORK is likely to be delayed due to the CONTRACTOR's inability to make arrangements for supply of materials which normally he has to arrange for, the ENGINEER-IN-CHARGE shall have the right at his own discretion to issue such materials, if available with the EMPLOYER or procure the materials from the market or as elsewhere and the CONTRACTOR will be bound to take such materials at the rates decided by the ENGINEER-IN-CHARGE. This, however, does not in any way absolve the CONTRACTOR from responsibility of making arrangements for the supply of such materials in part or in full, should such a situation occur nor shall this constitute a reason for the delay in the execution of the WORK.
- viii) None of the materials supplied to the CONTRACTOR will be utilised by the CONTRACTOR for manufacturing item which can be obtained as supplied from standard manufacturer in finished form.
- ix) The CONTRACTOR shall, if desired by the ENGINEER- IN-CHARGE, be required to execute an Indemnity Bond in the prescribed form for safe custody and accounting of all materials issued by the EMPLOYER.
- x) The CONTRACTOR shall furnish to the ENGINEER-IN- CHARGE sufficiently in advance a statement showing his requirement of the quantities of the materials to be supplied by the EMPLOYER and the time when the same will be required by him for the works, so as to enable the ENGINEER-IN-CHARGE to make necessary arrangements for procurement and supply of the material.
- xi) Account of the materials issued by the EMPLOYER shall be maintained by CONTRACTOR indicating the daily receipt, consumption and balance in hand. This account shall be maintained in a manner prescribed by the ENGINEER-IN-CHARGE along with all connected papers viz. requisitions, issues, etc., and shall be always available for inspection in the CONTRACTOR's office at SITE.
- xii) The CONTRACTOR should see that only the required quantities of materials are got issued. The CONTRACTOR shall not be entitled to cartage and incidental charges for returning the surplus materials, if any, to the stores wherefrom they were issued or to the place as directed by the ENGINEER-IN-CHARGE.
- xiii) Materials/Equipment(s) supplied by EMPLOYER shall not be utilised for any purpose(s) than issued for.

68 Material procured with assistance of employer/return of surplus:

68.1 Notwithstanding anything contained to the contrary in any or all the clauses of this CONTRACT where any materials for the execution of the CONTRACT are procured with the assistance of the EMPLOYER either by issue from EMPLOYER's stock or purchases made under order or permits or

licences issued by Government, the CONTRACTOR shall hold the said materials as trustee for the EMPLOYER and use such materials economically and solely for the purpose of the CONTRACT and not dispose them off without the permission of the EMPLOYER and return, if required by the ENGINEER-IN-CHARGE, shall determine having due regard to the condition of the materials. The price allowed to the CONTRACTOR, however, shall not exceed the amount charged to him excluding the storage charges, if any. The decision of the ENGINEER-IN-CHARGE shall be final and conclusive in such matters. In the event of breach of the aforesaid condition, the CONTRACTOR shall, in terms of the licences or permits and/or criminal breach of trust, be liable to compensate the EMPLOYER at double rate or any higher rate, in the event of those materials at that time having higher rate or not being available in the market, then any other rate to be determined by the ENGINEER-IN-CHARGE and his decision shall be final and conclusive.

69 Materials obtained from dismantling:

69.1 If the CONTRACTOR in the course of execution of the WORK is called upon to dismantle any part for reasons other than those stipulated in Clauses 74 and 77 hereunder, the materials obtained in the WORK of dismantling etc., will be considered as the EMPLOYER's property and will be disposed off to the best advantage of the EMPLOYER.

70 Articles of value found:

70.1 All gold, silver and other minerals of any description and all precious stones, coins, treasure relics, antiquities and other similar things which shall be found in, under or upon the SITE, shall be the property of the EMPLOYER and the CONTRACTOR shall duly preserve the same to the satisfaction of the ENGINEER-IN-CHARGE and shall from time to time deliver the same to such person or persons indicated by the EMPLOYER.

71 Discrepancies between instructions:

71.1 Should any discrepancy occur between the various instructions furnished to the CONTRACTOR, his agent or staff or any doubt arises as to the meaning of any such instructions or should there be any misunderstanding between the CONTRACTOR's staff and the ENGINEER-IN-CHARGE's staff, the CONTRACTOR shall refer the matter immediately in writing to the ENGINEER-IN-CHARGE whose decision thereon shall be final and conclusive and no claim for losses alleged to have been caused by such discrepancies between instructions, doubts, or misunderstanding shall in any event be admissible.

72 Action where no specification is issued:

72.1 In case of any class of WORK for which there is no SPECIFICATION supplied by the EMPLOYER as mentioned in the Tender Documents such WORK shall be carried out in accordance with Indian Standard Specifications and if the Indian Standard Specifications do not cover the same, the WORK should be carried out as per standard Engineering Practice subject to the approval of the ENGINEER-IN-CHARGE.

73 Inspection of works:

73.1 The ENGINEER-IN-CHARGE will have full power and authority to inspect the WORK at any time wherever in progress either on the SITE or at the CONTRACTOR's premises/workshops wherever situated, premises/ workshops of any person, firm or corporation where WORK in connection with the CONTRACT may be in hand or where materials are being or are to be supplied, and the CONTRACTOR shall afford or procure for the ENGINEER-IN-CHARGE every facility and assistance to carry out such inspection. The CONTRACTOR shall, at all time during the usual working hours and at all other time at which reasonable notice of the intention of the ENGINEER-IN-CHARGE or his representative to visit the WORK shall have been given to the CONTRACTOR, either himself be present or receive orders and instructions, or have a responsible agent duly accredited in writing, present for the purpose. Orders given to the CONTRACTOR's agent shall be considered to have the

same force as if they had been given to the CONTRACTOR himself. The CONTRACTOR shall give not less than seven days notice in writing to the ENGINEER-IN-CHARGE before covering up or otherwise placing beyond reach of inspection and measurement of any work in order that the same may be inspected and measured. In the event of breach of above the same shall be uncovered at CONTRACTOR's expense for carrying out such measurement or inspection.

73.2 No material shall be despatched from the CONTRACTOR's stores before obtaining the approval in writing of the Engineer-in-Charge. The CONTRACTOR is to provide at all time during the progress of the WORK and the maintenance period, proper means of access with ladders, gangways etc. and the necessary attendance to move and adopt as directed for inspection or measurements of the WORK by the ENGINEER-IN-CHARGE.

73.3 The CONTRACTOR shall make available to the ENGINEER-IN-CHARGE free of cost all necessary instruments and assistance in checking or setting out of WORK and in the checking of any WORK made by the CONTRACTOR for the purpose of setting out and taking measurements of WORK.

74 Tests for quality of work:

74.1 All workmanship shall be of the respective kinds described in the CONTRACT DOCUMENTS and in accordance with the instructions of the ENGINEER-IN-CHARGE and shall be subjected from time to time to such test at CONTRACTOR's cost as the ENGINEER-IN-CHARGE may direct at the place of manufacture or fabrication or on the site or at all or any such places. The CONTRACTOR shall provide assistance, instruments, labour and materials as are normally required for examining, measuring and testing any workmanship as may be selected and required by the ENGINEER-IN-CHARGE.

74.2 All the tests that will be necessary in connection with the execution of the WORK as decided by the ENGINEER-IN-CHARGE shall be carried out at the field testing laboratory of the EMPLOYER by paying the charges as decided by the EMPLOYER from time to time. In case of non-availability of testing facility with the EMPLOYER, the required test shall be carried out at the cost of CONTRACTOR at Government or any other testing laboratory as directed by ENGINEER-IN-CHARGE.

74.3 If any tests are required to be carried out in conjunction with the WORK or materials or workmanship not supplied by the CONTRACTOR, such tests shall be carried out by the CONTRACTOR as per instructions of ENGINEER-IN-CHARGE and cost of such tests shall be reimbursed by the EMPLOYER.

75 Samples for approval:

75.1 The CONTRACTOR shall furnish to the ENGINEER-IN-CHARGE for approval, when requested or if required by the specifications, adequate samples of all materials and finished to be used in the WORK. Such samples shall be submitted before the WORK is commenced and in ample time to permit tests and examinations thereof. All materials furnished and finishes applied in actual WORK shall be fully equal to the approved samples.

76 Action and compensation in case of bad work:

76.1 If it shall appear to the ENGINEER-IN-CHARGE that any work has been executed with unsound, imperfect or unskilled workmanship, or with materials of any inferior description, or that any materials or articles provided by the CONTRACTOR for the execution of the WORK are unsound, or of a quality inferior to that contracted for, or otherwise not in accordance with the CONTRACT, the CONTRACTOR shall on demand in writing from the ENGINEER-IN-CHARGE or his authorised representative specifying the WORK, materials or articles complained of notwithstanding that the same may have been inadvertently passed, certified and paid for, forthwith rectify or remove and reconstruct the WORK so specified and provide other proper and suitable materials or articles at his own cost and in the event of failure to do so within the period specified by the ENGINEER-IN-CHARGE in his demand aforesaid, the CONTRACTOR shall be liable to pay compensation at the rate

of 1 % (One percent) of the estimated cost of the whole WORK, for every week limited to a maximum of 10% (ten percent) of the value of the whole WORK, while his failure to do so shall continue and in the case of any such failure the ENGINEER- IN-CHARGE may on expiry of notice period rectify or remove and re-execute the WORK or remove and replaced with others, the materials or articles complained of to as the case may be at the risk and expense in all respects of the CONTRACTOR. The decision of the Engineering-in-charge as to any question arising under this clause shall be final and conclusive.

77 Suspension of works:

77.1 i) Subject to the provisions of sub -para (ii) of this clause, the CONTRACTOR shall, if ordered in writing by the ENGINEER-IN-CHARGE, or his representative, temporarily suspend the WORKS or any part thereof for such written order, proceed with the WORK therein ordered to be suspended until, he shall have received a written order to proceed therewith. The CONTRACTOR shall not be entitled to claim compensation for any loss or damage sustained by him by reason of temporary suspension of the WORKS aforesaid. An extension of time for completion, corresponding with the delay caused by any such suspension of the WORKS as aforesaid will be granted to the ONTRACTOR should he apply for the same provided that the suspension was not consequent to any default or failure on the part of the CONTRACTOR.

ii) In case of suspensions of entire WORK, ordered in writing by ENGINEER-IN-CHARGE, for a period of more than two months, the CONTRACTOR shall have the option to terminate the CONTRACT.

78 Employer may do part of work:

78.1 Upon failure of the CONTRACTOR to comply with any instructions given in accordance with the provisions of this CONTRACT the EMPLOYER has the alternative right, instead of assuming charge of entire WORK, to place additional labour force, tools, equipments and materials on such parts of the WORK, as the EMPLOYER may designate or also engage another CONTRACTOR to carry out the WORK. In such cases, the EMPLOYER shall deduct from the amount which otherwise might become due to the CONTRACTOR, the cost of such work and material with ten percent (10%) added to cover all departmental charges and should the total amount thereof exceed the amount due to the CONTRACTOR, the CONTRACTOR shall pay the difference to the EMPLOYER.

79 Possession prior to completion:

79.1 The ENGINEER-IN-CHARGE shall have the right to take possession of or use any completed or partially completed WORK or part of the WORK. Such possession or use shall not be deemed to be an acceptance of any work completed in accordance with the CONTRACT agreement. If such prior possession or use by the ENGINEER-IN- CHARGE delays the progress of WORK, equitable adjustment in the time of completion will be made and the CONTRACT agreement shall be deemed to be modified accordingly.

80 Defects Liability Period (Twelve months period of liability from the date of issue of completion certificate):

80.1 The CONTRACTOR shall guarantee the installation/WORK for a period of 12 months from the date of completion of WORK as certified by the ENGINEER-IN-CHARGE which is indicated in the Completion Certificate. Any damage or defect that may arise or lie undiscovered at the time of issue of Completion Certificate, connected in any way with the equipment or materials supplied by him or in the workmanship, shall be rectified or replaced by the CONTRACTOR at his own expense as deemed necessary by the ENGINEER-IN-CHARGE or in default, the ENGINEER- IN-CHARGE may carry out such works by other work and deduct actual cost incurred towards labour, supervision and materials consumables or otherwise plus 100% towards overheads (of which the certificate of ENGINEER-IN-CHARGE shall be final) from any sums that may then be or at any time thereafter, become due to the CONTRACTOR or from his Contract Performance Security, or the proceeds of sale thereof or a sufficient part on thereof.

80.2 If the CONTRACTOR feels that any variation in WORK or in quality of materials or proportions would be beneficial or necessary to fulfil the guarantees called for, he shall bring this to the notice of the ENGINEER- IN-CHARGE in writing. If during the period of liability any portion of the WORK/equipment, is found defective and is rectified/ replaced, the period of liability for such equipment/ portion of WORK shall be operative from the date such rectification/ replacement are carried out and Contract Performance Guarantee shall be furnished separately for the extended period of liability for that portion of WORK/ equipment only. Notwithstanding the above provisions the supplier's, guarantees/warantees for the replaced equipment shall also be passed on to the EMPLOYER.

80.3 LIMITATION OF LIABILITY

Notwithstanding anything contrary contained herein, the aggregate total liability of CONTRACTOR under the Agreement or otherwise shall be limited to 100% of Agreement / Contract Value. However, neither party shall be liable to the other party for any indirect and consequential damages, loss of profits or loss of production.

81 Care of works:

81.0 From the commencement to completion of the WORK, the CONTRACTOR shall take full responsibility for the care for all works including all temporary works and in case any damages, loss or injury shall happen to the WORK or to any part thereof or to any temporary works from any cause whatsoever, shall at his own cost repair and make good the same so that at completion the WORK shall be in good order and in conformity in every respects with the requirement of the CONTRACT and the ENGINEER-IN- CHARGE's instructions.

81.1 DEFECTS PRIOR TO TAKING OVER:

If at any time, before the WORK is taken over, the ENGINEER-IN-CHARGE shall:

- a) Decide that any works done or materials used by the CONTRACTOR or by any SUB-CONTRACTOR is defective or not in accordance with the CONTRACT, or that the works or any portion thereof are defective, or do not fulfill the requirements of CONTRACT (all such matters being hereinafter, called 'Defects' in this clause), and
- b) As soon as reasonably practicable, gives to the CONTRACTOR notice in writing of the said decision, specifying particulars of the defects alleged to exist or to have occurred, then the CONTRACTOR shall at his own expenses and with all speed make good the defects so specified. In case CONTRACTOR shall fail to do so, the EMPLOYER may take, at the cost of the CONTRACTOR, such steps as may in all circumstances, be reasonable to make good such defects. The expenditure so incurred by the EMPLOYER will be recovered from the amount due to the CONTRACTOR. The decision of the ENGINEER-IN-CHARGE with regard to the amount to be recovered from the CONTRACTOR will be final and binding on the CONTRACTOR. As soon as the WORK has been completed in accordance with the CONTRACT (except in minor respects that do not affect their use for the purpose for which they are intended and except for maintenance thereof provided in clause 80.1 of General Conditions of Contract) and have passed the tests on completion, the ENGINEER-IN-CHARGE shall issue a certificate (hereinafter called Completion Certificate) in which he shall certify the date on which the WORK have been so completed and have passed the said tests and the EMPLOYER shall be deemed to have taken over the WORK on the date so certified. If the WORK has been divided into various groups in the CONTRACT, the EMPLOYER shall be entitled to take over any group or groups before the other or others and there upon the ENGINEER-IN-CHARGE shall issue a Completion Certificate which will, however, be for such group or groups so taken over only. In such an event if the group /section/ part so taken over is related, to the integrated system of the work, notwithstanding date of grant of Completion Certificate for group/ section/ part. The period of liability in respect of such group/ section/ part shall extend 12 (twelve) months from the date of completion of WORK.

81.2 DEFECTS AFTER TAKING OVER:

In order that the CONTRACTOR could obtain a COMPLETION CERTIFICATE he shall make good,

with all possible speed, any defect arising from the defective materials supplied by the CONTRACTOR or workmanship or any act or omission of the CONTRACT or that may have been noticed or developed, after the works or groups of the works has been taken over, the period allowed for carrying out such WORK will be normally one month. If any defect be not remedied within a reasonable time, the EMPLOYER may proceed to do the WORK at CONTRACTOR's risk and expense and deduct from the final bill such amount as may be decided by the EMPLOYER. If by reason of any default on the part of the CONTRACTOR a COMPLETION CERTIFICATE has not been issued in respect of any portion of the WORK within one month after the date fixed by the CONTRACT for the completion of the WORK, the EMPLOYER shall be at liberty to use the WORK or any portion thereof in respect of which a completion certificate has not been issued, provided that the WORK or the portion thereof so used as aforesaid shall be afforded reasonable opportunity for completing these works for the issue of Completion Certificate.

82 Guarantee/transfer of guarantee:

82.1 For works like water-proofing, acid and alkali resisting materials, pre-construction soil treatment against termite or any other specialized works etc. the CONTRACTOR shall invariably engage SUB-CONTRACTORS who are specialists in the field and firms of repute and such a SUB-CONTRACTOR shall furnish guarantees for their workmanship to the EMPLOYER, through the CONTRACTOR. In case such a SUB-CONTRACTOR/ firm is not prepared to furnish a guarantee to the EMPLOYER, the CONTRACTOR shall give that guarantee to the EMPLOYER directly.

83 Training of employer's personnel:

83.1 The CONTRACTOR undertakes to provide training to Engineering personnel selected and sent by the EMPLOYER at the works of the CONTRACTOR without any cost to the EMPLOYER. The period and the nature of training for the individual personnel shall be agreed upon mutually between the CONTRACTOR and the EMPLOYER. These engineering personnel shall be given special training at the shops, where the equipment will be manufactured and/ or in their collaborator's works and where possible, in any other plant where equipment manufactured by the CONTRACTOR or his collaborators is under installation or test to enable those personnel to become familiar with the equipment being furnished by the CONTRACTOR. EMPLOYER shall bear only the to and fro fare of the said engineering personnel.

84 Replacement of defective parts and materials:

84.1 If during the progress of the WORK, EMPLOYER shall decide and inform in writing to the CONTRACTOR, that the CONTRACTOR has manufactured any plant or part of the plant unsound or imperfect or has furnished plant inferior to the quality specified, the CONTRACTOR on receiving details of such defects or deficiencies shall at his own expenses within 7 (seven) days of his receiving the notice, or otherwise within such time as may be reasonably necessary for making it good, proceed to alter, re-construct or remove such work and furnish fresh equipments upto the standards of the specifications. In case the CONTRACTOR fails to do so, EMPLOYER may on giving the CONTRACTOR 7 (seven) day's notice in writing of his intentions to do so, proceed to remove the portion of the WORK so complained of and at the cost of CONTRACTOR's, perform all such works or furnish all such equipments provided that nothing in the clause shall be deemed to deprive the EMPLOYER of or affect any rights under the CONTRACT, the EMPLOYER may otherwise have in respect of such defects and deficiencies.

84.2 The CONTRACTOR's full and extreme liability under this clause shall be satisfied by the payments to the EMPLOYER of the extra cost, of such replacements procured including erection/installation as provided for in the CONTRACT; such extra cost being the ascertained difference between the price paid by the EMPLOYER for such replacements and the CONTRACT price portion for such defective plants and repayments of any sum paid by the EMPLOYER to the CONTRACTOR in respect of such defective plant. Should the EMPLOYER not so replace the defective plant the CONTRACTOR's extreme liability under this clause shall be limited to the repayment of all such sums paid by the EMPLOYER under the CONTRACT for such defective plant.

85 Indemnity

85.1 If any action is brought before a Court, Tribunal or any other Authority against the Employer or an officer or agent of the EMPLOYER, for the failure, omission or neglect on the part of the CONTRACTOR to perform any acts, matters, covenants or things under the CONTRACT, or damage or injury caused by the alleged omission or negligence on the part of the CONTRACTOR, his agents, representatives or his SUB-CONTRACTOR's, or in connection with any claim based on lawful demands of SUB-CONTRACTOR's workmen suppliers or employees, the CONTRACTOR, shall in such cases indemnify and keep the EMPLOYER and/or their representatives harmless from all losses, damages, expenses or decrees arising out of such action.

86 Construction aids, equipments, tools & tackles:

86.1 CONTRACTOR shall be solely responsible for making available for executing the WORK, all requisite CONSTRUCTION EQUIPMENTS, Special Aids, Barges, Cranes and the like, all Tools, Tackles and Testing Equipment and Appliances, including imports of such equipment etc. as required. In case of import of the same the rates applicable for levying of Custom Duty on such Equipment, Tools, & Tackles and the duty drawback applicable thereon shall be ascertained by the CONTRACTOR from the concerned authorities of Government of India. It shall be clearly understood that EMPLOYER shall not in any way be responsible for arranging to obtain Custom Clearance and/or payment of any duties and/or duty draw backs etc. for such equipments so imported by the CONTRACTOR and the CONTRACTOR shall be fully responsible for all taxes, duties and documentation with regard to the same. Tenderer in his own interest may contact, for any clarifications in the matter, concerned agencies/Dept./Ministries of Govt. of India. All clarifications so obtained and interpretations thereof shall be solely the responsibility of the CONTRACTOR.

SECTION-VI CERTIFICATES AND PAYMENTS

87 Schedule of rates and payments:

87.1 i) CONTRACTOR'S REMUNERATION:

The price to be paid by the EMPLOYER to CONTRACTOR for the whole of the WORK to be done and for the performance of all the obligations undertaken by the CONTRACTOR under the CONTRACT DOCUMENTS shall be ascertained by the application of the respective Schedule of Rates (the inclusive nature of which is more particularly defined by way of application but not of limitation, with the succeeding sub-clause of this clause) and payment to be made accordingly for the WORK actually executed and approved by the ENGINEER-IN-CHARGE. The sum so ascertained shall (excepting only as and to the extent expressly provided herein) constitute the sole and inclusive remuneration of the CONTRACTOR under the CONTRACT and no further or other payment whatsoever shall be or become due or payable to the CONTRACTOR under the CONTRACT.

ii) SCHEDULE OF RATES TO BE INCLUSIVE:

The prices/rates quoted by the CONTRACTOR shall remain firm till the issue of FINAL CERTIFICATE and shall not be subject to escalation. Schedule of Rates shall be deemed to include and cover all costs, expenses and liabilities of every description and all risks of every kind to be taken in executing, completing and handing over the WORK to the EMPLOYER by the CONTRACTOR. The CONTRACTOR shall be deemed to have known the nature, scope, magnitude and the extent of the WORK and materials required though the CONTRACT DOCUMENT may not fully and precisely furnish them. Tenderer's shall make such provision in the Schedule of Rates as he may consider necessary to cover the cost of such items of WORK and materials as may be reasonable and necessary to complete the WORK. The opinion of the ENGINEER-IN-CHARGE as to the items of WORK which are necessary and reasonable for COMPLETION OF WORK shall be final and binding on the CONTRACTOR, although the same may not be shown on or described specifically in CONTRACT DOCUMENTS. Generality of this present provision shall not be deemed to cut down or limit in any way because in certain cases it may and in other cases it may not be expressly stated that the CONTRACTOR shall do or perform a work or supply articles or perform services at his own cost or without addition of payment or without extra charge or words to the same effect or that it may be stated or not stated that the same are included in and covered by the Schedule of Rates.

iii) SCHEDULE OF RATES TO COVER CONSTRUCTION EQUIPMENTS, MATERIALS, LABOUR ETC.:

Without in any way limiting the provisions of the preceding sub-clause the Schedule of Rates shall be deemed to include and cover the cost of all construction equipment, temporary WORK (except as provided for herein), pumps, materials, labour, insurance, fuel, consumables, stores and appliances to be supplied by the CONTRACTOR and all other matters in connection with each item in the Schedule of Rates and the execution of the WORK or any portion thereof finished, complete in every respect and maintained as shown or described in the CONTRACT DOCUMENTS or as may be ordered in writing during the continuance of the CONTRACT.

iv) SCHEDULE OF RATES TO COVER ROYALTIES, RENTS AND CLAIMS:

The Schedule of Rates (i.e., VALUE OF CONTRACT) shall be deemed to include and cover the cost of all royalties and fees for the articles and processes, protected by letters, patent or otherwise incorporated in or used in connection with the WORK, also all royalties, rents and other payments in connection with obtaining materials of whatsoever kind for the WORK and shall include an indemnity to the EMPLOYER which the CONTRACTOR hereby gives against all actions, proceedings, claims, damages, costs and expenses arising from the incorporation in or use on the WORK of any such articles, processes or materials, octroi or other municipal or local Board Charges, if levied on materials, equipment or machineries to be brought to site for use on WORK shall be borne by the

CONTRACTOR.

v) SCHEDULE OF RATES TO COVER TAXES AND DUTIES:

No exemption or reduction of Customs Duties, Excise Duties, Sales Tax, Sales Tax on works Contract quay or any port dues, transport charges, stamp duties or Central or State Government or local Body or Municipal Taxes or duties, taxes or charges (from or of any other body), whatsoever, will be granted or obtained, all of which expenses shall be deemed to be included in and covered by the Schedule or Rates. The CONTRACTOR shall also obtain and pay for all permits or other privileges necessary to complete the WORK.

vi) SCHEDULE OF RATES TO COVER RISKS OF DELAY:

The Schedule of Rates shall be deemed to include and cover the risk of all possibilities of delay and interference with the CONTRACTOR's conduct of WORK which occur from any causes including orders of the EMPLOYER in the exercise of his power and on account of extension of time granted due to various reasons and for all other possible or probable causes of delay.

vii) SCHEDULE OF RATES CANNOT BE ALTERED:

For WORK under unit rate basis, no alteration will be allowed in the Schedule of Rates by reason of works or any part of them being modified, altered, extended, diminished or committed. The Schedule of Rates are fully inclusive of rates which have been fixed by the CONTRACTOR and agreed to by the EMPLOYER and cannot be altered. For lumpsum CONTRACTS, the payment will be made according to the WORK actually carried out, for which purpose an item wise, or work wise Schedule of Rates shall be furnished, suitable for evaluating the value of WORK done and preparing running account bill. Payment for any additional work which is not covered in the Schedule of Rates, shall only be released on issuance of change order.

88 Procedure for measurement and billing of work in progress:

88.1 BILLING PROCEDURE:

Following procedures shall be adopted for billing of works executed by the CONTRACTOR.

88.1.1 All measurements shall be recorded in sextuplicate on standard measurement sheets supplied by EMPLOYER and submitted to EMPLOYER/CONSULTANT for scrutiny and passing.

88.1.2 EMPLOYER/CONSULTANT shall scrutinize and check the measurements recorded on the sheets and shall certify correctness of the same on the measurement sheets.

88.1.3 ENGINEER-IN-CHARGE shall pass the bills after carrying out the comprehensive checks in accordance with the terms and conditions of the CONTRACTS, within 7 days of submission of the bills, complete in all respects and send the same to the Employer to effect payment to the CONTRACTOR.

88.1.4 DPA-III Division /IFD shall make all endeavor to make payments of undisputed amount of the bills submitted based on the joint measurements within 15 (Fifteen) days from the date of certification by the Engineer-in-Charge.

88.1.5 Measurements shall be recorded as per the methods of measurement spelt out in EMPLOYER/CONSULTANT SPECIFICATIONS / CONTRACT DOCUMENT. EMPLOYER/CONSULTANT shall be fully responsible for checking the measurements quantitatively and qualitatively as recorded in the Measurement Books/ Bills.

88.1.6 While preparing the final bills overall measurements will not be taken again. Only volume of work executed since the last measured bill along with summary of final measurements will be considered for the final bill. However, a detailed check shall be made as to missing measurements and in case there are any missing items or measurements the same shall be recorded.

88.2 SECURED ADVANCE ON MATERIAL:

Unless otherwise provided elsewhere in the tender, no 'Secured Advance' on security of materials brought to site for execution of contracted items(s) shall be paid to the Contractor whatsoever.

88.3 DISPUTE IN MODE OF MEASUREMENT:

In case of any dispute as to the mode of measurement not covered by the CONTRACT to be adopted for any item of WORK, mode of measurement as per latest Indian Standard Specifications shall be followed.

88.4 ROUNDING-OFF OF AMOUNTS:

In calculating the amount of each item due to the CONTRACTOR in every certificate prepared for payment, sum of less than 50 paise shall be omitted and the total amount on each certificate shall be rounded off to the nearest rupees, i.e., sum of less than 50 paise shall be omitted and sums of 50 paise and more upto one rupee shall be reckoned as one rupee.

89 Lumpsum in tender:

89.1 The payment against any Lumpsum item shall be made only on completion of that item as per the provision of the CONTRACT after certification by ENGINEER-IN-CHARGE.

90 Running account payments to be regarded as advance:

90.1 All running account payments shall be regarded as payment by way of advance against the final payment only and not as payments for WORK actually done and completed and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be removed and taken away and reconstructed or re- erected or be considered as an admission of the due performance of the CONTRACT, or any part thereof, in this respect, or of the accruing of any claim by the CONTRACTOR, nor shall it conclude, determine or affect in any way the powers of the EMPLOYER under these conditions or any of them as to the final settlement and adjustment of the accounts or otherwise, or in any other way vary or affect the CONTRACT. The final bill shall be submitted by the CONTRACTOR within one month of the date of physical completion of the WORK; otherwise, the ENGINEER-IN-CHARGE's certificate of the measurement and of total amount payable for the WORK accordingly shall be final and binding on all parties

91 Notice of claims for additional payments:

91.1 Should the CONTRACTOR consider that he is entitled to any extra payment for any extra/additional WORKS or MATERIAL change in original SPECIFICATIONS carried out by him in respect of WORK he shall forthwith give notice in writing to the ENGINEER-IN-CHARGE that he claims extra payment. Such notice shall be given to the ENGINEER-IN-CHARGE upon which CONTRACTOR bases such claims and such notice shall contain full particulars of the nature of such claim with full details of amount claimed. Irrespective of any provision in the CONTRACT to the contrary, the CONTRACTOR must intimate his intention to lodge claim on the EMPLOYER within 10 (ten) days of the commencement of happening of the event and quantify the claim within 30 (thirty) days, failing which the CONTRACTOR will lose his right to claim any compensation/reimbursement/damages etc. or refer the matter to arbitration. Failure on the part of CONTRACTOR to put forward any claim without the necessary particulars as above within the time above specified shall be an absolute waiver thereof. No omission by EMPLOYER to reject any such claim and no delay in dealing therewith shall be waiver by EMPLOYER of any of these rights in respect thereof.

91.2 ENGINEER-IN-CHARGE shall review such claims within a reasonably period of time and cause to discharge these in a manner considered appropriate after due deliberations thereon. However, CONTRACTOR shall be obliged to carry on with the WORK during the period in which his claims are under consideration by the EMPLOYER, irrespective of the outcome of such claims, where additional payments for WORKS considered extra are justifiable in accordance with the CONTRACT provisions, EMPLOYER shall arrange to release the same in the same manner as for normal WORK payments. Such of the extra works so admitted by EMPLOYER shall be governed by all the terms, conditions, stipulations and specifications as are applicable for the CONTRACT. The rates for extra works shall

generally be the unit rates provided for in the CONTRACT. In the event unit rates for extra works so executed are not available as per CONTRACT, payments may either be released on day work basis for which daily/hourly rates for workmen and hourly rates for equipment rental shall apply, or on the unit rate for WORK executed shall be derived by interpolation/ extrapolation of unit rates already existing in the CONTRACT. In all the matters pertaining to applicability of rate and admittance of otherwise of an extra work claim of CONTRACTOR the decision of ENGINEER-IN-CHARGE shall be final and binding.

92 Payment of contractor's bill:

92.1 No payment shall be made for works estimated to cost less than Rs.10,000/- till the whole of the work shall have been completed and a certificate of completion given. But in case of works estimated to cost more than Rs.10,000/-, that CONTRACTOR on submitting the bill thereof be entitled to receive a monthly payment proportionate to the part thereof approved and passed by the ENGINEER-IN-CHARGE, whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the CONTRACTOR. This payment will be made after making necessary corrections/deductions as stipulated elsewhere in the CONTRACT DOCUMENT for materials, Contract Performance Security, taxes etc.

92.2 Payment due to the CONTRACTOR shall be made by the EMPLOYER by Account Payee cheque forwarding the same to registered office or the notified office of the CONTRACTOR. In no case will EMPLOYER be responsible if the cheque is mislaid or misappropriated by unauthorised person/persons. In all cases, the CONTRACTOR shall present his bill duly pre-receipted on proper revenue stamp payment shall be made in Indian Currency.

92.3 In general payment of final bill shall be made to CONTRACTOR within 60 days of the submission of bill on joint measurements, after completion of all the obligations under the CONTRACT.

93 Receipt for payment:

93.1 Receipt for payment made on account of work when executed by a firm, must be signed by a person holding due power of attorney in this respect on behalf of the CONTRACTOR, except when the CONTRACTOR's are described in their tender as a limited company in which case the receipts must be signed in the name of the company by one of its principal officers or by some other person having authority to give effectual receipt for the company.

94 Completion certificate:

94.1 APPLICATION FOR COMPLETION CERTIFICATE: When the CONTRACTOR fulfils his obligation under Clause 81.1 he shall be eligible to apply for COMPLETION CERTIFICATE. The ENGINEER-IN-CHARGE shall normally issue to the CONTRACTOR the COMPLETION CERTIFICATE within one month after receiving any application therefore from the CONTRACTOR after verifying from the completion documents and satisfying himself that the WORK has been completed in accordance with and as set out in the construction and erection drawings, and the CONTRACT DOCUMENTS. The CONTRACTOR, after obtaining the COMPLETION CERTIFICATE, is eligible to present the final bill for the WORK executed by him under the terms of CONTRACT.

94.2 COMPLETION CERTIFICATE: Within one month of the completion of the WORK in all respects, the CONTRACTOR shall be furnished with a certificate by the ENGINEER-IN-CHARGE of such completion, but no certificate shall be given nor shall the WORK be deemed to have been executed until all scaffolding, surplus materials and rubbish is cleared off the SITE completely nor until the WORK shall have been measured by the ENGINEER-IN-CHARGE whose measurement shall be binding and conclusive. The WORKS will not be considered as complete and taken over by the EMPLOYER, until all the temporary works, labour and staff colonies are cleared to the satisfaction of the ENGINEER-IN-CHARGE. If the CONTRACTOR fails to comply with the requirements of this clause on or before the date fixed for the completion of the WORK, the ENGINEER-IN-CHARGE may at the expense of the CONTRACTOR remove such scaffolding, surplus materials and rubbish and dispose off the same as he thinks fit and clean off such dirt as aforesaid, and the CONTRACTOR shall

forthwith pay the amount of all expenses so incurred and shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realised by the sale thereof.

94.3 COMPLETION CERTIFICATE DOCUMENTS:

For the purpose of Clause 94.0 the following documents will be deemed to form the completion documents:

- i) The technical documents according to which the WORK was carried out.
- ii) Six (6) sets of construction drawings showing therein the modification and correction made during the course of execution and signed by the ENGINEER-IN-CHARGE.
- iii) COMPLETION CERTIFICATE for 'embedded' and 'covered' up work.
- iv) Certificates of final levels as set out for various works.
- v) Certificates of tests performed for various WORKS.
- vi) Material appropriation, Statement for the materials issued by the EMPLOYER for the WORK and list of surplus materials returned to the EMPLOYER's store duly supported by necessary documents.

95 Final decision and final certificate:

95.1 Upon expiry of the period of liability and subject to the ENGINEER-IN-CHARGE being satisfied that the WORKS have been duly maintained by the CONTRACTOR during monsoon or such period as hereinbefore provided in Clause 80 & 81 and that the CONTRACTOR has in all respect duly made-up any subsidence and performed all his obligations under the CONTRACT, the ENGINEER- IN-CHARGE shall (without prejudice to the rights of the EMPLOYER to retain the provisions of relevant Clause hereof) otherwise give a certificate herein referred to as the FINAL CERTIFICATE to that effect and the CONTRACTOR shall not be considered to have fulfilled the whole of his obligations under CONTRACT until FINAL CERTIFICATE shall have been given by the ENGINEER- IN- CHARGE notwithstanding any previous entry upon the WORK and taking possession, working or using of the same or any part thereof by the EMPLOYER.

96 Certificate and payments on evidence of completion:

96.1 Except the FINAL CERTIFICATE, no other certificates or payments against a certificate or on general account shall be taken to be an admission by the EMPLOYER of the due performance of the CONTRACT or any part thereof or of occupancy or validity of any claim by the CONTRACTOR.

97 Deductions from the contract price:

97.1 All costs, damages or expenses which EMPLOYER may have paid or incurred, which under the provisions of the CONTRACT, the CONTRACTOR is liable/will be liable, will be claimed by the EMPLOYER. All such claims shall be billed by the EMPLOYER to the CONTRACTOR regularly as and when they fall due. Such claims shall be paid by the CONTRACTOR within 15 (fifteen) days of the receipt of the corresponding bills and if not paid by the CONTRACTOR within the said period, the EMPLOYER may, then, deduct the amount from any moneys due i.e., Contract Performance Security or becoming due to the CONTRACTOR under the CONTRACT or may be recovered by actions of law or otherwise, if the CONTRACTOR fails to satisfy the EMPLOYER of such claims.

98 RETENTION MONEY: 5% of amount shall be retained from each bill of contractor till the defect liability period.(Defect Liability period is One Year from the date of physical completion of work)

SECTION-VII TAXES AND INSURANCE

98 Taxes, Duties, Octroi etc:

98.1 The CONTRACTOR agrees to and does hereby accept full and exclusive liability for the payment of any and all Taxes, Duties, including Excise duty, octroi etc. now or hereafter imposed, increased, modified, all the sales taxes, duties, octrois etc. now in force and hereafter increased, imposed or modified, from time to time in respect of WORKS and materials and all contributions and taxes for unemployment compensation, insurance and old age pensions or annuities now or hereafter imposed by any Central or State Government authorities which are imposed with respect to or covered by the wages, salaries, or other compensations paid to the persons employed by the CONTRACTOR and the CONTRACTOR shall be responsible for the compliance of all SUB-CONTRACTORS, with all applicable Central, State, Municipal and local law and regulation and requirement of any Central, State or local Government agency or authority. CONTRACTOR further agrees to defend, indemnify and hold EMPLOYER harmless from any liability or penalty which may be imposed by the Central, State or Local authorities by reason or any violation by CONTRACTOR or SUB-CONTRACTOR of such laws, suits or proceedings that may be brought against the EMPLOYER arising under, growing out of, or by reason of the work provided for by this CONTRACT, by third parties, or by Central or State Government authority or any administrative sub-division thereof. Tax deductions will be made as per the rules and regulations in force in accordance with acts prevailing from time to time.

99 Sales tax/Turnover tax:

99.1 Tenderer should quote all inclusive prices including the liability of Sales Tax/Turnover Tax whether on the works contract as a whole or in respect of bought out components used by the CONTRACTOR in execution of the CONTRACT. EMPLOYER shall not be responsible for any such liability of the CONTRACTOR in respect of this CONTRACT.

100 Statutory variations

100.1 Tenderer should quote prices inclusive of excise-duty and sales tax applicable on finished product. Any statutory variations in Excise Duty and sales tax on finished product during the contractual completion period, shall be to the Employer's account for which the Contractor will furnish documentary evidence(s) in support of their claims to MEA. However, any increase in the rate of these taxes and duties (E.D. and S.T.) beyond the contractual completion period shall be to Contractor's account and any decrease shall be passed on to MEA.

101 Insurance:

101.1 GENERAL CONTRACTOR shall at his own expense arrange secure and maintain insurance with reputable insurance companies to the satisfaction of the EMPLOYER as follows: CONTRACTOR at his cost shall arrange, secure and maintain insurance as may be necessary and to its full value for all such amounts to protect the WORKS in progress from time to time and the interest of EMPLOYER against all risks as detailed herein. The form and the limit of such insurance, as defined here in together with the under works thereof in each case should be as acceptable to the EMPLOYER. However, irrespective of work acceptance the responsibility to maintain adequate insurance coverage at all times during the period of CONTRACT shall be that of CONTRACTOR alone. CONTRACTOR's failure in this regard shall not relieve him of any of his responsibilities and obligations under CONTRACT. Any loss or damage to the equipment, during ocean transportation, port/custom clearance, inland and port handling, inland transportation, storage, erection and commissioning till such time the WORK is taken over by EMPLOYER, shall be to the account of CONTRACTOR. CONTRACTOR shall be responsible for preferring of all claims and make good for the damage or loss by way of repairs and/or replacement of the parts of the Work damaged or lost. CONTRACTOR shall provide the EMPLOYER with a copy of all insurance policies and documents taken out by him in pursuance of the CONTRACT. Such copies of document shall be submitted to the EMPLOYER immediately upon the CONTRACTOR having taken such insurance coverage. CONTRACTOR shall

also inform the EMPLOYER at least 60(Sixty) days in advance regarding the expiry cancellation and/or changes in any of such documents and ensure revalidation/renewal etc., as may be necessary well in time. Statutory clearances, if any, in respect of foreign supply required for the purpose of replacement of equipment lost in transit and/or during erection, shall be made available by the EMPLOYER. CONTRACTOR shall, however, be responsible for obtaining requisite licences, port clearances and other formalities relating to such import. The risks that are to be covered under the insurance shall include, but not be limited to the loss or damage in handling, transit, theft, pilferage, riot, civil commotion, weather conditions, accidents of all kinds, fire, war risk (during ocean transportation only) etc. The scope of such insurance shall cover the entire value of supplies of equipments, plants and materials to be imported from time to time. All costs on account of insurance liabilities covered under CONTRACT will be to CONTRACTOR's account and will be included in VALUE OF CONTRACT. However, the EMPLOYER may from time to time, during the currency of the CONTRACT, ask the CONTRACTOR in writing to limit the insurance coverage risk and in such a case, the parties to the CONTRACT will agree for a mutual settlement, for reduction in VALUE OF CONTRACT to the extent of reduced premium amounts. CONTRACTOR as far as possible shall cover insurance with Indian Insurance Companies, including marine Insurance during ocean transportation.

i) EMPLOYEES STATE INSURANCE ACT:

The CONTRACTOR agrees to and does hereby accept full and exclusive liability for the compliance with all obligations imposed by the Employee State Insurance Act 1948 and the CONTRACTOR further agrees to defend, indemnify and hold EMPLOYER harmless for any liability or penalty which may be imposed by the Central, State or Local authority by reason of any asserted violation by CONTRACTOR or SUB-CONTRACTOR of the Employees' State Insurance Act, 1948, and also from all claims, suits or proceeding that may be brought against the EMPLOYER arising under, growing out of or by reasons of the work provided for by this CONTRACTOR, by third parties or by Central or State Government authority or any political sub- division thereof. The CONTRACTOR agrees to fill in with the Employee's State Insurance Corporation, the Declaration Forms, and all forms which may be required in respect of the CONTRACTOR's or SUB- CONTRACTOR's employees, who are employed in the WORK provided for or those covered by ESI from time to time under the Agreement. The CONTRACTOR shall deduct and secure the agreement of the SUB- CONTRACTOR to deduct the employee's contribution as per the first schedule of the Employee's State Insurance Act from wages and affix the Employees Contribution Card at wages payment intervals. The CONTRACTOR shall remit and secure the agreement of SUB-CONTRACTOR to remit to the State Bank of India, Employee's State Insurance Corporation Account, the Employee's contribution as required by the Act. The CONTRACTOR agrees to maintain all cards and Records as required under the Act in respect of employees and payments and the CONTRACTOR shall secure the agreement of the SUB-CONTRACTOR to maintain such records. Any expenses incurred for the contributions, making contributions or maintaining records shall be to the CONTRACTOR's or SUB-CONTRACTOR's account. The EMPLOYER shall retain such sum as may be necessary from the total VALUE OF CONTRACT until the CONTRACTOR shall furnish satisfactory proof that all contributions as required by the Employees State Insurance Act, 1948, have been paid. This will be pending on the CONTRACTOR when the ESI Act is extended to the place of work.

ii) WORKMEN COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE:

Insurance shall be effected for all the CONTRACTOR's employees engaged in the performance of this CONTRACT. If any of the work is sublet, the CONTRACTOR shall require the SUB-CONTRACTOR to provide workman's Compensation and employer's liability insurance for the later's employees if such employees are not covered under the CONTRACTOR's Insurance.

iii) ACCIDENT OR INJURY TO WORKMEN:

The EMPLOYER shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workman or other person in the Employment of the CONTRACTOR or any SUB-CONTRACTOR save and except an accident or injury resulting from any act or default of the EMPLOYER, his agents or servants and the CONTRACTOR shall indemnify and keep indemnified the EMPLOYER against all such damages and compensation (save and except and aforesaid) and against all claims, demands, proceeding, costs, charges and expenses, whatsoever in respect or in relation thereto.

iv) TRANSIT INSURANCE

In respect of all items to be transported by the CONTRACTOR to the SITE of WORK, the cost of transit insurance should be borne by the CONTRACTOR and the quoted price shall be inclusive of this cost.

v) COMPREHENSIVE AUTOMOBILE INSURANCE

This insurance shall be in such a form as to protect the Contractor against all claims for injuries, disability, disease and death to members of public including EMPLOYER's men and damage to the property of others arising from the use of motor vehicles during on or off the 'site' operations, irrespective of the Employership of such vehicles.

vi) COMPREHENSIVE GENERAL LIABILITY INSURANCE

a) This insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of member of public or damage to property of others due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractor's or from riots, strikes and civil commotion.

b) Contractor shall take suitable Group Personal Accident Insurance Cover for taking care of injury, damage or any other risks in respect of his Engineers and other Supervisory staff who are not covered under Employees State Insurance Act.

c) The policy shall cover third party liability. The third party (liability shall cover the loss/ disablement of human life (person not belonging to the Contractor) and also cover the risk of damage to others materials/ equipment/ properties during construction, erection and commissioning at site.

The value of third party liability for compensation for loss of human life or partial/full disablement shall be of required statutory value but not less than Rs. 2 lakhs per death, Rs. 1.5 lakhs per full disablement and Rs. 1 lakh per partial disablement and shall nevertheless cover such compensation as may be awarded by Court by Law in India and cover for damage to others equipment/ property as approved by the Purchaser. However, third party risk shall be maximum to Rs. 10(ten) lakhs to death.

d) The Contractor shall also arrange suitable insurance to cover damage, loss, accidents, risks etc., in respect of all his plant, equipments and machinery, erection tools & tackles and all other temporary attachments brought by him at site to execute the work.

e) The Contractor shall take out insurance policy in the joint name of EMPLOYER and Contractor from one or more nationalised insurance company from any branch office at Project site.

f) Any such insurance requirements as are hereby established as the minimum policies and coverages which Contractor must secure and keep in force must be complied with, Contractor shall at all times be free to obtain additional or increased coverages at Contractor's sole expenses.

vi) ANY OTHER INSURANCE REQUIRED UNDER LAW OR REGULATIONS OR BY EMPLOYER:

CONTRACTOR shall also carry and maintain any and all other insurance(s) which he may be required under any law or regulation from time to time without any extra cost to EMPLOYER. He shall also carry and maintain any other insurance which may be required by the EMPLOYER.

102 Damage to Property or to any Person or any Third Party

102.1 i) CONTRACTOR shall be responsible for making good to the satisfaction of the EMPLOYER any loss or any damage to structures and properties belonging to the EMPLOYER or being executed or procured or being procured by the EMPLOYER or of other agencies within in the premises of all the work of the EMPLOYER, if such loss or damage is due to fault and/or the negligence or wilful acts or omission of the CONTRACTOR, his employees, agents, representatives or SUB-CONTRACTORS.

ii) The CONTRACTOR shall take sufficient care in moving his plants, equipments and materials from one place to another so that they do not cause any damage to any person or to the property of the EMPLOYER or any third party including overhead and underground cables and in the event of any damage resulting to the property of the EMPLOYER or of a third party during the movement of the aforesaid plant, equipment or materials the cost of such damages including eventual loss of production, operation or services in any plant or establishment as estimated by the EMPLOYER or ascertained or demanded by the third party shall be borne by the CONTRACTOR. Third party liability risk shall be Rupees One lakh for single accident and limited to Rupees Ten lakhs.

iii) The CONTRACTOR shall indemnify and keep the EMPLOYER harmless of all claims for damages

to property other than EMPLOYER's property arising under or by reason of this agreement, if such claims result from the fault and/or negligence or willful acts or omission of the CONTRACTOR, his employees, agents, representative of SUB-CONTRACTOR.

MOBILISATION ADVACNE: If requested by the contractor mobilization advance upto **maximum of 10% (ten percent)** of the accepted estimated contract value, shall be paid to the contractor on acceptance of LOI, subject to the bank guarantee towards security of "Mobilization Advance".

SECTION-VIII LABOUR LAWS

103 Labour laws:

- 103.1 i) No labour below the age of 18 (eighteen) years shall be employed on the WORK.
- ii) The CONTRACTOR shall not pay less than what is provided under law to labourers engaged by him on the WORK.
- iii) The CONTRACTOR shall at his expense comply with all labour laws and keep the EMPLOYER indemnified in respect thereof.
- iv) The CONTRACTOR shall pay equal wages for men and women in accordance with applicable labour laws.
- v) If the CONTRACTOR is covered under the Contract labour (Regulation and Abolition) Act, he shall obtain a licence from licensing authority (i.e. office of the labour commissioner) by payment of necessary prescribed fee and the deposit, if any, before starting the WORK under the CONTRACT. Such fee/deposit shall be borne by the CONTRACTOR.
- vi) The CONTRACTOR shall employ labour in sufficient numbers either directly or through SUB-CONTRACTOR's to maintain the required rate of progress and of quality to ensure workmanship of the degree specified in the CONTRACT and to the satisfaction of the ENGINEER-IN-CHARGE.
- vii) The CONTRACTOR shall furnish to the ENGINEER-IN-CHARGE the distribution return of the number and description, by trades of the work people employed on the works. The CONTRACTOR shall also submit on the 4th and 19th of every month to the ENGINEER-IN-CHARGE a true statement showing in respect of the second half of the preceding month and the first half of the current month (1) the accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage and injury caused by them and (2) the number of female workers who have been allowed Maternity Benefit as provided in the Maternity Benefit Act 1961 on Rules made thereunder and the amount paid to them.
- viii) The CONTRACTOR shall comply with the provisions of the payment of Wage Act 1936, Employee Provident Fund Act 1952, Minimum Wages Act 1948, Employers Liability Act 1938, Workmen's Compensation Act 1923, Industrial Disputes Act 1947, the Maternity Benefit Act 1961 and Contract Labour Regulation and Abolition Act 1970, Employment of Children Act 1938 or any modifications thereof or any other law relating thereto and rules made thereunder from time to time.
- ix) The ENGINEER-IN-CHARGE shall on a report having been made by an Inspecting Officer as defined in Contract Labour (Regulation and Abolition) Act 1970 have the power to deduct from the money due to the CONTRACTOR any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non- fulfillment of the Conditions of the Contract for the benefit of workers, non-payment of wages or of deductions made from his or their wages which are not justified by the terms of the Contract or non-observance of the said regulations.
- x) The CONTRACTOR shall indemnify the EMPLOYER against any payments to be made under and for the observance of the provisions of the aforesaid Acts without prejudice to his right to obtain indemnity from his SUB-CONTRACTOR's. In the event of the CONTRACTOR committing a default or breach of any of the provisions of the aforesaid Acts as amended from time to time, of furnishing any information or submitting or filling and Form/ Register/ Slip under the provisions of these Acts which is materially incorrect then on the report of the inspecting Officers, the CONTRACTOR shall without prejudice to any other liability pay to the EMPLOYER a sum not exceeding Rs.50.00 as Liquidated Damages for every default, breach or furnishing, making, submitting, filling materially incorrect statement as may be fixed by the ENGINEER-IN-CHARGE and in the event of the CONTRACTOR's default continuing in this respect, the Liquidated Damages may be enhanced to Rs.50.00 per day for each day of default subject to a maximum of one percent of the estimated cost of the WORK put to tender. The ENGINEER-IN-CHARGE shall deduct such amount from bills or Contract Performance Security of the CONTRACTOR and credit the same to the Welfare Fund constitute under these acts. The decision of the ENGINEER-IN-CHARGE in this respect shall be final and binding.

104 Implementation of Apprentices Act, 1961:

104.1 The CONTRACTOR shall comply with the provisions of the Apprentices Act, 1961 and the Rules and Orders issued thereunder from time to time. If he fails to do so, his failure will be a breach

of the CONTRACT and the ENGINEER -IN-CHARGE may, at his discretion, cancel the CONTRACT. The CONTRACTOR shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions, of the Act.

105 Contractor to indemnify the Employer:

105.1 i) The CONTRACTOR shall indemnify the EMPLOYER and every member, office and employee of the EMPLOYER, also the ENGINEER-IN-CHARGE and his staff against all actions, proceedings, claims, demands, costs and expenses whatsoever arising out of or in connection with the matters referred to in Clause 102.0 and elsewhere and all actions, proceedings, claims, demands, costs and expenses which may be made against the EMPLOYER for or in respect of or arising out of any failure by the CONTRACTOR in the performance of his obligations under the CONTRACT DOCUMENT. The EMPLOYER shall not be liable for or in respect of or arising out of any failure by the CONTRACTOR in the performance of his obligations under the CONTRACT DOCUMENT. The EMPLOYER shall not be liable for or in respect of any demand or compensation payable by law in respect or in consequence of any accident or injury to any workmen or other person. In the employment of the CONTRACTOR or his SUB-CONTRACTOR the CONTRACTOR shall indemnify and keep indemnified the EMPLOYER against all such damages and compensations and against all claims, damages, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

ii) PAYMENT OF CLAIMS AND DAMAGES: Should the EMPLOYER have to pay any money in respect of such claims or demands as aforesaid the amount so paid and the costs incurred by the EMPLOYER shall be charged to and paid by the CONTRACTOR and the CONTRACTOR shall not be at liberty to dispute or question the right of the EMPLOYER to make such payments notwithstanding the same, may have been made without the consent or authority or in law or otherwise to the contrary.

iii) In every case in which by virtue of the provisions of Section 12, Sub-section (i) of workmen's compensation Act, 1923 or other applicable provision of Workmen Compensation Act or any other Act, the EMPLOYER is obliged to pay compensation to a workman employed by the CONTRACTOR in execution of the WORK, the EMPLOYER will recover from the CONTRACTOR the amount of the compensation so paid, and without prejudice to the rights of EMPLOYER under Section 12, Sub-section (2) of the said act, EMPLOYER shall be at liberty to recover such amount or any part thereof by deducting it from the Contract Performance Security or from any sum due to the CONTRACTOR whether under this CONTRACT or otherwise. The EMPLOYER shall not be bound to contest any claim made under Section 12, Sub-section (i) of the said act, except on the written request of the CONTRACTOR and upon his giving to the EMPLOYER full security for all costs for which the EMPLOYER might become liable in consequence of contesting such claim.

106 Health and sanitary arrangements for workers:

106.1 In respect of all labour directly or indirectly employed in the WORKS for the performance of the CONTRACTOR's part of this agreement, the CONTRACTOR shall comply with or cause to be complied with all the rules and regulations of the local sanitary and other authorities or as framed by the EMPLOYER from time to time for the protection of health and sanitary arrangements for all workers.

106.2 The CONTRACTOR shall provide in the labour colony all amenities such as electricity, water and other sanitary and health arrangements. The CONTRACTOR shall also provide necessary surface transportation to the place of work and back to the colony for their personnel accommodated in the labour colony.

SECTION-IX APPLICABLE LAWS AND SETTLEMENT OF DISPUTES

107 Arbitration:

107.1 Unless otherwise specified, the matters where decision of the Engineer- in-Charge is deemed to be final and binding as provided in the Agreement and the issues/disputes which cannot be mutually resolved within a reasonable time, all disputes shall be referred to arbitration by Sole Arbitrator. The Employer [MEA (India) Ltd.] shall suggest a panel of three independent and distinguished persons to the bidder/contractor/supplier/buyer (as the case may be) to select any one among them to act as the Sole Arbitrator. In the event of failure of the other parties to select the Sole Arbitrator within 30 days from the receipt of the communication suggesting the panel of arbitrators, the right of selection of the sole arbitrator by the other party shall stand forfeited and the EMPLOYER (MEA) shall have discretion to proceed with the appointment of the Sole Arbitrator. The decision of Employer on the appointment of the sole arbitrator shall be final and binding on the parties. The award of sole arbitrator shall be final and binding on the parties and unless directed/awarded otherwise by the sole arbitrator, the cost of arbitration proceedings shall be shared equally by the parties. The Arbitration proceedings shall be in English language and venue shall be New Delhi, India. Subject to the above, the provisions of (Indian) Arbitration & Conciliation ACT 1996 and the Rules framed there under shall be applicable. All matter relating to this contract are subject to the exclusive jurisdiction of the court situated in the state of Delhi. Bidders/suppliers/contractors may please note that the Arbitration & Conciliation Act 1996 was enacted by the Indian Parliament and is based on United Nations Commission on International Trade Law (UNCITRAL model law), which were prepared after extensive consultation with Arbitral Institutions and centers of International Commercial Arbitration. The United Nations General Assembly vide resolution 31/98 adopted the UNCITRAL Arbitration rules on 15 December 1976.

107.2 FOR THE SETTLEMENT OF DISPUTES BETWEEN GOVERNMENT DEPARTMENT AND ANOTHER AND ONE GOVERNMENT DEPARTMENT AND PUBLIC ENTERPRISE AND ONE PUBLIC ENTERPRISE AND ANOTHER THE ARBITRATION SHALL BE AS FOLLOWS:

"In the event of any dispute or difference between the parties hereto, such dispute or difference shall be resolved amicably by mutual consultation or through the good offices of empowered agencies of the Government. If such resolution is not possible, then, the unresolved dispute or difference shall be referred to arbitration of an arbitrator to be nominated by Secretary, Department of Legal Affairs ("Law Secretary") in terms of the Office Memorandum No.55/3/1/75-CF, dated the 19th December 1975 issued by the Cabinet Secretariat (Department of Cabinet Affairs), as modified from time to time. The Arbitration Act 1940 (10 of 1940) shall not be applicable to the arbitration under this clause. The award of the Arbitrator shall be binding upon parties to the dispute. Provided, however, any party aggrieved by such award may make a further reference for setting aside or revision of the award to Law Secretary whose decision shall bind the parties finally and conclusively.

108 Jurisdiction:

108.1 The CONTRACT shall be governed by and constructed according to the laws in force in INDIA. The CONTRACTOR hereby submits to the jurisdiction of the Courts situated at DELHI for the purposes of disputes, actions and proceedings arising out of the CONTRACT, the courts at DELHI only will have the jurisdiction to hear and decide such disputed, actions and proceedings.

SECTION-X SAFETY CODES

109 General:

109.1 CONTRACTOR shall adhere to safe construction practice and guard against hazardous, and unsafe working conditions and shall comply with EMPLOYER's safety rules as set forth herein. Prior to start of construction, CONTRACTOR will be furnished copies of EMPLOYER's "Safety Code" for information and guidance, if it has been prepared.

110 Safety regulations:

110.1 i) In respect of all labour, directly employed in the WORK for the performance of CONTRACTOR's part of this agreement, the CONTRACTOR shall at his own expense arrange for all the safety provisions as per safety codes of C.P.W.D., Indian Standards Institution. The Electricity Act, The Mines Act and such other acts as applicable.

ii) The CONTRACTOR shall observe and abide by all fire and safety regulations of the EMPLOYER. Before starting construction work CONTRACTOR shall consult with EMPLOYER's safety Engineers or ENGINEER-IN-CHARGE and must make good to the satisfaction of the EMPLOYER any loss or damage due to fire to any portion of the work done or to be done under this agreement or to any of the EMPLOYER's existing property.

111 First aid and industrial injuries:

111.1 i) CONTRACTOR shall maintain first aid facilities for its employees and those of its SUB-CONTRACTOR.

ii) CONTRACTOR shall make outside arrangements for ambulance service and for the treatment of industrial injuries. Names of those providing these services shall be furnished to EMPLOYER prior to start of construction and their telephone numbers shall be prominently posted in CONTRACTOR's field office.

ii) All critical industrial injuries shall be reported promptly to EMPLOYER, and a copy of CONTRACTOR's report covering each personal injury requiring the attention of a physician shall be furnished to the EMPLOYER.

112 General rules:

112.1 Smoking within the battery area, tank farm or dock limits is strictly prohibited. Violators of the no smoking rules shall be discharged immediately.

113 Contractor's barricades:

113.1 i) CONTRACTOR shall erect and maintain barricades required in connection with his operation to guard or protect:-

a)Excavations

b)Hoisting Areas.

c)Areas adjudged hazardous by CONTRACTOR's or EMPLOYER's inspectors.

d)EMPLOYER's existing property subject to damage by CONTRACTOR's Operations.

e)Rail Road unloading spots.

ii) CONTRACTOR's employees and those of his SUB- CONTRACTOR's shall become acquainted with EMPLOYER's barricading practice and shall respect the provisions thereof.

iii) Barricades and hazardous areas adjacent to, but not located in normal routes of travel shall be marked by red flasher lanterns at nights.

114 Scaffolding:

114.1 i) Suitable scaffolding should be provided for workmen for all works that cannot safely be done from the ground or from solid construction except such short period work as can be done safely from

ladders. When a ladder is used an extra Mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying material as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical).

ii) Scaffolding or staging more than 4 metre above the ground or floor, swing suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise retarded at least one metre high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

iii) Working platform, gangway and stairway should be so constructed that they should not sag unduly or unequally and if the height of platform of the gangway or the stairway is more than 4 metres above the ground level or floor level, they should be closely boarded, should have adequate width and should be suitably fastened as in ii) above.

iv) Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum heights shall be 1 metre.

v) Safe-means of access shall be provided to all working platforms and other working places, every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length while the width between side rails in rung ladder shall in no case be less than 30 cms for ladder upto and including 3 metres in length. For longer ladder this width should be increased 5mm for each additional foot of length. Uniform steps spacing shall not exceed 30 cms. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites or work shall be so stacked or placed to cause danger or inconvenience to any person or public. The CONTRACTOR shall also provide all necessary fencing and lights to protect the workers and staff from accidents, and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any person for injury sustained owing to neglect of the above precautions and pay any damages and costs which may be awarded in any such suit or action or proceeding to any such person or which may with the consent of the CONTRACTOR be paid to compromise any claim by any such person.

115 Excavation and trenching:

115.1 All trenches 1.2 metres or more in depth, shall at all times be supplied with at least one ladder for each 50 metres length or fraction thereof. Ladder shall be extended from bottom of the trenches to atleast 1 metre above the surface of the ground. The sides of the trenches which are 1.5M in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5 metres of the edge of the trench or half of the trench width whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or under-cutting shall be done.

116 Demolition/general safety:

116.1 i) Before any demolition work is commenced and also during the progress of the demolition work

a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.

b) No electric cable or apparatus which is liable to be a source of danger shall remain electrically charged.

c) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.

ii) All necessary personal safety equipment as considered adequate by the ENGINEER-IN-CHARGE, should be kept available for the use of the persons employed on the SITE and maintained in condition suitable for immediate use, and the CONTRACTOR shall take adequate steps to ensure proper use of equipment by those concerned.

a) Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective gloves.

b) Those engaged in white washing and mixing or stacking or cement bags or any material which are injurious to the eyes be provided with protective goggles.

- c) Those engaged in welding and cutting works shall be provided with protective face & eye shield, hand gloves, etc.
- d) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
- e) When workers are employed in sewers and manholes, which are in use, the CONTRACTOR shall ensure that the manhole covers are opened and are ventilated atleast for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or board to prevent accident to the public.
- f) The CONTRACTOR shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken.
- 1) No paint containing lead or lead product shall be used except in the form of paste or readymade paint.
- 2) Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
- 3) Overalls shall be supplied by the CONTRACTOR to the workmen and adequate facilities shall be provided to enable the working painters to wash them during and on cessation of work.
- 4) When the work is done near any place where there is risk of drowning, all necessary safety equipment should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.
- 5) Use of hoisting machines and tackles including their attachments, anchorage and supports shall conform to the following standards or conditions:
- a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.
- b) Every rope used in hoisting or lowering materials or as means of suspension shall be of durable quality and adequate strength and free from patent defects.
- c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding, winch or give signals to the operator.
- d) In case of every hoisting machine and of every chain ring hook, shackle, swivel, and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gears referred to above shall be plainly marked with the safe working load of the conditions under which it is applicable and the same shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of testing.
- e) In case of departmental machine, the safe working load shall be notified by the ENGINEER-IN-CHARGE. As regards CONTRACTOR's machines, the CONTRACTOR shall notify the safe working load of the machine to the ENGINEER-IN-CHARGE whenever he brings any machinery to SITE of WORK and get it verified by the Engineer concerned.
- f) Motors, gears, transmission lines, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as to reduce to minimum the accidental descent of the load, adequate precautions should be taken to reduce the minimum risk of any part or parts of a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energised, insulating mats, wearing apparel, such as gloves, sleeves, and boots as may be necessary should be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.
- 6) All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffolds, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.
- 7) These safety provisions should be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work-spot. The person responsible for compliance of the safety code shall be named therein by the CONTRACTOR.
- 8) To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the CONTRACTOR shall be open to inspection by the Welfare Officer,

ENGINEER-IN- CHARGE or safety Engineer of the Administration or their representatives.

9) Notwithstanding the above clauses there is nothing in these to exempt the CONTRACTOR for the operations of any other Act or rules in force in the Republic of India. The work throughout including any temporary works shall be carried out in such a manner as not to interfere in any way whatsoever with the traffic on any roads or footpath at the site or in the vicinity thereto or any existing works whether the property of the Administration or of a third party. In addition to the above, the CONTRACTOR shall abide by the safety code provision as per C.P.W.D. Safety code and Indian Standard Safety Code from time to time.

117 Care in handling inflammable gas:

117.1 The CONTRACTOR has to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinder/inflammable liquids/paints etc. as required under the law and/or as advised by the fire Authorities of the EMPLOYER.

118 Temporary combustible structures:

118.1 Temporary combustible structures will not be built near or around work site.

119 Precautions against fire:

119.1 The CONTRACTOR will have to provide Fire Extinguishers, Fire Buckets and drums at worksite as recommended by ENGINEER-IN-CHARGE. They will have to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinders/ inflammable liquid/ paints etc. as advised by ENGINEER-IN-CHARGE. Temporary combustible structures will not be built near or around the work-site.

120 Explosives:

120.1 Explosives shall not be stored or used on the WORK or on the SITE by the CONTRACTOR without the permission of the ENGINEER-IN-CHARGE in writing and then only in the manner and to the extent to which such permission is given. When explosives are required for the WORK they will be stored in a special magazine to be provided at the cost of the CONTRACTOR in accordance with the Explosives Rules. The CONTRACTOR shall obtain the necessary licence for the storage and the use of explosives and all operations in which or for which explosives are employed shall be at sole risk and responsibility of the CONTRACTOR and the CONTRACTOR shall indemnify the EMPLOYER against any loss or damage resulting directly or indirectly therefrom.

121 Mines act:

121.1 SAFETY CODE: The CONTRACTOR shall at his own expense arrange for the safety provisions as required by the ENGINEER-IN-CHARGE in respect of all labour directly employed for performance of the WORKS and shall provide all facilities in connection therewith. In case the CONTRACTOR fails to make arrangements and provides necessary facilities as aforesaid, the ENGINEER-IN- CHARGE shall be entitled to do so and recover the costs thereof from the CONTRACTOR.

121.2 Failure to comply with Safety Code or the provisions relating to report on accidents and to grant of maternity benefits to female workers shall make the CONTRACTOR liable to pay Company Liquidated Damages an amount not exceeding Rs.50/- for each default or materially incorrect statement. The decision of the ENGINEER-IN-CHARGE in such matters based on reports from the Inspecting Officer or from representatives of ENGINEER-IN-CHARGE shall be final and binding and deductions for recovery of such Liquidated Damages may be made from any amount payable to the CONTRACTOR from all the provisions of the Mines Act, 1952 or any statutory modifications or re-enactment thereof the time being in force and any Rules and Regulations made thereunder in respect of all the persons employed by him under this CONTRACT and shall indemnify the EMPLOYER from and against any claim under the Mines Act or the rules and regulations framed thereunder by or on

behalf of any persons employed by him or otherwise.

122 Preservation of place:

122.1 The CONTRACTOR shall take requisite precautions and use his best endeavours to prevent any riotous or unlawful behaviour by or amongst his worker and others employed or the works and for the preservation of peace and protection of the inhabitants and security of property in the neighborhood of the WORK. In the event of the EMPLOYER requiring the maintenance of a Special Police Force at or in the vicinity of the site during the tenure of works, the expenses thereof shall be borne by the CONTRACTOR and if paid by the EMPLOYER shall be recoverable from the CONTRACTOR.

123 Outbreak of infectious diseases:

123.1 The CONTRACTOR shall remove from his camp such labour and their facilities who refuse protective inoculation and vaccination when called upon to do so by the ENGINEER- IN-CHARGE's representative. Should Cholera, Plague or other infectious diseases break out the CONTRACTOR shall burn the huts, beddings, clothes and other belongings or used by the infected parties and promptly erect new huts on healthy sites as required by the ENGINEER-IN-CHARGE failing which within the time specified in the Engineer's requisition, the work may be done by the EMPLOYER and the cost thereof recovered from the CONTRACTOR.

124 Use of intoxicants:

124.1 The unauthorised sale of spirits or other intoxicants, beverages upon the work in any of the buildings, encampments or tenements owned, occupied by or within the control of the CONTRACTOR or any of his employee is forbidden and the CONTRACTOR shall exercise his influence and authority to the utmost extent to secure strict compliance with this condition. In addition to the above, the CONTRACTOR shall abide by the safety code provision as per C.P.W.D. safety code and Indian Standard Code framed from time to time.

PROFORMA OF INDEMNITY BOND FOR SUPPLY OF MATERIALS BY EMPLOYER

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

WHEREAS Ministry of External Affairs, Government of India (hereinafter referred to as MEA) which expression shall unless repugnant to the context includes their legal representatives, successors and assigns having their office at _____ New Delhi has entered into a CONTRACT with _____ (hereinafter referred to as the CONTRACTOR which expression shall unless repugnant to the context include their legal representatives, successors and assigns) for _____ on the terms and conditions as set out, inter-alia, in the CONTRACT No..... Dated..... and various documents forming part thereof hereinafter collectively referred to as the "CONTRACT" which expression shall include all amendments, modifications and/or variations thereto.

AND WHEREAS

i) MEA has agreed to supply to the CONTRACTOR, equipment, plants and materials (finished, semi-finished and raw) for the purpose of EXECUTION of the said CONTRACT by the CONTRACTOR (the equipment, plants and materials to be supplied by MEA to the CONTRACTOR, hereinafter for the sake of brevity referred to as the "said materials") and pending execution by the CONTRACTOR of the CONTRACT incorporating the said materials, the said materials shall be under the custody and charge of the CONTRACTOR and shall be kept, stored, altered, worked upon and/or fabricated at the sole risk and expense of the CONTRACTOR.

ii) As a pre-condition to the supply of the said materials by MEA to the CONTRACTOR, MEA has required the CONTRACTOR to furnish to MEA an Indemnity Bond in the manner and upon terms and conditions hereinafter indicated.

NOW, THEREFORE, in consideration of the premises aforesaid the CONTRACTOR hereby irrevocably and unconditionally undertakes to indemnify and keep indemnified MEA from and against all loss, damage and destruction (inclusive but not limited to any or all loss or damage or destruction to or of the said materials or any item or part thereof by theft, pilferage, fire, flood, storm, tempest, lightning, explosion, storage, chemical or physical action or reaction, binding, warping, exposure, rusting, faulty workmanship, faulty fabrication, or faulty method or technique of fabrication, strike, riot, civil commotion, or other act or omission or commission whatsoever within or beyond the control of the CONTRACTOR, misuse and misappropriation (inclusive but not limited to the misuse or misappropriation by the CONTRACTOR and the Contractor's servants and/or agents) whatsoever to, or of in the said materials or any part of them thereof from the date that the same or relative part of item thereof was supplied to the CONTRACTOR upto and until the date of return to MEA of the said materials or relative part of item thereof or completed fabricated works(s) incorporating the said material and undertake to pay to MEA forthwith on demand in writing without protest or demur the value as specified by MEA of the said material or item or part thereof, lost, damaged, destroyed, misused and/or misappropriated, as the case may be or, together with MEA'S costs and expenses (inclusive of but not limited to handling, transportation, cartage, insurance,

freight, packing and inspection costs/or expenses upto) and _____ aggregate limit of
Rs. _____ (Rupees

_____).

AND THE CONTRACTOR hereby agrees with MEA that:

i) This Indemnity/Undertaking shall be a continuing Indemnity/ Undertaking and shall remain valid and irrevocable for all claims of MEA arising hereunder upto and until the midnight of _____. However, if the CONTRACT for which this Indemnity/Undertaking is given is not completed by this date, the CONTRACTOR hereby agrees to extend the Indemnity/Undertaking

till such time as is required to fulfill the CONTRACT.

ii) This Indemnity/Undertaking shall not be determined by any change in constitution or upon insolvency of the CONTRACTOR but shall be in all respects and for all purposes be binding and operative until payment of all moneys payable to MEA in terms of hereof.

iii) The mere statement of allegation made by or on behalf of MEA in any notice or demand or other writing addressed to the CONTRACTOR as to any of the said material or item or part thereof having been lost , damaged, destroyed, misused or misappropriated while in the custody of the CONTRACTOR and/or prior to completion of the completed fabricated work(s) and delivery to job site thereof incorporating the said materials shall be conclusive of the factum of the said material or item or part thereof having been supplied to the CONTRACTOR and/or the loss, damage, destruction, misuse or misappropriation thereof, as the case may be, while in the custody of the CONTRACTOR and/or prior to the completion of the completed fabricated work(s) and delivery to job site thereof incorporating the said materials without necessity on the part of MEA to produce any documentary proof or other evidence whatsoever in support of this.

iv) The amount stated in any notice of demand addressed by MEA to the CONTRACTOR as to the value of such said materials lost, damaged, destroyed, misused or misappropriated, inclusive relative to the costs and expenses incurred by MEA in connection therewith shall be conclusive of the value of such said materials and the said cost and expenses as also of the amount liable to be paid to MEA to produce any voucher, bill or other documentation or evidence whatsoever in support thereof and such amount shall be paid without any demur and on demand and no dispute shall be raised concerning the same.

The undersigned has full power to execute this Indemnity Bond on behalf of the CONTRACTOR under the Power of Attorney dated_____.

(SIGNED BY COMPETENT AUTHORITY)

Place:

Dated:

Official seal of the CONTRACTOR

PROFORMA FOR CONTRACT AGREEMENT

LOA No. MEA /

dated -----

Contract Agreement Form

AGREEMENT for “_____” (hereinafter called the "Job") made on _____ day of _____, 200_ between M/s _____, hereinafter called the “CONTRACTOR” (which term shall unless excluded by or repugnant to the subject or context include its successors and permitted assignees) of the one part and the Ministry of External Affairs hereinafter called “MEA” (which term shall unless excluded by or repugnant to the subject or context include its successors and assignees) of the other part.

WHEREAS

MEA being desirous of having provided for execution of certain work mentioned, enumerated or referred to in the LOA including Completion Schedule of job has called for proposal.

A. The CONTRACTOR has examined the Job specified in TENDER of MEA and has satisfied himself by careful examination before submitting his proposal as to the nature of the Job and local conditions, the nature and magnitude of the Job, the availability of manpower and materials necessary for the execution of Job and has made local and independent enquiries and obtained complete information as to the matters and thing referred to, or implied in LOA or having any connection therewith and has considered the nature and extent of all probable and possible situations, delays, hindrances or interference's to or with the execution and completion of the Job to be carried out under the Agreement, and has examined and considered all other matters, conditions and things and probable and possible contingencies, and generally all matters incidental thereto and auxiliary thereof affecting the completion of the Job and which might have included him in making his proposal.

B. The LOA including Completion Schedule of Job and Letter of Acceptance of proposal form part of this Agreement though separately set out herein and are included in the expression Agreement wherever herein used.

AND WHEREAS

MEA accepted the bid of the CONTRACTOR for the provision and the execution of the said Job at the values stated in bid and finally approved by MEA upon the terms and subject to the conditions of Agreement.

NOW THIS AGREEMENT WITNESSETH AND IT IS HEREBY AGREED AND DECLARED AS FOLLOWS :

1. In consideration of the payment to be made to the CONTRACTOR for the Job to be executed by him the CONTRACTOR hereby covenants with MEA that the CONTRACTOR shall and will duly provide, execute and complete the said Job and shall do and perform all other acts and things in the Agreement mentioned or

described or which are to be implied there from or may be reasonably necessary for the completion of the said Job and at the said times and in the manner and subject to the terms and conditions or stipulations mentioned in the Agreement.

2. In consideration of the due provision execution and completion of the said Job, MEA does hereby agree with the Agreement that MEA will pay to the CONTRACTOR the respective amounts for the Job actually done by him and approved by MEA at the

amount specified in this LOA, such payment to be made at such time in such manner as provided for in the Agreement and LOA.

In witness whereof the parties have executed these presents in the day and the year first above written.

Signed and Delivered for
for and on behalf of
Ministry of External Affairs
Government of India

Date : _____

Place: _____

Signed and Delivered
and on behalf of

M/s _____

Date : _____

Place: _____

IN PRESENCE OF TWO WITNESSES

1. _____

2. _____

1. _____

2. _____

SPECIAL CONDITIONS OF CONTRACT

SPECIAL CONDITIONS OF CONTRACT.

1.0 GENERAL

1.1 Special Conditions of Contract shall be read in Conjunction with the General conditions of Contract, specification of work, Drawings and any other documents forming part of this Contract wherever the context so requires.

1.2 Notwithstanding the sub-division of the documents into these separate sections and volumes, every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the Contract so far as it may be practicable to do so.

1.3 Where any portion of the General Condition of Contract is repugnant to or at variance with any provisions of the Special Conditions of Contract, unless a different intention appears, the provisions of the special Conditions of Contract shall be deemed to over-ride the provisions of the General Conditions of Contract and shall to the extent of such repugnancy, or variations, prevail.

1.4 Wherever it is mentioned in the specifications that the Contractor shall perform certain work or provide certain facilities, it is understood that the Contractor shall do so at his cost and the value of contract shall be deemed to have included cost of such performance and provisions, so mentioned.

1.5 The materials, design, and workmanship shall satisfy the relevant Indian Standards, the Job Specifications contained herein and Codes referred to. Where the job specification stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.

1.6 It will be the Contractor's responsibility to bring to the notice of Engineer-in-Charge any irreconcilable conflict in the contract documents before starting the work (s) or making the supply with reference which the conflict exists.

1.7 In the absence of any Specifications covering any material, design of work (s) the same shall be performed / supplies / executed in accordance with Standard Engineering Practice as per the instructions / directions of the Engineer-in-Charge, which will be binding on the Contractor.

2.0 Order of Precedence:

In case of an irreconcilable conflict between Indian or other applicable standards, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings or Schedule of Rates, the following shall prevail to the extent of such irreconcilable conflict in order of precedence :

- i) Letter of Acceptance along with Statement of Agreed Variations & its enclosures and any corrigendum/addendum.
- ii) Fax / Letter of Intent / Fax of Acceptance.
- iii) Schedule of Rates as enclosures to Letter of Acceptance.
- iv) Special Conditions of Contract
- v) Specifications / Special notes regarding specifications / Drawings in conjunction with each other.
- vi) General Conditions of Contract.

3.0 Site Location and Conditions:

Site is located at Hetauda, Nepal The contractor shall be deemed to have inspected the site and thoroughly acquainted himself with the site conditions availability of storage space for materials, work area available for construction, disposal/stacking of surplus earth from excavation of all kinds of soil/rocks and to acquaint him self with the general nature of the site, sub-soil water table and its other features likely to affect his tender and construction of works. No claim/extension of the time

whatsoever shall be entertained on account of prevailing site conditions.

4.0 Scope of Work

GENERAL:

The Scope of Work comprises construction and completion of Civil, Structural, Architectural, Plumbing, Electrical, Mechanical, Landscape, Fire safety and external development and all other allied works as per design, specifications, and BOQ mentioned in the Contract or other connected / relevant documents and its maintenance thereof and except in so far as the Contract otherwise provides, the provision of all labour, materials, construction plant of temporary or permanent nature, works and everything whether of a temporary or permanent nature, required in an for such construction, completion and maintenance so far as the necessity for providing the same is specified in or reasonably to be inferred from the Contract. Maintenance thereof means rectification of defects observed during the defects liability period of one year.

Works shown upon the drawing but not mentioned in the specifications or described in the specifications without being shown on the drawings shall nevertheless be held to be included in the same manner as if they had been specifically shown upon the drawings and described in the specifications

In these contract documents unless otherwise stated specifically, the singular shall include the plural and vice versa wherever the context so requires

Wherever it is mentioned in the Specifications that the Contractor shall perform certain work or provide certain facilities, it is understood that the contractor shall do so at his cost.

The materials, design and workmanship shall satisfy the relevant Indian Standard, CPWD specification, the Specifications contained herein and codes referred to. Where the Specifications stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.

Nepal Bharat Maitri Polytechnic is a institutional complex with residential facilities for students and staff.

The Scope of Work comprises construction and completion of Civil, Structural, Architectural, Plumbing, Electrical, Mechanical, Landscape, Fire safety and external development and all other allied works which will includes clearing and dressing the site, excavation up to all depth, ant termite work, water proofing, laying of PCC and RCC , in foundations, raft, columns, beams, slabs, staircase, wall, lintels etc at all levels, ,shuttering work, cutting binding and placing of reinforcement steel, fabrication of structural steel and stain less steel, brick work, plaster, flooring work, tiling, Aluminium doors and windows, external façade, providing and laying of water supply line, waste water line, sanitary fittings and fixtures, sewerage and drainage system, storm water line, rainwater harvesting system, development of surrounding area including landscaping work and all other allied works as per design, specifications and schedule of quantities mentioned in the Contract or other connected / relevant documents and its maintenance thereof and except in so far as the Contract otherwise provides, the provision of all labour, materials, construction plant of temporary or permanent nature, works and everything whether of a temporary or permanent nature, required in an for such construction, completion and maintenance so far as the necessity for providing the same is specified in or reasonably to be inferred from the Contract. Maintenance thereof means rectification of defects observed during the defects liability period of one year.

The scope of reinforced cement concrete includes the supply from a reputed ready mix concrete plant including pumping and pouring to the required location at all levels and heights.

5.0 Scope of Supply:

All materials (cement, reinforcement steel, structural steel etc.) required for the completion of the work are to be supplied by the contractor unless mentioned otherwise. The contractor shall have to make necessary arrangements for proper storage of materials brought for the execution of work.

6.0 Owner's obligations:

The owner's obligations are limited to the following:

- a) Handing over the site.
- b) Supply of construction drawings.
- c) Payment to the contractor for performance of work under the contract as per the terms and conditions specified therein.
- d) Location for setting up temporary office, godown, etc.

7.0 Power & Water for Construction and other purposes

Water and power shall be arranged by the contractor at his own cost. Contractor will arrange for Power back-up through DG set in case power from electricity board is not available / supplied. All expenses pertaining to operating and running of DG Set will be borne by the contractor.

8.0 Mode of Payment

8.1 Payments will be made as per the running bills certified by the EIC.

Based on checked measurement contractor should prepare a running account bill in six (6) copies.

Following procedures shall be adopted for billing of works executed by the Contractor.

All measurements shall be recorded in quadruplicate on standard measurement sheets as approved by Engineer-in-Charge submitted to Engineer-in-Charge for scrutiny and passing.

Engineer-in-Charge shall scrutinize and check the measurements recorded on the sheets and shall certify correctness of the same on the measurement sheets. Distributions of the checked measurement sheets shall be as follows: -

- a) One copy to be retained by Engineer-in-Charge.
- b) Two copies to be forwarded to be submitted to DPA-III division who will release the payment after approval of IFD..

8.3 Engineer-in-Charge shall recommend the bills after carrying out the comprehensive checks in accordance with the terms and conditions of the Contract, within 20 days of submission of the bills, complete in all respects and send the same to the DPA-III division who will release the payment after approval of IFD to contractor..

8.4 Engineer-in-Charge shall make all endeavours to make payments of undisputed amount of the bills submitted based on the joint measurements within 20 days from the date of certification by the Engineer-in-Charge.

8.5 Measurements shall be recorded as per the methods of measurement spelt out in Specifications/Contract Document. Engineer-in-Charge shall be fully responsible for checking the measurements quantitatively and qualitatively as recorded in the Measurement Books/Bills.

8.6 While preparing the final bills overall measurements will not be taken again. Only the volume of Work executed since the last measured bill along with summary of final measurements will be considered for the final bill. However, a detailed check shall be made as to missing measurements and

in case there are any missing items on measurements the same shall be recorded.

8.6 The bill shall be raised for minimum of Rs. 1, 00, 00,000/- (Rs. One crore).

8.7 The invoices shall be raised to Ministry of External Affairs, Government of India

8.8 Dispute in mode of measurement

Where Works have to be measured for any purpose whatsoever, it shall be in accordance with item specifications as per relevant Indian Standards unless otherwise specifically indicated in the Contract Specifications. All measurements will be recorded in metric units only. In case of absence of mode of measurement of any item not covered by both the methods mentioned above, the Engineer-in-Charge's decision shall be final and binding. The required number of bills, registers, bill forms, level/field books, materials/ account registers, testing registers, site order books and any other stationary item pertaining to this contract shall be printed and provided for by the contractor, at his own cost in the format prescribed and approved by the Engineer-in-Charge in writing. The Measurement book will have three copies in different colour pages and the book will be in measurement book format in a bound form and pages will be printed so that proper referring and record of complete measurement is maintained. Original sheet will be retained in the book and will be returned to Owner on completion of Work.

9.0 TIME FOR COMPLETION

Time for completion for all the works shall be **"TWENTY FOUR MONTHS FOR ALL WORKS"** (including 30 days for Mobilization) from the date of issue of LOI.

9.1 The work shall be executed strictly as per the Time Schedule, working drawings and specification of the items included into the schedule of items. The period of work given includes the time required for mobilization and completion in all respects to the entire satisfaction of the Engineer-in-Charge and the Owner.

9.2 The time for completion is a time for overall completion of all works. The whole work may be awarded to a single Tenderer hence the Contractor shall plan and make schedule accordingly such that all Works can be completed within stipulated time limit and will constantly keep the Engineer-in-Charge aware of the Work schedule.

9.3 Weekly programs of work will be drawn up by the Contractor to be approved by the Engineer-in-Charge. The Contractor shall scrupulously adhere to these schedules by deploying adequate personnel and construction tools and tackles. In all matters concerning the extent of targets set out for weekly programs and degree of achievements, the decision of Engineer-in-Charge shall be final and binding.

9.4 The time for completion mentioned above shall be inclusive of any monsoon following within the aforesaid time for completion. For such reason exceptional rain will not be taken into consideration for delay.

10.0 Escalation

The escalation for labour and materials shall be paid as per the following RBI formula:

If the price of materials (not being materials supplied or services rendered at fixed prices by contractor in accordance with the provisions in the contract) and /or increase due to revision under the minimum wages act, the contractor shall be compensated with such increase as per the provision detailed below and the amount of contract shall accordingly be revised, subjected to the condition that such compensation for escalations in the price shall be available only for the work done during stipulated

period of the contract including such period of which the contract is validly extended under the provision of relevant clauses of contract without any action under relevant clause (and also subject to the condition that no such compensation shall be payable for a work for which the stipulated period of completion is 6 months or less). Such compensation for the escalation in the price of materials and labour when due shall be worked out based on the following provisions:

1. The base date for working out such escalations shall be from the date of receipt of the tender.
2. Maximum limit on amount payable under this clause shall be limited to 10% of contract value.
3. The cost on which the escalation will be payable shall be taken as 85%, after deducting 15% for contractor profit and overheads,
4. Out of 85% of the cost of work, 25% is considered towards the labour component.
5. Thus the escalation payable shall be as per the following formula:

Escalation for labour component:

$$PL = 0.25 W \times (L1 - L0) / L0$$

Where

L0 = Minimum wage rate at the site of work on the date of receipt of the tender in respect of unskilled workers.

L1 = Revised minimum wage rate for the month under review at site of work as per the Government notification.

W = Value of the work done after the minimum wage rate is revised as per govt. notification.

PL = Amount payable to contractor extra over the contract price due to labour escalation.

B. Escalation for materials procured by contractor:

$$PM = 0.6 W \times (C1 - C0) / C0$$

Where

C0 = All India wholesale price index for all commodities as published by RBI / Economic advisor to Govt. of India for the month of receipt of tender.

C1 = All India wholesale price index for all commodities as published by RBI / Economic advisor to Govt. of India for the month under reference.

W = Value of the work done during the month under reference.

PM = Amount payable to contractor extra over the contract price due to material escalation.

In case of materials brought to site for which any secured advance is included in the bill the full value of such materials as assessed by engineer in-charge (and not the reduced amount for which secured advance has been paid) shall be included in the cost of work done for operation of this clause. Similarly when such materials are incorporated in the work and secured advance is deducted from the bills, the full assessed value of the materials originally considered for the operation of this clause should be deducted from cost works shown in the bills running or final. Further the cost of work shall not include any work for which payment is made as extra/substituted/deducted item based on the prevailing market rates.

11.0 Mobilization Advance

11.1 Contractor shall be paid **with interest (SBI PLR RATE + 2%)**, recoverable mobilization advance of 10 % of the accepted value of the contract. This advance shall be payable at following two stages :

a) 5% (five percent) of awarded contract value shall be payable as the first instalment of mobilization advance after fulfilling the following formalities by the contractor

1. Signing of contract agreement by the contractor.
2. Submission of bank guarantee from nationalized/scheduled bank towards Contract Performance Security deposit as per clause 24 of GCC (General conditions of contract)
3. Submission of bank guarantee from scheduled nationalized bank equivalent to 10% (Ten percent) of awarded contract value covering mobilization advance valid till completion date of contract or till full recovery of mobilization advance whichever is earlier.

b) Balance 5% after the contractor has constructed site office, storage shed; fabrication yard etc. has mobilized adequate numbers of men and equipment at site and is ready to start to the work to the entire satisfaction of engineer in-charge and commencement of work at site.

11.2 Recovery of Mobilization Advance

The mobilization advance so paid shall be recovered from each running account bills @ 12% (Twelve percent) of gross amount of RA bill in such a manner that the total advance is recovered when 85% of the contract value gets paid. Balance amount if any remaining un-recovered shall be deducted from the final bill.

12.0 Secured Advance against delivery of materials

No secured advance shall be paid on materials brought to site.

13.0 Labour at Site

Contractor shall arrange the accommodation of labour by own. The contractor shall built and maintain the labour colony at his own expenses. Contractor will arrange for electricity and water Supply to them. Electricity and Water if provided by owner shall be recoverable from the Contractor.

14.0 Land for Contractor's Field Office, Godown & Workshop

The contractor shall provide a fully furnished site office for the owner/architect/consultants for an area of at least 15 Sqm area and, 15 Sqm for conference/meeting room for conducting project review meetings with a pantry and toilet facility.

The Owner at his own discretion and convenience and for the duration of the execution of the Work shall make available at the site, land for construction of Contractor's temporary field office, godowns, workshops and assembly areas required for the execution of the Contract. The Contractor shall at his own cost construct all these temporary buildings and provide suitable water supply and sanitary arrangement and get the same approved by the Owner.

On completion of the Works undertaken by the Contractor, he shall remove all temporary works erected by him and have the site cleaned immediately as directed by Engineer-in-Charge. If the Contractor shall fail to comply with these requirements, the Owner may at the expenses of Contractor

remove such surplus and rubbish materials and dispose off the same as he deems fit and get the site cleared as aforesaid; and Contractor shall forthwith pay the amount of all expenses so incurred and shall have no claim in respect of any such surplus materials disposed off as aforesaid. But the Owner reserves the right to ask the Contractor any time during the pendency of the Contractor to vacate the land by giving 7 (seven) days' notice on security reasons or on national interest or otherwise occupied.

The Contractor shall put up temporary structures as required by them for their office, fabrication shop and construction stores only in the area allocated to them on the project site by the Owner or his authorized representative. No tea stalls/canteens should be put up or allowed to be put up by any Contractor in the allotted land or complex area without written permission of the Owner.

No unauthorized buildings, constructions or structures should be put up by the Contractor anywhere on the project site.

For uninterrupted fabrication work during all seasons, the Contractor shall put up temporary covered structures at his cost within the area in the location allocated to them in the project site by the Owner or his authorized representative.

No person except for authorized watchman shall be allowed to stay in the plant area/ contractor's area after completion of the day's job without prior written permission from the Owner.

15.0 Extra Items / Substituted Items

In respect of any Extra/Substituted/Deleted items ordered to be executed, the rates payable shall be derived.

a) The rates can be derived on the basis of similar items for which he has quoted rate in schedule of rates, the quote rate will be applicable.

b) If the rates for the additional, altered or substituted work are not specifically provided in schedule of rates quoted by contractor in volume III the rate will be derived from item of work appearing in volume III.

c) If the rate for the item of work does not appear in the agreed schedule of work quoted by contractor in VOL-III, nor can the rate for such item be derived from similar item of work appearing there in, the rate payable for such item shall be derived / as per rate for such item if any, approved by MEA & accepted by contractor in VOL-IV

d) If the rates for altered, additional or substituted work which can not be determined in the manner specified in the sub-clause (a) to (c) above, in that case the rate of such items shall be derived from cost of material and labour plus 15% to cover contractors profit, overheads and other expenses. For the calculation of cost of materials and labour, the basic rates in volume IV of tender as approved by MEA and accepted by contractor shall be referred.

e) The rates for those items of work which cannot be derived from schedule of rates (VOL-III) quoted by contractor, or schedule of items, basic rates of material labour as approved by MEA & accepted by contractor in VOL-IV, will be derived from prevailing market rates, labour cost at schedule of labour rates in VOL-IV plus 15% towards contractors overheads & profits. The opinion of engineer in charge as to the current market rates for material and quantum of labour & material involved permit shall final & binding on contractor. For this purpose & for the purpose of sub clause (d) & (e) above, the efficient of labour, material, & wastage shall be adopted from the CPWD analysis of rates / National building code / Standard Schedule of rates as decided by Engineer in charge.

16.0 Suspension of Work

a) The Contractor shall, on receipt of the order in writing of the Engineer-in-Charge, suspend the progress of the Works or any part thereof for such time in such manner or the Engineer-in-Charge may consider necessary for any of the following reasons.

- i) On account of any default on part of the Contractor, or;
- ii) For proper execution of the Works or part thereof for reasons other than the default of the Contractor, or;
- iii) For safety of the Works or part thereof.

he Contractor shall during such suspensions properly protect and secure the Works to the extent necessary and carry out the instructions given in that behalf by the Engineer-in-Charge.

b) If the suspension is ordered for reasons (ii) & (iii) in sub-para (a) above:

i) The Contractor shall be entitled to an extension of time equal to the period of every such suspension.

ii) If the suspension is ordered for reasons (I) in sub-Para (a) above, the Engineer- in-Charge shall without prejudice to any other right of remedy be at liberty to forfeit the Earnest Money absolutely.

17.0 Income Tax & Work Contract Tax

Income Tax and Works contract Tax at the prevailing rate as applicable from time-to-time shall be deducted from CONTRACTOR's bills, and quoted rates shall be deemed to include this.

18.0 Taxes, Duties, Octroi, Levies Etc

The rates quoted must cover all applicable taxes, duties, government levies, etc. except Service tax & Cess thereon. No extra payment shall be considered on account of taxes etc.. Service Tax & Cess thereon, if applicable, shall be mentioned in the price bid separately & clearly and shall be payable extra at actuals. Payments shall be made on the basis of measurement of actual work executed by the contractor and approved by Engineer-in-Charge.

19.0 Service Tax

The bidder shall mention the amount & rate of service tax & cess thereon, if applicable in the price bid separately & clearly. If the same is not mentioned in the Price Bid, The quoted price shall be deemed to include the full applicable service tax (as on due date of submission of bid). For payment of service tax, cenvatable serially numbered invoice bill shall be issued by the service provider

& should also specify following: -

- i) Name & address and registration number of service provider.
- ii) Name & address of recipient of the taxable service.
- iii) Description, classification & value of taxable service provided and
- iv) The service tax payable on such services.

Service tax & cess thereon shall be payable at actual on submission of invoice.

20.0 Warranties and Guarantees

All manufacturers' warranties & guaranties for the equipments supplied by the contractor shall be passed on the owner.

21.0 Alterations, Additions & Omissions

The architect can make a variation of the form, quality or quantity of the works or any part there of that may in his opinion, be necessary and for that purpose or if for any other reasons it shall, in his opinion be desirable he shall have power to under in writing to the contractor to do and the contractor shall do any of the following: -

- a) Increase or decrease in quantity of any work included in contract within limits and as per terms given in GCC.
- b) Omit any such work
- c) Change the levels, lines, position and dimension of any part of the works and
- d) Execute additional work of any kind necessary for completion of works & no such variation shall in any way vitiate or invalidate the contract. But the value, if any of all such variation, shall be taken into account in ascertaining the amount of the contract price.

22.0 Approvals

Statutory approvals wherever required such as approval & NOC from local authorities for water supply & sewer connection, tree cutting, shifting and rerouting of services including electrical, permit, licensing, labour & safety clearances, are the responsibility of the contractor.

23.0 Selection of sub contractors

The contractor shall employ only approved Sub-contractor for specialized items of work like Sanitary, Plumbing, Waterproofing works, anti termite etc. in case, in Owner/Architect opinion, the main contractor is himself not licensed/adequately experienced to carry out such works. For this purpose the Contractor shall submit complete Bio-Data of at least two Sub Contractors in each such specialized trade adequately experienced in their respective trades for approval of Owner/Architect. In case the Contractor fails to submit necessary data or if the agencies as proposed by the Owner/Architect (who shall not be required to give any reason thereof), such trades of work shall be got executed through agencies to be nominated by Owner/Architect, with all cost implications & liabilities remaining the responsibility of the Contractor. In case the Contractor does not accept the decision of the Owner/Architect on this account, this work shall be withdrawn from his contract & got executed at his risk & cost.

24.0 Tender Documents

The tender document consists of:

- a) Instructions to Bidders
- b) General conditions of contract
- c) Special conditions of contract
- d) Specifications
- e) Drawings
- f) Schedule of quantities / rates
- g) Basic rate of materials & labour
- h) List of drawings

All these components of the tender documents are part & parcel of the tender. These are jointly applicable to the contractors.

25.0 Measurements

The Engineer-in-Charge shall, except as otherwise stated ascertain and determine by measurement the value of Work done, in accordance with the Contract and as per actual Work done. The Engineer-in-Charge shall, when he requires any part or parts of the Works to be measured, give notices to the Contractor's authorized agent or representative who shall forthwith attend or send a qualified agent to assist the Engineer-in-Charge in making such measurement and shall furnish all particulars required by either of them. Should the Contractor not attend or neglect or omit to send such representative then the measurement made by the Engineer- in-Charge shall be taken to be the correct measurement of

the Work. For all measurements, figured dimensions given in the drawings shall be followed. Measurement of all hidden items shall be carried out by the Engineer-in-Charge. The Contractor or his representative who attends may at the time of measurement take such notes and measurements as he may desire.

Where Works have to be measured for any purpose whatsoever, it shall be in accordance with item specifications as per relevant Indian Standards unless otherwise specifically indicated in the Contract Specifications. All measurements will be recorded in metric units only. In case of absence of mode of measurement of any item not covered by both the methods mentioned above, the Engineer-in-Charge's decision shall be final and binding. The required number of bills, registers, bill forms, level/field books, materials/ account registers, testing registers, site order books and any other stationary item pertaining to this contract shall be printed and provided for by the contractor, at his own cost in the format prescribed and approved by the Engineer-in-Charge in writing. The Measurement book will have three copies in different colour pages and the book will be in measurement book format in a bound form and pages will be printed so that proper referring and record of complete measurement is maintained. Original sheet will be retained in the book and will be returned to Owner on completion of Work.

26.0 Abnormally High Rates Items (A.H.R.)

In item rate contract/ item rate portion of contract where the tenderer's quoted for the items exceeds 50% of the owner's estimated rate such rates shall be considered as abnormally high rates (A.H.R.) and payments of A.H.R. items beyond the B.O.Q. stipulated quantity shall be made at the lesser of the following rates

- (i) As per the quoted rate for the quantities mentioned in the tender.
- (ii) Payments of A.H.R. items beyond the BOQ quantity shall be made at the least of the following rates :
 - (a) Rate as per Bill of Quantities.
 - (b) Based on basic rates of materials and labour (as approved by MEA and accepted by the contractor in Volume IV) + 15% to cover Contractors profit overheads and other expenses.
 - (c) Market rates (if not covered in Volume IV) of the item which shall be derived based on actual market of materials & carriage, labour, taxes, etc.(as per DSR 2007) + 15% to cover Contractors profit overheads and other expenses

27.0 CONTRACTOR PERSONNEL AT SITE:

List of persons employed by Contractor for the subject work mentioning there residential address shall be submitted to MEA. In case of any revision, the same shall be informed to MEA from time-to-time. If required necessary verification from Police / Gram Pradhan shall have to be submitted by the contractor.

The Contractor shall be directly responsible for any/all disputes arising between him and his personnel and keep indemnified against all losses, damage and claims arising thereof.

Within the MEA's premises, the Contractor's personnel shall not do any private work other than their normal duties.

The personnel engaged by the Contractor shall be subject to security check by the MEA's security staff while entering/leaving the premises. The contractor & his personnel shall be required to follow the

rules and regulations of MEA in force from time-to-time. The contractor may also be required to provide photo passes to the personnel required by him, for security and safety reasons and furnished the details of the same when asked for.

No other person except Contractor's authorized representative shall be allowed to enter MEA premises Contractor shall also not entertain any outsider or extend any service beyond MEA's premises. Entry of Contractor's persons shall be regulated with proper identity/gate pass.

Contractor shall be fully responsible for theft, burglary, fire or any mischievous deeds by his staff and any loss to MEA shall be recovered from the immediate bill of the Contractor.

Contractor shall provide all necessary tools and tackles, equipments, safety belt, wheel burrow, scaffolding, ladders, drilling m/c & safety equipment etc. required to carry out job at his cost and material used by Contractor shall be of standard make and approval of Engineer-In-Charge shall be taken for the same.

MEA also reserves the right to ask the Contractor to remove particular person(s) from site with immediate effect if in the opinion of MEA, his behavior/performance is not up to the mark and/or found indulging in unlawful activities, Contractor shall immediately comply with such instructions.

It will be the responsibility of contractor's engineer to ensure that their personnel behave in a proper manners and behavior and not to undergo the argument with the employees. It will be the responsibility of the Contractor's Engineer to deal with such complaints or co- ordinate with the MEA Engineer.

CONDITIONS

The tenderer / contractor must visit the premises and ascertain the type and nature of work before quoting the rates. It is understood that the tenderer / contractor has satisfied himself of the information and knowledge required before bidding and as quoted rates shall remain firm during the currency of the contract.

The quoted rates shall include all costs transportation of material to and from the premises as and when required. Nothing extra is payable on this account. Transportation of any wastage, exchange of rejected or defective material, surplus material etc. shall have to be arranged by the tenderer/contractor at his own risk and costs. Also any material brought inside or taken out of the premises shall have necessary prior permission to do so.

The rates shall also be deemed to cover working under any adverse conditions that may be required at the convenience of the occupants and under the supervision of the contractor. The rates shall also be deemed to include cost towards all essential/contingent works, tools and tackles and any other material that may have to be taken up for the effective completion of this contract.

For the execution of this Contract Agreement, Engineer-in-charge (EIC) would mean the person nominated by MEA for this purpose or person(s) duly authorized by EIC.

All serviceable old material generated during the execution of the subject work shall be stacked and taken out of the MEA premises by the contractor for their own use and MEA shall not charge any cost for the same. Accordingly the tenderer shall quote the rates after considering the salvage cost of the above serviceable material.

The tenderer/contractor shall arrange the necessary quality tests from the reputed laboratory as per if required to be done for such items which are not ISI marked or if there is any doubt on the quality of ISI marked material. The material required for sampling for testing as per the CPWD specification. Material not found conforming to any of such tests shall have to be unconditionally replaced by the

tenderer/contractor and any damage caused by its use be made good by him. **Accordingly, the tenderer should take into consideration while quoting, the necessary expenses to be born by the contractor on account of testing of material to be conducted including the providing the samples for testing.**

The contract shall be carried out in a workman like manner and the workers will abide by all MEA rule and norms while inside the premises. They shall also restrict movement to their place of work only. The workmen shall work in close co-ordination of any other agencies working at site. This shall be adhered to at no extra cost.

The tenderer/contractor shall be responsible for any injury caused to persons, animals or things (fittings/fixtures/furnishings etc.) any damage caused to any property of MEA etc, which may arise from the operations or neglect of any person of the tenderer/contractors team or any person engaged by him for any purpose related to the execution of this contract. This clause shall include inter alias, any damage to buildings, roads, streets, footpaths etc. adjacent to or otherwise to the premises. The tenderer/contractor shall indemnify MEA of all liabilities arising out of his operations in any way under any acts of the Government and also in award of any compensation or damaged consequent upon any claim arising out of the above. The tenderer/contractor shall further make good all damaged caused thus either to MEA or any third party.

The tenderer shall indemnify MEA under Workmen's Compensation Act, Fatal Accident Act, Personal Injuries Act, Insurance Act etc. and or their Industrial Legislation in force from time to time. The contractor / tenderer shall indemnify MEA for compliance of the labour laws.

In the event of any accident occurring during the course of work, which may result in any injury to a person, the responsibility of their medical treatment will fully rest with the tenderer/contractor and expenditure incurred thereon will be borne entirely by the tenderer/contractor. MEA shall be totally indemnified of any liability whatsoever.

28.0 COMPLIANCE WITH LABOUR/INDUSTRIAL LAWS

1.0 RESPONSIBILITIES OF THE CONTRACTOR AND COMPLIANCE WITH LABOUR/INDUSTRIAL LAWS:

1.1. The contractor shall have his own PF code no. with the RPFC as required under Employee PF & Miscellaneous Provisions Act, 1952 and ESI code No. required under Employee State Insurance Act 1948.

1.2 The contractors shall periodically submit the challans / receipts / proof for the depositing PF contribution with RPFC and ESIC.

1.3 The contractor is require to obtain labour license under the provisions of Contract Labour (R&A) Act, 1970 from the office of ALC (Central), Ministry of Labour, Govt. of India, Dehradun.

1.4 The contractor is liable to abide by all necessary licenses / permissions from the concerned authorities as provided under the various labor legislations

1.5 The contractor shall discharge obligations as provided under various statutory enactment including the employees Provident Fund and Miscellaneous Provisions Act, 1952, Contract Labour (R&A) Act, 1970, Minimum Wages Act, 1948, Payment of wages act 1936, Workman Compensation Act 1923, Employees' State Insurance Act 1948 and other relevant acts, rules and regulations enforced from time to time.

- 1.6 The contractor shall be solely responsible for the payment of wages and other dues to the personnel, if any, deployed by him latest by 7th day of the subsequent month.
- 1.7 The contractor shall be solely responsible and indemnify the MEA against all charges, dues, claim etc. arising out of the disputes relating to the dues and employment of personnel, if any, deployed by him.
- 1.8 The contractor shall indemnify MEA against all losses or damages, if any, caused to it on account of acts of the personnel, if any, deployed by him.
- 1.9 All personnel deployed by the contractor should be on the rolls of the contractor.
- 1.10 The contractor shall ensure regular and effective supervision and control of the personnel, if any, deployed by him and gives suitable direction for undertaking the contractual obligations.
- 1.11 The personnel to be deputed by the contractor shall observe all security, fire and safety rules of MEA while at the site. His Work/Services will be supervised by the supervisors of contractor. Contractor has to be strictly adhere to guidance, instruction when required.
- 1.12 Contractor shall provide proper identification cards for his employees to be deputed by him for Work/Services, duly signed by the contractor or authorized person on behalf of contractor. Also the contractor should obtain entry passes from Security Dept. through OPERATION-IN-CHARGE for his employees.
- 1.13 Contractor has to deploy the personnel with no past criminal records. Reformed people, names of such persons should be clearly indicated in case of. Also the contractor has to provide police verification for all the persons deployed by him.
- 1.14 While confirming to any of these conditions, the contractor should ensure that no law of state regarding labour, their welfare, conduct etc, is violated. The contractor shall indemnify MEA for any action brought against him for violation, non-compliance of any act, rules & regulation of center / state / local statutory authorities.
- 1.15 All existing and amended safety / fire rules of MEA are to be followed at the work site.
- 1.16 Contractor shall ensure payment of wages to the personnel employed and meet all statutory obligations of payment as per Minimum Wages act 1948 and payment of wages Act 1936.
- 1.17 Special safety equipment e.g. safety belts, helmets, hand gloves, goggles, safety shoes etc shall be provided to the personnel engaged by the contractor.
- 1.18 Suitable site office space may be provided by MEA if required and available.
- 1.19 In case of accident, injury and death caused to the employee of the contractor while executing the Work under the contract, the contractor shall be solely responsible for payment of adequate compensation, insurance money etc. to the next kith & kin of injured / diseased. Contractor shall indemnify MEA from such liabilities.
- 1.20 The contractor shall also undertake to obtain necessary group insurance coverage covering all risks connected with the job to be undertaken by him under the contract from insurance company and pay the premium accordingly.
- 1.21 The contractor shall not employ or permit to be employed any person suffering from any

contagious, loathsome or infectious disease. The contractor shall get examined his employees / persons deployed from a civil govt. doctor.

1.22 No employees or person of contractor (including contractor) be allowed to consume alcoholic drinks or any narcotics within the plant premises. If found under the influence of above, the owner / MEA will terminate the contract immediately and may refer the case to police.

1.23 The contractor hereby agrees to indemnify owner / MEA and harmless from all claims, demands, actions, cost and charges etc brought by any court, competent authority / statutory authorities against owner/MEA.

2.0 PHOTOGRAPHS/LABOUR PERMISSION/VEHICLE PERMISSION:

The contractor shall arrange to make photo gate passes/labour permissions/vehicle passes etc. for his persons/labours/vehicles for working in site plant premises at his own cost as rules of the company.

29.0 Security

The contractor shall have total responsibility for all equipment and materials in his custody stores loose, semi-assembled and/or erected by him at site. All materials of the contract shall enter or leave the site only with the written permission of Engineer-in-Charge.

30.0 Compensation for Extended Stay

In case the time of completion of work is delayed beyond the time schedule indicated in the tender documents plus a grace period equivalent to 1/5th of the time schedule or two (02) months whichever is more due to reasons solely attributable to the owner, the contractor shall be paid extended stay compensation after grace period in order to maintain necessary organizational set up & construction tools, equipments at site work. The bidder shall mention the rate of such extended stay compensation per month in the price part which will be considered for evaluation for 1/5th of the time schedule or Three (03) months whichever is less. In case the bidder does not indicate the rate for existing stay comp. it will be presumed that no extended stay compensation is required to be paid to the contractor.

31.0 SPECIAL NOTE TO TENDERERS

While quoting the rates in the tender by the tenderer they should consider all the provisions of the tender including statutory requirement prevailing during the course of the contract.

The special conditions of contract supersede the relevant clauses of General Conditions of Contract.

32. Environmental Measures for Civil Works

All measures described bellow will need to be looked after by the CONTRACTOR and supervised by the PMC in order to assure the environmental issues.

1. Preservation of Natural Vegetation

A specialized horticulturist/agency with proven record of transplantation will have to be appointed in order to perform the below mentioned jobs in the manner provided. This agency shall have to be approved by the Architects.

a. Any existing vegetation tree on the site shall be preserved. Due to location of certain trees on the construction area of the site, these will have to be transplanted to the periphery of the site. All plants, bushes, trees, palms, etc to be tagged and numbered with permanent marker on a plastic tag around

the trunk/main branches so that the record of vegetation can be kept during construction and specially during transplantation on the periphery of the site.

If any vegetation is required to be removed from the boundary area in order to create the new access to the site, the same procedure above mentioned will have to be followed.

All trees/plants will have to be protected from construction process, therefore a barricade around them will have to be done in order to disturb it/them as little as possible during construction and proper care will need to be taken care of so that the roots are not damaged or lie exposed at any time. A galvanized sheet supported on poles will need to be kept between the trees and the construction activities in order to assure their survival in good state. An irrigation program to all vegetation will have to be implemented.

b. All top soil to be required to be preserved. All areas currently green areas that required to be temporarily used for construction activities will need to be preserved in the same manners so that their properties remain. These will have to be preserved at site as temporarily landscape features in other location of the site in order to assure that their current properties will not be lost.

2. Dust Control Measures and Temporary Erosion Control Measures

a. A gravel pit in all construction entries/exits of the site will have to be provided. Gravel pit of compacted soil ditch confined with a brick boundary of 300mm deep by 3mts long by entry width to be built and filled with 40mm down gravel or as per required to be kept at all times.

This will have to be maintained clean at all times so that the effectiveness of it does not reduce at anytime. Removing of soil from the gravel will have to be done as per required in order to keep the pit clean and functional.

b. Barriers - Erection of wooden poles fence up to a height of 3m with corrugated GI sheets with gaps of 100mm covered with plastic mesh fabric on all unprotected sides will need to be provided to obstruct the wind and prevent soil from blowing off the site.

c. Construct a mound of stabilized soil of minimum 150mm high along the perimeter of the site bellow the barricade where there is no existing neighboring boundary wall to divert surface runoff volumes and prevent any dispersion of loose soil from the site to the street.

d. Any areas were dismantling/demolitions to be taken place, should be sprinkled with water prior, during and after the activity is carried out.

e. A daily irrigation plan will have to be adopted in were water sprinkling to all soil areas would be done minimum twice a day to settle down the dust produced during construction process and stabilizes lose soil.

All cleared areas after excavation of individual structures will be stabilized to prevent both wind and water erosion.

Any stacked/non vegetated soil will have to be covered with stitched jute bags just after all soil in this location has been placed and it should remain covered at all times till is to be removed for its final use. Irrigation in these areas will be the same as the rest.

g. Restricted movement of trucks outside the site during construction phase.

3. Construction Waste Management

a. No material leaves site as a principle. No material will leave site without previous permission of Architects and the Project Manager at site. Any material can only leave site if a fully signed letter is obtained by the person/company receiving of the material on their letterhead where the location and purpose of the material obtained) purchased is clearly indicated. This applies for every material, including materials that are not laid at site but used for construction purposes like shuttering wood.

b. Site management plan to be produced by the Contractor and PMC where the following things are showed:

- Permanent entries/exits locations.
- Existing structures to be kept and to be removed.
- Site infrastructure to be kept and to be removed.
- Materials storing locations, for raw and reused materials.

c. Excavated soil to be utilized for backfilling to be kept on the site on a specific location that will have to be worked out with the PMC so that it remains in the same location until is removed to be used in its final location. Required soil for back filling to be calculated properly. Excess soil to be removed from site and proper photographical and paper record will have to be kept. Irrigation plan as described in point 2e will need to be done in this area also.

d. All rubble will be use as hard core below pavement area and Broken Brick bats will be used for floor cushioning and roof/roads slopes from brick work wastage. Therefore it should be kept in a designated area out of the people and vehicle movement.

4. Materials and Products

a. All materials to be used in this project will have to be of, and only off, the makes, specifications and sources approved. Any changes will have to be brought to notice to the Architects for approval. If there would be any problem with the supply of the material by the provider, a secondary option will need to be identified and suggested by the contractor and get it authorized by the Architect before any purchase is done.

b. Any colouring, paint, polish, coating to be used in any location and/or material of the site will have to be with previous approval of the Architect.

c. All materials should be stacked in an organized manner as per layout mentioned in point 3b, and materials should be covered with plastics sheets in order to protect them from sun and rain.

d. A strictly record of all materials coming and used in the site shall be kept since no materials is to leave the site as explained above.

6. Security measures

a. Proper security measures should be taken for all construction staff in all activities, like security belts, helmets, shoes, welding glasses, etc.

b. Air quality should be monitored, specially in enclosed spaces. HVAC equipments to be used if necessary for ventilating these spaces, with special specifications from the Architects. Breathing masks to be given to people and used during handling volatile materials like cement.

33.0 BASIC TECHNICAL GUIDELINES FOR TRANSPLANTATION OF VEGETATION

A specialized horticulturist/agency with proven records of transplantation will have to be appointed in order to perform the below mentioned jobs in the manner provided. This agency shall have to be approved by the Architects.

1. All trees / vegetation will be tagged with special tags for trees. List of all the plants to be transplanted with species, sizes, initial and transplanted location is mentioned to be prepared where the tag number should match the tree number on the list.

2. Each tree/group of trees moved will have to be planned well in advance since the time required for the move may be as long as two months to avoid environmental shock to the tree.

3. Before transplanting the tree, the immediate environment- light, moisture, soil pH, and wind exposure need to be considered for the particular species of tree, by the specialized agency.

4. Digging:

a) Water all plants two to three days before digging if the soil is dry.

b) Prior to digging, for shrubs and trees with low branches - the agency should tie up these branches to prevent injury during the digging, transporting and planting operations

c) One side of the trunk shall be marked to allow the tree to be placed in the same orientation at which it grew in its original location.

d) Deciduous trees with a stem diameter of less than 1 inch may be dug either bare root or with a soil ball. Larger plants should only be dug with soil attached. Bare root transplanting should only be done in the spring and care must be taken to prevent damage to roots when removing the soil.

e) For small trees - the root ball diameter shall be about two-thirds of the branch spread. The soil ball for trees should be a minimum of 12 inches for each 1 inch of trunk diameter.

f) Large trees should have a trench dug deep enough to get below all of the major roots. The trench should be dug completely around the tree to be transplanted. This will provide the angle necessary for the spade to undercut roots directly under the soil ball.

5. Storing and Transporting:

a) Do not allow plant roots to become dry during the transplanting process.

b) Trees and shrubs that have been dug for transplanting should be planted as soon as possible.

c) Cover the root ball immediately with damp material which will retain moisture (like burlap, peat moss, canvas, plastic, etc.) until planting. Plastic should only be used in shaded areas for less than a day or heat injury and/or root suffocation may occur.

d) When a tree or shrub is stored, it should be protected from direct sunlight, winds, and temperature extremes.

6. Planting:

- a) Planting holes should be two to three times wider than the root ball.
- b) If the soil is clayey and the sides of the hole become glazed during digging, the sides of the hole should be roughened with a spade.
- c) Pre-water holes before planting in dry soils.
- d) Plant at the same depth that the tree or shrub was growing in its previous location.
- e) Orient the tree or shrub in the same direction, relative to the sun, as it was facing in the previous location.

7. Post planting Care:

- a) The site should be thoroughly watered immediately after planting. Thereafter, the soil must be regularly monitored to prevent drying out.
- b) Mechanical support for trees may be necessary when the tree is tall, slow to recover, heavily foliated, or planted in a sandy site. Two stakes can be placed opposite of each other and the tree anchored to the stakes with a nonabrasive material, such as a soft, broad, fabric strap. Any support provided to a tree should be removed as soon as the tree can stand alone, usually after the first growing season.

* * * *

TECHNICAL SPECIFICATION CIVIL WORK

SECTION – 1.0

GENERAL

For all items of work described in the Bill of quantities, the work shall be carried out strictly in accordance with description in General Specifications, particular specifications and drawings. The description, drawings and specifications shall be taken complementary to each other and shall form part of this contract.

In case items are not exhaustively described in paras described above, the general specifications of CPWD in respect of material & workmanship shall be followed for which nothing extra shall be paid.

The quoted rates shall be deemed to include all necessary hardware, tools & plants, props, material, labour, duties, taxes, insurance premia etc., all needed to make the individual item functional, to the complete satisfaction of the Engineer-in-charge, whether specifically mentioned in the individual item or not.

Scope of Work :

The Scope of Work for buildings under this contract includes for full and final and entire completion of all works including all internal services in all respects described in General Specifications, particular specifications and as shown on drawings forming part of the contract.

Although all the details of construction have been by and large covered in these documents, any item or detail of construction not specifically covered but obviously implied and essential to consider Civil works and all internal services complete and functional, shall be deemed to have been covered in the item rate quoted. The Tenderer may however, consider a minimum level of specifications conforming to IS Code or National Building Codes to cover these missing details.

Samples of Materials :

The contractor shall produce samples of all materials at least four weeks before incorporation in the work and shall obtain approval of these in writing from the Engineer-in-charge, before he places bulk order for the materials. Materials to be incorporated in the work shall conform to latest relevant ISI specifications, ISI marked goods where manufactured shall be used. (This will apply to the materials where specific brand, names of manufacturer not stipulated) where brand, names are given then the material should be out of the brands, names as specified.

Slopes :

Adequate slope shall be provided in areas where there is likelihood of ingress of water such as toilets, balconies verandah, terraces, top of chajjas, window cills, plinth protections etc. though these may not be expressly shown in drawings.

Curing :

Exposed surfaces of all cement works viz. cement concrete, brick work, flooring, plastering, pointing and the like shall be cured by keeping surface adequately and continuously wet as directed by the Engineer-in-charge for at least seven days. Cost for this shall be deemed to be included in the percentage quoted against the respective schedule.

Bar Chart :

Contractor shall submit Bar Chart to the Engineer-in-charge and Project Manager, FENA for the entire work in the contract. The above bar chart shall be submitted by contractor within one week of acceptance of contract. Bar chart as submitted shall be scrutinized by the Engineer-in-charge and Project Manager. Mutually agreed Bar chart shall be finalized within 7 days of submission by the contractor. The contractor shall carry out the changes as suggested by Architect and Project Manager. The mutually agreed Bar chart shall be signed by contractor, Engineer-in-charge and Project Manager. This shall be binding on contractor for progressing the work for completion by due date.

Standard of Work :

To determine the acceptable standard of workmanship and also to decide if any variations are required in the layout of internal services or finishes, the contractor shall execute on sample room for each area. The sample room shall be put up for inspection and approval and specific dates put up in the bar-chart mentioned above for each of the following Structure including location of doors / windows

fixing of door / window frames and internal plaster location of electric light, fan, socket outlets, switch positions, False ceiling, telephone and water trap positions, wash hand, Basins, geyser positions. Complete sample room with all finished as per specifications For stage as per Para 11 (d) above all items of works, services and finishes such as floors, internal plaster, joinery including all fittings and hardware, sanitary fittings, plumbing, electrification, entire kitchen and toilet fittings, wall finishes and painting etc. shall be completed in all respects before putting up for inspection and approval.

All materials fittings / fixtures to be incorporated in the sample rooms conforming to specifications makes and brands as given in the Contract Agreement shall be got approved at least one week before they are required at site for incorporation. The order should be placed by the contractor in such a way that they can be procured in time and incorporated in the sample room. All stages of the sample room as per Para 11 above shall be jointly approved by Project Manager, Architect and Engineer-in-charge and record of approval stage wise duly signed and dated shall be kept by the Engineer-in-charge.

Completion of Sample Room: Immediately after completion of sample room the contractor shall give notice thereof to the Engineer-in-charge with a copy to the Project Manager. The sample room shall be completed to the entire satisfaction of the Engineer-in-charge, Architect and Project Manager. If satisfied, the Engineer-in-charge & Architect shall issue a certificate indicating the dates on which the specific sample room has been completed. The certificate shall be countersigned by the Project Manager. The Project manager, wherever mentioned shall be the project manager appointed by the client, who would be in charge of the project. The contractor must clearly understand that this project involves additions and alterations of an old structure, with variation in technologies of the existing building to the new structure. Immaculate planning and co-ordination with the Engineer-in-charge shall be needed and the contractor must ensure that his team consists of qualified and compatible engineers. Certain decisions may be taken on the site and shall need to be documented and dealt with accordingly.

SECTION – 2.0

EXCAVATION, EARTH WORK AND ANTITERMITE TREATMENT

Scope :

This section covers the works specification of earthwork in excavation in all kinds of soils including murrum, hard murrum, soft rock (without blasting, hard rock (without blasting), rock (with blasting), filling excavated earth in plinths, sand filling in plinth, rubble soling, and brick on edge soling.

Applicable Codes

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

- a) IS - 4081 Safety code for blasting and related drilling operations
- b) IS - 1200 Method of measurement of building works.
- c) IS - 3764 Safety code for excavation work.
- d) IS - 3385 Code of practice for measurement of Civil Engineering works.
- e) IS -2720 Part II Determination of moisture content.

Part VIII Determination of moisture content dry density relation using light compaction.

Part XXVIII Determination of dry density of soils, in-place by the sand replacement method.

Part XXIX Determination of dry density of soils, in-place, by the core cutter method. Drawings

Engineer-in-Charge will furnish all necessary drawings showing the areas to be excavated, filled, sequence of priorities etc. Contractor shall follow strictly such drawings.

General :

Contractor shall provide all tools, plants, instruments, qualified supervisory personnel, labour, materials, and temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein, for completion of the Work.

Contractor shall set properly all lines and establish levels for various works such as earthwork in excavation for levelling, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc.

The area to be excavated / filled shall be cleared of fences, trees, plants, logs, slumps, bush, vegetations, rubbish slush etc. and other objectionable matter. If any roots or stumps of trees are found during excavation, they shall also be removed. The material so removed shall be burnt or disposed off as directed by Engineer. Where earth fill is intended, the area shall be stripped of all loose/soft patches, top soil containing deleterious matter/materials before fill commences. Final cleaning shall be done with removal of all rubbish up to the distance of 30.0 m all around outside the periphery of building.

Relics, Objects of Antiquity, Etc.

All gold, silver, oil minerals archaeological and other findings of importance, all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of Engineer-in-Charge and Contractor shall dully preserve the same to the satisfaction of Engineer-in-Charge and from time to time deliver the same to such person or persons as Engineer-in-Charge may from time to time authorise or appoint to receive the same.

Classification of Soils :

Any earthwork will be classified under any of the following categories: -

- i) All kinds of soils

These shall include all kinds containing kankar, sand, silt, moorum and/or shingle, gravel, clay, loam peat, ash, shale etc. which can generally be excavated by spade, pick-axe and shovel and which is not classified under soft and decomposed rock, and hard rock defined below. This shall also include embedded rock boulders not bigger than 1 metre in any dimension and not more than 200 mm in any one of the other two dimensions or lighter than 500 Kg.

- ii) Soft Rock

This shall include rock, boulders, slag, chalk, slate, hard mica schist, laterite etc. which are to be excavated with or without blasting or could be excavated with picks, hammer, crow bars, wedges. This shall also include rock boulders not bigger than 1 metre in any dimension and not more than 500 mm in any one of the other two dimensions. Rubble masonry to be dismantled will also be measured under this item.

iii) **Hard Rock**

This shall include rock which cannot be easily excavated with pick-axes, hammer, crow bars and wedges but has to be either heated where blasting is prohibited or has to be blasted. They shall be stacked separately for measurement.

1. **Site Clearance** : Before the start of work, the area of the Site shall be cleared of all shrubs, vegetation, grass, bush wood, stumps and all the building shall be laid out to ensure that the layout plan fits at site. After completion of the work, the entire area of the site shall be cleared from all debris, unwanted materials / equipment and level / slope of ground as required at site up to peripheral roads. The debris and unwanted material shall be disposed off away from the site without any extra cost.

2. **Site Levels** : After site clearance and before commencement of excavation or filling, the contractor shall take levels at 5.0 Metre intervals in either directions or at lesser intervals as considered necessary at site for the entire site where the work is to be executed. A record of these levels shall be signed jointly by Contractor and the Engineer-in-charge. These records shall be submitted to the Project Manager and a copy kept with the Engineer-in-charge.

3. **Setting out of works** : The contractor shall set out the works and shall provide and fix all setting out apparatus required and solely be responsible for the true and perfect setting out the same and for correctness of the position, levels, dimensions and alignment of all buildings as per the drawings. The contractor shall take in writing the approval of the Engineer-in-charge and Project Manager for setting out and levels before starting the works. These approvals shall be recorded in the stage passing register and signed by the Engineer-in-charge and contractor and countersigned by the Project Manager.

4. **Surface Dressing** : The surface area to be occupied by the building shall be cleared of all debris, shrubs and plants, grass and thereafter excavated, if required to an average depth in 150mm including 3m all round the building ramps, if any. All roots and organic material shall be cleared from the filling area inside the building.

5. **Excavation in Trenches and Over Areas** :

(a) The earth work in excavation shall be done as per the consultant's drawings up to required depths and levels and alignments in all sorts of soils. Nothing shall be payable for excavation done for working space for labour. Only neat line excavation shall be payable. Roots or trees met with during the excavation shall be cut and removed. Excavated earth shall be stacked at least 3 m away from the trenches or as per the Engineer's instructions, so that it may not damage the sides of the excavated trenches. The sides of the excavated trenches shall be in straight line and bottom uniformly leveled watered, consolidated and ready for termite treatment. The maximum lead for stacking the earth shall be 200 m, unless otherwise categorically specified in the item description.

(b) Earth work in excavation in any type of soil as existing at site for foundations of rafts, columns and walls / half brick walls / from existing ground level shall be as indicated on the drawings.

(c) The depth of excavation for foundations / footings of columns / load bearing walls / dwarf walls toe walls / half brick walls / from existing ground level shall be as indicated on the drawings.

(d) The finish floor level of building shall be as per drawings. The finished floor levels of buildings shall be fixed at site by the Engineer-in-charge. The work shall be executed at site as per the levels approved by the Engineer-in-charge.

(e) Immediately after the execution of the foundation work and before covering the same the record of the following levels as actually executed at site shall be recorded in the measurement books and jointly signed and dated by the Engineer-in-charge & Contractor -

- i) Existing ground level
- ii) Level of bottom of lean concrete under footings of columns, walls and basement raft.
- iii) Finished floor levels at ground floor.

(f) If trenches or foundations are excavated beyond the specified dimensions due to bad workmanship of contractor, the extra excavation shall be filled with lean concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate of 40mm nominal size) without any extra cost of Employer.

Transportation, handling, storage and use of explosives shall be directed by Engineer-in-Charge of proven experience and ability in blasting or operations. These operations shall be in accordance with the procedures and practices recommended by Engineer-in-Charge. In the absence of any instructions available from Engineer-in-Charge corresponding procedures followed by State or Central Government shall be followed and shall be approved by Engineer-in-Charge. Any modifications or exceptions to the above provision shall be cleared with Engineer-in-Charge before any work is undertaken. Any license or permission of Collector or Police authorities required for blasting shall be obtained by the Contractor at his own cost. All procedures and safety precautions for the use of explosives drilling and loading of explosives before and after shot fixing and disposal of explosives shall be taken by the contractor as detailed in IS-4081- 1967 safety code for blasting and related drilling operation.

From the date when the Contractor starts work under this contract, or from the required contract date, whichever is earlier, the Contractor shall assume all responsibilities for earth and rock banks. Such responsibility shall continue to the date when all work under the contract is completed and approved by Engineer-in-Charge. The contractor shall provide sheeting, shoring and bracing required for the support of earth and rock banks during construction. Sheeting, shoring and bracing shall be maintained in place until immediately before filling or backfilling then shall be removed by stages as the filling or backfilling progresses. Engineer-in-Charge reserves the right to specify shoring or bracing as may be deemed necessary by them.

Any settlement or washing away of filled or backfilled areas, and earth and rock banks, that may occur from the action of the elements, or any other cause, prior to acceptance of work, shall be repaired and grades re- established to the required elevations and slopes, at no additional cost.

The excavated stacked earth shall be filled in trenches, sides of foundations in layers of 150mm thick and balance shall be disposed off by uniform spreading within the site as directed by the Engineer-in-Charge.

Adequate protective measures shall be taken by the Contractor to see that the excavation for the building foundation does not affect the adjoining structure's stability and safety. Contractor will be responsible if he has not taken precaution for the safety of the people, property or neighbor's property caused by his negligence during the constructional operations.

To the extent available, selected surplus spoils from excavated materials shall be used as backfill. Fill material shall be free from clods, salts, sulphates, and organic & other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of moorum or earth to fill up the voids and the mixture used for filling.

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches etc. shall be cleared of all debris and filled with earth in layers 15 cm to 20 cm, each layer being watered, rammed and properly consolidated before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Engineer-in-Charge.

Mode of measurement for Earth work in excavation including back filling

Lead

Lead for deposition/disposal of excavated material, shall be within a lead of 200m as directed by Engineer-in-Charge. Only leads beyond 200m shall be considered as extra lead and the Contractor shall be paid as per Tender items. For the purpose of measurement of lead the area to be excavated or filled or area on which excavated material is to be deposited/disposed off shall be divided into suitable blocks and for each of the blocks, the distance between centerlines shall be taken as the lead which shall be measured, as far as practically possible, by the shortest straight line route on the plan and not the actual route taken by Contractor. No extra compensation is admissible on the grounds that the lead including that for borrowed materials had to be transported over marshy or katcha land/route.

All excavation shall be measured according to neat line for measurement i.e. PCC dimensions as per drawing or as ordered in writing by Engineer-in-Charge for foundations of the walls, columns, footings, tanks, rafts or other foundations structure to be built, multiplied by the mean depth from the surface of the ground in accordance with the drawings. Contractor may make such allowances in his rates to provide for excavation in side slopes keeping in mind the nature of the soil and safety of excavation. Margin for stepping, slopes, space for providing & removing of shuttering, shoring etc, are deemed to have been considered in the rates. No extra payment will be claimed in this regard.

iii) Backfilling as per specification the side of foundations of columns, footings, structures, walls, tanks rafts, trenches etc. with excavated materials will not be paid for separately. It shall be clearly understood that the rate quoted for excavation including backfilling shall include stacking of excavated material as directed, excavation/stacking of selected stacked material, conveying it to the place of final backfill, compaction etc. as specified.

iv) The rates quoted shall also include for dumping of excavated materials in regular heaps, bunds, riprap with regular slopes as directed by Engineer within the lead specified and leveling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as directed by Engineer. As a rule, all softer material shall be laid along the centre of the heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Excavated soft rock or hard rock shall be stacked separately.

(v) The bailing out of water shall also be executed by the Contractor & deemed to have been included in the rates.

The general specification for excavation shall be same as for the item of excavation.

6. **ANTI-TERMITE TREATMENT :**

(a) This shall be provided to bottom, sides of foundation of trenches, including treating the back fill under floors and other locations as specified in IS-6313 1981 Part-II for pre-construction soil treatment with any of the following:

Chemical Con. by wt. %

- i) Chlorpyrifos emulsifiable concentrates conforming to IS 8944-1978 1.00
- ii) Heptachlor emulsifiable concentrates conforming to IS 6436-1978 0.50
- iii) Chlordane emulsifiable concentrates conforming to IS 2682-1978 1.00

(b) The work of antitermite treatment shall be got executed by a specified firm, which must be member of IPCA and approved by the Engineer-in-charge and shall be carried out as per Is 6313 Part II of 1981 for pre-construction soil treatment. The firm shall render a ten year guarantee to the employer through the contractor who will be the principle guarantor. The period of ten year shall be reckoned from the date of completion of the contract. The guarantor shall give the guarantee on non-judicial stamp paper of value Rs. 50/-.

7. **Plinth Filling :** Earth obtained from excavation shall be filled in layers not more than 200 mm in depth at a time, spread, leveled, watered and well consolidated around foundations, under floors and other locations. The earth used for filling shall be free from all grass, roots, debris etc.

8. **Filling in Plinth etc:**

a) Earth: Normally excavated earth from same area shall be used for filling. Earth used for filling shall be free from shrubs, rank vegetation, grass, brushwood, stone shingle and boulders (larger than 75mm in any direction), organic or any other foreign matter. Earth containing deleterious materials, saltpeter earth etc. shall not be used for filling. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before the earth is used for filling.

b) Filling: The space around the foundations, and drains in trenches shall be cleared of all debris, brick bats etc. The filling shall be done in layers not exceeding 20cm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of crowbars where rammers cannot be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches.

In case of filling under floor, the finished level of filling shall be kept to the slope intended to be given to the floor.

c) Filling in plinth and under floors: Depth of filling shall be the consolidated depth. The dimensions of filling shall be on the basis of pre-measurement correct to the nearest cm and cubical contents worked out in cubic meters correct to two places of decimal.

Mode of Measurement

Payment for filling in plinth and land development with selected excavated material will be made as specified/directed. Payment for this work will be made based on measurement of plinth/dimensions filled. The plinth/ground levels shall be surveyed before hand for this purpose. Filling in plinth and ground with Excavated earth excavated from borrow pit within site area.

The compaction shall be carried out as specified in the item for filling above.

Filling in plinth and ground with earth brought from outside

(A) Filling shall be carried out with approved material as described above. The material and source shall be subject to prior approval of Engineer-in-Charge. The approved area, from where the fill material is to be dug, shall be cleared of all bushes, roots plants, rubbish etc. top soil containing salts, sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by Engineer. The Contractor shall make necessary access roads to those areas and maintain the same, if such access road does not exist, at his cost.

(B) If any material is rejected by Engineer, Contractor shall remove the same forthwith from the site at no extra cost to the Engineer-in-Charge. Surplus fill material shall be disposed off by uniform spreading within the site as instructed by the Engineer.

(C) The compaction shall be carried out as specified in the item for filling in plinth above.

(D) Mode of Measurement

Backfilling, plinth filling etc. with borrowed earth will be paid for under specified items. The quoted rate shall include all operations such as clearing, excavation, lead and transport, fill, compaction etc. as specified. Actual quantity of consolidated filling shall be measured and paid for in cubic meters irrespective of lead and lift.

9. **Disposal of Surplus Soil:** Surplus soil / earth if any shall be disposed off with in the site up to the quantity as directed by the Engineer-in-charge and the same shall be spread out evenly for which no extra payment shall be made. The balance surplus quantity shall be removed away from site. The cost of this removal shall be deemed to be included in the quoted rates / percentages.

10. **Sand Filling :** Fine sand filling under floors at ground floor shall be provided. This shall be dry fine sand watered and consolidated including dressing and leveling.

11. **Sand Filling in Plinth:**

a) Sand : Sand shall be clean and free from dust organic and foreign matter and its grading shall be within the limits of grading.

b) Filling : Sand filling shall be done in a manner similar to earth filling in plinth specified in **8.c** expect that consolidation shall be done by flooding with water. The surface of the consolidated sand filling shall be dressed to the required level or slope and shall not be covered till the Engineer-in-Charge has inspected and approved of the sand filling.

12. **Treatment for existing building:**

To facilitate proper penetrations of chemical into the surface to be treated, hand operated pressure pump shall be used. To have proper check for uniform penetration of chemical, graduated containers shall be used. Proper check should be kept so that the specified quantity of chemical is used for the required area during the operation. Chemical treatment of the eradication and control of sub-terrene and termites in existing buildings shall be done as per Is: 6313 (Part - III). Treatment shall be got done only from the approved specialized agencies using the chemical procured directly by the Engineer-in-charge from reputed and authorized dealers.

13. **Treatment Along Outside of Foundations:** The soil in contact with the external wall of the building shall be treated with chemical emulsion at the rate of 7.5 liters per sqm of the vertical surface of the sub-structure to a depth of 300mm. To facilitate this treatment a shallow channel shall be excavated along and close to the wall face. The chemical emulsion shall be directed towards the wall at 1.75 liters per running metre of the channel. Roding with 12 mm diameter mild steel rods at 150mm apart shall be done in the channel, if necessary, for uniform dispersal of the chemical to 300mm depth from the ground level. The balance chemical of 0.5 liter per running metre shall than be used to treat the backfill earth as it is returned to the channel directing the spray towards the wall surface.

If there is a concrete or masonry apron around the building, approximately 12mm diameter holes shall be drilled as close as possible to the plinth wall about 300mm apart, deep enough to reach the soil below and the chemical emulsion pumped into these holes to soak the soil below at the rate of 2.25 liters per linear metre.

14. **Treatment of Soil Under Floors:**

Chemical treatment shall be done by drilling 12mm holes at the junction of floor and walls along the cracks on the floor and along the construction joints at the interval of 300mm to reach the soil below.

Chemical emulsion shall be squirted into these holes using a hand operated pressure pump to soak the soil below until refusal or upto a maximum of one liter per hole. The holes shall then be sealed properly with cement mortar 1:2 (1 cement : 2 coarse sand) finished to match the existing floors. The cement mortar applied shall be cured for at least 10 days as per instructions of Engineer-in-charge.

15. **Treatment of Voids in Masonry :** The movement of termites through the masonry wall may be arrested by drilling holes in masonry wall at plinth level and squirting chemical emulsion into the holes to soak the masonry. The holes shall be drilled at an angle of 45° from both sides of the plinth wall at 300mm intervals and emulsion squirted through these holes to soak the masonry using a hand operated pump. This treatment shall also be extended to internal walls having foundations in the soil. Holes shall also be drilled at wall corners and where door and window frames are embedded in the masonry or floor at ground. Emulsion shall be squirted through the holes till saturation or to a maximum of one litre per hole. Care shall be taken to seal the holes after the treatment.

16. **Treatment at Points of Contact of Wood Work :** All existing wood work in the building which is in contact with the floor or walls and which is infested by termites, shall be treated by spraying at the points of contacts with the adjoining masonry with the chemical emulsion by drilling 6mm holes at a downward angle of about 45° at the junction of wood work and masonry and squirting chemical emulsion into these holes till refusal or to a maximum of half a litre per hole. The treated holes shall then be sealed.

SECTION – 3.0

CEMENT CONCRETE WORK

I Applicable Codes:

The following codes and standards are made a part of the Specifications. All standards, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein , this specification shall prevail.

(a) Materials

- 1) IS 269 : Specification for ordinary, rapid hardening and low heat portland cement.
- 2) IS 455 : Specification for Portland blast furnace slag.
- 3) IS 1489: Specification for portland-pozollana cement.
- 4) IS 4031: Methods of physical tests for hydraulic cement.
- 5) IS 650 : Specification for standard sand for testing of cement.
- 6) IS 383 : Specification for coarse and fine aggregates from natural sources for concrete.
- 7) IS 2386 (Parts I to VIII): Methods of test for aggregates for concrete.
- 8) IS 516 : Methods of test for strength of concrete.
- 9) IS 1199 : Methods of sampling and analysis of concrete.
- 10) IS 2396(I) IS 5640 Flakiness Index of aggregates
- 11) IS 3025: Methods of sampling and test (physical and chemical water used in industry)
- 12) IS 432 : (Part I & II) : Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
- 13) IS 1139 : Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement
- 14) IS 1566: Specification for plain hard drawn steel wire fabric for concrete reinforcement.
- 15) IS 1785 : Specification for plain hard drawn (Part I) steel wire for pre-stressed concrete.
- 16) IS 1786 : Specification for cold twisted steel bars for concrete reinforcement.
- 17) IS 2090 : Specification for high tensile steel bars used in prestressed concrete
- 18) IS 4990 : Specification for plywood for concrete shuttering work.

- 19) IS 2645 : Specification for integral cement water-proofing compounds.

(b) Equipment

- 1) IS 1791 : Specification for batch type concrete mixers
- 2) IS 2438 : Specification for roller pan mixer
- 3) IS 2505 : Specification for concrete vibrators immersion type
- 4) IS 2506 : Specification for screed board concrete vibrators
- 5) IS 2514 : Specification for concrete vibrating tables.
- 6) IS 3366 : Specification for pan vibrators
- 7) IS 4656 : Specification for form vibrators for concrete.
- 8) IS 2722 : Specification for portable swing weigh-batchers for concrete (single and double bucket type)
- 9) IS 2750 : Specification for steel scaffoldings

(c) Codes of Practice

- 1) IS 456 : Code of practice for plain and reinforced concrete.
- 2) IS 1343 : Code of practice for pre-stressed concrete
- 3) IS 457 : Code of practice for general construction of plain and reinforced concrete for dams and other massive structures
- 4) IS 3370 : Code of practice for concrete (Part I to IV) structures for storage of liquids
- 5) IS 3935: Code of practice for composite construction
- 6) IS 3201: Criteria for design and construction of pre-cast concrete trusses.
- 7) IS 2204 : Code of practice for construction of reinforced concrete shell roof
- 8) IS 2210 : Criteria for the design of RC shell structures and folded plates.
- 9) IS 2751 : Code of practice for welding of mild steel bars used. : for reinforced concrete construction.
- 10) IS 2502 : Code of practice for bending and fixing of bars for concrete reinforcement.
- 11) IS 3558 : Code of practice for use of immersion vibrators for consolidating concrete.
- 12) IS 3414 : Code of practice for design and installation of joints in buildings
- 13) IS 4014 : Code of practice for steel tubular, (Part I&II) scaffolding.
- 14) IS 2571 : Code of practice for laying insitu cement concrete flooring.

(d) Construction Safety

- 1) IS 3696 : Safety code for scaffolds and ladders

(e) Measurement

- 1) IS 1200 : Method of measurement of building works.
- 2) IS 3385 : Code of practice for measurement of civil engineering works.

The above mode of measurements shall be applicable only if it is not given specifically in the Tender document.

2.2 General :

The quality of materials, method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise shall conform to the applicable portions of this specification.

Engineer-in-Charge shall have the right to inspect the source/s of material/s, the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and engineer's approval obtained, prior to starting of concrete work.

2.3 Materials :

The ingredients to be used in the manufacture of standard concrete shall consist solely of standard type portland cement, clean sand, natural coarse aggregate, clean water and admixtures.

2.3.1 Cement :

a) **If the Contractor is instructed to supply cement, then the following points shall be applicable:**

i) Unless otherwise specified the cement shall be ordinary portland cement in 50 kg bags of 43/53 Gr. as applicable. The use of bulk cement will be permitted only with the approval of Engineer-in-Charge. For this the contractor will be required to construct proper storage facility.

ii) A certified report attesting to the conformance of the cement to IS specifications by the cement manufacturer's chemist shall be furnished to Engineer-in-Charge, if demanded.

b) **If the cement is supplied by the Engineer-in-Charge**

i) Contractor will have to make his own arrangements for the storage of minimum 2500bags of cement. If supplies are arranged by Engineer-in-Charge, cement will be issued in quantities to cover work requirements of one month or more, as deemed fit by Engineer and it will be the responsibility of contractor to ensure adequate and proper storage. Cement in bulk may be stored in bins or silos, which will provide complete protection from dampness contamination and minimize caking and false set. Cement bags shall be stored in a dry enclosed shed (storage under tarpaulins will not be permitted), well away from the outer walls and insulated from the floor to avoid contact with moisture from ground and so arranged as to provide ready access damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site. The storage bins and storage arrangements shall be such that there is no dead storage. Not more than 12 bags shall be stacked in any tier. The storage arrangement shall be approved by Engineer-in-Charge. Consignments of cement shall be stored as received and shall be consumed in the order of their delivery. Different types of cement shall not be mixed together. Incase more than one type of cement is used in any work, a record shall be kept showing the location and the types of cement used.

2.3.2 Aggregates

a) Unless otherwise the aggregates shall conform to the requirements as per IS-383-1970. Aggregate in general designates both fine and coarse inert materials used in the manufacture of concrete. Fine aggregate is aggregate all of which passes through 4.75 mm IS sieve. Coarse aggregate is aggregate most of which is retained on 4.75 mm sieve

b) All fine and coarse aggregates proposed for use in the work shall be subject to Engineer-in-Charge approval and after specific materials have been accepted the source of supply of such materials should not be changed without prior approval of Engineer-in-Charge.

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

d) Sampling and testing

Samples of the aggregates for mix design and determination of suitability shall be taken under the supervision of Engineer-in-Charge and delivered to the laboratory, well in advance of the scheduled placing of concrete. Records of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to Engineer-in-Charge in advance of the work for use in determining aggregate suitability. The costs of all such tests, sampling etc. shall be borne by contractor.

e) Storage of Aggregates

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

f) Specific Gravity

Aggregate except as noted above, and for other than light weight concrete shall consist of natural or crushed sand and shall conform to IS 383. The sand shall be clean sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, alkali, organic matter, mica, salt or other deleterious substances, which can be injurious to the setting qualities/strength/ durability of concrete.

2.3.3 Machine made Sand:

Machine made sand will be acceptable, provided the constituent rock/gravel composition shall be sound, hard dense, non-organic un-coated, durable against weathering and subject to conformity with gradation as given in the table.

i) Screening and Washing Sand shall be prepared for use for such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions.

ii) Gradation

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

IS Sieve Designation	Percentage passing for			
	Grading Zone I		Grading Zone II	Grading Zone III Zone IV
9.5 mm	100	100	100	100
4.75 mm	90-100		90-100	90-100 95-100
2.36 mm	60-95		75-100	85-100 95-100
1.18 mm	30-70		55-90	75-100 90-100
600 microns	15-34		35-59	60-79 80-100
300 microns	5-20	8-30	12-40	15-50
150 microns	0-10	0-10	0-10	0-15

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

iii) Fineness Modulus

The sand shall have a fineness modulus of not less than 2.2 or more than 3.2. The fineness modulus is determined by adding the cumulative percentages retained on the following IS sieves sizes 4.75mm, 2.36 mm, 1.18 mm 600 micron, 300 micron and 150 micron and dividing the sum by 100.

2.3.4 Coarse Aggregate :

a) Coarse aggregate for concrete, except as noted above and for other than lightweight concrete shall conform to IS 383. This shall consist of natural or crushed stone and gravel and shall be clean and free from elongated, flaky or laminated pieces adhering coatings, clay lumps, coal residue, clinkers slag, alkali, mica, organic matter or other deleterious matter.

b) Screening and Washing

Natural gravel and crushed rock shall be screened and/or washed for the removal of dirt or dust coating, if so demanded by Engineer-in-Charge.

c) Grading

Coarse aggregate shall be graded in both cases the grading shall be within the following limits.

IS Sieve Designation mm	% passing for single sized aggregate of nominal size mm						% passing for graded aggregate of nominal size				
	63	40	20	16	12.5	10	40	20	16	12.5	
80mm	100	-	-	-	-	-	100	-	-	-	
63mm	85- 100	100	-	-	-	-	-	-	-	-	
40mm	0-30	85- 100	100	-	-	-	95- 100	100	-	-	
20mm	0-5	0-20	85- 100	100	-	-	30-70	95-100	100	100	
16mm	-	-	-	85- 100	100	-	-	-	90- 100	-	
12.5mm	-	-	-	-	-	85- 100	100	-	-	90- 100	
10mm	0- 5	0- 5	0- 20	0- 30	0- 45	85- 100	10- 35	25- 55	30- 70	40- 85	
4.75mm	-	-	0- 5	0- 5	0- 10	0- 20	0- 5	0- 10	0- 10	0- 10	
2.36mm	-	-	-	-	0- 5	-	-	-	-	-	

The pieces shall be angular in shape and shall have granular or crystalline surfaces, Friable, flakey and laminated pieces, mica and shale, if present, shall be only in such quantities that will not, in the opinion of Engineer affect adversely the strength and/or durability of concrete. The maximum size of coarse aggregate shall be in no case greater than 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. Plums above 150 mm and up to any reasonable size can be used in plain mass concrete work of large dimensions up to a maximum limit of 20% of volume of concrete when specifically approved by Engineer-in-Charge. For heavily reinforced concrete members the nominal maximum size of the aggregate shall be 5 mm less than the minimum clear distance between the reinforcing main bars or 5mm less than the minimum cover to the reinforcement whichever is smaller. The amount of fine particles occurring in the free state or as loose adherent shall not exceed 1% when determined by laboratory sedimentation tests as per IS 2386. After 24 hours immersion in water, a previously dried sample shall not have gained more than 10% of its oven dry weight in air, as determined by IS 2386.

d) Foreign Materials Limitations

The percentages of deleterious substance in the coarse aggregate delivered to the mixer shall be limited in conformity with IS-383-1970.

2.3.5 Water :

Unless otherwise stated the water quality & requirements for concrete will be in conformity with IS:456-1978.

a) Water used for both mixing and curing shall be free from injurious amounts of deleterious materials. Potable waters are generally satisfactory for mixing and curing concrete.

b) In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in IS-456. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that

envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

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

d) The initial setting time of test block made with the appropriate set cement and the water proposed to be used shall not be less than 30 minutes and shall not differ by more than plus minus 30 seconds from the initial setting time of control test block prepared with the appropriate test cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of IS 4031.

e) Where water can be shown to contain an excess of acid, alkali sugar or salt, engineer may refuse to permit its use. As a guide, the following concentrations represent the maximum permissible values:

i) To neutralize 200 ml sample of water, using phenolphthalein as indicator, it should not require more than 2 ml of 0.1 normal NaOH. The details of test shall be as given in IS 3025.

ii) To neutralize 900 ml sample of water using methyl orange as an indicator, it should not require more than 10 ml of 0.1 normal HCl. The details of test shall be given in IS 3025.

iii) Percentage of solids when tested in accordance with the method indicated below shall not exceed the following :

	Percent	Method of Test(Ref. to clause no. in IS 3025-1964
	-----	-----
Organic	0.02	10 and 11 (organic solids = total solids minus ignited residue)
Inorganic		
Sulphate (as SO ₄	0.30	11 (Ignited residue)
Alkali Chlorides (as Cl)	0.05	20
	0.10	24
Suspended matter	0.20	-

2.3.6 Reinforcement Steel :

a) All MS reinforcing bars shall conform strictly to IS:432- 1982 and high strength deformed steel (Tor Steel) bars IS:1786-1985. All reinforcement shall be clean and free from loose mill scales, rust, loose rust, coats of paints, oil or other coatings, which may destroy or reduce bond.

b) All reinforcing bars shall conform to drawings and dimensions shown on the drawing or where required to carry out intent of drawings or specifications. Reinforcement shall not be bent or straightened in a manner injurious to the materials.

Bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 25mm in diameter which may be bent hot if specifically approved by the Engineer-in-Charge. Bars which depend for their strength on cold working, shall not be bent hot. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 845 Deg. C) and after bending the same

shall be allowed to cool slowly without quenching. No reinforcement shall be bent when in position in the work without approval, whether or not it is partially embedded in hardened concrete. Bars with kinks or bends not shown on drawings shall not be used.

Reinforcing bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This is considered as a part of reinforcement bending fabrication work.

Laps and splices for reinforcement shall be as shown on the drawings. The locations of all splices except those specified on the drawings shall be approved by the Engineer-in-Charge. Reinforcement shall not be spliced at points of maximum stresses. Splices shall have sufficient lap, to transfer the full stress by bond. Unless otherwise stated laps for bars in tension shall have minimum length of 45 times diameter and for those in compression shall have minimum length of 35 times diameter. Wherever possible, laps shall be staggered. Reinforcing bars shall be held rigidly in position before concreting and ensure correct clearances as indicated on the drawings. All end hooks and anchorage bends shall be dimensioned in accordance with IS:2502-1963. Welding of reinforcement shall not be permitted unless authorised by the Engineer-in-Charge.

The Contractor shall see that the reinforcement is laid out correctly. Bars intended to be in contact at crossing points shall be securely bound together at all such points with number 16 gauge annealed soft iron wire. The vertical distances required between successive layers of bar in beams or similar members shall be maintained by the provision of spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars. The contractor shall provide any temporary gang-ways, platforms, other means of access which may be necessary to prevent men walking on the reinforcement bars. Fully cured concrete chairs or blocks not leaner than 1:2 part cement and sand shall be used to obtain the correct cover to the reinforcing bars. Brick, timber block, pebble or stone shall not be used for this purpose. Erected and secured reinforcement shall be inspected and approved by the Engineer-in-Charge prior to placement of concrete.

b) The payment for reinforcement shall be based on weight. The weight shall be derived from the sizes and corresponding weights given in I.S. hand book. The quantities for binding wires, chairs, supports, spacer-bars, laps, wastage etc. shall not be measured nor paid for separately except for laps indicated on the drawings. However, only for reconciliation purpose the measurement of chairs, supports, spacer bars, etc. shall be considered.

2.3.7 Mixing of Cement Concrete :

The quantities of cement shall be determined by weight. Ordinary Portland Cement shall be taken to weight 1442 kg/m³. The quantities of fine and coarse aggregates shall be determined either by volume for ordinary concrete and by weight for controlled one. The proportions of volume or weights specified are based on dry aggregates, due allowance is to be made for bulking or variation in weight of aggregates according to IS:2386 (Part-III)-1963.

All concrete shall be mixed in a mechanical mixer until there is uniform distribution of the materials, and the mass is uniform in colour and consistency, but in no case shall the mixing be done for less than two minutes. Hand mixing shall not be allowed for any concreting work on the job.

Mix Design

a) All concrete in the works shall be of design mix as defined in IS 456, unless it is a nominal mix concrete such as 1:2:4, 1:3:6, 1:4:8 or 1:5:10. Whether reinforced or otherwise, all design mix concrete works to be carried out under this specification shall be divided into the following classifications:

MINIMUM COMPRESSIVE STRENGTH OF 15 CM CUBES AT 7 AND 28 DAYS AFTER MIXING,
CONDUCTED IN ACCORDANCE WITH IS 516

Class	Preliminary test N/SQ.MM			Work test Max.size N/SQ.MM of aggregate mm.			Minimum Cement content per cum
	at 7 days	at 28 days	at 28 days	at 7 days	at 28 days		
M 25	23.5	35.0	17.0	28.0	40 or 20	as per design mix	
M 20	22.0	29.0	13.5	22.0	40 or 20	as per design mix	
M 15	14.0	17.0	10	16.0	40 or 20	as per design mix	

b) It shall be very clearly understood that whenever the class of concrete such as M 20 is specified it shall be the Contractor's responsibility to ensure that minimum crushing strength stipulated for the respective class of concrete is obtained at works. The maximum total quantity of aggregate by weight per 50 kg of cement shall not exceed 450 kg except when otherwise specifically permitted by Engineer-in-Charge.

c) To fix the grading of aggregates, water cement ratio, workability and the quantity of cement required to give preliminary and works cubes of the minimum strength specified, the proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out according to Indian Standard Specifications.

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

e) While fixing the value for water cement ratio for preliminary mixes, assistance may be derived from the graph (appendix IS 456 showing the relationship between the 28 day compressive strengths of concrete mixes with different water cement ratios and the 7 days compressive strength of cement tested in accordance with IS 269.

2.3.8 Preliminary tests of Concrete (Cube Test)

a) Test specimens shall be prepared with at least two different water/cement ratios for concrete, consistent with workability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in all respects to those to be actually employed in the works as the object of these tests is to determine the proportions of cement, aggregates and water necessary to produce concrete of required consistency and to give the specified strength. It will be the Contractor's sole responsibility to carry out these tests and he shall therefore furnish to Engineer a statement of proportions proposed to be used for the various concrete mixes.

b) Materials shall be brought to the room temperature and all materials shall be in a dry condition. The quantities of water, cement and aggregates for each mix shall be determined by weight/volume to an accuracy of 1 part in 1000 parts.

c) Mixing shall be done by a mixer machine as per IS 516 in such a manner as to avoid loss of water. The cement and fine aggregate shall first be mixed dry until the mixture is uniform in colour. The coarse aggregate shall then be added, mixed and water added and mixed thoroughly for a period of not less than 3 minutes until the resulting concrete is uniform in appearance. Each mix of concrete shall be of such a quantity as to leave about 10% excess concrete after moulding the desired number of test specimens.

d) The consistency of each mix of concrete shall be measured immediately after mixing, by the slump test in accordance with IS 1199. If in the slump test, care is taken to ensure that no water or other materials is lost, the materials used for the slump test may be remixed with the remainder of the concrete for making the specimen test cubes. The period of re-mixing shall be as short as possible yet sufficient to produce a homogeneous mass.

e) Compression tests of concrete cubes shall be made as per IS 516 on 15 cm cubes. Each mould shall be provided with a metal base having a plane surface so as to support the mould during filling without leakage. The base plate shall be preferably attached to the mould by springs or screws. The parts of the mould when assembled shall be positively and rigidly held together. Before placing concrete the mould and base plate shall be cleaned and oiled. The dimensions and internal faces of the mould shall be accurate within the following limits:

Height and distance between the opposite faces of the mould shall be of specified size plus minus 0.2mm. The angle between the adjacent internal faces and between internal faces and top and bottom planes of mould shall be $90^{\circ} \pm 5^{\circ}$. The interior faces of the mould shall be plane surfaces with a permissible variation of 0.03mm.

f) Concrete test cubes shall be moulded by placing fresh concrete in the mould and compacted as specified in IS 516.

g) Curing shall be as specified in IS 516. The cubes shall be kept in moist air of at least 90% relative humidity at a temp. of $27^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 24 hours plus minus half hour from the time of adding water to the dry ingredients. Thereafter they shall be removed from the moulds and kept immersed in clean, fresh water and kept at $27^{\circ}\text{C} \pm 2^{\circ}\text{C}$ temperature. until required for test. Curing water shall be renewed every seven days. A record of maximum and minimum temperatures at the place of storage of the cubes shall be maintained during the period they remain in storage.

h) Testing of specimens

The strength shall be determined based on not less than five cubes test specimens for each age and each water cement ratio. All these laboratory test results shall be tabulated and furnished to Engineer. The test result shall be accepted by Engineer if the average compressive strengths of the specimens are tested subject to the condition that only one out of the five consecutive test may give a value less than the specified strength for that age. The Engineer may direct the Contractor to repeat the tests if the results are not satisfactory and also to make such changes as he considers necessary to meet the requirements specified. All these preliminary tests shall be conducted by the Contractor at his own cost in an approved laboratory.

2.3.9 Proportioning consistency, batching and mixing of concrete :

Proportioning

a) Aggregate

The proportions which shall be decided by conducting preliminary test shall be by volume. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete mixing. The supply of properly graded aggregate of uniform quality shall be maintained over the period of work, the grading of aggregates shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stock piles. The grading of coarse and fine aggregate shall be checked as frequently as possible as determined by Engineer, to ensure maintaining of grading in accordance with the samples used in preliminary mix design. The material shall be stock piled well in advance of use.

b) Cement

The cement shall be measured by volume in normal cases. However, in case of central weight batching plants. Cement may be weighed for each batch if so desired by Engineer-in-Charge.

c) Water

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

The water cement (W/C) ratio is defined as the volume of water in the mix (including the surface moisture of the aggregates) divided by the volume of cement in the mix. The actual water cement ratio to be adopted shall be determined in each instance by the Contractor and approved by the Engineer-in-Charge.

d) Proportioning by water/Cement ratio

The W/C ratio specified for use by Engineer shall be maintained. The Contractor shall determine the water content of the aggregates as frequently as directed by Engineer as the work progress and as specified in IS 2386 (Part-III) and the amount of water added at the mixer shall be adjusted as directed by Engineer so as to maintain the specified W/C ratio. To allow for the variation in volume of aggregates due to variation in their moisture content suitable adjustments in the volume of aggregates shall also be made.

e) Consistency and slump

Concrete shall be of a consistency and workability suitable for the conditions of the job. After the amount of water required is determined, the consistency of the mix shall be maintained throughout the progress of the corresponding parts of the work and approved tests e.g. slump tests, compacting factor tests, in accordance with IS 1199 shall be conducted from time to time to ensure the maintenance of such consistency.

f) The following tabulation gives a range of slumps which shall generally be used for various types of construction unless otherwise instructed by the Engineer.

SLUMPS FOR VARIOUS TYPES OF CONSTRUCTION

Only sufficient quantity of water shall be added to concrete during mixing to produce a mix of sufficient workability to enable it to be well consolidated, to be worked in to the corners of the shuttering and around the reinforcement, to give the specified surface finish, and to have the specified surface strength. The following slumps shall be adopted for different kinds of works:-

Name of Work	When	When
	vibrator used	vibrator not used
Mass concrete in foundations, footings retaining walls and pavements.	10mm to 25mm	50mm to 75mm

Thin sections of floors of less than

75mm thick	25mm to 40mm	75mm to 100mm
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For Reinforced cement concrete work:

Mass concreting in
foundations, footings
retaining walls and
pavements

10mm to 25mm

25mm to 75mm

Beams, slabs, columns

25mm to 40mm

75mm to 125mm

Thin shells, folded
plates etc.

40mm to 50mm

125 mm to 150mm

2.3.10 Sampling and testing concrete in the field :

a) Facilities required for sampling materials and concrete in the field shall be provided by the Contractor at no extra cost. The following equipment with operator shall be made available at Engineer-in-Charge's request (all must be in serviceable condition):

i) One concrete cube testing machine suitable for 15 cm cubes of 100 tones capacity with proving calibration ring.

ii) Six cast iron cube moulds of 15 cm size

iii) One Lab. balance to weigh upto 5 kg with sensitivity of 10gm

iv) One set of sieves for coarse and fine aggregates

v) One set of slump cone complete with tamping rod

vi) A set of measures from 0.1 litre to 5 litre

vii) One electric oven with thermostat upto 120°C

viii) One flakiness gauge

ix) One elongation index gauge

x) One sedimentation pipette

xi) One Pyconometer

xii) Two calibrated glass jar of 1litre capacity

Arrangement can be made by the contractor to have the cubes tested in an approved laboratory in lieu of a testing machine at site at his expense, with the prior consent of the Engineer-in-Charge.

b) At least 6 test cubes of concrete shall be made for every 15.0 cum. of concrete or part thereof. Such samples shall be drawn on each day for each type of concrete. Of each set of 6 cubes, three shall be tested at 7 days age and three at 28 days age. The laboratory test results shall be tabulated and furnished to Engineer-in-Charge. Engineer will pass the concrete if average strength of the specimens tested is not less than the strength specified, subject to the condition that only one out of three consecutive tests may give a value less than the specified strength but this shall not be less than 90% of the specified strength. The cubes shall be tested on 7th and 28th day from the day of

casting of the cubes. Contractor should maintain a register indicating proportion of mix number of test cubes, date of casting cubes, date of testing, test results and signature of testing authority and Engineer-in-Charge.

2.3.11 Admixtures :

a) Admixtures may be used in concrete only with the approval of Engineer based upon evidence that, with the passage of time, neither the compressive strength nor its durability reduced. Calcium chloride shall not be used for accelerating setting of the cement for any concrete containing reinforcement, or embedded steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1.5% of the volume of the cement in concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instructions and in the manner and with the control specified by Engineer-in-Charge.

b) Air entraining agents

Where specified and approved by Engineer-in-Charge, neutralised vinyl resin or any other approved air-entraining agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6260 air entraining admixtures for concrete. The recommended total air content of the concrete is 4% plus minus 1%. The method of measuring air content shall be as per IS 1199.

c) Water reducing admixtures

Where specified and approved by Engineer-in-Charge water reducing mixture shall be added in quantities specified by Engineer-in-Charge. The admixtures shall be added in the form of a solution.

d) Retarding admixtures

Where specified and approved by Engineer, retarding agents shall be added to the concrete mix in quantities specified by Engineer-in-Charge.

f) Water proofing agent

Where specified and approved by Engineer, water proofing agent conforming to IS:2645 shall be added in quantities specified by Engineer-in-Charge.

2.3.12 Optional tests :

a) Engineer may order tests to be carried out on cement, sand, coarse aggregate and water in accordance with the relevant Indian Standards. Tests on cement shall include (i) fineness test (ii) test for normal consistency (iii) test for setting time (iv) test for soundness (v) test for tensile strength (vi) test for compressive strength (vii) test for heat of hydration by experiment and by calculations in accordance with IS:269. Tests on fine aggregate and coarse aggregate cover under IS:2386 Part-I & VIII. Any or all these tests would normally be ordered to be carried out only if Engineer feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by contractor at site or at an approved test laboratory. If the tests are successful, Engineer-in-Charge shall pay for all such optional tests otherwise the Contractor shall have to pay for them.

b) If the cubes do not give the stipulated strengths Engineer-in-charge reserves the right to ask contractor to dismantle such portions of the work, which in his opinion are unacceptable and re-do the work to the standard stipulated at contractor's cost in the manner and schedule approved by Engineer-in-Charge.

- c) Load test on members or any other tests

The Engineer-in-Charge may instruct for a load test or other test to be carried out on any structure if in his opinion such a test is deemed necessary for any of the following reasons :-

- i) The concrete test cube made at work site failing to attain the specified strength.
- ii) Shuttering being either prematurely removed or not being according to the specifications.
- iii) Curing of the concrete is inadequate or improperly carried out.

In case of results of load test being unsatisfactory, the Engineer-in-Charge shall have the right to ask the contractor to demolish and reconstruct the structure or part thereof at the contractor's cost.

2.3.13 REBOUND HAMMER TEST :

If a rebound hammer is regularly used by trained personnel in accordance with procedure described in IS:13311 (Part-II)- 1992 and a continuously maintained individual charts are kept showing a large number of readings and the relation between the readings and strength of concrete cubes made from the same batch of concrete, such charts may be used in conjunction with hammer readings to obtain an approximate indication of the strength of concrete in a structure or element. If calibration charts are available from manufacturers, it can be used. When making rebound hammer tests each result should be the average of at least 12 readings. Readings should not be taken within 20mm of the edge of concrete members and it may be necessary to distinguish between readings taken on a troweled face and those on a moulded face. When making the tests on a precast units, special care should be taken to bed them firmly against the impact of the hammer.

ADDITIONAL TESTS FOR CONCRETE

In case the concrete fails when tested, one or more of the following check tests may be carried out at the discretion of Engineer-in-Charge to satisfy the strength of the concrete laid. All testing expenditure shall be borne by the contractor. The number of additional tests to be carried out shall be determined by the Engineer-in-Charge. He shall be the final authority for interpreting the results of additional tests and shall decide upon the acceptance or otherwise. His decision in this regard shall be final and binding. For the purpose of payment, the Hammering test result only shall be the criteria. Some of the tests are outlined below :-

CUTTING CORES

This method involves drilling and testing cores from the concrete for determination of compressive strength. In suitable circumstances the compressive strength of the concrete in the structure may be assessed by drilling cores from the concrete and testing. The procedure used shall comply with the requirements of IS-1199-1959 and IS-516- 1959.

The points from which cores shall be taken shall be representative of the whole concrete and at least three cores shall be obtained and tested. If the average of the strength of all cores cut from the structure is less than the specified strength, the concrete represented by the cores shall be liable to rejection and shall be rejected if a static load test either cannot be carried out or is not permitted by the Engineer-in-Charge.

ULTRASONIC TEST

If an ultrasonic apparatus is regularly used by trained personnel in accordance with IS 13311 (Part-I)-1992 and continuously maintained individual charts are kept showing a large number of readings & the relation between the reading and strength of cubes made from the same batch of concrete, such charts may be used to obtain approximate indications of the strength of concrete in the structures. In case of suspected lack of compaction or low cube strength the results obtained from the ultrasonic test results on adjacent acceptable sections of the structures may be used for the purpose of assessing the strength of concrete in the suspected portion.

Concrete in alkali soils and alkaline water

Where concrete is liable to attack from alkali salts or alkaline water, special cements containing low amount of tricalcium aluminate shall be used, if so specified in the drawings. Such concrete shall have a minimum 28 days compressive strength of 250 kg per sq.cm and shall contain not less than 370 kg of cement per cubic metre of concrete.

If specified, additional protection shall be obtained by the use of a chemically resistant stone facing or a layer of plaster of paris covered with suitable fabric, such as jute thoroughly impregnated with tar.

2.3.14 Preparation prior to concrete placement :

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

b) The various agencies shall be permitted ample time to install drainage and plumbing lines in floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedment to be cast in the concrete as indicated on the drawings or as is necessary for the proper execution of the work. Contractor shall cooperate fully with all such agencies and shall permit the use of scaffolding, form work etc. by other agencies at no extra cost.

c) All embedded parts, inserts etc. supplied by Engineer-in-Charge or Contractor shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.

d) Anchor bolts shall be positioned and kept in place with the help of proper manufactured templates. The use of all such templates, fixture etc. shall be deemed to be included in the rates. No extra payment will be made for making or providing templates.

e) Slots, openings, holes, pockets etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by Engineer-in-Charge.

f) Prior to concrete placement all work shall be inspected and approved by Engineer and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected at Contractor's cost. Cat ladders shall be provided on the reinforcement to facilitate labour movement.

g) Approval by Engineer for all materials and work as required herein shall not relieve contractor from his obligation to produce finished concrete in accordance with the drawings and specifications.

h) No concrete shall be placed in wet weather or on water covered surface. Any concrete that has been washed by heavy rains, the work shall be entirely removed, if there is any sign of cement and sand having been washed from the concrete mixture. To guard against damage

which may be caused by rains, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over/around freshly placed concrete, suitable drains and sumps shall be provided.

l) Immediately before concrete placement begins, proposed surfaces except formwork , which will come in contact with the concrete to be placed, shall be covered with approved bonding.

2.3.15 Transportation :

a) All buckets, containers or conveyors used for transporting concrete shall be mortar tight. Irrespective of the method of transportation adopted, concrete shall be delivered with the required consistency and plasticity without segregation or loss of slump. However, chutes shall not be used for transport of concrete without the written permission of Engineer and concrete shall not be re-handled before placing.

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

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

2.3.16 Procedure for placing of concrete :

a) Before any concrete is placed, the entire placing program, consisting of equipment, layout proposed procedures and methods shall be submitted to engineer for approval if so demanded by Engineer and no concrete shall be placed until Engineer's approval has been received.

Conveyor for conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete during depositing without segregation of materials, considering the size of the job and placement location.

b) Concrete shall be placed in its final position before the cement shall normally be compacted in its final position within thirty minutes of leaving the mixer and once compacted it shall not be disturbed.

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

d) Except when otherwise approved by Engineer, concrete shall be placed in shovels or other approved implements and shall not be dropped from a height more than 1.5 M or handled in a manner which will cause segregation.

e) The following specification shall apply when placing of concrete by use of mechanical equipment is specifically called for while inviting bids or is warranted considering the nature of work involved. The control of placing shall begin at the mixer discharger, concrete shall be discharged by a vertical drop into the middle of the bucket or hopper and this principle of a vertical discharge of

concrete shall be adhered to throughout all stages of delivery until the concrete comes to rest in its final position.

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

g) In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1.5 M. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.

h) Concrete placed in restricted forms by wheel barrows, buggies, cars, short chutes or hand shoveling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position.

i) Where it is necessary to use transfer chutes, specific approval of Engineer must be obtained to the type, length, slopes, baffles, vertical terminals and timing of operations, the discharge and without segregation. To allow for the loss of mortar against the sides of the chutes, the first mix shall have less coarse aggregate. During cleaning of chutes the waste water shall be kept clear of the forms. Concrete shall not be permitted to fall from the end of the chutes by more than 1.5 M. Chutes when approved for use shall have slopes not flatter than 1 : 3 and steeper than 1 : 2 chutes shall be of metal or metal lined and of rounded cross section. The slopes of all chutes sections shall be approximately the same. The discharge end of the chutes shall be maintained above the surface of the concrete in the forms.

j) Concrete may be conveyed and placed by mechanically operated equipment e.g. pumps or pneumatic placers only with the written permission of Engineer. The slump shall be held to the minimum necessary for conveying concrete by this method.

k) When pumping is adopted, before pumping of concrete is started, the pipeline shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. The concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

l) When pneumatic placer is used, the manufacturer's advice on layout of pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at this end. Manufacturer's advice shall be followed regarding concrete quality and all other related matters when pumping or pneumatic placing equipment are used.

m) Concreting, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 to 90 mm as directed by Engineer. These shall be placed as rapidly practicable to prevent the formation of cold joints or planes of weakness between each succeeding layer within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of deposit shall be spotted progressively along the face of the layer with such overlap as will facilitate spreading the layer to uniform depth and texture with a minimum of shoveling. Any tendency to segregation shall be corrected by shoveling stones into mortar rather than mortar on to stones. Such a condition shall be corrected by redesign of mix or other means, as directed by Engineer.

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

The contractor should arrange the tarpaulins ready before starting of placing of concrete during rainy seasons.

During cold weather, concreting shall not be done when the temperature falls below 4.5°C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone.

During hot weather, precaution shall be taken to see that the temperature of wet concrete does not exceed 30°C. No concrete shall be laid within half an hour of the closing time of the day, unless permitted by Engineer-in-Charge.

p) Compaction

concrete shall be judged to be properly compacted, when the mortar fills the spaces between the coarse aggregate and begins to cream-up to form an even surface. When this condition has been attained, the vibrator shall be stopped in case of vibrating tables & external vibrators.

Particular care shall be taken to ensure that all concrete placed against the forms faces and into corners of forms or against hardened concrete at joints is free from voids or cavities. The use of vibrators shall be consistent with the concrete mix and caution exercised not to over-vibrate the concrete to the point that segregation results. No concrete work should be allowed to start unless adequate number of vibrators are at hand.

ii) Vibrators shall conform to IS specifications. Type of vibrator to be used shall depend on the structure where concrete is to be placed. Shutter vibrators, to be effective, shall be firmly secured to the formwork which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Immersion vibrators shall have no load frequency, amplitude and acceleration as per IS 2505 depending on the size of vibrator. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted.

iii) The exact manner of application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention shall be paid to vibration at the top of a lift e.g. in a column or wall.

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

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

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

vii) Form attached vibrators shall be used only with specific authorization of Engineer-in-Charge.

viii) The surface vibrators will not be permitted under normal conditions. However for thin slabs vibration by specially designed vibrators may be permitted upon approval of Engineer-in-Charge.

ix) The formation of stone pockets or mortar bondages in corner and against faces of forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for through bonding, as directed by Engineer-in-Charge.

q) Placement interval

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

r) Special provision in placing

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

s) Construction Joints

Concreting shall be carried out continuously upto construction joints. The position and details of which shall be predetermined by the Engineer-in-Charge. When the work has to be resumed on a surface which has hardened such surfaces shall be roughened, cleaned and wetted with a coat of neat cement grout immediately before placing of new concrete. Shear keys as indicated on the drawings shall be provided at all construction joints.

Joints shall be kept at places where the shear forces is minimum and these joints shall be at right angles to the direction of the main reinforcement. In the case of columns, the joints shall be horizontal at 150mm below the bottom of the deepest beam framing into the column head or as directed and the portion of the column between these joints and the top of the slab shall be concreted along with the beams. when stopping the concrete on a vertical plane in slabs and beams an approved and reasonably water tight stop-board shall be placed with necessary slots for reinforcement bars to pass freely without bending or any other obstructions and by providing a rectangular or trapezoidal fillet nailed on the stop board for shear key.

Where paper or card board joints are required as shown on the drawings, the paper used shall be waterproof. The concreting rate shall include providing any such joint material.

2.3.17 Curing, protecting, repairing and finishing :

a) Curing

i) All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays or ponded water continuously saturated covering of sacks, canvas, hessian or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot water as outlined hereinafter. The quality of curing water shall be the same as that used for mixing concrete.

ii) Certain types of finish or preparation for overlaying concrete must be done at certain stage of the curing process and special treatment may be required for specific concrete surface finish.

iii) Curing of concrete made of high alumina cement and super-sulphated cement shall be carried out as directed by Engineer.

iv) Fresh concrete shall be kept continuously wet for a minimum period of 10 days from the date of placing of concrete following a lapse of 12 to 14 hours after laying of concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately after the

concrete has hardened. Water shall be applied uniformly to concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms. Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.

v) Whenever, by the judgment of Engineer, it may be necessary to omit the continuous spray method, a covering of clean sand or other approved means such as wet gunny bags which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which would stain or damage the concrete during or after the curing period. Covering shall be kept continuously wet during the curing period.

vi) For curing of concrete in pavements, side-walks floors, flat roofs or other level surfaces, the pounding method of curing is preferred. The method of containing the pounded water shall be approved by Engineer. Special attention shall be given to edges and corners of the slabs to ensure proper protection to these areas. The pounded area shall be kept continuously filled with water during the curing period.

vii) Surface coating type compounds shall be used only by special permission of Engineer. Curing compounds shall be liquid type white pigmented. Other curing compounds shall be used on surfaces where future blending with concrete, water or acid proof membrane or painting is specified.

viii) All equipment and materials required for curing shall be on hand and ready for use before concrete is placed.

b) Protecting fresh concrete

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

c) Repair and replacement of unsatisfactory concrete

i) Immediately after the shuttering is removed, the surface of concrete shall be very carefully inspected and all defective areas called to the attention of Engineer who may permit patching of the defective areas or also reject the concrete unit either partially or entirely. Rejected concrete shall be removed and replaced by contractor at no additional expense to Engineer-in-Charge. Holes left from bolts etc. shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing 2.36 mm IS sieve after removing any loose stones adhering to the concrete and shall be finished as described under the particular items of work.

ii) Superficial honey combed surfaces and rough patches shall be similarly made good immediately after removal of shuttering in the presence of Engineer and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with a wooden float. Excess water shall be avoided. Unless instructed otherwise by Engineer, the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other irregularities and necessary care being taken to avoid damage to the surface. Surface irregularities shall be removed by grinding.

iii) If reinforcement is exposed or the honeycombing occurs at vulnerable positions e.g. ends of beams or columns it may be necessary to cut out the member completely or in part and reconstruct. The decision of Engineer shall be final in this regard. If only patching is necessary, the

defective concrete shall be cut out till solid concrete is reached (or to a minimum depth of 25mm), the edges being cut perpendicular to the affected surface or with small under cut if possible. Anchors, tees or dovetail slots shall be provided whenever necessary to attach the new concrete securely in place an area extending several centimeter beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.

iv) The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Engineer. Epoxy shall be applied in strict accordance with the instructions of the manufacturer.

v) Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bottom, grout insert holes and slots cut for repair of cracks shall be repaired as follows:

The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops. A 5mm thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched, followed immediately by the patching concrete which shall be well consolidated with a wooden float. The concrete patch shall be built up in 10 mm thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and smooth finish obtained by wiping with hessian. A steel trowel shall be used for this purpose. The mix for patching shall be of same material and in the same proportions as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.

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

vi) The patched area shall be covered immediately with an approved non-staining water saturated material such as gunny bag which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by fine spray of sprinkling for not less than 10 days.

vii) All materials, procedures and operations used in the repairing of concrete and also the finished repair work shall be subject to the approval of Engineer. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and finished.

d) Self Finishing

i) The type of finish for formed concrete surface shall be as follows, unless, other wise specified by the Engineer-in- Charge:

For surfaces against which backfill or concrete is to be placed, no treatment is required except repairing of defective areas.

For surface below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper application of the waterproofing material which is specified for use.

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

ii) Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless the drawing specifies such as stair treads, walls shall be sloped across the width approximately 1 in 30 broader surface such as walkways, roads, parking areas and platforms shall be sloped about 1 in 50. Surface irregularities shall not exceed 6mm. Surfaces which will not be covered by backfill, concrete or tile toppings such as outside decks, floors of galleries and sumps, parapets, gutters, sidewalks floors and slabs shall be consolidated. Excess water and laitance shall be removed before finishing. Floating may be done with hand or power tools and started as the surface has attained a stiffness to permit finishing operation and these shall be the minimum required to produce a surface uniform in texture and free from marks or other imperfections. Joints, edges, panels and forms, linings shall be of uniform size. Upon removal of forms the joint marks shall be smoothed off and all blemishes, projections etc, removed leaving the surfaces reasonably smooth and unmarred.

iv) Exposed Concrete finish/Rendering

A rubbed finish shall be provided only on exposed concrete surfaces as specified on the drawings. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, off-sets levelled and voids and damaged sections be immediately saturated with water and repaired by filling with a concrete or mortar of the same composition as was used in the surface. Then surface shall be thoroughly wetted and rubbed with carborundrum or other abrasive. Cement mortar may be used in the rubbing, but the finished surface shall be brush coated with either cement grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

Mode of Measurement

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

ii) Payments of concrete will be made on the basis of unit quoted for the respective items in the Schedule of Quantities. No deduction in the concrete quantity will be made for reinforcements, inserts, Sleeves etc. and openings less than 0.05 cum. where concrete is measured in cum . Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets etc. will not be made.

iii) Payment for beams will be made for the quantity based on the depth being reckoned from the underside of the slabs and length measured as the clear distance between supports. Payment for columns shall be made for the quantity based on height reckoned up to the underside of Columns.

2.4 Pre-cast Reinforced Cement Concrete :

Pre-cast concrete shall comply with IS 456 and with the following requirements:

a) All precast units shall be cast on suitable bed or platform with firm foundation and free from wind. Contractor shall be responsible for the accuracy of the level or shape of the bed or platform. A suitable serial number and the date of casting shall be impressed or painted on each unit. The concreting will be done by weigh batching as per design mix or machine mixed nominal concrete will be done for various grade of concrete.

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

c) The lifting and removal of precast units from casting yard shall be undertaken without causing shock, vibration or undue bending stresses to or in the units. Before lifting and removal takes place, Contractor shall satisfy Engineer or his representative that the methods he proposes to adopt for these operations shall not over stress or otherwise affect seriously the strength of the precast units. The reinforced side of the units shall be distinctly marked.

d) All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each unit shall be kept constantly watered or preferably be completely immersed in water bond if the size of the unit so permits, otherwise curing practice as given in RCC clause shall be followed.

e) Slots, openings or holes, pockets lifting hooks etc. shall be provided in the pre-concrete work as per the drawings or as directed by Engineer-in-Charge. Any deviation from the approved drawings shall be made good by Contractor at his own expense, without damaging any other work. Sleeves, bolts, inserts, etc. shall also be provided in concrete work where so specified.

Mode of Measurement

It shall be measured in cubic meter or as per the item schedule. The unit rate for precast concrete members shall include formwork, concrete of appropriate grade, mouldings, finishing, hoisting and setting in position including mortar bed & jointing, provision of lifting arrangement, exposed concrete finish etc. complete. Only reinforcement, inserts, bolts etc. shall be paid under respective items.

2.6 Form Work :

2.6.1 Form work shall include all temporary or permanent forms or moulds required for forming the concrete which is cast- in- situ, together with all temporary construction required for their supports.

Design & Tolerance in Construction

Form work shall be designed and constructed to the shapes, lines and dimensions shown on the drawings with the tolerances given below :-

- a) Deviation from specified dimensions of cross section of columns and beams = +12 mm
- b) Deviation from dimensions of footings = +12 mm
- c) Dimension in Plan = +50 mm
- d) Eccentricity in plan :-
0.02 time the width of the footings in the direction of deviation but not more than 50mm.
- e) Thickness :-
+0.05 times the specified thickness

(Note - Tolerance apply to concrete dimensions only, and not to positioning of vertical steel or dowels).

General requirement

It shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, Screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete.

Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing the surface of concrete or disturbing other sections. Care shall be taken to see that no piece is keyed into the concrete.

Material for form work

a) Propping and centering

All propping and centering should be either of steel tubes with extension pieces or built up sections of rolled steel.

Centering/Staging

Staging should be as designed with required extension pieces as approved by Engineer-in-Charge to ensure proper slopes, as per design for slabs/beams etc. and as per levels as shown in drawings. All the staging to be either of Tubular steel structure with adequate bracing as approved or made of built up structural sections made from rolled structural steel sections.

In case of structures with two or more floors, the weight of concrete, centering and shuttering of any upper floor being cast shall be suitably supported on one floor below the top most floor already cast.

Form work and concreting of upper floor shall not be done until concrete of lower floor has set at least for 14 days.

Shuttering

Shuttering used shall be of sufficient stiffness to avoid excessive deflection and joints shall be tightly butted to avoid leakage of slurry. If required, rubberised lining of material as approved by Engineer-in-Charge shall be provided in the joints.

Steel shuttering used for concreting should be sufficiently stiffened. The steel shuttering should also be properly repaired before use and properly cleaned to avoid stains, honey combing, seepage of slurry through joints etc.

a) Runner Joists :

RSJ, MS Channel or any other suitable section of the required size shall be used as runners.

b) Assembly of beam head over props. Beam head is an adopter that fits snugly on the head plates of props to provide wider supports under beam bottoms.

Form work shall be properly designed for self weight, weight of reinforcement, weight of fresh concrete, and in addition, the various live loads likely to be imposed during the construction process (such as workmen, materials and equipment). In case the height of centering exceeds 3.50 metres, the prop may be provided in multi-stages.

Camber

Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per metre (1 in 250) or as directed by the Engineer-in-Charge, so as to offset the subsequent deflection. For cantilevers the camber at free end shall be 1/50 th of the projected length or as directed by the Engineer-in-Charge.

Walls

The form faces have to be kept at fixed distance apart and an arrangement of wall ties with spacer tubes or bolts is considered best.

Removal of Form work (Stripping Time)

In normal circumstances and where ordinary port land cement is used, forms may generally be removed after the expiry of the following periods :-

- a) Walls, columns and vertical faces of all structural members 24 to 48 hrs. as may be decided by the Engineer-in-Charge.
- b) Slab
 - i) Spanning up to 4.50 M 7 days
 - ii) Spanning over 4.50 M 14 days
- c) Beams and arches
 - i) Spanning up to 6 M 14 days
 - ii) Spanning over 6M & up to 9M 21 days
 - iii) Spanning over 9 M 28 days
- b) Design of formwork

The design of the formwork as well as its construction shall be the responsibility of Contractor. If so instructed, the drawings and/or calculation for the design for the formwork shall be submitted to Engineer for approval before proceeding with work, at no extra cost. Engineer's approval shall not however relieve Contractor of the full responsibility for the design and construction of the formwork. The design shall take into account all the load vertical and lateral that the forms will be carrying live and vibration loadings.

c) Type of formwork

Formwork may be of timber, plywood metal, plastic or concrete. For special finishes the formwork may be lined with plywood, steel sheets oil tempered hard board etc. Sliding forms and slip forms may be used with the approval of Engineer.

d) Form work requirements

i) All new and used form timber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces. Form timber unsatisfactory in any respect shall not be used and if rejected by Engineer shall be removed from the site.

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

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

iv) Excessive construction camber to compensate for shrinkage, settlement which may impair the structural strength of members shall not be permitted.

v) Forms shall be so designed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and be as directed by engineer.

vi) Where exposed smooth or rendered concrete finishes are required the forms shall be constructed with special care so that the resulting concrete surfaces require a minimum finish.

e) Formwork For Slope Surfaces

i) Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration inspection and repair of the concrete.

ii) The formwork shall also be built so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 4 horizontal: 1 vertical shall be provided with top shuttering if required.

f) Formwork For Curved Surfaces

i) The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form timber shall be built up of laminated sheets cut to make tight, smooth form surfaces.

ii) After the forms have been constructed, all surface imperfections shall be corrected and all surface irregularities at matching faces of form material shall be dressed to the specified curvature.

g) Formwork For Exposed Concrete Surfaces (Wrought Form Work)

i) Where it is desired, directed or shown on the drawings to have original fair face finish of concrete surface without any rendering or plastering, formwork shall be carried out by using wood planks, plywood or steel plates of approved quality size and pattern as per direction of the Engineer.

ii) The contractor shall use one type of material for all such exposed concrete faces and the forms shall be constructed so as to produce uniform and consistent texture and pattern on the face of the concrete. Patches or forms for these surfaces will not be permitted. The formwork shall be placed so that all horizontal formworks are continuous across the entire surface.

iii) To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features, cills, window heads or change in direction of the surface. All joints between shuttering plates or panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be provided between sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.

iv) To achieve a finish which shall give the rough appearance of concrete cast against sawn boards, formwork boards unless otherwise stated shall be of 150 mm wide, securely jointed with tongue and grooved joints if required to prevent grout loss with tie rod positions and direction of boards carefully controlled. Sawn boards shall be set horizontally, vertically or at an inclination shown in the drawings. All shuttering bolt holes shall be accurately aligned horizontal and vertical and shall be filled with matching mortar recessed 5mm back from the surrounding concrete face.

v) Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicate top of pour) at horizontal construction joints, unless the use of groove strips is specified on the drawings. Such forms shall be removed and reset from lift to lift, they shall not be continuous from lift to lift. Sheeting of reset forms shall be tightened against the concrete so that the forms will not be spread and permit abruting irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.

vi) For fair faced concrete (exposed concrete face), the position of through bolts will be restricted and generally indicated on the drawings.

vii) Chamfer strips shall be placed in the corners of forms for exposed exterior corners so as to produce 20 mm bevelled edges except where otherwise shown in the drawings. Interior corners and edges at formed joints shall not be bevelled unless shown on the drgs. Moldings for grooves, drip courses and bands shall be made in the form itself.

viii) The wood planks, plywood and steel plates used in formwork for obtaining exposed surfaces shall not be used for more than 3 times in case of wood planks, 6 times for plywood and 10 times for steel plates respectively. However, no forms will be allowed for reuse, if in the opinion of the Engineer it is doubtful to produce desired texture of exposed concrete.

ix) In order to obtain exposed concrete work of uniform colour it shall be necessary to ensure that the sand used for all exposed concrete work shall be of approved uniform colour. Moreover the cement used in the concrete for any complete element shall be from single consignment.

x) No exposed concrete surface shall be rendered or painted with cement or otherwise. Plastering of defective concrete as a means of achieving the required finish shall not be permitted, except in the case of minor porosity on the surface, the Engineer may allow a surface treatment by rubbing down with cement and sand mortar of the same richness and colour as for the concrete. This treatment shall be made immediately after removing the formwork.

xi) The contractor shall also take all precautionary measures to prevent breaking and chipping of corners and edges of completed work until the building is handed over.

h) Bracings struts and props

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

ii) The shuttering for beams and slabs shall be so erected that the shuttering on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the shuttering. If the shuttering for a column, is erected for the full height of the column, one side shall be left open and built up in sections as placing of concrete from the sides to limit the drop of concrete to 3M or as directed by engineer.

i) Mould Oil

Shuttering gives much longer service life if the surfaces are coated with suitable mould oil which acts both as a parting agent and also gives surface protections.

A typical mould oil is heavy mineral oil or purified cylinder oil containing not less than 5% pentachlorophenol conforming to IS 716-1987 well mixed to a viscosity of 70-80 centi poise.

After 3-4 uses and also in cases when shuttering has been stored for a long time, it should be re-coated with mould oil before the next use.

The design of form work shall conform to sound Engineering practices and relevant IS code.

j) Reuse of forms

Number of repeated usage of shuttering materials shall be depended upon the quality of shuttering materials and to be as approved by the Engineer-in-Charge.

Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer. Warped lumber shall be resized. Contractor shall equip himself with enough shuttering material to complete the job in the stipulated time.

Measurement

Measurement shall be done on the basis of square metre of the actual area in contact with concrete. Formwork required for providing cutouts and openings in concrete work shall be measured as per IS-1200 but however formwork necessary for construction joint shall not be measured and paid for separately.

DESIGN MIX CONCRETE

Design mix concrete is that concrete in which the design of mix (i.e) the determination of proportions of cement, aggregate & water is arrived as to have target mean strength for specified grade of concrete. It will be designed based on the principles given in IS:456 & SP-23.

In order to ensure that not more than the specified proportion of test results are likely to fall below the characteristic strength, the concrete mix has to be designed for higher average compressive strength and this higher average compressive strength for a specified grade of concrete is defined a target mean strength.

PROVIDING AND MIXING OF PLASTICIZERS

The plasticizer to be used shall be of approved make like **FOSROC** or equivalent as per IS:9103-1979 material will be used as per manufacturer's specification. The payment will be in ltrs basis of actual material used as per manufacturer's specification.

NOTE :

Clean-up

- i) Upon the completion of concrete work, all forms, equipment, construction tools protective coverings and any debris resulting from the work shall be removed from the premises.
- ii) All debris, i.e. empty containers, wooden pieces etc. shall be removed .
- iii) The finished concrete surfaces shall be left in a clean condition to the entire satisfaction of Engineer-in-Charge.

ARCHITECTURAL CONCRETE WORKS

1. Damp Proof Course :

- (a) This shall consist of 40mm thick PCC 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.50 mm nominal size) with waterproof compound CICO-I as per manufacturer's specifications, including centering and shuttering. The top surface of the DPC shall be finished fair and even but not smooth.
- (b) DPC as specified above shall be provided 40mm thick at level with finish floor to the full width of walls (Ground Floor only)
- (c) No DPC shall be provided over dwarf walls but floors shall be carried over to the width over the dwarf wall finished 10mm projecting over from the wall.
- (d) The dried up surface of DPC shall be cleaned with brushes and finally with a piece of cloth soaked in kerosene oil and then applied with hot bitumen using 1.7 kg per sq. m. of DPC area.
- (e) Vertical damp proof coarse shall be provided at ground floor on common walls between floors at different levels and shall consist of 20mm thick plaster of mix 1:4 (1 cement : 4 coarse sand) with water proofing compound at the rate as used in horizontal DPC and coated with hot Bitumen as in (d) above before filling earth / sand is carried out.

2. Plinth Protection :

- (a) PCC 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size) 50mm thick of width as shown on drawing shall be provided and laid in alternate bays in slope over 75 mm thick hard core of rammed dry brick aggregate of 40mm nominal change grouted with fine sand over well rammed and consolidated earth base with brick edging, all around the building except in portions covered by steps, ramps and platforms. A joint of 12mm shall be left through depth of concrete all along with junction between wall and plinth protection at all turnings and across at every 2.5m. These joints shall be filled with a mixture of blown grade Bitumen 82/25 and sand. The surface shall be finalized smooth without using extra cement. Brick edging shall be laid on header with cement mortar 1:4 (1 cement : 4 coarse sand) as per detail.

3. Coping of Parapet Walls :

This shall be in cement concrete 1:2:4 (1 cement: 2 Coarse sand: 4 stone aggregate 20mm nominal size) as per drawings for all parapet walls on roof parapet wall, compound wall, balconies and other places as under layer and finishing layer of 10mm thick cement sand plaster, Projection on both sides of wall with a drip course drip course 5mm x 5mm or as shown in drawing and as directed by the Engineer-in-charge.

4. RAMPS :

All parking areas shall be provided with cement concrete ramps as shown on drawings. Cement concrete shall be PCC 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm graded), 100mm thick laid over 75 mm thick sub base of PCC graded) over rammed earth. The surface shall be broom finish. Ramp shall be for the full width of the opening of Door/Shutter and shall extend to the road beyond outer edge of wall or as shown specifically in the drawing.

5. FILLING IN LOWERED/HOLLOW/SUNKEN PORTION OF SLAB :

The filling in lowered/hollow/sunken portion of slab shall be done with cinder concrete irrespective of whatsoever is shown on the drawings. The cinder shall be 12.5mm nominal size. It shall be sufficiently hard cinder that it shall not get powdered when rammed with wooden thappies in the ratio of 1:15. The top surface of the roof slab shall be thoroughly cleaned of all dust, dirt and other

foreign matter. The cinder concrete shall then be laid and spread on the slab to the required slope and well rammed with wooden thappies to give a uniform spongy concrete correct to shapes & levels. The finished surface shall be cured for at least 7 days. During this period it shall be protected from sun, rain & other damages. Cinder concrete shall be 1 : 5 (1 cement : 5 cinder).

6. **CONCRETE JALI**

The contractor shall inspect the existing jali at site and shall be free to re-use the same in case it can be salvaged and put at the new specified location. There shall be no additional payment for salvaging.

The new jali shall be in exactly the same pattern & design as the existing one.

The jali shall be cast as per mould. After getting the first mould approved from the Engineer-in-charge, the jali shall be manufactured and fitted with minimum 3 nos, 8mm dia steel bars, protruding 100 on both vertical sides of the jali. Each of these These shall be embedded in concrete bed-blocks 1:2:4, 100x150 on either side.

CEMENT AND SAND GROUTING UNDER BASE PLATE AND POCKETS

This shall be filled in the Pockets of steel column footings, under base plate as directed by the Engineer/shown in the drawings. After erection and alignments of equipment, frames etc. Proportion of cement and sand is specified in item description.

Mode of Measurement

This shall be measured in M³ basis as per the item in the Schedule of Quantities.

SECTION – 4.0

BRICK WORK

Material

1.0 SAND FOR MASONRY MORTAR

Unless otherwise indicated, sand for masonry mortars shall consist of natural sand (generally termed as coarse sand), crushed stone sand or crushed sand or a combination of any of these conforming to IS: 2116-1965 specifications for sand for masonry mortars. Sand shall be hard, durable, clean and free from adherent coating and impurities such as iron pyrites, alkalies, salts, coal, mica, shale or similar laminated or other materials exceeding the specified limits. Grading of sand shall be as under:-

IS Sieve Designation	Percentage passing by weight					
	Unreinforced masonry			Reinforced Masonry		
4.75mm	100	-	-	100	-	
2.36 mm	90	-	100	90	-	100
1.18mm	70	-	100	70	-	100
600 micron	40	-	100	40	-	100
300 micron	5	-	70	5	-	70
150 micron	0	-	75	0	-	10

2.0 The maximum impurities of clay, fine silt and fine dust in sand shall not be more than 4 percent by weight. Organic impurities shall be below that obtained by comparison with the standard solution specified in 6.2.2. of IS: 2386-1983 (Part – II).

3.1 COMMON BURNT CLAY BUILDING BRICK

a) Common burnt clay building bricks (here-in-after termed as bricks) shall conform to the requirement laid down in IS: 1077-1976 for common burnt clay building bricks. Bricks shall be class designation 75 as per the parameters given in the IS regarding edges, dimensions etc. The overall dimensions shall however be as per local practice of moulds. Water absorption after immersion in cold water for 24 hours shall not exceed 20% and efflorescence shall be less than moderate. Bricks shall be free from cracks, flaws and nodules or free lime. All dimensions shall be within tolerance limits. Under/over burnt bricks and warped bricks shall be totally rejected.

b) Test checks on random samples from each lot of bricks brought at site shall be carried out for compressive strength and water absorption test. Result of these tests duly signed by Contractor & Engineer-in-charge shall be recorded in a separate register, a copy of which shall be kept with the Project Manager also.

WORKMANSHIP

4. PREPARATION OF CEMENT MORTAR

Mortar shall be of mix as indicated. The mixing specified are by volume. Mixing shall be done in a mechanical mixer. The mortar shall be mixed for at least three minutes after adding of water. Cement

mortar shall be freshly mixed for immediate use. Any mortar which has commenced to set shall be discarded and removed from the site. The thickness of joints shall not exceed 1 cm.

5. SOAKING OF BRICKS

Bricks required for brick work shall be adequately soaked in stacks, before use, by profusely spraying with clean water at regular intervals for a period of not less than six hours so as to keep them wet.

6. BOND

All works shall be built in English bond unless otherwise indicated. Half brick walls shall be built in stretcher bond. Header bond shall be used for walls curved on plan for better alignment. Header bond shall also be used in foundation. Stretchers may be used when the thickness of wall renders use of headers impracticable. Where the thickness of footings is uniform for a number of courses, the top course of the footings will be of headers. Brick courses at DPC level and at all slab levels the bearings of slab shall be as bricks on edges.

Half or cut brick shall not be used except where it is necessary to complete the bond.

Overlap in stretcher bond is usually half brick and is obtained by commencing each alternate course with a half brick. The overlap in header bond which is equally half width of the alternate course at quoins. In general, the cross joints in any course of brick work shall not be nearer than a quarter of brick length from those in the course below or above it.

7. CURING

The brick work shall be constantly kept wet for at least ten days.

8. HALF BRICK WALLS REINFORCED

The bricks of class designation of 75 shall be laid in stretcher bond in cement and sand mortar 1:4 (1 cement : 4 coarse sand) or as indicated. The reinforcement shall be 2 nos. MS round bars or as directed. The diameter of bars shall be 6 mm. The first layer of reinforcement shall be used at second course and then at every third course of brick work. The bars shall be properly anchored at their ends where the portions and/or where these walls join with other walls. The inlaid steel reinforcement, shall be completely embedded in mortar. Overlap in reinforcement, if any, shall not be less than 30 cm. The cover i.e., the mortar interposed between the reinforcement bar and brick shall not be less than 6 mm. The mortar covering in direction of joints shall not be less than 15 mm.

9. BRICK WORK IN FOUNDATION AND STEPS UPTO PLINTH

Brick work in foundations shall be with bricks of class designation 75 in cement mortar 1:6 (1 cement : 6 coarse sand). The brick course just below the DPC shall be laid with bricks on edges in proper level.

10. BRICKS WORK IN SUPER STRUCTURE

a) This shall be with bricks of class designation 75 and cement mortar shall be used of mix 1:6 (1 cement : 6 coarse sand) in all floors.

b) Half bricks walls shall be with bricks of class designation 75 in cement mortar 1:4 (1 cement : 4 coarse sand) for all floors including reinforcement (2 numbers of 6 mm dia MS bar at every fourth courses).

c) Brick work in steps of staircase : Brickwork in steps of staircase shall be in bricks of class designation 75 and in cement mortar 1 : 4 (1 cement : 4 sand).

11. PARAPET WALLS

Parapets shall be provided to balconies, terraces, roof tops and stair landings etc. of upper floors as per details shown on drawings. Cement mortar 1:4 shall be used.

SECTION - 5.0

STEEL & IRON WORKS

Pressed cold rolled formed steel frames for Doors : -

a) Frames shall be confirming to IS-4351 and shall be manufactured from mild steel sheet of 1.25 mm thickness conforming to IS : 513-1973 (Second Revision). The overall size and type of door frames (four / double / single rebated) shall be made in the profiles as shown on drawing .

b) Each door frame shall consist of hinge jamb, lock jamb and head mullion where shown in drawings. The whole frame shall be welded. At the base an MS angle 50 x 25 x 3 mm shall be welded in order to form a rigid unit. The ties shall not be removed after fixing the frame in position. This shall get embedded in the floor concrete. There shall be three MS flat hold fasts 300 mm long, 40 mm x 3 mm with one end split, into fish tail for each jamb. One end of hold fast shall be bent and welded to frame and the other shall be embedded in wall in cement concrete blocks in PCC 1:3:6 of size 230 x 230 x 150 mm. MS flats 150 x 35 x 6 mm shall be welded on inner face of the frame at the position of the hinges and lock plate and tower bolts/sliding bolts. Four number 125 mm long MS heavy duty hinges shall be provided for each leaf fixed to the screws including drilling threaded holes. Recess shall be formed in frames so that hinges to be fitted are flush with the steel surface. Necessary provision/slots shall be made for fixing locks, tower bolts, bolts etc. The work shall conform to the sample available for inspection. Suitable size of MS flats 6 mm thick and mortar parts are to be welded at the rear of the frame where slots/holes are to be provided.

c) Vertical members of door frames shall be 40 mm more than the specified height and shall be embedded in floor finish at all floor levels. Before erection and fixing in position, all members of the frame shall be rubbed with sand paper to remove all scalings and rust. A coat of redoxide zinc Chromate primer shall be applied as primer coat all round as per manufacturer's specifications. Thereafter, the frame shall be filled with cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 stone aggregate 12.5 and down gauge). The concrete shall be compacted very carefully to ensure that no voids are left, and it shall be cured for atleast 5 days. The cement concrete shall not have a slump more than 1 cm.

PRESSED STEEL FRAMES FOR WINDOWS INCLUDING COMBINED DOOR AND WINDOW AND VENTILATORS.

a) Frames shall be confirming to IS-4351 and shall be manufactured from mild steel sheet of 1.25 mm thickness conforming to IS : 513-1973 (Second Revision). The overall size and type of window frames (double / single rebated) shall be made in the profiles as shown on drawing .

b) Each window/ventilator frame shall consist of jambs (Sides), heads (tops), cills (bottom) Mullions (central members). The whole frame shall be welded. In case of door window frames, the door portion shall be as described in para 1 (b) & 1 (c) above.

c) There shall be two MS holdfast 200 mm long out of MS flat 40 mmx 3 mm with one end split into fish tail to each jamb upto 1650 mm length and three holdfasts for jambs more than 1650 mm in length. One end of the holdfasts shall be bend and welded to the frame and the other embedded in wall in cement concrete block 1:3:6 of size 230 x 230 x 150 mm. Before erection, the frames shall be rubbed with sand paper to remove all scaling and rust. A coat of Redoxide zinc Chromatic primer shall be applied all round as per manufacturer's specifications, and filled with concrete (1:3:6) as in the case of door frames. 100 mm x 35 mm x 6 mm MS flats shall be welded on inner face of the frame at the position of the hinges and lock plate. Two number 50 mm long heavy duty box type hinges shall be provided for each leaf of window shutter welded at a distance of 150 mm from top and bottom welded to the pressed steel frame. Necessary provision / slots shall be made for fixing tower bolts, sliding bolts etc. The work shall conform to the sample available for inspection. Suitable size of MS flats 6 mm thick and mortar guards are to be welded at the inner side of the frame where slots/holes are to be provided.

d) For the fixed portion of windows glazing is to be provided, MS beading 12 mm x 12 mm made out of 18 gauge sheet shall be provided alongwith the pressed steel frames. The beading shall be fixed to the frames with machine screws.

e) Frame shall be fixed in position true to line and levels. Necessary opening shall be left in the walls to receive frames. During construction of masonry lay dry brick in mud mortar in position that they can be removed subsequently for providing cast in situ concrete blocks for holdfast.

f) Whenever frames are required to be fixed adjacent to RCC columns, the frame shall be fixed with MS straps and Anchor (dash) fastener in lieu of holdfasts. The strap shall be concealed in plaster after covering with chicken wire mesh 150 mm wide.

Overall dimensions of the doors/windows/ventilators shown in the drawing shall be maintained.

The contractor shall submit fabrication (shop) drawings from the manufacturers for the approval of the Engineer-in-charge before starting the fabrication. On getting approval of the drawings, the Contractor shall produce one sample piece of each profile for final approval and comments of the Engineer-in-charge, Architect & Project Manager before mass production by the Manufacturer.

If excise duty is applicable, then excise duty gate passes shall be submitted by the contractor for each consignment of door/ window frames dispatched by the factories and brought at site for incorporation in the work.

STEEL WINDOW, FRAMES AND SHUTTERS :

Windows shall be fabricated out of standard rolled sheet sections as shown on drawings and confirming to IS – 1038-1983. The steel shall confirm to IS: 1977-1969.

Fabrication : The type , overall sizes, side openings etc. of windows shall be as shown on drawings. The sections of window frame and shutters shall be cut to length and mitred. The corner of shutters shall be welded to form solid fused welded joints (electrically butt-welded joints) confirming to the following requirements.

- i) Weld shall be made all along with place of meeting the members.
- ii) Welds shall be properly grounded.
- iii) Complete cross-section of the corner shall be checked up to see that the joints are completely solid and there are no cavities visible.

Size and number of lugs to each window shall be provided as specified in IS-1038. Hinges shall be non-projecting type i.e., Box hinges with hinge pin of electro galvanized.

Two Aluminium tower bolt and one Aluminium handle shall be screwed to each leaf. For this purpose 20x3 mm flats shall be welded to full height as shown on drawing and 1 eye hook also be screwed to each leaf.

Fixing of windows in openings shall be carried out by making necessary holes in masonry for accommodating lugs not less than 10 cm long 15x3 mm size and embedded in cement concrete blocks 15x10x10 cm size in PCC 1:3;6.

The contractor shall provide one sample piece of fabricated steel window including lugs, box hinges, Aluminium tower bolts and handle and GI hook and eye for approval by the Engineer-in-charge, architect and Project Manager before mass production.

Glazing:

The glass panes shall be free from flaws, specks or bubbles and shall have square corners and straight edges. The glass panes shall be so cut that it fits slightly loose in the frames. The glass pane shall be fixed to the shutter with MS beading of size 12mm x 12mm and E.P.M.D gasket properly snapped on as per the drawing. The glass panes shall be of make MODifloat or Asahi.

RAILING TO STAIRCASE & LANDING :

- a) Railing to staircase, landing etc. Shall be fabricated with MS flat and MS square bars as per details shown on the drawing complete with necessary welding and vertical supports to be fixed in to steps / floor as shown on drawing.
- b) The hand rail shall be of PVC sleeve.
- c) The fixing details and dimensions for railings shall be as shown in drawings. All welded joints shall be grounded properly before painting.

Welding :

This shall be done by electric process with precautions for health and safety. The places to be welded are cut angularity so that the welding material does not protrude and the members to be welded join properly. The welds shall be ground clean to give a one piece appearance. The weld shall run around the contact surfaces of two meeting sections. Throat thickness not less than 4 mm.

ROLLING SHUTTERS :General

Rolling shutters shall be self rolling type (push pull manual type) obtained from a reputed manufacturer. These shall include necessary locking arrangement and handles, etc. and shall conform to IS 6248.

Shutters

These shall consist of M.S. laths 1.25mm thick and 80mm wide. The laths shall be of machine rolled and straightened with an effective bridge depth of 16mm.

Spring

The springs shall be preferable of coiled type. The spring shall be manufactured from high tensile steel wire or strip of adequate strength to balance the shutters in all positions.

Guide Channels

The guide channels shall be of mild steel deep channel section and of rolled, pressed or built up construction. The thickness of the sheet used shall not be less than 3.15mm.

The minimum depths for guide channel shall be as follows:

For width upto 3.50m – 60mm

3.5m and above – 75mm

Fixing

Brackets shall be fixed on the lintel or under the lintel. The shaft along with the spring shall then be fixed on the brackets.

The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with it with ropes, etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and the cover frame shall then be fixed to the walls through the plate, welded to the guides. The plates and screw bolts shall be concealed in cement plaster to make their location invisible. Fixing shall be done accurately in a workmen like manner that the operations of the shutter is easy and smooth. Greasing should be done on spring and guide channel.

Rolling shutters shall be painted with two coats of zinc chromate primer followed by two coats of synthetic enamel paint.

Rolling Grills :

Rolling grills are similar in design construction and operation to rolling shutters and shall conform to IS : 6248.

Rolling grills shutter and the rolling grill portion of the rolling shutter-cum-grill shall be fabricated with 8mm diameter mild steel round bars. Straight bars and bars bent to the required profile are place alternatively and held in position with 20mm wide and 5mm thick mild steel flat links. Straight bars

shall be spaced not exceeding 150mm center to center and the bars bent to required profile shall be placed symmetrically between two consecutive straight bars. Unless otherwise specified or directed by the Engineer-in-charge, bars placed alternatively with straight bars shall be bent to form a corrugated profile such that the pitch of the corrugation is 100 to 120mm and the depth of corrugation is 80 to 100 mm. All the bent bars shall have uniform profile. Straight bar along with the adjoining bent bars on it both sides shall be held in position by passing the bars through holes in the links. Each link shall have three holes and the length of the links shall be such that the distance from the center of the hole to the nearest edge of the flat is not less than the diameter of the hole. The corner of the links shall be rounded. All links shall be of uniform size and shape. The spacing of the links measured along the straight bar shall be the same as center to center distance between two consecutive crests / troughs of the bars bent to the required profile. Each bar and link shall be a continuous single piece without any joint.

HOLDFASTS :

Holdfasts shall be made out of MS flats of size as specified with split fish tail ends coats with antirust Paint/tar. Holdfast shall be welded to door/windows/ventilator frame as specified.

GATES :

The gate shall be fabricated in accordance with details as shown in drawings. The pillars shall be constructed in R.C.C. Masonry plastered on all sides with 15mm thick CM (1:4), to give final finish. The foundation of pillars shall be as per structural details. Gate shall be fabricated from angle steel sections as per IS-226 -1975. The main outer frame (vertical & horizontal members) shall be 50 x 50 x 5 mm M.S. angle section.

The gate shall be fixed to pillars with holdfasts made of MS flat 25 x 6 of length 200mm split at ends. The gate shall be fixed to pillars by hinges made from angle iron 75x75x6 welded to the gates and 20mm dia MS Bolt acting as pintle, two numbers for each gate, with gate closer and bolting. The gate shall be painted with two coats of Zinc Chromate Primer, followed by two coats of Enamel Paint of colour and shade approved by the Engineer-in-charge.

Installation panel shall be provided in the production area to bring in plant & machinery and providing access for maintenance. The size shall be 3 M x 2.4M. It shall be fitted with a MS 75 x 75 x 6 mm frame, with 6 mm th. MS sheet bolted from outer side and Isowall make or eq. sandwich panel (Refer false ceiling for details of panel) from inside, flushed with the inner wall and jointed with silicone sealants from inside to give a flushed joint. All steel surfaces shall be painted with architectural polyurethane paint. The frame shall be fixed to the walls with 6 nos. holdfasts, 250x50x4 mm th. In between the frame and the sheeting / paneling, neoprene edging to make the system air tight shall be used.

Bump Rail:

Bump rails shall be provided at 450 & 900 ht. from FFL along all corridors, wherever the trolley movement is happening. The rails shall be in SS pipe 35mm dia (OD), 1.5 mm thickness. It shall be held in SS Brackets, with the center of the pipe protruding 150 from the wall edges. The brackets shall be fixed to the wall with SS screws, with PVC rawl plugs. The plugs shall be drilled into the walls and positions specifically aligned and marked to avoid damage to plaster / walls. Damaged portions, if any shall be immediately repaired and cured as directed by the Engineer-in-charge. The edges for the pipe lengths shall be fitted with two brackets, each with a curtain rod type threaded pipe length of at least 40 mm. The dia of these edges shall be inner clear dia of 35mm.

Tubular sections for door frames : The steel tube sections for frames shall be 100x50x3, and shall be filled with concrete / cement slurry. The edges of these shall be finished, ground and painted in architectural poly urethane paint. All other details such as of holdfasts, fixing and finishing etc. shall be same as for PS frames mentioned above.

Barbed Wire :

The barbed wire shall be galvanized steel as specified and it shall conform to IS:278. The sampling criteria is given in Table 13.1 below. The wire shall be manufactured from steel by any process and shall not contain sulphur and phosphorous exceeding 0.065 percent. The galvanized steel barbed wires shall be of two types : Type A (Lowa Type) and Type B (Glidden Type)

Lowa Type :

The barbs shall have four points and shall be formed by twisting two point wires, each two turns, tightly around both line wires making altogether four complete turns.

Glidden Type :

The barbs shall have four points and shall be formed by twisting two point wires, each two turns, tightly around one line wire making altogether four complete turns.

Detail of Barbed Wire

The galvanized steel barbed wire shall be of the size designations given in Table 13.1 below :-

Table 13.1

Size designation		Nominal dia of Wire				Mass of completed Barbed Wire	Distance between two barbs	No. of lays between the the conese- cutive barbs
		Line Wire		Point Wire				
		Max.	Min.					
	Nom (mm)	Tol (mm)	Nom (mm)	Tol	(g/m) (mm)		(g/m)	(mm)
1.	2.50	±0.08	2.50	±0.08	155		136	75±12
2.	2.50	±0.08	2.50	±0.08	120		108	150±12
3.	2.50	±0.08	2.00	±0.08	125		108	75±12
4	2.50	±0.08	2.00	±0.08	103		89	150±12
5	2.24	±0.08	2.00	±0.08	106		97	75±12
6	2.24	±0.08	2.00	±0.08	85		78	150±12

Note : The mass in g/m shall be obtained by dividing the total mass of the reel by the linear length in metres.

The number of lays between the two consecutive barbs shall vary between 2 to 7.

The barbed wire shall be formed by twisting together two line wires, one or both containing the barbs. The size of the line and point wires and barbs spacings shall be as specified. The permissible deviation from the nominal diameter of the line wire and the point wires shall not exceed + 0.08mm. The line and point wires shall be circular in section, free from scales and other defects and shall be uniformly galvanized. The line wire, shall be in continuous lengths, and shall not contain any welds other than those in the rod before it is drawn. the distance between two successive splices shall not be less than 15 metres. It shall have the tensile properties as specified in Table 13.2 below .

Table 13.2
TENSILE PROPERTIES

Size of Line Wire mm	Tensile Strength of line wire kgf/sq. mm	Minimum Breaking Load of Completed Barbed Wire kgf
2.50	40 to 60	375
2.24	40 to 60	300

The number of reels to be selected at random for this purpose shall be in accordance with Table – 13.3

Table 13.3
SAMPLING CRITERIA

No. of Reels in the Lot	No. of Reels to be selected
Up to 25	3
26 to 50	4
51 to 150	5
151 to 300	7
301 and above	

SECTION- 6.0

JOINERY WORKS

Door Shutters – Flush Shutters :

1. All door shutters shall be 35 mm thick flush door solid core type non-decorative Industrial made conforming to IS – 2202 and ISI certified with block board core (confirming to the requirements as per IS-1659), for which the manufacturer shall produce the necessary evidence. The flush shutters shall be made with internal lipping of hardwood 25 mm thick and both faces commercial ply veneered. Adhesive used shall be phenol formaldehyde synthetic resin conforming to BWP types specified in IS-848-1974.
2. Contractor shall obtain the approval for the name of the manufacturer of the flush door shutters from the Engineer-in-charge before placing the supply order. While asking for the approval, copy of the “Bureau of Indian Standard” letter under which manufacturer has been authorized to mark the product with ISI marking should be attached. Engineer-in-charge, before giving the approval shall ensure that the validity date of license has not expired.

Testing of Flush Door Shutters :

3. On receipt of the shutters at site, the Engineer-in-charge shall be entitled to get the samples of door shutters tested in any approved laboratory. From each lot of shutters, one shutter shall be selected at random by the Engineer-in-charge. The cost of the door shutters selected as samples, their transportation to the laboratory and cost of testing by the laboratory shall be borne by the Contractor, and shall be deemed to be included in the quoted rates.
4. a) **REBATING:** The shutters shall be single leaf or doubled leafed as shown in the drawings and as directed by Engineer-in-charge. In case of double leafed shutters, the meeting of the stiles shall be rebated by one third the thickness of the shutter.
- b) On all door shutters, laminate, 1.5 mm th. shall be pasted with adhesives as specified by the manufacturers. The laminate shall be as per approved shade & texture, of make Formica, Decolam, Greenlam or National.
- c) The bottom of shutters shall be 5mm above the finished floor level.
- d) Wherever stainless steel sheeting as a strike plate is mentioned, it shall be pasted with SR 198, along with SS stud screws @ 200 c/c, 50mm inside of all edges. This shall be pasted upto the bottom 1350mm ht. or as shown in the drawing. The SS sheet shall be 0.5 MM th. A sample of a single leaf as well as a double leaf shall be made and got approved from the Engineer-in-charge before ordering mass production. The sample, once approved shall be retained in the approved materials store under the supervision of the Engineer-in-charge.
- e) Vision panel, wherever needed shall be 5.5mm. th. plain glass of the size as mentioned in the drawings. The panel shall be fixed within the cut-out made from within the door shutter. The cut edges shall be fixed with TW lipping 35 x 8mm. The lipping shall be flushed with the outer edges of the door and the glass fixed in the center of this lipping with quarter round beadings, 15x15 mm.

Glazed Window :

5. For fixed portion of windows glazing shall be with 4mm thick glass fixed to the pressed steel frames with 12 x 12 mm M.S. beading 1.25 mm thick. Screwed with machine screws and Rubber gasket shall be provided.

6. For openable portion of windows glazing shall be with 4mm thick glass fixed to the steel frames with M.S. beading of required size as per details shown on drawings.
7. **Steel Windows** : These shall be of standard rolled steel sections as per given drawings.
8. Industrial made shutters for Doors shall be procured from the approved factories, in consultation with the Engineer-in-charge. All timber members shall be kiln seasoned with ASCU, treatment. IS test certificates for the lots shall be obtained prior to accepting orders:

Glazing To fan Light Portion of the Doors:

9. In fan light portions of doors, glazing shall be with 4mm thickness glass fixed to the pressed steel frame with 15x15mm MS beading 1.25 mm thick. Screwed with machine screws and rubber gasket shall be provided between glass and pressed steel frame.

SECTION – 7.0

HARDWARE

1. Mongery shall be provided to all doors, windows and ventilators with necessary matching CP screws of suitable size, etc.
2. Fittings and fixtures to all doors , windows, ventilators, etc. shall be aluminium anodized matt finish ISI marked of make as approved by the Engineer-in-charge.
3. Butt hinges for doors, windows and ventilators shall be ISI marked cold rolled mild steel heavy quality of size 125 x 65 x 2.12mm for doors and 75 x 65 x 2.12 mm for windows and ventilators with mild steel pin end shall be oxidised finish. These shall be welded to pressed steel frames as specified.
4. One sample piece of each fitting shall be produced for approval from Project Manager/Architect. The bulk supply order shall be placed by the Contractor only after approval is accorded by the Engineer-in-charge.
5. It shall be the responsibility of the contractor to ensure proper functioning of each item of door / window / shutters / openings and necessary mongery should be made available to the complete satisfaction of the Engineer-in-charge.
6. The material movement doors, wherever specified shall be with swing hinges, 180 deg, with HD hinges, four nos on each leaf. The hinge shall be fixed in a recess created in the door, with a SS box fixed to the recess with SS screws. The hinge shall be concealed in this box. If required, this box may be bigger than 35 mm and shall protrude out equally on either side.
7. Special Handles, door closers & special locking arrangement shall be paid for as extra, wherever required. Normal mortice lock set, door stopper, tower bolts wherever required shall be included in the item rate mentioned.
8. The makes of the hardware shall be GODREJ, OZONE, GOLDEN, ACME, EbCO, GIESSE, AJANTA or eq. as approved by the Engineer-in-charge.

SECTION – 8

ALUMINUM WORKS

The all aluminum extruded sections shall conform to IS 737 and Is 1285 and shall be of manufacturers such as Hindalco or Indal or equivalent manufacturers to be approved by the Engineer-in-charge. These shall be extruded built up standard tubular and other section as per requirement.

The aluminum Doors, Windows, Ventilators and Glazing section shall be anodized (anodic coating shall conform to IS 1868) as per colour approved by the Architect and Project Manager. Anodic coating shall be tested in accordance with IS 5523.

The fabrication shall be carried out having mechanical joints, accurate / machined and fitted to form hair – line joints, with the vertical and horizontal sections at the corners to meet in 45 degree mitered. The jointing shall be either with accessories such as cleats and cleating screws or by crimping with Hydraulic Press on to heavy duty extruded Aluminum cleats. The relevant arrangement shall be got approved by the Architects.

Before proceeding with any manufacturer, Shop Drawings for each typical elevation shall be submitted for the approval of the Architect and no work shall be performed until the approval of the Shop Drawings is obtained. The contractor shall produce one sample piece of each profile for final approval and comments of the architects before production.

All Glazing shall be air tight and water tight, using appropriate extruded Ethyl Propylene Di amine Monomer (E.P.D.M.) gasket / as manufactured by Anand Lecuyver Pvt. Ltd., or equivalent: and GE Silicone sealant which shall be of high quality and performance.

Each Glazing shall be tailor – made as per openings at Site. No cutting and making good of external plaster surfaces shall be permitted.

All the aluminum sections shall be wrapped with self adhesive non-staining thick layer of PVC tapes as manufactured by M/s Bhor Industries or equivalent as approved by the Architects, and shall be duly packed for avoiding scratches or blemishes to the anodized surfaces of the sections till installation is completed.

The frames shall be fixed to aluminum rough ground fixed to concrete / masonry / brick work with dash fasteners and the method of fixing shall be got approved by the Engineer-in-charge before installation. The drilling of holes for inserting the dash fasteners shall be carried out with drilling machines and the frame shall be fixed in plumb, line and level at jambs, sills and heads.

For all internal glazing, which is double glazed, a de-vacuum button hole fixture shall be provided in the central portion of the glazing to avoid condensate.

All glass & panels shall be fixed with neoprene beadings for air-tight fitting.

The perimeter gap between the outer frame and the masonry shall be sealed with GE Silicone sealant as per the make approved by the Engineer-in-charge.

Glazing : The glass panes shall be free from flaws, specks or bubbles and shall have square corners and straight edges. The glass panes shall be so cut that it fits slightly loose in the frames. The glass pane shall be fixed to the shutter with Aluminum beading and E.P.D.M. gasket properly snapped on as per the drawing. The glass panes shall be of make MODIFLOAT or ASAHI.

SECTION - 9

ROOF COVERING, WATER PROOFING AND RAIN WATER PIPES

1. EXPOSED ROOF AT TERRACE FLOOR LEVEL & MUMTY ROOFS

Roof slabs shall be cleaned thoroughly and following treatment / covering shall be provided :

- a) Clean the RCC slab surfaces including sides up to 300 mm high wire brush. Chisel out any mortar sticking to the surface and then rendering rough / uneven surface with cement mortar 1:4 (1 cement : 4 coarse sand) and rounding off at corners forming a coving (gola)
- b) Wash it with water and dust it cleared and cleaned.
- c) Apply one coat of water soluble Epoxy-Techoxy and two coats of coal tar epoxy as per manufacturer's instructions on the slab surface including sides up to 300 high.
- d) Covering Epoxy Treatment with 12 mm thick cement plaster of mix 1:6 (1 cement : 6 coarse sand) including rounding of corners and junctions and carried upto 300mm.
- e) The treated areas shall be tested by allowing water to stand on the area to depth of 150 mm for at least 72 hrs. by pounding. If seepage marks are observed then over the effected area treatment as per (c) & (d) shall be repeated.
- f) Providing and laying 100 mm thick (average consolidated thickness) mud phaska including applying a coat of 25 mm thick mud gobi leaping plaster. Mud phaska shall be prepared as per CPWD specifications.
- g) Providing and laying 40 mm thick brick tiles of class designation 75, grouted and pointed with cement mortar 1:3 (1 cement : 3 fine sand). The joints shall be finished flush with brick surface neatly. Brick tiles shall be of uniform colour, free from cracks, flaws with uniform and straight edges and surfaces. Entire roof surface to be kept wet for seven days after this operation.
- h) **Gola** : Providing coving 75 x 75 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.5 mm and down gauge) at the junction of tiles and Parapet wall including finishing exposed surface with cement mortar 1:4 (1 cement : 4 coarse sand) as per drawing. Gola shall be done before the plaster of parapet.
- i) **Khurras** : Khurras shall be provided to all inlet points of rain water pipes as per drawing with average minimum thickness of 50 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 10 mm nominal size) with 12 mm cement plaster 1:4 (1 cement : 4 coarse sand) and a coat of neat cement including rounding the edge and making and finishing the outlet complete.

2. LOWERED SLAB OF TOILETS / KITCHENS

Water proofing treatment shall be provided to all sunken / lowered portions of slabs. This shall consist of the following :

- a) All CI / GI pipes passing through the walls of the sunken floors shall be laid before the waterproofing treatment is carried out.
- b) Clear the sunken / lowered portion of RCC slab surface (including vertical total depth) by wire brush. Chisel out any mortar sticking to the surface thereafter rendering 6mm of uneven surface with cement mortar 1:4 (1 cement : 4 coarse sand) to make it even.
- c) Wash it with water and dust it clear and clean.

- d) All junction points of side walls where CI / GI pipes are passing through shall be sealed with putty made out of Epoxy and Cement.
- e) Apply one coat of water soluble Epoxy-Techoxy and two coats of coal tar epoxy to bottom and vertical sides upto skirting height of floor as per manufacturers specifications.
- f) Plastering the bottom and sides with 12 mm thick cement mortar 1:4 over (e) above with water proofing compound of makes CICO -1 or chemcrete as per manufacturer's specifications including rounding of corners and junctions.
- g) When the treatment set dry fill with water for seven days and ensure that the treated area is fully water proofed. If seepage marks are observed over the effected area, then treatment as per (c), (d) & (e) above shall be repeated.
- h) All GI/CI pipes laid in sunken portion shall be covered with 50 mm PCC 1:3:6 alround after painting with anticorrosive paint (Japan black) GI pipes in sunken portion shall also be protected by applying two coats of bitumen paint and then covered with polythene tape and finally painted with one coat of bitumen paint.

3. FILLING

- i) One 50 mm dia GI pipe spouts with wire gauge on inside mouth shall be provided to each sunken portion at the time of casting of RCC sunken part of kitchen / toilet.
3. The chemical treatment as in para 1 to 2 above shall be got carried out through a specialist firm only as approved by the Engineer-in-charge. The specialist firm shall render 10 years guarantee to the Employer through the contractor who will be principal guarantor.

4. Unplasticised Rain Water Pipes

- a) PVC pipes and fittings shall be as per IS specifications and conforming IS:4985-81 and ISI marked. The UPVC pipes shall be of as shown in the drawings and working pressure 4 kgs/ sqcm. Internal & external surfaces of the pipes shall be smooth and clean, reasonably free from grooving and other defects. The UPVC pipe shall be injection moulded or fabricated type conforming to IS-8008-1976 (Part I & IV) and / or IS 8360-1970 (Part I to III) and / or as per manufacturers recommendations. The pipes will start from 150 mm above plinth protection with band and a toe junction shall be provided at all terrace levels to collect water from khurras and vertical pipe shall be extended up to top of parapet. At top UPVC cowl shall also be provided.
- b) CI chamber and grating at the top and outlet of every rain water pipe shall be provided and shall fit in snugly on the socket and of the pipe. The perforations in the gratings shall be at least 60% of the total area of gratings.
- c) Where the rain water pipes are to be provided concealed within masonry, the pipes shall be embedded in the walls with PCC 1:2:4 (1 cement:2 coarse sand: 4 stone aggregate 20 mm down gauge) encasing all round. External surface of the pipes shall be painted with PVC adhesive and than coarse sand shall be sprinkled before embedding the pipe in the concrete for proper gripping with concrete.
- d) Irrespective of what is shown on drawings, rain water pipes running down along the walls / columns shall be firmly fixed to the wall / column at all joints and at one meter spacing on pipe with PVC clips as per manufacturers instructions.
- e) Provide angled and pieces PVC shoe at bottom and splash stone 450 x 300 x 20 mm embedded in plinth protection. Stones shall be quartzite chisel dressed.

5. Precoated Galvanised Steel Roofing

Application Method :

Lloyddeck, Lloydtile and Lloydpanel – 30 are fixed on to purlins / subgirts with joints overlapped and fastened using hot dip zinc coated self drilling hexagonal washer head fasteners. Stainless steel fasteners are available as optional.

For purlins above 4mm thickness , a pilot hole maybe needed to self drill fasteners. Side laps and flashing are fixed using no. 10 – 12 x 20mm stitch screws. Fasteners are fixed on every crest / valley at purlin locations. For side laps and flashing, suggested spacing of stitch screws is approx. 500mm. The gutters shall be provided as per the required slope shown in the drawing. The contractor has to ensure leak-proof fitting, along with overlap as required by individual manufacturer. Only the flat completed area shall be measurable and paid for.

It should be all complete as per manufacturer specifications.

6. STEEL RUNG

Steel rung ladder at inaccessible areas of the mumty / roofs shall be provided for the water tank / softening plant maintenance. The rungs shall be 25mm dia steel, protruding 200 from the wall and fixed in a concrete bed block on either end. the bed-block shall be 115 x 230. The rung shall be 450 wide.

The rungs shall be placed vertically at a spacing of 300 c/c.

7. POLYCARBONATE SHEET PORTICO ROOFING

Polycarbonate sheet roofing over fabricated steel structure as per structural drawing and moulded to size as per architectural drawing shall be done over the porticos as shown.

The sheeting shall be 8 mm multiwall, bronze coloured sheet of make GE Plastics or eq. The fixing arrangement shall be leakage-free, with the aluminum sections, with EPDM gaskets & self tapping SS screws, as provided by the manufacturer. The overlap for continuity shall be minimum 150 or specified by the Engineer-in-charge. All exposed metal sections shall be painted in architectural polyurethane paint in the required shade.

SECTION – 10.0

FLOORING, FINISHING, TILING, SKIRTING & DADO

1. Flooring :

Floor shall be provided inside the rooms, corridors, toilet, stairs, landings, terrace etc. Floor shall be laid to level and/or to slope as required and directed by Engineer-in-charge. Floor shall be carried through all the doors and other openings and over dwarf walls. Exposed edge of floors and steps provided up to floors shall be finished in the same manner as for top surfaces. Skirting shall match with the floor finish. The floor finishes shall be provided as described in schedules.

2. SUB FLOORING :

a) **For ground floor :** Sub floor (base concrete under floor finish) 100mm thick lean concrete in 1:4:8) 1 cement : 4 coarse sand and 8 stone aggregate 40mm nominal size) shall be laid over a layer of fine sand 150mm thick at ground floor only.

b) **For upper / basement floors :**

- i) Sunken. lower portion of slabs : Sub base shall be in lean concrete in 1:4:8 (1 cement : 4 coarse sand and 8 brick ballast 40mm nominal size).
- ii) Other Floors: Lean concrete 1:5:10 (1 cement : 5 coarse sand : 10 brick aggregate 40 mm nominal size) laid over RCC slab wherever as required or as directed.

3. **PLAIN CEMENT CONCRETE FLOORING :**

- a) 40 mm thick concrete floor 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 12.5 graded) with 4 mm thick 38 mm wide PVC strips. These strips shall be placed in position to form bays as specified. The top surface shall be worked with leveled with screening board to leave slightly rough surfaces.
- b) Skirting : 18 mm thick cement plastered skirting under layer 12mm thick plaster in cement mortar 1:6 (1 cement 6 coarse sand), top layer 6mm thick in cement mortar 1:3 (1 cement 3 fine sand) finished with a floating coat neat cement.

4. **White Glazed Tile in Dado for Toilets & Kitchens :**

(a) Glazed tiles shall be minimum 5 mm thick of first quality and from approved manufacturer and shall conform to IS 777. The tiles shall be free from cracks, twist uneven edged and other defects. The rear face of tiles shall be grooved and / or resist to provide on adequate key for the cement plaster. The cement plaster shall be minimum 12 mm thick 1:3 (1 cement : 3 coarse sand) and shall be roughened with wire brushes or by scratching diagonal at close in troubles. The tiles should be soaked in water washed clean and a coat of cement slurry applied liberally at their leak of tiles and set in the bedding mortar including painting with white cement mixed with pigment. The tiles shall be tamped and corrected the proper plane and lines. The tiles shall be set in the required pattern. The joints shall be neat & fine. After laying tiles shall be thoroughly washed and cleaned to the satisfaction of the Engineer-in-charge.

(b) Size, colour and height for tiles for different areas shall be as per schedule and instructions of Engineer-in-charge.

5. The glazed tiles shall be first quality vitreous China and of the following makes.

- (a) Kajaria

6. **Marble Stone** : The best quality marble stone from approved quarry, shall be machine cut and machine polished as specified in respective items and shall be of specified thickness and of approved quality and size, free from cracks and flakes and shall be uniform colour, with straight edges . The sides of machine cut and machine polished stones shall have perfect right angles and surface smooth. The stone slabs shall be laid and finished on bedding of cement mortar 1:3 (1 cement : 3 coarse sand) 20 mm (average) thickness. The finished stone surface thus laid shall then be polished to the required degree as per para 7 (iii) below and as approved by the Architects. Flooring shall be finally wax polished and protected till the handing over of the building.

For Risers the process shall be same as described in 8 (a) & (b) below and specifications same as for treads, mentioned above.

7. **Polished Kota Stone in Flooring :**

The kota stone slabs shall be machine cut and machine polished and of selected quality, hard sound, dense and homogeneous textures, free from cracks decay watering and flaws. They shall be machine cut to the requisite thickness. The edges shall be truly vertical. The colour of the slabs will be approved by the Engineer-in-charge, before starting of work, the slabs shall have the top (exposed) face polished before being brought to site. The slabs shall conform to the size required. The thickness of the slabs shall be 22-25 mm and all stones size shall not be less than 60x60CM.and all shall be matching uniform colour.

i) Dressing : Every slab shall be cut to the required size and shape and fine chisel dressed on the edges to the full depth. The edges shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges shall be true and square and the surface shall be true and plane.

ii) Preparation of Surface and Laying : The sub grade concrete or RCC slab on which the kota stone slabs are to be laid shall be cleaned, wetted and mopped. The bedding shall be with cement mortar of an average thickness of 20mm and mix 1:4 (1 cement : 4 coarse sand). Over this bedding, neat grey cement slurry of honey like consistency shall be spread. The edges shall be pasted with cement slurry @ 4.4 kg of cement per sqm mixed with pigment to match the shade of the slabs and stone slabs set in the bedding mortar. The joints shall be kept as thin as possible.

iii) Polishing and Finishing : The floor shall then be kept wet for a minimum period of seven days. The surface thereafter shall be grounded with machine fitted with grit block no. 60, 120 and finally with no. 320. Between every two successive grinding the surface shall be washed, cleaned and covered with a thin coat of grey cement in order to fill any pin hole that appear. After the final polish oxalic acid shall be dusted over the surface at the rate of 33 gm Per sqm sprinkled with water and rubbed hard with mandah block (pad 7% woolen rags) the following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

8. **Polished Kota Stone in skirting :**

The kota stone slabs for skirting shall be as specified in clause 7 here-in-before and of thickness 12mm. The height of skirting shall be as specified or as per instruction of Engineer-in-charge / Project Manager.

a) Preparation of surface and laying : The surface shall be chipped off the projections productions if any cleaned if any cleaned and wetted. 12mm thick plaster of cement mortar 1:3 (1 cement : 3 coarse sand) shall be applied and allowed to harden. The plaster shall be roughened with wire brushed or by scratching diagonal lines 2mm deep at approximately 7.5 cm centers both ways. The back and edges of the stone slabs shall be buttered with a coat of grey cement slurry and set in bedding mortar.

b)Cutting, Polishing and Finishing : Cutting, grinding and polishing of skirting shall be done in the same manner as of flooring but by hand.

9. **Coving**

All areas of production and stores shall have coved (curved) edges, as shown in the drawing. The coving shall be seamless, monolithic concrete flooring and shall be cast along with the main flooring. The epoxy coat shall continue up to the height as shown in drawings.

10. **Working Platforms :**

Finish of the working platform shall be with 20mm thick pre-polished granite stone slabs diamond cut of Brown / Maroon or shade as approved by Project Manager / Architect laid over RCC slab with 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand). Where the straight length of the platform is less than 1500mm, the granite stone slab shall be provided in one piece. But if the straight length of the platform is more than 1500mm, the granite stone slab shall be provided in two pieces only irrespective of what is shown on drawings. Granite slab, including grinding smooth and polishing complete. The front facia of kitchen working platform and the facia of partition walls below platform shall be provided with 20mm thick granite stone slabs of same shade and texture as of slabs over platform. The bedding layer shall be 12mm thick cement mortar 1:3 (1 cement : 3 coarse sand) jointed with white cement slurry mixed with pigment of matching colour.

11. **Ceramic Tile Flooring :**

The tiles shall be of approved make and shall generally conform to IS : 777. They shall be flat, and true to shape and free from blisters crazing, chips, welts, carling or other imperfections detracting from their appearance. The tiles shall be tested as indicated in Appendix of IS : 777.

The tiles shall be square 400 x 400 or 300 x 300 mm or as directed by the Engineer-in-charge. The thickness of the tiles shall be 10 mm as specified. The length of all four sides shall be measured correct to 0.1mm and average length breadth shall not vary more than $\pm 0.8\text{mm}$ from specified dimension. The variation of individual dimension from average value of length / breadth shall not exceed $\pm 0.5\text{mm}$. Tolerance in thickness shall be $\pm 0.4\text{mm}$.

Preparation of Surface and Laying:

- a) Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as specified. The average thickness of the bedding shall be 10mm while the thickness under any portion of the tiles shall not be less than 5 mm.
- b) Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.
- c) Over this mortar bedding neat gray cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square meter over such an areas as would accommodate about twenty tiles. Tile shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.
- d) The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope.
- e) Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10mm under the plaster, skirting or dado.
- f) After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing :

The joints shall be cleaned off the grey cement slurry with wire / coir brush or trowel to a depth of 2mm to 3mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment; if required to match the colour of tiles. the floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

12. Acid Proof Tiles :

The specification shall be same as for Ceramic Tiles but the tiles should be “Acid Proof Tiles” in place of Ceramic Tiles.

13. Red Stone Flooring :

Stone Slab :

The slab shall be red or as specified in the description of the item. The stone slabs shall be hard, sound, durable and tough, free from cracks, decay and weathering. In case of red sand stone, white patches or streaks shall not be allowed. However, scattered spots up to 10mm diameter will be

permitted. Before starting the work the contractor shall get sample of slabs approved by the Engineer-in-charge.

The slab shall be hand or machine cut to the requisite thickness along planes parallel to the natural bed of stone and should be of uniform size, if required.

FINISHING :

Any unevenness existing between the edges of slabs at joints shall be removed by chiseling in a slant.

14. **Red Fine Dressed and Rubbed Sand Stone Flooring :**

Stone slab shall be same as specified above for Red Stone Flooring.

Dressing :

Every slab shall be cut to the required size and shape, and rough chisel dressed on the top, so that the dressed surface shall not be more than 6mm from a straight edge when placed on it, The edge of depression or projections shall be chisel dressed in a slant so that the surface does not have sharp unevenness. The sides shall also be chisel dressed to a minimum depth of 20mm so that the dressed edge shall at no place be more than 30mm from a straight edge butted against it. Beyond this depth the sides may be dressed slightly splayed so as to form inverted 'V' shaped joint with adjoining slabs. All angles and edges of the slab shall be true, square and free from chippings and the surface reasonably true and plane.

In addition the dressed top and sides shall be table rubbed with coarse grade carborundum stone before paving, to obtain a perfectly true and smooth surface free from chisel marks.

The thickness of the slabs after dressing shall be as specified with a permissible tolerance of ± 2 mm.

Finishing shall be same as specified above for red stone flooring.

15. **Raising of plinth of existing floors :**

The existing plinth level, wherever is needed to be raised shall be raised with Base concrete soling and sand-filling. The existing surface should be inspected by the Tenderer to ensure proper flooring. The existing surface shall then be tuckered or made rough, or demolished till the top layer before putting the soling. The contractor, after commencing works shall immediately take up a sample area for raising the FFL and then proceed with tucking / dismantling top layer of existing flooring. The Engineer-in-charge's decision regarding tucking / dismantling shall be final. Once approved, the same system shall be followed for all areas.

The soling shall then be as mentioned in particular specifications, along with Yamuna sand filling and then the base flooring in PCC, 1:2:4. The top coat of flooring shall be as per individual areas.

Vacuum Compressed De-Watered Concrete Flooring (Tremix):

Technical Assistance/Training of Labour

During the placement of concrete, the Contractor shall have a minimum of one person present at all times who has been adequately trained by a representative of the equipment manufacturer. This person shall be experienced in the vacuum dewatering process, and in the operation of all related equipment and shall direct all concrete dewatering work performed.

The Contractor shall provide the services of a representative from the manufacturer of the vacuum dewatering equipment on site for a period of time of at least eight (8) hours. The manufacturer's representative shall provide technical assistance for the vacuum dewatering process on the initial day of operation.

Equipment for compacting, placing, vacuum processing and finishing of slab

All process equipment to be used shall be of a design representative of the state of the art, and shall be subjected to the approval of the engineer. Equipment shall be Tremix or approved equal. System shall have a demonstrated five years history of performing such work. The vacuum pumps shall be able to generate a minimum vacuum of 609 mm(24 inches) of mercury (0.80 atmospheres) in actual operation using the maximum number and size of suction mats required for this work.

The Contractor shall have at the job site sufficient equipment (vacuum pumps, mats, fitter pads and accessories) to ensure that the vacuum dewatering process continues uninterrupted to completion. Stand by equipment is sometimes required.

Mix Design :

The Contractor is responsible for the mix design of the class as called for on the Contract Drawings and must submit the mix proposed for use in the Contract before any work is started.

The Contractors shall utilize a knowledgeable and experienced concrete technician for the design and production of mix (mixes) meeting all the requirements of the specifications.

Do not deliver any concrete to the construction site until all the approvals have been obtained.

Quality Control:

The Contractor has the responsibility for achieving the quality of concrete specified by controlling the concrete mixes, placing, vacuum process finishing and curing. The concrete technician in charge must be present at the site when work is in progress.

The Contractor shall be responsible for mix adjustments, performing necessary tests, correcting deficiencies and trouble shooting in general.

The Contractor shall be required to maintain control charts showing individual test results for aggregate gradation, slump, air content, cement content and compressive strength.

Planning of Placing :

The Contractors shall submit for review shop drawings for floor slabs detailing the location of all construction joints and the sequence of the slab placement and manufacturer's literature describing the equipment to be used. In addition to the shop drawings, the Contractor shall indicate the quantity of each piece of dewatering equipment that will be located at the construction site and shall include the dimensions of all suction mats.

Before concreting is started the work should be planned with a view to determine areas to be placed daily, the required amount of equipment, size of vacuum mats, length of vacuum hoses, arrangement of rails, if any, or screeds etc. Crew required for the vacuum process is two men to handle the mats and the pump. Note that placing, vibration, vacuum treatment and floating follow immediately behind each other.

Check position of vacuum pump in relation to vacuum mat location to find whether extra vacuum hoses are required.

Concrete Materials:

All materials such as cement, sand & aggregates etc. shall be as per relevant specification mentioned for concrete work.

Equipment Specification : Tremix System

Poker vibrator with high frequency preferably 335 hz (20 000 vibr/min) dia.1 to 1 1/2".

Surface vibrator type double beam with beam spacing 12".

Preferably one piece beam in full length exceeding bay width 8" to 24". Beam should easily be adjusted to absolute straightness and controlled every morning before placing of concrete starts.

Suction mat type RM 60. 100% tight plastic material weight 650 gram/m². Width same as bay size and length 20' for capacity and flexibility.

Filter Pad type RD 12 weight 600 g/m², width 4' & length= bay width- 8".

Vacuum Pump P 4001B with 10 HP engine and specially designed pump unit with heavy duty chrome housing and sealing. Adjustable vacuum by valve on top of tank for ease of operation with different mix designs.

Skim floater type G 900/G 700 with disc which allows direct floating of dewatered concrete. Weight maximum 90 kg(200 pounds) for 40"(W. disc.) Finishing is done with G 900, using blades only and is normally done with 30 minutes intervals between passes.

The above equipment specified should be used for the production of quality concrete floors according to the Tremix System. Inter-changeability of equipment is not recommended.

Execution of Tremix System :

General:

The work shall be planned and executed so that there is no delay between the placement, screeding, dewatering and floating of the concrete. Concrete to be vacuum dewatered shall be handled and placed so as to prevent segregation. The concrete shall be internally vibrated prior to screeding.

Leveling Immediately following placement :

The concrete shall be leveled with a vibrating screed running on a true surface, set at the proper elevation required to provide the specified finished elevation. The concrete surface shall be screeded high by 2% of the slab's thickness to compensate for the compaction caused by the vacuum dewatering process. (Slabs to have an aggregate hardener shall have compensation made to maintain elevation). The vibrating screed shall be moved forward as rapidly as proper consolidation allows. The proper surcharger of concrete must be maintained in front of the leading edge of the screed.

Vacuum :

Immediately after leveling, the concrete shall be covered with filter pads and suction mats in strict accordance with the recommendation of the manufacturer to have the slab fully dewatered. The suction mat shall extend 4 inches beyond the edge of the filter pad on all sides. The pads shall extend to within 4" of the edge of concrete slab, and the mats shall cover entire slab. Before connecting the hose on the suction mat to the vacuum pump, the edges of the mat shall be smoothed to enable an airtight seal to be created. A vacuum shall then be applied to the mat. After a minute the gauge on the vacuum pump should indicate a minimum vacuum of 0.70 atmospheres (24.0 in. Hg) and if not, the mat must be checked for leakage. For concrete that dewaterers readily the vacuum should then be maintained at 0.70-0.80 atmospheres (24.0-25.5 in. Hg.) For concrete which dewaterers less efficiently (e.g. air-entrained concrete) the vacuum shall then be reduced to 0.50-0.60 atmospheres (15.0-18.0 in. Hg). After approximately 10 minutes the vacuum can then be increased to 0.80 atmospheres.

The vacuum shall be maintained for at least 3 minutes per inch of concrete thickness at 0.80 atmospheres. (Where aggregate hardeners are specified, sufficient moisture shall be maintained to meet manufacturer's requirements). The suction mats and filter pads shall then be removed and moved to the next section in leapfrog manner.

Stop the vacuum dewatering when light foot prints only are left in the concrete when stepped upon. A suitable suction time can also be checked with a Proctor-apparatus which should show 1.5-2 kg/cm².

Floating & Hardener Topping :

Upon removal of the suction mats and filter pads the concrete surface shall be power-floated without delay until all imprints from the vacuum process are removed. If crusting occurs, the floating operation must be delayed till the concrete carries the machine.

The higher speed is recommended for the floating operation. Two passes with the floating disc should be made in the junction of two mats in order to avoid risk for cracking.

NITOFLO HARDTOP/ MC - Dreitop FH or approved equivalent provide a highly abrasion resistant surface to concrete floor by the dry shake method which ensures the hard wearing surface bonds

monolithically to the concrete. This types of work executed shall be strictly under the supervision of manufacturers Technical field supervisor.

Hardener shall be applied according to the requirement of traffic, heavy or medium and coverage of the hardener shall be considered as per the manufacturer's standards.

It is recommended that the floor be marked off into of known area. Sufficient material should then be laid out to meet the required spread rates.

Application of HARDNERS can be started when the base concrete has stiffened to the point when light foot traffics leaves an imprint of about 3 mm. Any bleed water should now have evaporated.

Finishing:

The waiting time after the floating operation depends on concrete temperature and humidity and varies from 10 minutes to 2 hours.

The toweling operation cannot take place before the concrete has hardened enough to carry the machine, i.e. the toweling blades will not leave any marks on the concrete. Repeated toweling. With intervals between the passes which are adapted to the setting of the concrete, greatly improves the surface characteristics. The surface will be more wear- resistant and less dusty.

At least two passes are recommended for floors which are not to be covered. The top surface finish shall be in line and level or in gradient as per drawing. The undulation in the finished surface shall not exceed ± 3 mm per strip.

Curing :

Vacuum dewatered concrete should be cured like any other quality concrete in order to achieve a good final result with pounding.

The payment shall be made in m^2 of total area covered by Tremix.

Mode of Measurement :

This shall be measured in Sq. mt. of part there of.

Heavy Duty Epoxy Resin Floor Screed (Nitoflor TF-30 or approved equal)

Nitoflor TF 30 is a three part solvent free combination of epoxy resin, modified amine hardeners filled with specially graded chemically inert aggregates with high crushing strength.

It is laid by trowel as a durable chemical resistant screed approximately 3-6 mm thick depending upon the requirement. The 3-6 mm thickness topping is highly chemical and abrasion resistant by the very careful choice of amine curing agents and graded aggregate. The system includes "Nitoprime 28" a two part epoxy primer and "Nitoflor TF-30" which are both supplied in pre-weighed units ready for on site mixing and application. The finished, cured floor has a slightly granular texture of uniform self colour. However as the natural grade takes its colour from the aggregate which is subject to variation , colour matching is not practicable with this grade. A two part epoxy sealing coating Nitoflor FC 140 is recommended as a topcoat for Nitoflor TF 30 epoxy screed. Nitoflor FC-140 is available in a range of attractive colour.

Precautions :

Some people are sensitive to epoxy resins and solvent so gloves, barrier creams, protective clothing and eye goggles should be worn when handling these products.

SECTION – 11.0

FINISHING WORKS

Internal Surface

1. Cement plastering internally on all internal surfaces including soffits of RCC slabs, chajjas, lintels, all round shelves, inner side of parapets shall be as under :

(a) 12mm thick plaster in cement mortar 1:6 (1 cement : 6 parts fine sand) mixed with 10% of lime water over brick and concrete surfaces. Dubbing out wherever required (i.e. bringing up the undulation on the rough face of brick work in level with proudest points) shall also be executed in the same mix along with rendering coat. Cost of dubbing shall be deemed included in the rates of this item of plastering.

(b) 6mm thick plaster in cement mortar 1:3 (1 cement : 3 fine sand) on soffits of RCC slabs chajjas, lintels, waist slab of staircase and shelves or wherever directed.

(c) All vertical as well as horizontal edges shall be curved, minimum 75 radius. NO grooving or edge in the production and stores area shall be acceptable.

(d) Before plastering it should be ensured that brick masonry joints are raked out (at least on even surface) to a depth of 12mm and all concrete surfaces are rough for proper adhesion of plaster. If not they shall be made rough by racking or bush hammering at intervals of 50mm. Efflorescence if any and dust / dirt shall be removed. The surfaces shall be wetted adequately before plastering.

(e) Sand used in plaster shall be within the grading zones as stipulated in the IS silt contents shall not exceed 4% by weight. Brick surface shall be raked out at the end of day brick work to afford key to plaster. Plaster surface shall be hard and even without patchy appearance. If they flake or show scratch marks if rubbed by a pointed nail, the plaster shall be rejected, dislodged and redone.

(f) GI chicken wire mesh 24 gauge and 20mm mesh shall be provided and fixed all along RCC and Brick Work joints giving 150mm lapping on either sides, secured with nails etc. before plastering.

2. **Drip Course :** Drip course shall be provided to all projections as per details shown in drawings for which no extra payment shall be made.

3. **External Surfaces :**

(a) **Sand Face Plaster (Externally) :** Sand face plaster in two coats shall be provided to all external face of walls including jambs of doors, windows, opening, external surfaces of parapets and external surfaces of lift & entrance lobbies, corridors, etc. and all surfaces of beams and columns .

i) Under coat 15mm thick in cement mortar 1:4 (1 cement : 4 coarse sand) admixed with approved water proofing compound keeping the surface rough to receive the second coat of plaster.

ii) Over the under coat of plaster apply second coat of plaster with 10mm thick cement and sand mortar 1:3 (1 cement : 3 parts of coarse sand using coarse parts of sand after screening out the fine particles) admixed with approved water proofing compound in recommended portion and even the surface with wooden floats and finally press and pick up with rubber sponge. The sand faced plaster shall be finished off uniform texture through out and no patch work shall be allowed. Grooves 15 - 10mm as per instructions of Engineer-in-charge shall be formed using wood beads (chapattis) to be fixed over under coat before applying second coat. These shall be removed when the top layer is set firmly. The grooves shall be finished with neat cement slurry admixed with water proofing compound in recommended proportions. The second coat shall be applied over first coat before it is dry preferably within 48 hours. The grooves shall be finished with neat cement admixed with approved water proofing compound.

(c) **Curing** : Plastering shall be kept damp continuously for at least 7 days. Moistening shall commence as soon as the plaster has hardened sufficiently and is not susceptible to injury. The water shall be applied preferably by using a fine fog. Soaking of wall shall be avoided, and only as much water as can be readily absorbed shall be used. Excessive evaporation on the sunny or windward sides of buildings in hot dry weather shall be prevented by handing matting or gunny bags on the outside of the plaster and keeping them wet.

(d) The external plaster work shall be carried out with double scaffolding as approved by the Engineer-in-charge.

a) Sand face plaster shall be provided to external face of walls including external jambs of doors, windows and parapets, balcony, projections etc.

b) Render the surface (under coat) with cement and coarse sand mortar 1:5 (1 cement : 5 coarse sand) 12 mm thick with water proofing compound 3% and finish the surface rough to receive a final coat of plaster.

c) Over the under coat of plaster, apply a coat of plaster 6 mm thick with cement and sand mortar (1:3) with 3% water proofing compound (using coarse parts of sand after screening out the fine particles and finish the surface even, using wooden floats). When the surface is still green, press and pick up with a rubber sponge against the plaster so as to remove the surface moisture and to enable the coarse sand grains of the surface to show out. The sand face plaster shall be finished evenly throughout and no patch work shall be allowed.

ARCHIVES/ MOULDINGS

Archives/ mouldings as per design/ pattern, if shown in elevation drawings & as per detail given, shall be of cast in situ RCC 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate) & nominal reinforcement of 6mm dia bars encased/ embedded in brick work below cill level in each window of different size. This shall be plastered in cement mortar 1:5 (1 cement: 5 sand (4 parts of fine sand: 1 part of coarse sand)).

IF ANY, RAIN WATER PIPES FOR BALCONY SHALL BE ENCASED WITH 1:2:4 CEMENT CONCRETE (1 CEMENT : 2 COARSE SAND : 4 STONE AGGREGATE 20 MM NOMINAL SIZE) AND WATERPROOF COMPOUND MIXED WITH CONCRETE. BEFORE ENCASING THE RAIN WATER PIPE, THE APPROVAL OF THE ENGINEER-IN-CHARGE IS ESSENTIAL. THE ENGINEER-IN-CHARGE SHALL GIVE APPROVAL ONLY AFTER INSPECTING THE WORKMANSHIP, TESTING & FIXTURE ARE BEEN FITTED AS PER REQUIRED STANDARD.

SECTION – 12.0
PAINTING

1. White wash shall be provided to over plastered surfaces, if any, as directed by Project Manager and Architect.
2. Dry distemper of approved shade shall be provided to all internal surface of all rooms including toilets and kitchen etc. all as directed by Project Manager and Architect.
3. Before application of white wash / distemper the surfaces shall be prepared to clean and even surface.
4. White wash shall be prepared from lime slacked on site, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for 24 hours and shall be screened through clean cloth. Four kg. of gum dissolved in hot water shall be added to each cubic meter of the cream (115 gm/cft). Blue shall be added to give required whiteness. The approximate quantity of water to be added in making cream shall be five liters per kg. of lime. 10% Zinc Oxide shall also be added to obtain a desired shining in the white wash.
5. Dry distemper shall be carried out in two or more coats over one coat of approved primer as per manufacturer's instructions to give even shades.
6. White wash and dry distemper shall be applied in specified coats by using flat brushes or spray pumps. Each coat shall be allowed to dry before next coat is applied, if additional coats than what have been specified are necessary to obtain uniform and smooth finish it shall be given to no extra cost.
7. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

Painting

8. Cement Base Paint:

Two or more coats of cement base paint shall be applied to give even shade on all external cement plaster, internal plaster surfaces or parapet surfaces. Soffits of chajja, lintels, beams and cills of external windows. The shades of paint shall be used as approved by the Engineer-in-charge. Each coat shall be cured well by wetting surfaces for at least three days.

Alternatively, white cement slurry shall be used with pigment as required to achieve the desired shade. The white cement slurry shall be such as to provide a spread of 15 SqM per bag (50Kg) of white cement.

For all external paints, a patch at least 10 SqM. in area has to be done and got approved from the Engineer-in-charge for quality, shade & texture.

9. Paint to Steel Surface :

All exposed steel surfaces shall be prepared, cleaned with sand paper to completely remove scales and rusts and shall be painted with two or more coats of synthetic enamel paint to give an even shade over one coat of steel primer. The shade of synthetic enamel paint shall be as approved by Engineer-in-charge.

10. Painting to CI, GI Pipes :

All exposed CI and GI pipes shall be painted by applying two or more coats of oil paint. The shade and quality shall be as approved by Engineer-in-charge.

11. Synthetic Enamel Paints And Primer Manufactured By The Following Firms Shall Be Used:-

(a) ICI

(b) Asian

} Only first quality brand of the manufacturer's paints and primer shall be incorporated in the work.

12. **ACRYLIC EMULSION PAINT :**

These paints are to be used on internal surfaces except wooden and steel.

Plastic/Acrylic emulsion paint as per IS : 5411 of approved brand and manufacture and of the required shade shall be used.

Painting on New Surface

a) The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-charge after inspection, before painting is commenced.

b) Application : The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush, spray or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

c) Precautions :

i) Old brushes if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water. Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

ii) In the preparation of wall for plastic emulsion paintings, no oil base putties shall be used in filling cracks, holes etc.

iii) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

iv) Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

SECTION – 13.0

DISMANTLING AND DEMOLITION

1. Demolition and dismantling shall imply carefully breaking up the components of the structure and ensuring that no damage is done to any adjoining item of work. The items after dismantling / demolition shall be removed and the site shall be cleared.
2. All materials coming out of dismantling / demolition shall become the property of the contractor and shall be removed from site after taking permission from the Engineer-in-charge & the Project Manager. For this material, the contractor shall give suitable credit. The amount of the credit shall be accounted by the contractor while quoting the at the summary at the end of the Bill of Quantities.
3. The material going out of dismantling / demolition, whether in unserviceable or serviceable conditions shall not be incorporated in any item of work to be executed under this contract.
4. The contractor should carefully understand the scope of dismantling and additions / alterations work before commencing any dismantling work. The scheduling for this in the bar-chart shall be done in consultation with the Architect, Engineer-in-charge & the Project Manager and the same shall be carried out only after getting written approvals from all of them.

SECTION – 14.0

FALSE CEILING

Metallic False Ceiling

Seamless false ceiling, with walkable top surface, of structural insulated sandwich panels, shall be provided. The manufacturer's specification to be followed with the following parameters:

The outer skin on both top & bottom shall be pre-coated steel, 0.5m thick, hot-dip galvanized with zinc coating of 275 gm. per SqM. The bottom skin coating shall be architectural polyester paint with a coating thickness of 25 microns, (5 microns of primer & 20 microns of finish coat). The reverse side shall have a grey backing coat of 5 microns, compatible for bonding. The adhesive shall be specially formulated polyurethane adhesive, applied under required heat & pressure to ensure adhesion. A peel off film to ensure protection against pre-installation scratches must be provided. The overlapping panels shall have a recessed male edge on one side & interlocking roll formed female edge on the other panel to ensure panel to panel finish and a snug insulation to insulation fit. The panels shall be 1170 in width & shall span across the room size in the other direction. The inner core shall be 50 thermocol, with steel pipe framework, as necessary to make the ceiling walkable as well as support the services systems above and within the false ceiling. The joints shall be filled with the manufacturer's specified silicone fillers & sealants, ensuring flushed bottom surface of the false ceiling. The item shall be inclusive of all necessary cuttings as needed for electrical fixtures, ac ducts, diffusers & other services, all complete including hardware, suspenders, support etc as needed for the successful completion of the job to the satisfaction of the Engineer-in-charge.

Plaster of Paris Ceiling

Frame:

The frame work shall be as specified and framed. In case of flat roofs, the frame work made out of 50mm Square M.S. tube of 18 Gauge thickness, the tube shall be securely fixed to the walls and pillars by holding down bolts and shall be fastened to the slabs above with iron straps or M.S. bars of suitable sections and encroached therein. Cross members as specified shall then be fixed at right angles to the main members. The underside of the frame work shall be true to planes and slopes.

Rabbit Wire Mesh :

Rabbit Wire Mesh 18 Gauge shall then be fixed to the underside of tube members and their junctions with screw / welded as ordered by the Engineer-in-charge. The rabbit wire mesh shall be straight, tight and perfectly true to planes and slopes and without any sagging and shall be slightly below the underside of the frame to allow the plaster to encase the metal round.

Plaster of Paris :

The plaster of Paris shall be of the calcium-sulphate semi-hydrate variety. Its fineness shall be such that when sieved through a sieve of designation 3.35mm for 5 minutes after drying the residue left on it shall be not more than 1% by weight. It shall not be too quick setting. Initial setting time shall not be less than 13 minutes. The average compressive strength of material determined by testing 5 cm cubes after removal from moulds, after 24 hours and drying in an oven at 40 degree C till weight of the cubes is constant, shall not be less than 84 kg per square meter.

Application :

The material will be mixed with water to a workable consistency. Plaster of Paris shall be applied to the underside of the frame over the rabbit wire mesh in suitable sized panels and finished to a smooth surface by steel trowels. The plaster shall be applied in such a manner that it fully fills the gaps between the members and the thickness over the members is minimum 25mm to maximum 40mm as per instructions of Engineer – in - charge. The joints shall be finished flush to make the ceiling in one piece. The finished surface shall be smooth and true to plane, slopes or curves as required.

SECTION – 15.0

BOUNDARY WALL

1. **General :**

Boundary wall shall be provided on the periphery of the plot. Boundary wall to the extent marked and shown on drawing shall be covered under the scope of the work in this Tender.

2. **Materials and Workmanship :**

Specifications of materials and workmanship in respect of all items of Schedule shall be same as of identical items for the buildings work as described in schedules and as specified in particular specifications of brickwork, concrete work, plastering work, and excavation, earthwork & anti-termite treatment, except with the change described in succeeding paragraphs.

3. **Site Clearance, Site Levels and Surface Digging :**

Same as above

4. **Layout :**

After setting out of work as per stage of mentioned, the layout of boundary wall shall be got approved from the Engineer-in-charge, Project manager & Architect.

5. **Excavation in Trenches :**

Earth work in excavation in any type of soil for foundation of wall shall be carried out as per drawings and instructions of Engineer-in-charge.

6. The detailed specifications for earth filling, plinth filling, RCC work, Brick Work, DPC, Pointing, Sand face plaster and Steel iron work, cement base paint etc. shall be as per general specifications mentioned above.

SECTION -16.0

ROAD WORKS

1 SCOPE OF WORK :

The work under this contract comprises of provision of roads with soling, WBM and premixed carpet including cement concrete pavements, kerb stones, brick edging and earth filling all as described in schedule items and as specified in succeeding paragraphs.

MATERIALS

2 SOLING AND WATER BOUND MACADAM :

Stone for soling/WBM shall be local quartzite. This shall be broken stones not exceeding 80 mm gauge. The broken stones shall be free from soft and disintegrated particulars. It shall also not have excess of dirt or other objectionable matters.

3 (a) Stone Chipping shall consist of broken/crushed stone. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, salt, alkali, organic or other deleterious matter. The aggregate shall be in of low porosity.

(b) The aggregate shall satisfy the following physical requirement:

SL No	TEST	TEST METHOD	REQUIREMENT
i)	Los angles abrasion valve, or Aggregate Impact valve	IS-2305 (Pt IV)	35 percent maximum
ii)	Flakiness	IS-2386 (Pt I)	30 percent maximum
iii)	Water absorption	IS-2386 (Pt III)	1 percent maximum

(c) The size of the chipping shall be 10 mm nominal size, that is, it shall pass through 12 mm square mesh sieve and shall retain on 6 mm sieve.

4 SAND FOR SEAL COAT :

Sand for seal coat shall be fine aggregate consisting of natural sand or crusher run screening or a mixture of both and shall be clean, durable, uncoated, coarse dry particles and be free from injurious amounts of dust, soft or flaky particles or organic matter or other deleterious substances.

5 **BITUMEN :**

(a) Paving bitumen shall conform to IS-73-1961, 'Specification for paving bitumen (Revised)' and shall be of penetration grade 30/40 or 80/100 as approved by Engineer-in-charge.

(b) Cut back bitumen shall conform to IS-217/1961, 'Specification for cut back bitumen (Revised)'. The type to be used shall be specified by Engineer-in-charge.

(c) The bitumen (Penetration grade or cut back) shall be obtained from approved, manufactures and delivered to site in makers sealed containers bearing ISI marking. The binder shall be stocked as directed by Project Manager/Architect on one side of the roadway.

6 **SCREENINGS :**

Approved moorum shall be used as screening.

WORKMANSHIP:

7 (a) **Preparing formation :** _

The ground shall be formed to proper gradient, camber, super elevation, etc. corresponding to the required surface, by trimming the surface. If indicated all soft shall be excavated and filled in with approved soil and well rammed. Surplus soil (if any) shall be thrown clear of the road formation. The formation shall be watered and rolled.

(b) **Preservation of Property :**

Road side trees, shrubs, poles, fences, monuments, buildings, pipe lines, sewers etc. within or adjacent to the road which are not to be disturbed shall be protected from injury or damage.

8 Preparation of Sub-grade :

The surface of the formation for a width equal of that of soling course shall first be cut to the depth below the proposed finished level, equal to the combined depth of soling and wearing course (due all allowances being made for consolidation). It shall then be cleared of all foreign substance and sub-grade shall be dressed off parallel to the finished profile.)

9 Consolidation of Sub-grade :

The sub-grade shall then be sprinkled with water and rolled with minimum of 5 number of passes of 8 – 10 tonne smooth wheeled roller, till the soil is evenly and densely consolidated.

10. **Removal of Undulations :**

All undulations in the surface that might develop due to rolling shall be made good with earth or quarry spoils as the case may be and sub-grade re-rolled.

11. **STONE SOLING :**

The soling stone shall be laid on the prepared sub-grade in conformity with lines, grades, thickness as directed by Engineer-in-charge. The edging of soling shall be marked out by strings and stacks. Stones shall be hand packed carefully to the required cambers of the top surface of laying correct to the templates placed 15 M apart. Stone shall be laid resting their broad base with their height equal to the thickness of the soling and the largest dimension at right angles to the centre line of the road. Stone shall be laid in close contact with each other. All interstices between soling stones

shall be wedge in with smaller stones of suitable size well driven in to ensure tight packing and complete filling of the interstices.

12. ROLLING :

The rolling shall then be consolidated by a road roller of 8 to 10 tonnes weight as directed. Rolling shall be done at the side overlapping equally the shoulders and shall continue till the shoulders and soling are firmly bound together. Rolling shall progress from edge towards the centre (or from low to higher edge in case of super elevation) parallel to the centre line of the road and lapping uniformly each proceeding rear wheel track by one half width of such track. Rolling shall continue until the road metal is thoroughly keyed with no creeping of metal ahead of the roller. Finally a layer of moorum of sandy soil of thickness not less than 25 mm shall be spread and watered and rolled with a light roller. Particular care shall be taken to use only sufficient quantity of water so as not to soften the surface.

13. SURFACED WATER BOUND MACADAM :

Where road side strips do not confine the spread metal, well tempered clay bunds of fillets about 15 cm wide and to the height required shall be formed on each side of the metal to prevent its spreading out during consolidation. The shall be laid true and parallel having a clear distance between them equal to the width to be metalled.

14. SPREADING OF COARSE AGGREGATE:

The coarse aggregate shall be spread uniformly and evenly upon the prepared base in required quantities from stock piles along the side of the roadway. But in no case shall the aggregate be dumped in heaps directly on the base within the area over which it is to be spread nor shall hauling over the partly completed base be permitted. The aggregate shall be spread uniformly to proper profile by using templates placed across the roads about 6 metres apart. Whenever possible, approved mechanical devices shall be used to spread the aggregate uniformly so as to minimize the need for manipulation by hand.

The surface or the aggregate spread shall be carefully checked with the templates and all high or low spots corrected by removing or adding aggregate as may be required. The surface shall be checked from time to time during the spreading and rolling of coarse aggregate to ensure a finished surface with variation not greater than 12 mm when a 3 metre long straight edge is laid parallel to centre line of the road.

The coarse aggregate shall not normally be spread in lengths more than three days average work in advance of the rolling, screening and bending of the proceeding section.

When spread thickness exceeds 11.5 cm the metal shall be spread and consolidated in layers not exceeding 11.5 cm but not less than 5 cm.

15. DRY ROLLING

Immediately following the spreading of the coarse aggregate, it shall be compacted to full width by rolling with either three wheel power roller of 8 to 10 tonnes capacity or tandem roller or equivalent vibratory roller. The weight of the roller shall depend upon the type of the aggregate.

The rolling shall begin from edges with roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually from edges to the centre, parallel to the centre line of the road and lapping uniformly each reseeding rear wheel track by one half width and shall continue until the entire area of the course has been rolled by the rear wheel.

Rolling shall continue until aggregate is thoroughly keyed and the screening of the aggregate ahead of the roller is no longer visible. Slight sprinkling of water may be done if required.

On the super elevated curves, the rolling shall proceed from the lower edge and proceed gradually continuing towards the upper edge of the pavement.

The course shall not be rolled when the sub-grade is soft or yielding or when the rolling causes a wave, like motion in the base course or sub-grade. When roller develops irregularities that exceed 12mm when tested with a 3 metre straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives a uniform surface conforming to the desired cross section and grade. The surface shall also be checked transversely by template and any irregularities corrected in the manner described above. Screening shall not be allowed to make up depressions.

16. APPLICATION OF SCREENINGS:

After the coarse aggregate has been thoroughly keyed and set by rolling, screening to completely fill the interstices shall be applied gradually over the surface. Dry rolling shall be continued while the screenings are being spread so that the jarring effect of the roller will cause them to settle into the voids of the coarse aggregate. The screenings shall be spread uniformly and thickly as to cake or bridge on the surface. Rolling and brooming shall continue with the spreading of the screening until no more screening can be forced into the voids. Damp and wet screenings shall not be used. The spreading, rolling and brooming of screenings shall be performed on sections which can be completed within one day operation.

17. WET ROLLING:

When all the possible voids have been filled with screenings, the surface shall then be continuously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screening into the unfilled voids and to distribute them evenly. The sprinkling, sweeping and rolling shall be continued and additional screenings applied, where necessary, until the coarse aggregate is well bonded and firmly set for its entire depth and until a grout has been formed of screenings and after that will fill all voids and form a wave of grout ahead of the wheels of the roller. Care shall be taken to see that the base or sub-grade does not get damaged due to the use of excessive quantity of water during construction.

PREMIX CARPET (40 MM THICK):

18. PREPARATION OF BASE :

Before the carpet is applied on the existing base, the surface shall be absolutely free from dust or caked mud or other foreign matter.

Pot hole or ruts, if any, in the existing surface shall be filled with premix chippings and well rammed, about a week before the carpet is laid.

19. PRIMING / TACK COAT:

The bituminous primer shall be heated to the temperature as recommended by the manufacturer and applied uniformly to the base by means of a sprayer.

The tack coat shall be applied just ahead of spreading of the premix.

20. PREPARATION OF PREMIX :

Mechanical mixers shall be employed for mixing. For small quantities of work, improvised hand mixing drums may be used as directed by the Engineer-in-charge. The binder shall be heated to the temperature as recommended by the manufacturers and mix until the chipping are thoroughly coated with the binder.

21. SPREADING OF PREMIX :

Immediately after the application of the primer/tack coat, the premix shall be spread evenly with rakes to the desired thickness and to the correct camber or distributed evenly by means of a drag spreader. The surface shall then be checked for camber by camber board and any inequalities found, shall be corrected.

22. ROLLING :

As soon as sufficient length has been spread with the premix, the surface shall be rolled with 8 to 10 tonnes power roller. Rolling shall commence at the edge and progress towards the centre (except in the case of super elevated curves, where rolling shall progress from inside towards the outside of the curve) longitudinally.

When the roller has passed once over the area, any high spot or depression which becomes apparent, shall be corrected by removing or adding premix. When this has been done the surface shall be rolled to compaction and all roller marks shall overlap uniformly by at least ½ width. The roller wheel shall be kept damp to prevent the premix for adhering to wheels and being picked up. Fuel and lubricating oil shall not be used for this purposes.

The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat before new mix is placed against it.

23. SEAL COAT

In dry areas, a premix sand seal coat shall be applied immediately after laying the carpet. The binder shall be heated in boilers of suitable design, to the temperature appropriate to the grade of bitumen. The aggregate shall be dry and suitably heated to a temperature as directed by Engineer-in-charge before the same are placed in the mixer of suitable design. Mixing of binder with aggregate to the specified proportions shall be continued till the later are thoroughly coated with binder. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 8 to 10 tonnes power roller. Rolling shall be continued till hot premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

24. PCC KERBS, AND PAVEMENTS

These shall be in precast/cast in situ concrete as per site requirement and as described in the schedule of quantities, finished even and concrete cured well. The specifications in respect of materials and workmanship shall be same as specified in section II and section IX of Particular Specifications Part I.

25. Brick Edging :

Brick edging shall be of best quality bricks of class designation 100. Edging shall be laid dry on edges. Length of the finished work shall be measured in running metres along the edge of the road correct to a cm.

26. EARTH FILLING OVER AREA

Earth filling over areas shall consist of bringing earth from outside by the contractor. The entire plot levels shall be taken in a grid of 3M x 3M and jointly signed by Contractor & Engineer-in-charge before filling. Earth shall be spread in layers of 20 cm watered and consolidated by road rollers. Final levels shall be attained as indicated by the Engineer-in-charge.

27. The volume of earth in filling/cutting shall be computed by Pyramidal formula or Simpsons Rule or Trapezoidal formula as the case may be. Area covered by buildings shall be deducted. Any excess excavation in foundations after plinth filling etc shall also be deducted. The net payable volume shall be arrived after deducting 10% from the gross volume. Rate quoted shall be deemed to include all above operations and provisions.

SECTION - 17.0

STRUCTURAL STEEL

SCOPE :

This specification covers the general requirements for supply, fabrication, painting, transport and erection of all type of structural steel. Unless otherwise stated the fabrication drawings shall be prepared by contractor and got approved by consultant. The fabrication drawings shall indicate the shop and field rivets, bolts and welds.

LAYING OUT :

A figure of the steel structure to be fabricated shall be drawn on a level platform to full scale. This may be done in full or in parts as shown on drawings or as directed by the Engineer-in-Charge. Steel tape shall be used for measurements.

GENERAL :

All structural steel materials such as angles, RS joists, flats, tees, plates, channels etc. shall conform to the latest edition of IS 2062. All structural steel shall be free from twist before fabrication. Cutting of members shall be done by shearing, cropping, sawing or gas cutting. Contact surfaces of plates and butt joints shall be accurately machined over the whole area so that the parts connected shall butt over the entire surface of contact. Welding of pieces shall be done with the approval of the Engineer-in-Charge. Tolerances for fabrication of steel structures shall conform to IS:7215-1974. Tolerance for erection of steel structures shall conform to the Indian Standard. For general guidance on fabrication by welding, reference may be made to IS:9595-1980.

FABRICATION :

Fabrication shall generally be done as specified in IS:800- 1984. Great accuracy shall be observed in the fabrication of various members. So that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twist, kinks, buckles or open joints.

The component parts shall be assembled in such a manner that they are not damaged in any way and specific cambers as shown in the drawing or as directed by the Engineer-in- Charge, shall be provided.

For bolted connection, where necessary washers shall be tapered or otherwise suitably shaped to give satisfactory bearing. The threaded portion of the bolt shall project beyond the nut by at least 1.5 thread.

Welding shall be done in accordance with the latest edition of IS 813, 814, 816, 819, 1024, 1261, 1323 and IS:9595-1980 as appropriate. **Code of Practice for use of Electric Arc welding for general Construction in mild steel.** In welding it must be ensured that the base metal is in fused state when filler metal makes contact with it ; filler metal does not overflow upon any unused base metal; base metal is not cut along the weld edges; flowing metal floats the slag, oxide and gas bubbles at the surface behind advance pole. For this current shall be adjusted or the electrode size is changed. Welding shall be free from cracks, discontinuity, under or over size welding thickness.

Surface to be welded shall be free from loose mill scale, rust, grease, paint and any other foreign material. As far as possible avoid the welding at heights and at difficult positions. Generally fillet welding is preferred. The parts to be welded are brought in as close contact as practicable and rigidly clamped together.

Before erection, steel work shall be thoroughly cleaned, of rust, loose scale, dust, welding slag, and shall be given one coat of red oxide primer of approved make and one coat of synthetic enamel paint of approved make as specified in the item before erection and final coat of painting after the erection as directed.

Steel members shall be hoisted and put in position carefully without any damage to the member and to the building and labour. The trusses shall be lifted at such points that they do not buckle or deform or be unduly stressed. The end of the truss which faces the prevailing wind shall be fixed and the other end may be kept free to move. The steel work shall be securely fastened wherever necessary, temporarily braced, to provide for all loads to be carried by the member during erection including the load due to the erection equipment and its operation. **No permanent bolting or welding is done until proper alignment has been obtained.** The holes for the rivets shall be determined with the

help of templates and drilled. Erection clearance of the cleared ends shall not be more than 1.5mm and without cleating end clearance shall not be more than 3mm. Grouting or embedding of structural steel members done after the approval of the alignment, level & position of the members by the Engineer.

PRECAUTIONS:

All operations connected with welding and cutting equipment shall conform to the safety requirements given in IS:818- 1968 for safety requirements and health provision in elective and gas welding and cutting operations. Inspection and testing of welds shall be as per IS:822-1970.

MAKING HOLES :

Holes through more than one thickness of material for members, such as compound stanchion and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, provided the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall be not greater than 16 mm. For dynamically loaded structures, punching shall be avoided.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to H8 tolerance specified in IS:919-1963.

Holes for rivets or bolts shall not be formed by gas cutting process.

PAINTING OF STRUCTURAL STEEL:

For box sections/closed sections, the internal surfaces of the sections shall be painted with one coat of red oxide primer before forming of box sections either by welding or bolting. All surfaces which are to be painted, oiled or otherwise treated shall be dry and thoroughly cleaned to remove all loose scale and loose rust.

A priming coat of approved steel primer i.e. Red Oxide primer conforming to IS:2074-1979 shall be applied before any member of steel structure are placed in position or taken out of workshop.

After erection also, one coat of Red Oxide primer shall be applied and then two coats of approved synthetic enamel paint of approved shade shall be applied.

INSPECTION AND APPROVAL:

The Engineer-in-Charge shall have free access at all reasonable times to the contractor's fabrication shop and shall be given all facilities like tools, gauge, instruments, etc. and technical and non-technical personnel for shop tests free of cost for satisfying himself that the fabrication is being carried out in accordance with the drawings and the specification. Approval in the shop shall include but not limited to:-

- a) Approval of material
- b) Approval of field joints
- c) Approval of parts with planed surfaces
- d) Approval of members
- e) Approval of markings
- f) Approval of erection procedure
- g) Approval of special features like rollers, load platform mechanism etc.
- h) Approval of shop primer coats
- i) Approval of mode of loading and transportation

Approval described above shall be given at different stages of fabrication so as to facilitate the operation of fabrication.

ERECTION:

Erection shall be started only when permitted by the Engineer – in - Charge, after checking in advance all levels, alignments of foundations, foundation bolts and inserts. Any discrepancies shall be brought to the notice of the Engineer-in-Charge immediately.

Permissible erection deviations are as follows:-

SI No	Type	Nature	Tolerance
1.	Columns	a) Shifting of areas with respect to marked axes	5mm

		in the lower section	
	b)	In upper section up to 10M Greater then 10M	10mm 1mm of every 1M height of Column but not exceeding 35MM
	c)	Deflection	1mm of column height 1M but not exceeding 15MM
	d)	Boring surface from design level	± 5 mm
2.	Trusses Beams purlins	a) Levels of supporting joints of trusses and beams	± 20 mm
	b)	Deviation of upper chord in the plane running through centre of support	1mm of structure 250mm height
	c)	Deflection of straight section of compression chord from the plane of truss or girder	1mm span 1500mm but not exceeding 10MM
	d)	Deviation in distance in distance between purlins	5mm
3.	Crane girders & rails (Unless otherwise specified	a) Difference in levels of crane rail measured between adjacent columns	2mm
	b)	Deviation to crane rail gauge	± 3 mm
	c)	Relative shifting of ends of adjacent crane rail in plan & elevation	2mm
	d)	Deviation of crane rail axis from centre line of web	± 3.5 mm

IMPORTANT POINTS:

Before the actual execution of the job, the Contractor shall prepare fabrication drawings for all structural steel work from the structural drawings supplied to him and determine the exact cutting lengths of the members, sizes of gusset plates, welding lengths by marking out on a level platform to full scale.

Welding plant, electrodes and other equipments, scaffolding, labour shall be arranged by the Contractor at his cost. Erection equipment of required capacity , sufficient number of spare parts and staff shall be maintained by the Contractor at site at his cost.

Mode of Measurement:

All structural steel members shall be measured in lengths and are converted into weights as per IS tables. All rivets, bolts shall be measured in kg. and paid for. No deduction shall be made for rivet holes and bolts. Nothing extra shall be paid for wastages.

MS CHEQUERED PLATES:

The Chequered plates shall be cut to the required shape with arc gas cutting machine. The cut edges shall be ground and finished properly. The plates shall be given a coat of primer and two coats of approved synthetic enamel paint.

Mode of Measurement:

The measurement shall be on weight basis in MT.

MS HOLDING DOWN BOLTS (ANCHOR BOLTS):

The MS holding down bolts of specified dia. length and shape shall be provided as per the drawings in line & level. These shall be fixed to RCC work or brick work by grouting as specified. The bolt shall be provided with nuts and washers. The grease shall be applied to the threaded portion with the help of templates.

Mode of Measurement:

The measurement shall be made on weight basis of total assembly.

INTERNAL ELECTRICAL

INTERNAL ELECTRICAL WORKS

TECHNICAL SPECIFICATIONS

INDEX

SECTION	DESCRIPTION
I	WIRING
II	MEDIUM VOLTAGE DISTRIBUTION BOARDS
III	CABLE TRAYS
IV	AUTOMATIC FIRE DETECTION & ALARM SYSTEM
V	IP CCTV SURVEILLANCE SYSTEM
VI	PUBLIC ADDRESSABLE SYSTEM
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VIII	LIFT
IX	LIGHTING
X	UPS
XI	LIGHTNING PROTECTION SYSTEM (ESE TECHNOLOGY)
XII	EARTHING
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XIV	SPECIAL INSTRUCTIONS TO TENDERERS

I TECHNICAL SPECIFICATION OF WIRING

1 GENERAL

Technical Specifications in this section cover the Internal Wiring Installations comprising of:

Wiring for lights and convenience socket outlets etc. in concealed/surface conduit/Wire mesh cable tray.

- Wiring for telephone outlets.
- Wiring for fire detection system
- Sub main wiring.

2 STANDARDS AND CODES

The National Electrical code NFPA 70 will apply to the equipment and the work covered by the scope of this contract. Wherever appropriate NFPA 70 are not available, relevant British and/or IEC Standards shall be applicable.

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

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

660/1100 V grade PVC insulated wires.

NFPA 70

Article 300

Rigid steel conduits for electrical wiring.

NFPA 70

Artical 344

3 CONDUITS

3.1 PVC Conduits :

Conduits shall be heavy gauge rigid PVC of minimum thickness of 1.8 mm. Conduits shall be as per British standard code. All conduit and conduit accessories shall be of PVC. Conduits shall be joined together by a vinyle type cement/ solvent. Minimum size of conduit shall be 25 mm. Conduit shall be fixed on ceiling, floor, wall or above false ceiling. All conduits shall be concealed in wall ceiling etc. or fixed on surface of wall with clamps at regular interval as called for elsewhere. For termination of PVC conduits into switch outlet boxes, PVC female adopters shall be used. Wherever conduit run exceeds 10 meter, circular junction boxes shall be provided to facilitate pulling and inspection of wires. Inspection boxes shall be suitable size springs. Long radius bends shall be provided. Heating shall not be used to bend the conduits. Size of conduit shall depend upon number and size of wires to be drawn.

3.1.1 FIXING OF CONDUITS

Surface Conduit

Conduit pipes shall be fixed by heavy gauge saddles, secured to suitable wood plugs or other approved plugs with screws in an approved manner at an interval of not more than one mete but on either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm from the center of such fittings. The saddles should not be less than 24 gauge for conduits upto 25 mm dia and not less than 20 gauge for larger diameter conduits. The corresponding widths shall be 19 mm & 25 mm. Where conduit pipes are to be laid along the trusses, steel joint etc. the same shall be secured by means of special clamps made of MS. Where as it is not possible to drill holes in the trusses members suitable clamps with bolts and nuts shall be used.

For 25mm diameter conduit width of clip shall be 19 mm and of 20 SWG. For conduit of 32 mm and above, width of clip shall be 25 mm and of 18 SWG.

Where conduit pipes are to be laid above false ceiling, either conduit pipes shall be clamp to false ceiling frame work or suspended with suitable supports from the soffit of slab. For conduit

pipe run along with wall, the conduit pipe shall be clamped to wall above false ceiling in uniform pattern with special clamps if required to be approved by the Engineer-in Charge at site.

3.1.2 Recess/ concealed Conduit

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burning the conduit in mortar before plastering shall form part of this work.

The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60 cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius, which shall permit easy drawing in of conductors. All threaded joints of conduit pipe shall be treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and to facilitate replacement of wires if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then circular junction box shall be provided.

3.2 Steel Conduits

These shall be of mild steel 16 gauge upto 32mm and 14 gauge for sizes above 32mm, electric resistance welded (ERW), electric threaded type having perfectly circular tubing. Conduits shall be precession welded ERW and shall be fabricated from tested steel strips of thickness as per ISS by high frequency induction weld process. Weld shall be smooth and of consistent of high quality to ensure crack proof bending. The conduits shall be black enamel painted inside and outside in its manufactured form. Wherever so specified, the conduit shall be galvanized. All conduits used in this work shall be ISI embossed.

3.3 HDPE Conduits:

Wiring shall be carried out in recessed/surface HDPE conduits. The HDPE conduit shall conform to American Standards ASTM D1248/D3035/F714. The inner wall shall be with silicone lining and should be free from all obstructions. The conduits shall be bendable with bending radius not less than 20 times of outer diameter of conduit. All joints in conduits shall be made with approved accessories. Damaged conduits/fittings shall not be used. Cut ends of conduits shall not have sharp edges. Conduits shall be supplied with end caps so that dirt & water does not clog the conduit.

Bends:

Large right angle bends (more than 75 mm radius) or non-right angle bends in conduit runs shall be made carefully so as not to cause any crack/kink in the conduit. Small right angle bends in conduit runs can be made by standard conduit accessories (Long bend/Elbow/Inspection Elbow). No run of conduits shall have more than four right angle bends from outlet to outlet. Bends in multi runs of conduits shall be parallel to each other and neat in appearance, maintaining the same distance as between straight runs of conduits.

Conduit Accessories

Heavy duty standard conduit fittings and accessories like standard/Deep junction boxes, Bends, End caps, Standard/Inspection elbows, Inspection Tees, Couplers, Bell couplers, Saddles etc. shall be of superior quality and of approved makes.

3.4 Steel Conduit Connections

Connections between steel conduits shall be with screwed couplers of approved quality and finish, ensuring screwed metal to metal contact. Length of threads shall be as per ISS and sufficient to accommodate pipes to full threaded portion of couplers or accessories. Threads and sockets shall be free from grease and oil. Conduits shall be connected to outlet boxes by means of M.S. hexagon check-nuts fixed both inside and outside the box. Conduit edges shall be free of burrs and provided with screwed PVC bushes to avoid damage to insulation of conductors while pulling them through the

conduits. Connections between M.S. and PVC conduits, if required, shall be through a junction box and never directly.

3.5 Bends

Large right angle bends (more than 75 mm radius) or non right angle bends in conduit runs shall be made by means of conduits bending machines carefully so as not to cause any crack in the conduit. Small right angle bends in conduits runs can be made by standard conduit accessories (solid/inspection bends/elbows) no run of conduits shall have more than four right angle bends from outlet to outlet. Bends in multi runs of conduits shall be parallel to each other and neat in appearance, maintaining the same distance as between straight runs of conduits.

3.6 Conduit Accessories.

3.6.1 Standard accessories

Heavy duty black enamel painted standard conduit fittings and accessories like standard/extra-deep circular boxes, looping in boxes, junction boxes, normal/ inspection bends, solid/inspection elbows, solid/inspection tees, couplers, nipples, saddles, check nuts, earth clips, ball socket joints etc. shall be of superior quality and of approved makes. Heavy duty covers screwed with approved quality screws shall be used. Superior quality screwed PVC bushes shall be used. Samples of all conduits fittings and accessories shall be got approved by Owners/Architects before use.

3.6.2 Fabricated accessories

Wherever required, outlet/junction boxes of required sizes shall be fabricated from 1.6 mm thick MS sheets excepting ceiling fan outlet boxes which shall be fabricated from minimum 2 mm thick sheets. The outlet boxes shall be of approved quality, finish and manufacture. Suitable means of fixing connectors etc., if required, shall be provided in the boxes. The boxes shall be protected from rust by zinc phosphate primer process. Boxes shall be finished with minimum 2 coats of enamel paint of approved colour. A screwed brass stud shall be provided in all boxes as earthing terminal.

3.6.2.1 Outlet Boxes For Light Fittings.

These shall be minimum 75mm x 75mm x 50mm deep and provided with required number of threaded collars for conduit entry. For ceiling mounted florescent fittings, the boxes shall be provided 300 mm off centre for a 1200 mm fitting and 150 mm off centre for a 600 mm fitting so that the wiring is taken directly to the down rod. 3 mm thick perspex/hylam sheet cover of matching colour shall be provided.

3.6.2.2 Outlet Boxes For Ceiling

Outlet boxes for ceiling fans shall be fabricated from minimum 2 mm thick MS sheet steel. The boxes shall be hexagonal/round in shape of minimum 75 mm depth and 60 mm sides or 120 dia in case of round type box. Each box shall be provided with a recessed fan hook in the form of one 'U' shaped 12 mm dia rod welded to the box and securely tied to the top reinforcement of the concrete slab for a length of minimum 150 mm on either side. 3 mm thick Perspex/hylam sheet cover of matching colour shall be provided.

3.6.3 Boxes For Modular Wiring Accessories

3.6.3.1 Switch Boxes - Modular Type

Switch boxes suitable to house modular type switches of required ratings, and fan regulators as required shall be provided. In case the number of switches in one box is not tallying with that available in standard manufacture, the box accommodating the next higher number of switches shall be provided without any extra cost. In case fan regulator/regulators is /are to be provided at a later dated, suitable provision for accommodating such regulators shall be made in the switch boxes and blank off covers shall be provided without any extra cost. Boxes shall be of same make as of Switches

Switch boxes shall be so designed that accessories are mounted on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, check-nuts and screwed bushes at conduit entries etc. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. Boxes shall be attached to conduits by means of check-nuts on either sides of their walls. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilised engineering plastics shall be fixed by means of counter sunk chromium plated brass machine screws. No timber shall be used for any supports. Switch boxes shall be located with bottom at 1200 mm above floor level unless otherwise indicated.

3.6.3.2 Modular Type Boxes For Socket/ Telephone/Call Bell Outlets

Outlet boxes shall be suitable for housing modular type switched socket outlets/ telephone outlets/ buzzers and any other outlet as required. These shall be so designed that accessories are mounted

on a grid plate with tapped holes for brass machine screws leaving ample space at the back and on the sides for accommodating conductors, checknuts and screwed bushes at conduit entries etc. The grid plates and M.S. boxes shall be fitted with a brass earth terminal. These shall be attached to conduits by means of check nuts on either sides of their walls. Moulded front covers made from high impact resistant, flame retardant and ultra violet stabilized engineering plastics shall be used to mount the outlets and shall be fixed to the outlet M.S. boxes by means of counter sunk chromium plated brass machine screws. No timber supports shall be used.

3.7 Cross Section

The conduits shall be of ample sectional area to facilitate simultaneous drawing of wires and permit future provision also. Total cross section of wires measured overall shall not normally be more than half the area of the conduit. Maximum number of PVC insulated 660/1100 Voltage grade copper conductor cable conforming to IS - 694 - 1990 as per table give below.

Maximum no of PVC insulated 660/1100 V grade aluminium/copper
Conductor cable conforming to British Standard

Normal Cross Sectional area of conductor in sq. mm	20 mm		25 mm		32 mm		38 mm		51 mm		64 mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1	2	3	4	5	6	7	8	9	10	11	12	13
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	3	4	8	7	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25					3	2	5	3	8	6	9	7
35							3	2	6	5	8	6
50									5	3	6	5
70									4	3	5	4

Note:

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
3. Conduits sizes are the nominal external diameters.

4. WIRES

Wiring shall be carried out with PVC insulated (FRLS) 660/1100 volt grade unsheathed single core wires with electrolytic annealed stranded copper (unless otherwise stated) conductors and conforming to British standard. All wire rolls shall be BS.6346. All wires shall bear manufacturer's label and shall be brought to site in new and original packages. Manufacturer's certificate, certifying that wires brought to site are of their manufacture shall be furnished as required.

5 COAXIAL CABLES

The coaxial cables shall be of wide band type with operation up to 300 MHz capability. Aging resistance shall comply with DIM 472.52 part 2 e.i. maximum 5% increase in attenuation at 200 MHz measured by artificial aging (14 days at 80o C) cables shall meet all exceed following specifications

Center core Dia	0.8 mm
Diaelectric Dia	4.8 mm
Dielectric	PE
Outer Conductor Dia	5.4 mm
Outer Dia	7.0 mm

Bending radius	more than 30 mm
Impedance	75 ohms
D.C Resistance	50 ohms/KM
Screening factor	more than 50
Attenuation	
50 Mhz	6.5
100 Mhz	9
200 Mhz	13
300 Mhz	16

6 LAYING OF CONDUITS

- Conduits shall be laid either recessed in walls and ceilings or on surface on walls and ceilings or partly recessed and partly on surface, as required.
- Same rate shall apply for recessed and surface conduiting in this contract.
- Stranded copper conductor insulated wire of size as per schedule of quantities shall be provided in entire conduiting for loop earthing.
- GI wire of suitable size to serve as a fish wire shall be left in all conduit runs to facilitate drawing of wires after completion of conduiting.

6.1 Recessed Conduiting

Conduits recessed in concrete members shall be laid before casting, in the upper portion of slabs or otherwise as may be instructed, so as to embed the entire run of conduits and ceiling outlet boxes with a cover of minimum 12 mm concrete. Conduits shall be adequately tied to the reinforcement to prevent displacement during casting at intervals of maximum 1 meter. No reinforcement bars shall be cut to fix the conduits. Suitable flexible joints shall be provided at all locations where conduits cross expansion joints in the building.

Conduits recessed in brick work shall be laid in chases to be cut by electrical Contractor in brick work before plastering. The chases shall be cut by a chase cutting electric machine. The chases shall be of sufficient width to accommodate the required number of conduits and of sufficient depth to permit full thickness of plaster over conduits. The conduits shall be secured in the chase by means of heavy duty pressed steel clamps screwed to MS flat strip saddles at intervals of maximum 1 meter. The chases shall then be filled with cement and coarse sand mortar (1:3) and properly cured by watering.

Entire recessed conduit work in concrete members and in brick work shall be carried out in close coordination with progress of civil works. Conduits in concrete members shall be laid before casting and conduits in brick work shall be laid before plastering. Should it become necessary to embed conduits in already cast concrete members, suitable chase shall be cut in concrete for the purpose. For minimizing this cutting, conduits of lesser diameter than 25 mm and outlet boxes of lesser depth than 50 mm could be used by the Contractor for such extensions only after obtaining specific approval from Architects/Owners. For embedding conduits in finished and plastered brick work, the chase would have to be made in the finished brick work. After fixing conduit in chases, chases shall be made good in most workmanlike manner to match with the original finish.

Cutting chases in finished concrete or finished plastered brick work for recessing conduits and outlet boxes etc shall be done by the Contractors without any extra cost.

6.2 Surface Conduiting

Wherever so desired, conduit shall be laid in surface over finished concrete and/or plastered brickwork. Suitable spacer saddles of approved make and finish shall be fixed to the finished structural surface along the conduit route at intervals not exceeding 600 mm. Holes in concrete or brick work for fixing the saddles shall be made neatly by electric drills using masonry drill bits. Conduits shall be fixed on the saddles by means of good quality heavy duty MS clamps screwed to the saddles by counter sunk screws. Neat appearance and good workmanship of surface conduiting work is of particular importance. The entire conduit work shall be in absolute line and plumb.

6.3 Fixing of conduit fittings and accessories

For concealed conduiting work, the fittings and accessories shall be completely embedded in walls/ceilings leaving top surface flush with finished wall/ceiling surface in a workman like manner.

Loop earthing wire shall be connected to a screwed earthstead inside outlet boxes to make an effective contact with the metal body.

6.4 Painting and Colour coding of conduits

Before laying, conduits shall be painted specially at such places where paint has been damaged due to vice or wrench grip or any other reason.

If so specified, surface conduits shall be provided with 20 mm wide and 100 mm long colour coding strips as below

Use	Code colour
Low voltage	Grey
Fire alarm	Red
Telephone	Black
PA system	Brown
Earthing system	Green
Control system lighting	Purple

6.5 Protection of Conduits

To safeguard against filling up with mortar/plaster etc. all the outlet and switch boxes shall be provided with temporary covers and plugs which shall be replaced by sheet/plate covers as required. All screwed and socketed joints shall be made fully water tight with white lead paste.

6.6 Cleaning of Conduit Runs

The entire conduit system including outlets and boxes shall be thoroughly cleaned after completion of erection and before drawing in of cables.

6.7 Protection against Dampness

All outlets in conduit system shall be properly drain and ventilated to minimise chances of condensation/sweating.

6.8 Expansion Joints

When crossing through expansion joints in buildings, the conduit sections across the joint shall be through approved quality heavy duty metal flexible conduits of the same size as the rigid conduit.

6.9 Loop Earthing

Loop earthing shall be provided by means of insulated stranded copper conductor wires of sizes as per Schedule of Quantity laid alongwith wiring inside conduits for all wiring outlets and sub-mains. Earthing terminals shall be provided inside all switch boxes, outlet boxes and draw boxes etc.

7 LAYING AND DRAWING OF WIRES

7.1 Bunching of Wires

Wires carrying current shall be so bunched in conduits that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

7.2 Drawing of Wires

The drawing of wires shall be done with due regard to the following precautions:-

- No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Burrs in cut conduits shall be smoothen before erection of conduits. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Approved type bushes shall be provided at conduit terminations.

- Before the wires are drawn into the conduits, conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits if necessary..

- While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which cause breakage of conductors.

- There shall be no sharp bends.

- The Contractor shall, after wiring is completed, provide a blank metal/sunmica plate on all switch / outlet / junction boxes for security and to ensure that wires are not stolen till switches / outlets etc.. are fixed at no extra cost the contractor shall be responsible to ensure that wires and loop earthing conductors are not broken and stolen. In the event of the wire been partly / fully stolen , the contractor shall replace the entire wiring alongwith loop earthing at no extra cost to the Owners. No joint of any nature whatsoever shall be permitted in wiring and loop earthing .

7.3 Termination /Jointing of Wires

- Sub-circuit wiring shall be carried out in looping system. Joints shall be made only at distribution board terminals, switches/buzzers and at ceiling roses/connectors/lamp holders terminals for lights/fans/ socket outlets. No joints shall be made inside conduits or junction/draw/inspection boxes.
- Switches controlling lights, fans or socket outlets shall be connected in the phase wire of the final sub circuit only. Switches shall never be connected in the neutral wire.
- Wiring conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any special reason shall be made by approved connectors. Specific prior permission from Architect/Owners in writing shall be obtained before making such joint.
- Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or wringing.
- Strands of wires shall not be cut for connecting terminals. All strands of wires shall be twisted round at the end before connection.
- Conductors having nominal cross sectional area exceeding 4 sq. mm shall always be provided with crimping sockets.
- At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used.
- Brass nuts and bolts shall be used for all connections.
- The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.
- Switches controlling lights, fans, socket outlets etc. shall be connected to the phase wire of circuits only.
- Only certified valid license holder wiremen shall be employed to do wiring / jointing work.

7.4 Load Balancing

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

7.5 Colour Code of Conductors

Colour code shall be maintained for the entire wiring installation - red, yellow, blue for three phases, black for neutral and green for earth.

8. MEASUREMENT AND PAYMENT OF WIRING

Wiring for lights, fans, convenience socket outlets and telephone outlets etc. shall be measured and paid for on POINT BASIS as itemized schedule of quantities and as elaborated as below unless otherwise stated

8.1 Primary and Secondary light point wiring

In respect of group control of lights (more than one light controlled by one switch or MCB), wiring upto the first light in the group shall be measured and paid for as a primary light point. Wiring for other lights looped in one group for switch controlled as also MCB controlled lights shall be measured and paid for as secondary light points. Primary light points for switch controlled lights shall include the cost of control switch whereas primary light points controlled by MCBs shall not include the switch cost. The cost of MCB controlling such lights shall not be included in the primary light point rate since the MCB shall be paid for in the item of DB.

The point wiring basis shall assume average wiring length and average conduiting length per point based on parameters stipulated in para 8.2 below. The average wiring length and average conducting length forming the basis of point wiring payment, shall take the electrical layouts of the entire project into consideration. Tenderers are advised to seek clarifications, if they so desire, on this aspect before submitting their tenders. No claim for extra payment on account of electrical layouts in part or whole of the project requiring larger average wiring and conduiting length per point, whether specifically shown in tender drawings or not, shall be entertained after the award of contract.

8.2 Parameters: Wiring shall be carried out as per following parameters in recessed/ surface conduit system.

- Only looping system of wiring shall be adopted throughout. No joints excepting at wiring terminals shall be permitted.
- All accessories shall be flush type unless otherwise stated.
- For estimation of load, following loads per point shall be assumed.

	Light points	100 Watts.
6 amps socket outlet points	100 Watts.	
Fan points	60 Watts.	
Exhaust fan points	300 Watts or as specified.	
16 amp socket outlet points	1000 Watts.	

- Lights, fans and 6 amp socket outlets may be wired on a common final such circuit. Such circuit shall not normally have more than a total of ten lights, fans or socket outlets or a load of 800 watts whichever is lesser.
- Power circuits shall normally have maximum one 16 amps socket outlet unless otherwise stated. Separate circuit shall be run for each geyser, kitchen equipment, window air conditioners and similar appliances.
- Wiring rates shall include painting of conduits and other accessories as required.
- Wiring rates shall include cleaning of dust, splashes of colour wash or paint from all fixtures, fans, fittings etc. at the time of taking over of the installation.
- Wiring rates shall include blanking of outlet boxes to prevent damage/pilferage of wires as elaborated in para 7.2.

8.3 Definitions

8.3.1 Wiring for Lights

Primary Light Points : Wiring for primary light points, as defined in para 8.1 above, shall commence at the Distribution Board terminals and shall terminate at the ceiling rose/connector in ceiling box/lamp holder via the control switch (for switch controlled lights). Rates for primary light point wiring shall be deemed to be inclusive of the cost of entire material and labour require for completion of primary light point thus defined including : .

- Recessed / surface conduting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required,
- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.
- Control switch with switch box and cover plate of specified type including fixing screws, earth terminal etc. complete as required. Cost of this switch is applicable only for switch controlled points. This cost shall not be applicable for DB controlled points.
- Loop earthing with insulated copper wires.

Secondary Light points :

Secondary light points, as defined in para 8.1 above, shall cover the cost of interconnection wiring between group controlled light fittings and shall be deemed to be inclusive of the cost of entire materials and labour required for completion of the secondary light point thus defined including

- Recessed / surface conduting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required,
- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.
- Loop earthing with insulated copper wires.

8.3.2 Wiring for Ceiling Fans

Wiring for ceiling fan points shall be same as for primary light points and shall, in addition, include ceiling outlet box with recessed fan hooks and provision in the switch box for mounting the fan regulator.

8.3.3 Wiring for Exhaust Fans

Wiring for exhaust fan points shall be same as for primary light points and shall in addition include the cost of providing a 3/5 pin 6 amp socket outlet near the fan and a 6 amp control switch at convenient location near the room entry.

8.3.4 Wiring for Call Bell Points

Wiring for call bell points shall be the same as for primary light points and shall in addition include the cost of a call bell/buzzer of approved type and make in the required location and a call bell in lieu of the control switch at a convenient location as required.

8.3.5 Wiring for Telephone Outlets

Wiring for telephone outlets points shall include the entire wiring and conduiting from the Jack panel to the telephone outlet including the telephone outlet complete as required and as itemized in the Schedule of Quantities

8.3.6 Wiring for Convenience Socket Outlets

3 pin 6 amps and 3 pin 16 amps single phase multipronged switched convenience socket outlets shall be provided in the building as indicated in the layout drawings.

9. ROUTINE AND COMPLETION TESTS

9.1 Installation Completion Tests

At the completion of the work, the entire installation shall be subject to the following tests:

1. Wiring continuity test
2. Insulation resistance test
3. Earth continuity test
4. Earth resistivity test

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

9.2 Wiring Continuity Test

All wiring systems shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energized.

9.3 Insulation Resistance Test

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all fuses in place and all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 megaohms divided by the number of points provided on the circuit the whole installation shall not have an insulation resistance lower than one megaohm.

The insulation resistance shall also be measured between all conductors connected to one phase conductor of the supply and shall be carried out after removing all metallic connections between the two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant Standard specification or where there is no such specification, shall not be less than half a megohm or when PVC insulated cables are used for wiring 12.5 megohms divided by the number of outlets. Where a whole installation is being tested a lower value than that given by the above formula subject to a minimum of 1 Megohms is acceptable.

9.4 Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same alongwith the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm

9.5 Testing Of Polarity Of Non-Linked Single Pole Switches

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three of four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Architect as well as the local authorities.

9.6 Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

9.7 Performance

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.

9.8 Tests And Test Reports

The Contractor shall furnish test reports and preliminary drawings for the equipment to the Architect/owners for approval before commencing supply of the equipment. The Contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc., required by the local Inspectors or any other Authorities would be supplied by the Contractor without any extra charge.

9.9 Voice & DATA System:

A complete outlet and wiring system for voice/data must be provided. All work must be in accordance with the recommended standards of America.

Provide conduit c/w wiring as per drawings/owner's requirements. Confirm all requirements with owner for complete communication system at the time of tender and before rough-in/installation.

Conduits shall not exceed two (2) 90 degrees sweep bends or the equivalent without the use of a pull box. Two offsets equal one (1) 90 degrees bend.

Minimum conduit size shall be 25mm.

No conduit run shall be longer than 30.5 m (100') between pull boxes or telephone terminating points.

The electrical contractor shall supply and install all wiring in/beyond the telephone demarcation point (main DC room on each floor).

Wiring guideline:

Wiring shall be minimum 6 pair "cat.6" or better (better transmission performance) from Jack Panel (located on each floor) to each telephone outlet. Leave spare loops of wire at outlet box.

The contractor shall ensure that termination, labelling and testing is performed by the telecommunications specialist

Outlet cover plates shall match the finish of other accessories (lighting switch/socket outlets/etc.) Within the same area.

The contractor shall provide 25% spare capacity in each telephone closet.

II TECHNICAL SPECIFICATIONS OF MEDIUM VOLTAGE DISTRIBUTION BOARDS

1 GENERAL

This section covers specification of DBs.

2. STANDARDS AND CODES

The following British Standard Specifications/IEC and Codes of Practice will apply to the equipment and the work covered by the scope of this contract.

IEC 439-3 and BS EN 60439-3

For IEC-60947-2

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

3. MINIATURE CIRCUIT BREAKERS

The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system as per For IEC-60947-2

- The MCB's shall have a rupturing capacity of 10 KA at 0.5 p.f.
- The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with H.R.C. fuse/PVC cable characteristic.
- Type test certificates from independent authorities shall be submitted with the tender.

4. FINAL DISTRIBUTION BOARDS

- Final distribution boards shall be flush mounting, totally enclosed, dust and vermin proof and shall comprise of miniature circuit breakers, earth leakage circuit breakers, neutral link etc as detailed in the schedule of quantities.
- The distribution equipment forming a part of the Distribution Boards shall comply to the relevant Standards and Codes of British Standards and as per detailed specifications included in this tender document.
- The board shall be fabricated from 1.6 mm thick CRCA sheet steel and shall have a hinged lockable spring loaded cover. All cutouts and covers shall be provided with synthetic rubber gaskets. The entire construction shall give a IP 42 degree of protection.
- The bus-bar shall be of electrical grade copper having a maximum current density of 1.6 ampere per square mm and PVC insulated throughout the length.
- All the internal connections shall be with either solid copper PVC insulated or copper conductor PVC insulated wires of adequate rating.
- All the internal connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.
- All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a frame work for easy removal and maintenance.

- The sheet steel work shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.
- All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Owners.
- A sample of the completed board is to be got approved by the architects/owners before commencement of supply and erection.

5 SHEET STEEL TREATMENT AND PAINTING

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- All sheet steel shall after metal treatment be given powder coated finish painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

6. NAME PLATES AND LABELS

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

III TECHNICAL SPECIFICATIONS CABLE TRAYS

A Referenced Standards:

BS EN 61537 Cable Management

BS 729 Hot dip galvanized coating on iron and steel articles

1. Cable trays, of sizes as per schedule of quantities and drawings shall be of perforated doubled bend channel/ladder design unless otherwise stated. Cable trays shall be fabricated from minimum 2 mm thick sheet steel and shall be complete with tees, elbows, risers, and all necessary hardware. Cable trays shall comply with the following:

2. Trays shall have suitable strength and rigidity to provide proper support for all contained cables. Trays shall not have sharp edges, burrs or projections injurious to cable insulation. Trays shall include fittings for changes in direction and elevation. Cable trays and accessories shall be power coated or approved equivalent. Cable trays shall not have sharp edges, burrs or projection that may damage the insulation jackets of the wiring. Cable trays shall have side rails or equivalent structural members.

3. Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out ensuring the following :

4. Cable tray mounting arrangement type to be as marked on layout drawing. Assembly of tray mounting structure shall be supplied fabricated, erected & painted by the electrical contractor. Tray mounting structures shall be welded to plate inserts or to structural beams as approved by the Owners/Architects. Wherever embedded plates & structural beams are not available for welding the tray mounting structure electrical contractor to supply the MS plates & fix them to floor slab by four anchor fasteners of minimum 16 mm dia having minimum holding power of 5000 Kg at no extra cost. Maximum loading on a horizontal support arm to be 120 Kg. metre of cable run. Width of the horizontal arms of the tray supporting structures to be same as the tray widths specified in tray layout drawings, plus length required, for welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers shown in tray layout drawings. Spacing between horizontal supports arms of vertical tray runs to be 300 mm. Cable trays will be welded to their mounting supports. Minimum clearance between the top most tray tier and structural member to be 300 mm. Cables in vertical race ways to be clamped by saddle type clamps to the horizontal slotted angels. Clamps to be fabricated from 3 mm thick aluminium strip at site by the electrical contractor to suit cable groups. The structural steel (standard quality) shall be according to latest revision of international code. Welding shall be as per latest revisions of international code. All structural steel to be painted with one shop coat of red oxide and oil primer followed by a finishing coat of aluminium alkyl paint where any cuts or holes are made on finished steel work these shall be sealed against oxidation by red oxide followed by the same finishing paint. Steel sheet covers wherever indicated to be similarly painted. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. Trays shall be supported adequately by means of painted MS structural members secured to the structure by dash fasteners or by grouting. The entire cable tray system shall be rigid. Each run of cable tray shall be completed before laying of cables. Cable trays shall be erected so as to be exposed and accessible.

1.0 SCOPE

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

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

2.0 STANDARDS AND CODES

National Fire Protection Association (NFPA) - USA:

Specification for Smoke Detectors BS 5445: 1984/ NFPA-72

Specification for Heat Sensitive Detectors NFPA-72
for use in automatic fire alarm Systems

Code of Practice for installation of automatic NFPA-72
Fire Alarm System using Heat sensitive type Fire Detectors

Code of Practice for Electrical Wiring installations NFPA-70
(System voltage not exceeding 660 volts)

Automatic Fire Alarm Systems in buildings BS 3116 Part I/ NFPA-72

Control and indicating equipment BS 3116 Part IV/ NFPA-72

British Code of practice for installation CP 1019: 1972/ NFPA-72
and servicing of Fire Alarm Systems

Life Safety Code NFPA101

European Standards EN 54

B. Underwriters Laboratories Inc. (UL) - USA:

Smoke Detectors for Fire Protective Signaling Systems UL 268

Control Units for Fire Protective Signaling Systems **9th Edition Listed** UL 864

A Smoke Detectors for Duct Applications UL 268

Heat Detectors for Fire Protective Signaling Systems UL 521

Audible Signaling Appliances UL 464

Manually Actuated Signaling Boxes UL 38

Water flow Indicators for Fire Protective Signaling Systems UL 346
Visual Notification Appliances UL 1971

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

3.0 PHOTO ELECTRIC TYPE SMOKE DETECTORS

3.1 GENERAL

The Photo-electric type Smoke Detectors shall be capable of sensing fire in the smoldering or the incipient stage. Smoke Detectors shall be sensitive to visible products of combustion in accordance with the sensitivity requirements of BS 5445 Part 7 : 1984.

3.2 CONSTRUCTIONAL FEATURES

3.2.1 DETECTOR HEAD

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

3.2.2 DETECTOR BASES

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

3.2.3 LED INDICATION LAMP

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

3.2.4 ELECTRONICS

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

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

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

- protection against high voltage spikes on the supply line
- protection against polarity reversal
- protection of the ionization chamber monitoring circuits from high voltage static discharges
- protection against high frequency transients

- detection of alarm at the control unit even in the event of LED failure
- protection against transient spikes on long lead lines to the remote indicators

3.2.5 DETECTOR WIRING

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

3.2.6 OPERATIONAL PARAMETERS

The Detectors shall be suitable for operation at a maximum ambient temperature of 60 deg C. and a minimum of 0 deg C with a maximum relative humidity of 93%.

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

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

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

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

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

3.2.7 DETECTOR TESTING IN SITU

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

3.2.8 DETECTOR CERTIFICATION

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

4.0 HEAT SENSITIVE RATE OF RISE CUM FIXED TEMPERATURE TYPE DETECTORS

4.1 GENERAL

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

4.2 CONSTRUCTIONAL FEATURES

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

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

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

4.3 MOUNTING PLATES

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

4.4 DETECTOR OPERATION

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

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

4.5 DETECTORS APPROVALS

The Detectors shall meet the performance requirements as per International Standards. The Detectors shall be UL Listed and FM approved and shall meet the approval requirements of the Local Fire Authorities. Test certificates from independent authorities and the approvals for the Detectors shall be furnished with the tender.

5.0 HEAT SENSITIVE FIXED TEMPERATURE TYPE DETECTORS

5.1 GENERAL

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

5.2 CONSTRUCTIONAL FEATURES

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

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

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

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5.4 DETECTOR OPERATION

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

5.5 DETECTORS CERTIFICATION

The Detectors shall meet the performance requirements as per International Standards. The Detectors shall be UL Listed and FM approved and shall meet the approval requirements of the Local Fire Authorities. Test certificates from independent authorities and the approvals for the Detectors shall be furnished with the tender.

6.0 MANUAL CALL POINTS

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

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

7.0 RESPONSE INDICATOR

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

8.0 ILLUMINATED SIGNS

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

9.0 ALARM SIRENS

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

10.0 MAIN CONTROL PANEL

10.1 GENERAL

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

10.2 CONSTRUCTIONAL FEATURES

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

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

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

10.3 MAIN CONTROL PANEL CONFIGURATION with PA Amplifier

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

a) **Microprocessor** based addressable electronic panel complete with a facia to provide the following indications, controls, ON site programmable Key Pads, suitable for RS-485 communication having 32 x 2 LINE LCD display EPROM event logging. :

- "FIRE" indication one per zone
- "FAULT" indication one per zone
- "FIRE TEST" push button one per zone
- "ZONE ISOLATE" switch one per zone
- "DETECTOR FAILURE - OPEN CIRCUIT - SHORT CIRCUIT" indication
- "DETECTOR REMOVED" indication
- "BREAK IN WIRING" indication with initiation of alarm

b) Mother Board to control and monitor the entire System with audio/visual alarms and with a facia to provide the following controls and indications:

- "MAINS ON" switch with indicating lamp
- "SYSTEM ON" switch with indicating lamp
- "MAINS FAILURE" indication
- "BATTERY LOW" indication
- "LAMP TEST" push button
- "STANDBY ON" indication
- "SYSTEM RESET" push button
- "ALARM CANCEL" push button
- "TRICKLE BOOST" toggle switch
- "AUDIO ALARM" selector switches for general and/or zone wise broadcast.
- "AUTO/MANUAL" selector switch for the Illuminated Signs

c) Power Supply for the System integral with the MCP. The power supply rating shall be adequate for the Detectors, Illuminated Signs and all other devices as required in the System.

The power supply unit integral with the Control Panel shall consist of a 230/24 volt step down transformer. The 24 volt secondary of the transformer shall be rectified through a silicon diode bridge rectifier unit and the D C output filtered to minimize ripples. The unregulated 24 volt DC supply shall be regulated for the electronic circuits and the power to the entire System.

d) Screw type terminal blocks and cable glands for termination of all control wiring.

e) Required potential free spare contacts/ or as called for in Bill Of Quantities.

f) End of Line resistors as required by the System design shall be provided as a part of the Control Panel.

g) Audio visual alarm unit with a provision to sound an alarm throughout the building from the Main Control Panel either as a general broadcast or selectively as may be required.

10.4 ELECTRONICS

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

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

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

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

10.5 DISPLAY

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

10.6 INTERNAL WIRING

All internal wiring shall be in accordance with BS.6346 & with 1.5 sq mm PVC insulated copper conductor wires colour coded and labelled with ferrules for easy identification. The wiring shall be properly bunched and harnessed. The wiring shall be done in a manner such that it is readily accessible from the front for maintenance.

10.7 SHEET STEEL TREATMENT AND PAINTING

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

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

10.8 NAME PLATES AND LABELS

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

11.0 REMOTE CONTROL PANELS

Remote Control Panels shall generally comply to the Specifications of the Main Control Panels as detailed in para 5.10.3 above. These shall be located remotely and will indicate the status of each Zone and the MCP but without any controls. The indications to be provided on the Remote Control Panel shall be :

- "FIRE" indication one per zone
- "FAULT" indication one per zone

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

12.0 BATTERY AND BATTERY CHARGER

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

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

13.0 WIRING

The wiring for the Fire Detection System shall in general comply with the requirements of BS.6346. The Detectors in each loop shall be wired upto the Main Control Panel with a 2 core 1.5 sq. mm. copper conductor or 2 core 2.5 sq mm aluminium conductor FRLS PVC insulated 660/1100 volt grade wires in concealed or surface conduit as required. Crimped terminations shall be used throughout the System.

14.0 TEST CERTIFICATES

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

15.0 SENSITIVITY ADJUSTMENTS

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

16.0 INSTALLATION, COMMISSIONING AND ACCEPTANCE TESTS

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

INSTALLATION TESTS

After installation of the Detector Bases and prior to installation of the Detectors, the wiring shall be tested for continuity and insulation resistance. A high voltage insulation meter 500 to 1000

volts shall be used to measure the insulation resistance between each conductor and between each conductor and earth. The value of insulation resistance shall not be less than 1 Mega ohm.

The insulation resistance of the wiring to the Response Indicators shall also be checked as above prior to the installation of the Indicators.

COMMISSIONING AND ACCEPTANCE TESTS

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

Each alarm circuit shall be energised separately and the sound level reading taken to check for conformity with the minimum standards.

Open circuit and removal of a Detector from a detection circuit shall be tested.

Short circuit operation for each detection circuit will be tested

Tests to prove satisfactory operation of the system shall be conducted simulating the conditions of

Mains Failure

Battery disconnection

Open circuit and short circuit conditions of each alarm circuit

The results of all the tests conducted shall be so recorded and approved by the Clients/Architects prior to acceptance of the System.

V. TECHNICAL SPECIFICATIONS OF IP CCTV SURVEILLANCE SYSTEM:

1. INTENT OF SPECIFICATION

a) This specification is intended to cover the following activities and services in respect of IP video surveillance system for Plant Surveillance System with all components and accessories. The Activities are: -

- i. Designing of complete system using specification for different equipment and cables.
- ii. Procurement of all required materials by contractor and organizing pre-dispatch inspection at contractor's place.
- iii. Providing engineering data, drawings and O&M manuals of all equipment for Owner's records.
- iv. Packing and transportation from the contractor's place to the site. In case of imported items Customs / port clearance, if required shall be organized by the contractor.
- v. Receipt, unloading, handling, storage, insurance, preservation and conservation of equipment at site. However client may provide space for site office.
- vi. Pre-assembly fabrication if any, erection, testing, commissioning and putting into satisfactory operation of all the equipment, cabling and complete IP video surveillance system in a planned and systematic manner acceptable to the Owner. This includes the earthing of camera & equipments also. All items required for earthing and erecting work is to be done by vendor.
- vii. Furnishing of spares on FOR site basis.

b) The bidder shall be responsible for providing all material, equipment and services specified or otherwise which are required to ensure and fulfill the intent of operability, maintainability and the reliability.

c) It is not intended to specify completely herein all aspects of design and construction of equipment; nevertheless, the equipment shall conform in all workmanship and shall be capable of performing in continuous commercial operation in industrial environment round the clock.

d) The equipment offered by the Bidder shall be complete in all respects. Any material and component not specifically stated in this specification shall be deemed to be included unless specifically excluded. All such Equipment/ accessories shall be supplied without any extra cost.

e) Design and manufacturing shall be such that equipment/accessories of same type and ratings are interchangeable.

2. SCOPE OF WORK

The scope of work includes design, manufacture, shop testing, packing and transport to site/storage before erection, installation, commissioning and testing of the complete system. The details of scope of work are as follows: -

a) Preliminary survey of the site and locations of IP cameras and cable route, finalization of same in consultation with engineer-in-charge and submission of detailed time schedule for executing the work.

b) Submission of final drawing as detailed.

- c) Design, manufacture and shop testing of all the equipment as per Bill of Material at vendor's place and organizing the pre-dispatch inspection as per quality plan. This includes the NVR application and client software also (original with licenses).
- d) Packing, transporting and then storage of the material at site till installation of equipment.
- e) Organizing and executing the cable trenching, cable laying, termination / finalized in the route and erection of GI pole for IP camera at designated locations.
- f) Fixing of cameras and junction boxes on the GI pole.
- g) Fixing of network switches, media converters at different locations in racks.
- h) All interconnections, all IO terminations, all cores of fiber optic cable, power cable, media convertors, access points as per the requirement.
- i) Installation of network video recorder (NVR servers), PCs, RAID all software, keyboards in both control room as per the requirement.
- j) Installation, testing and commissioning of the complete system and test run of the same for 15 days.
- k) Demonstration of all features of the system to client and commencing the trial run for 15 days after test run.
- l) Submission of all test reports, as built drawings, all technical documents, manuals etc.
- m) Any supply of item and work to be executed related with successful working of complete system reliability (with all features working) which is not included in the above points has to be informed by the vendor and same has to be supplied /executed by them at no extra cost.
- n) Providing training to client personnel on all aspects of the system, programming and maintenance.
- o) Warranty period shall be for a period of 36 months for the entire system from the date of acceptance by client i.e. issue of completion certificate by competent authority. All systems including units, assemblies, and sub assemblies shall be covered under warranty. Any parts found defective during warranty period shall be replaced by the contractor without any charges whatsoever.
- p) The contractor should attend all breaks down jobs within 24 hours.

3. BRIEF OVER VIEW OF IP VIDEO SURVEILLANCE SYSTEM:

3.1 It is decided to have main control room at Security department having network video recording system (NVRs) with the required software and data storage facility installed from where apart from cameras control facility, the recording of all cameras output for suitable duration can be done. The control functions of cameras shall be provided at Security department. The cameras shall have the day and night vision capability and should be able to withstand the outdoor industrial environment condition. Simultaneously the monitoring on a 32" Plasma LCD monitor screen of all/selected cameras shall be available with the help of PC if required.

3.2 Surveillance CCTV system is required to ensure effective surveillance of an area as well as create a tamperproof record for post event analysis. The System shall provide an online display of video images on TFT monitors at central control rooms.

3.3 System should facilitate viewing of live and recorded images and controlling of all cameras by the authorized users present in the LAN.

3.4 System should provide inter-operability of hardware, OS, software, networking, printing, database connectivity, reporting, and communication protocols. System expansion should be possible through off-the-shelf available hardware.

3.5 Equipment with better specifications shall be accepted.

4. GENERAL SPECIFICATIONS:

4.1 Proposed IP surveillance system shall be an open standard based integrated system with IP network centric functional and management architecture aimed at providing high-speed manual/automatic operation for best performance.

4.2 System shall use video signals from various IP cameras installed at different locations, process them for viewing on workstations/monitors at central Control Room and simultaneously record all the cameras after compression using MPEG-4 or better standard. The system shall also have capability and provision to transmit video signals in real time to user defined remote locations through onsite VSAT antennas Joystick or Mouse-Keyboard controllers shall be used for Pan, Tilt, Zoom, and other functions of desired cameras. It should also be possible to monitor and control the cameras through an IP network from a remote location.

4.3 The NVR/CAMERA SERVER can be embedded type or server based. However the NVR/CAMERA SERVER software shall run on common off the shelf available servers (Camera server & Database server). NVR/Camera Server shall be able to handle 80 or more cameras.

4.4 Network Video Recorder shall offer both video stream management and video stream storage management. Recording frame rate & resolution in respect of individual channel shall be programmable.

4.5 System should ensure that once recorded, the video cannot be altered; ensuring the audit trail is intact for evidential purposes.

4.6 System shall provide sufficient storage of all the camera recordings for a period of 30 days or more @ 25 FPS, at 4 CIF or better quality using necessary compression techniques for all cameras (extended capacity of cameras i.e. present capacity + 25 %).

4.7 System shall use IP enabled cameras. The video shall be compressed using MPEG-4 or better standard and streamed over the IP network.

4.8 The recording resolution and frame rate for each camera shall be user programmable.

4.9 The Area under surveillance shall be monitored and controlled from Central Control Room through workstations and Joystick controllers.

4.10 Surveillance System shall operate on 12V DC / POE / 230 V, 50 Hz single phase power supply. Power for all the equipment will be conditioned using on-line UPS. If any equipment operates on any voltage other than the supply voltage and supply frequency, necessary conversion/correction device for supply shall be supplied along with the equipment.

4.11 Power supply system to all surveillance cameras shall have provision for receiving back-up power (POE) from an off-site switch in the event of total power cut-off in the complex.

4.12 All the control equipments e.g. servers, NVR/CAMERA SERVER, NAS/Raid backup device, decoders etc. shall be provided in standard Racks.

4.13 All the cameras & control equipment, meant for installations, shall be suitable to work from (-) 10 degree C to (+) 50 degree C with RH up to 90% non-condensing. This temperature range may be achieved with or without heater.

5. SYSTEM REQUIREMENTS:

- 5.1. IP Camera shall be used for image capture. All Cameras shall be Day/Night cameras.
- 5.2. All cameras shall be powered through UPS. Housing of cameras meant for use must be integrated by the camera manufacturer.
- 5.3. System must provide built-in facility of watermarking or Digital certificate to ensure tamperproof recording so that these can be used as evidence at a later date, if so desired. The recording shall support audit trail feature.
- 5.4. All camera recordings shall have Camera ID & location/area of recording as well as date/time stamp. Camera ID, Location/Area of recording & date/time shall be programmable by the system administrator with User ID & Password.
- 5.5. Facility of camera recording in real-time mode (25 FPS)/15/12.5/10 or lower FPS as well as in any desired combination must be available in the system.
- 5.6. Facility of Camera recording in CIF, 2CIF, 4 CIF as well as in any combination i.e. any camera can be recorded in any quality – Selective or Group of cameras must be available in the system.
- 5.7. System to have facility of additional camera installation beyond the originally planned capacity.
- 5.8. In order to optimize the memory, while recording, video shall be compressed using MPEG-4 or better standard and streamed over the IP network. Once on the network, video can be viewed on a Control room workstation shall be recorded on NVR/CAMERA SERVER and shall be backed up on NAS/RAID Backup device.
- 5.9. System shall be triplex i.e. it should provide facility of Viewing, Recording & Replay simultaneously.
- 5.10. The offered system shall have facility to export the desired portion of clipping (from a desired date/time to another desired date/time) on CD or DVD. Viewing of this recording shall be possible on standard PC using standard software like windows media player etc.
- 5.11. Redundancy/Fail-over feature is required i.e. in case of failure of an NVR/CAMERA SERVER the relevant cameras shall automatically switch over to the redundant NVR/CAMERA SERVER.
- 5.12. Central Control Room will have workstations along with controllers for Camera operation. For monitoring purposes, Video monitors shall be setup with suitable mounting arrangements, as per user requirements. Facility for viewing and controlling all the cameras at various other locations, as required, shall be provided.
- 5.13. There shall be a Control System with Video Control Software to manage all the video surveillance devices.
- 5.14. Video stream from individual cameras shall be recorded on respective NVR/Camera Server & subsequently archived to NAS box/RAID backup device. System shall have provision to automatically over-write the new information after the period of 30/31 days & necessary script/algorithm must be available in the Application.
- 5.15. All the workstations in LAN should be provided with software to view and control the cameras, encoders and retrieve the recorded video images from the NVR/CAMERA SERVER / NAS/ Raid backup device seamlessly.
- 5.16. The system should have automatic frame rate detection and recording facility. The system should have automatic (Actively Controlled Frame rate) frame rate recording feature; if the scene is

inactive the video can be streamed at a much lower frame rate. As soon as the motion analysis software detects movement the video is streamed at full frame rate.

5.17. Database Server shall keep track of all configurations & events. This will help in proper System administration & management of redundancies etc.

5.18. Watchdog facility for abnormal system halt and operator alert alarm.

5.19. The system should provide Camera fault, light fault, extra delay, delay loss, signal loss, etc. It shall facilitate with additional TFT on screen display to log all type of faults and alert alarms to the operator with location, day, date, time with map.

6. TECHNICAL SPECIFICATIONS OF THE SUB-UNITS:

6.1. DOME NETWORK OUTDOOR CAMERA WITH PTZ

The product specified shall be a rugged, outdoor surveillance domed camera system. The camera system shall consist of an integrated high resolution, CCD camera and intelligent, integral receiver/driver.

Digital image stabilization shall be provided using electronic compensation that filters out vibrations caused by wind and other environmental conditions. This image stabilization function shall be on/off selectable from the controller's system keyboard.

Parameter	Description
Type	Network wired, Pan/Tilt/Zoom in-built, dome type IP
Imaging device	Interline transfer 1/4" or better format CCD sensor
Listing	UL
Optical Zoom	26 X or better
Digital zoom	12 X or better
Focal length	3.5 mm to 91 mm or better
Focus	Automatic, with manual override
Iris	Automatic, with manual override
No. of pixel	752 X 582
Compression format	MPEG-4/JPEG/H.264; Selectable
Scanning system	PAL, Progressive scan
Illumination	1 Lux (color), 0.01 Lux (B/W) or better
Signal to Noise Ratio	>= 50 dB
Frame Rate	1-25/30 fps (PAL); Field/frame based coding
Configuration	Via web browser, built-in web server interfaces
Gain Control	Off/Auto (with adjustable limit)
Aperture Correction	Horizontal and vertical
Pan travel	360 deg endless
Tilt travel	-5° - 90°
Manual Pan speed	0.3°/s to 160°/s
Manual Tilt speed	0.5°/s to 90°/s
Pre-position Speed	Pan: 400°/s or better, Tilt: 150°/s or better
Preset position	Min. 200 and selectable
Alarm control	Required
Motion detection	Built-in
Receiver/Driver unit	Built-in
Whit balance	Automatic
Electronic shutter	Automatic

Day & Night	Automatic/Manual
Backlight compensation	Required with black masking or other suitable technology
Audio support	Bi-directional
Remote programming with OSD	Yes on Screen display
Video analytics	At edge
Degree of protection	IP 66 Std or better, vandal proof
Power supply	As per OEM design, AC 230V / DC 12V / POE

6.2. DOME NETWORK INDOOR CAMERA WITH PTZ

The product specified shall be a indoor surveillance dome camera system. The camera system shall consist of an integrated high resolution, CCD camera and intelligent, integral receiver/driver.

Digital image stabilization shall be provided using electronic compensation that filters out vibrations caused by wind and other environmental conditions. This image stabilization function shall be on/off selectable from the controller's system keyboard.

Parameter	Description
Type	Network wired, Pan/Tilt/Zoom in-built, dome type IP
Imaging device	Interline transfer 1/4" or better format CCD sensor
Listing	UL
Optical Zoom	26 X or better
Digital zoom	12 X or better
Focal length	4 mm to 72 mm or better
Focus	Automatic, with manual override
Iris	Automatic, with manual override
No. of pixel	720 X 576
Compression format	MPEG-4/JPEG/H.264; Selectable
Scanning system	PAL, Progressive scan
Illumination	1 Lux (color), 0.01 Lux (B/W) or better
Signal to Noise Ratio	>= 50 dB
Frame Rate	1-25/30 fps (PAL); Field/frame based coding
Configuration	Via web browser, built-in web server interfaces
Gain Control	Off/Auto (with adjustable limit)
Aperture Correction	Horizontal and vertical
Pan travel	360 deg endless
Tilt travel	-5° - 90°
Manual Pan speed	0.3°/s to 160°/s
Manual Tilt speed	0.5°/s to 90°/s
Pre-position Speed	Pan: 400°/s or better, Tilt: 150°/s or better
Preset position	Min. 200 and selectable
Alarm control	Required
Motion detection	Built-in
Receiver/Driver unit	Built-in
Whit balance	Automatic
Electronic shutter	Automatic
Day & Night	Automatic/Manual
Backlight compensation	Required with black masking or other suitable technology
Audio support	Bi-directional

Remote programming with OSD	Yes on Screen display
Video analytics	At edge
Degree of protection	Vandal proof
Power supply	As per OEM design, AC 230V / DC 12V / POE

6.3. NETWORK FIXED INDOOR CAMERA

Image Sensor	1/3" vertical double density interline CCD
Effective Pixels	HD 720P
Lens	3.8- 30MM SR
Signal System	PAL
Electronic Shutter	1/25s ~1/100,000s
Min. Illumination	Color 0.17 and monochrome .0057 Lux Day Night
Day & Night	Electronic
Auto Iris	DC Drive
Wide Dynamic Range	84 dB
Video Compression	Dual H.264
Bit Rate	32 K ~ 8Mbps
Audio Compression	G.711
Frame Rate	25fps
Image Settings Functions	Saturation, Brightness, Contrast adjustable through web browser
Motion Detect	Support
Dual Stream	Support
SD Card Local Recording	Support
Protocols	TCP / IP, HTTP, DHCP, DNS,DDNS,RTP / RTSP, PPPoE, SMTP, NTP.
Digital Noise Reduction Interface	Support
Communication	Ethernet port
Alarm Input	2 channel signal input
Alarm Output	2 channel relay output
Others	
Working Temperature	-10 ~ 60 , Humidity 90% or less (non-condensing)
Power Supply	12VDC, ±10% / PoE (Power over Ethernet)
Power Consumption	5.5W MAX
Impact Protection	IEC60068-2-75Eh,50J;EN50102, up to IK10
Certification	UL

6.4. Speed dome controller/PTZ controller - Speed Dome Controller should have variable speed joystick, LCD display for programming and it should be able to control the speed dome for PAN/TILT/Zoom.

6.5. JUNCTION BOX:

Junction box shall accommodate all the equipment required at the camera site. It shall withstand the high temperature environment. The provision for mounting the JB on the pole shall be made available in the junction box. It shall be vandal proof and weather proof so as to withstand the industrial environment and climate. The JB shall have a switch to switch the power supply from UPS. It shall accommodate the FO converter and other components of the system. All the equipment except the cameras shall be accommodated in the junction box, which is to be mounted on same pole. For terminating all cables the junction box should have suitable terminating block or connections. All the cables shall be clamped with suitable clamp to avoid the damage of the core/conductors due to cables weight. Each junction box should be grounded to earth with suitable copper cable and earth pit made near the pole location. The earth pit making, earthing material required including the grounding wire shall be in scope of contractor. The earth pit shall be made as per the standard procedure being followed in GCF. The junction box shall be of IP 65 standards or better and vandal proof.

6.6. POLE MOUNT:

Length of the pole	3 Meters
Material	GI powder coated
Diameter	As given in Annexure -
Standards	ISI
Other Provision	Junction Box mounting provision, Cable wiring provision internal to the Pole at JB for cables entry.
Mounting	To be grouted in a Concrete Structure in the ground.

7. DIGITAL NETWORK ATTACHED STORAGE ARRAY

Network attached storage with video recording management system software (VRMSS) shall be provided to manage 64 channels

The VRMSSSS shall be configured from the VMS Configuration Client. It shall be possible to assign encoders and IP cameras to it.

The VRMSS shall manage exclusively IP-Cameras, and the supported NAS storage systems. It shall offer system wide recording monitoring and management of NAS storage and cameras.

The VRMSS shall support the encoders and cameras to directly stream the data to the NAS storage. The VRMSS shall not be involved in the processing of the data.

The VRMSS shall manage all disk arrays in the system as a single virtual common pool of storage. It shall dynamically assign portions of that pool to IP-Cameras.

It shall be possible to secure the access to the VRMSS software with a password. This shall be done in the Configuration Client.

The VRMSS shall support MPEG-4/H.264/HD video streams in real time simultaneously frame rates ranging from 1fps to 25fps and resolution ranging from ¼ CIF to 4 CIF and recording for 30 days

Each camera's bit rate, frame rate and resolution shall be set independently from other cameras in the system, and altering these settings will not affect the recording and display settings of other cameras

Provide overall status information such as uptime, bit rate, retention times, status on recording and on storage.

The VRMSS shall Set up the entire system and configuration of individual devices, storage systems and users

VMSS shall Provide configuration of the network attached storage subsystems, recording parameters such as schedules, data rates, frame rates, streams and privileges.

It shall Manage user and group's privileges and roles, Integrate senders and cameras into the system, Configure senders and cameras, Create users and user groups, Regulate access to recordings.

It shall Protect against unauthorized access.

a. Each sender and camera shall be protected against tampering with device passwords for different access levels.

b. User administration function shall set different users to have different access rights to recordings.

Access to Configuration Manager shall be password protected.

Bookmarks shall be stored centrally within the 1 GB storage blocks or locally on the client application.

Redundant dual Gigabit Ethernet network interface ports

storage capacity- (8 x 2TB)

Bandwidth - 200 Mbit/s

RAID-5 hardware redundancy

Dedicated storage operating system delivers robust , secure operation

Hot-swappable hard drives

Remote monitoring via desktop application or browser

Operating Temperature +10 °C to +35 °C (+50 °F to +95 °F)

Processor As per BOQ

Socket 1

Cache memory 1 x 3 MB Level 2 cache

Memory protection ECC Unbuffered

Max front side bus As per BOQ

Memory Installed As per BOQ

SAS RAID Card As per BOQ

8. Video management client software

The software shall allow a mix of HD as well as SD cameras to be viewed at the same time. It shall handle up to 128 cameras at any point of time.

Multiple cameras shall be dragged and displayed in predefined quick scratch views

Sets of favorite views showing a logical composition of camera images shall be defined and named by each user. These favorite views shall be easily accessible and allow one-click display of related camera images in a user-defined layout.

Alarm and relay status information shall be displayed on the live page. Connected relays shall be activated or deactivated with a mouse-click.

A single click in a cameo shall records live video images from a camera locally. Up to two cameras shall be recorded at the same time. Still snapshots of a camera video image shall also be exported locally. The instant playback function shall enable one-click replay of the previous minute of the active camera's video.

The playback window shall be optimized to replay and export recorded video. A timeline panel shall show recordings and events ordered in time. It shall also facilitate the pinpointing of recordings at a particular time. Selected time periods of video on the timeline shall be easily exported.

Four cameras shall be selected for export in either a native or Windows-compatible export format. Video export shall be a background task allowing other tasks to be continued without interruption. Still snapshots of a recorded camera video image shall also be exported locally.

Live view

- Camera list (all IP camera and encoder devices) with camera connection and motion detection status
- User-specified favorite views list with camera connection and motion detection status
- Alarm and relay list with status
- Relay activation and deactivation
- Standard multi-screen grids displaying live camera images with local recording, motion indication, digital zoom and PTZ control
- User-specified multi-screen grids displaying live camera images with local recording, motion indication, digital zoom and PTZ control

Toolbar with:

- Live and Playback switching
- User-specific preferences
- Multi-screen grid selection (1, 2X2, 3X3 and 4X4)
- Decoration mode selection
- Window / full-screen toggle
- Sequencing selection
- Audio and volume control
- Configuration manager shortcut
- Log-off and help

- Task panels for snapshots (BMP format), favorite view design, and instant playback
- PTZ camera control console
- Log and export task status panels

Playback view

- Camera list (all IP cameras and encoder devices)
- Playback window for 1 or 2x2 cameras with in-window digital zoom
- Playback shuttle control console with trick mode replay and video scratching
- Timeline display of up to 4 cameras simultaneously with calendar and time range search function, and export selection (both Windows ASF and native format)
- Replay of exported recordings and snapshots from lists
- Task panels for snapshots (BMP format), instant playback, motion search and IVA search
- Search results panel with direct replay

Minimum PC requirements for Video Client

Operating system - Windows XP (with SP3), Vista (with SP2), Windows 7 (32 and 64 bit)
Graphic software - DirectX 9.0C March 2009 update
Processor - Intel Pentium Dual Core 3.0 GHz or comparable
Ram - 2 GByte or more
Free disk space - 10 GByte
Graphics card - NVIDIA GeForce 8600 or better
Network interface - 100/1000 BaseT

9 LCD TV MONITOR OF 32 INCH.

- TV Monitor with LCD display of 32 inch diagonal.
- Should be with HDMI, PC Inputs.
- Should be provided with remote control and all fittings so as to hang on wall or table mount etc.
- Should be from OEM based in India with service centre.
- Should have various picture mode options.

10. MODULAR CONTROL CONSOLE FOR MAIN CONTROL ROOM

Made up of extruded aluminum profiles and MDF with provision of placing all the active and storage devices at the bottom .The bottom should be covered with modesties which should be operable from front and back by push lock mechanism. Finished control console of suitable color so as to match interiors of control room.

- Console should able to accommodate all control room equipments & accessories such as Matrix, NVR, UPS and battery bank along-with its related accessories.
- Should have sliding arrangements for Keyboards.
- Should have Lockable arrangements of good quality.

11. GI POLES OF 12 FEET HEIGHT.

- Should be of GI construction minimum 3" inner diameter.
- Should be with ladder arrangements so as to do repair, maintenance of cameras.
- Should be fitted with strong base as per site conditions.

12. SURGE PROTECTOR.

- *Data surge protector protects the equipment from lightning strikes and also has additional other safety features.*
- Terminal connector to terminal connector, two stages protection under 100ns-90v,over 100ns, 12v.
- Protect equipments from high voltages surges from nearby lightning strikes.
- Performs different function than grounding requirements.

13. NETWORK COMPONENTS:

13.1 Layer-2 8 / 16 / 24 port switch

13.1.1 MEDIA CONVERTER:

- Single mode Fx to Tx convertor (The individual media convertors are required at camera end)
- Shall support a data rate of 100 Mbps copper to Fiber single mode upto a distance 1000 meters.

- The converter at camera end should be mountable on junction box and at switch and should be rack mountable.
- Auto negotiation
- Half and Full duplex operations
- Electrical port RJ45
- Optical Port – SC
- Shall be supplied along with the power supply.

13.1.1.1 Media Convertor housing chassis –

At switch end the media converter should be housed in chassis as there will be more than one converter. The chassis should be able to house minimum of 8 media converter cords and should have in built AC to DC power supply.

13.1.1.2 Layer-3 Switches

Number of ports	24 Nos single mode 1000 base. Fiber LX duplex port module (1 ports) (to converge Fibre cable from Encode L2 Switches and existing Lan) 12 Nos 10/100/1000 base TX RJ 45 port to connect to L2 switch uplink and NVR box
Transmission Method	Store and forward
MAC Address Table	16 K entries per device
Packet Buffer Memory	16 Mbytes per device
Power Supply	AC 230 V @ 50 Hz

13.1.1.3 POWER CABLE: Armoured

No. Of cores	3
Voltage	1100 V
Conductor	Annealed Bare Copper
Conductor diameter	2.5 sq. mm
Conductor resistance	7.4 Ohm / KM
No. of strands	7
Diameter of strands	0.68 mm
Insulation	PVC
Insulation thickness	0.8mm
Colour	RED, BLACK, GREEN
Inner Sheath thickness	0.3mm FRLS PVC
Outer sheath thickness	1.5mm
Insulation resistance	100M ohm / KM @500V DC
Armouring	GI
Armouring thickness	1.4mm
No. Of wires	20
Metering	Input voltage, Battery voltage, Output voltage, Balance battery autonomy, Output frequency and load power (%)
By Pass :	
Voltage tolerance	10% adjustable
Transfer time	Instantaneous
PC interface Communication	RS 232
User Interface	Should be through means of a front panel consisting of LCD display and LED's for various functions

14. Pole Erection - The height of the pole at camera location above ground level may vary from 7.5 meters to 6 meters depending on the requirement and coverage required. The depth of pole

below the ground shall be 1.5 meter hence to adjust the height above ground level the pole length at bottom shall be cut accordingly.

For erection of pole a pit of 1M x 1M and 2M deep shall be dug. Concrete of 1:3:6 shall be filled up to 0.5M from bottom layer of pit and rammed to 95% proctor density. Above this the pole shall be erected in the center of the pit in such a way that bottom hole of the pole shall align towards trench direction. The pole should be perfect by 90 degrees to ground level. After erecting the pole as given above the HDPE pipe from trench shall be connected to the bottom hole of the pole and joint of pole and HDPE pipe shall be sealed properly. Then with the help of 1:3:6 concrete the complete trench shall be filled and rammed to earth surface.

After 15 days of settling and curing of concrete a circular slab of 30 cm dia up to 60cm height above ground level is to made of concrete and finished by sand cement plaster of suitable proportion as per architectural / landscape design.

15. The Junction Box Erection - The junction box is to be fixed on pole near the camera with the help of suitable clamps provided for this purpose (clamp is in the scope of vendor). In the erected position the inlet of cables in the box should be down side and should align with top hole of the pole for entry of all cables inside the junction box. The junction box should be earthed with standard earthing procedure mentioned earlier. The junction box shall comply IP 65 standard or better and should be vandal proof. Sample of junction box should be submitted for approval prior to installation

16. The Camera Erection - The camera dome should be mounted on top of the pole in such a way that the dome bottom surface is parallel to the ground surface. The top hole of pole should be aligned to cable entry points of camera dome. It is desired that camera erection to be done only in the end just before testing. The power and UTP cable from camera to junction box shall be done as per requirement.

17. Testing - The testing of the equipment and complete system shall commence only after erection of all equipment and completion of all cabling and earthing work. First the testing of all section of cabling and individual equipment shall be done and then only integrated testing shall commence.

a. Testing of Cameras - After mounting on pole and powering it with power source the camera output shall be checked individually at junction box termination with the help of LCD TV/Laptop for clear visual output. The control junction shall be checked only in integrated mode.

b. Testing of all other equipment like server, storage, video monitors, network video recorder shall be done in integrated testing mode.

c. After completion of individual testing as mentioned above of different equipment and cable section all connections and connectorisation shall be done for integrated testing.

d. In integrated testing following shall be observed:

- Video output of each camera on monitor of control room PCs.
- Pan, Zoom and tilt of individual camera from keyboard of PCs of both control room.
- Defining the preset point for individual camera and viewing timing for each preset point.
- Video clustering of video output from different camera for simultaneous viewing.
- The working on Network Video Recorder system, application server & software.
- The working of Video Client Software and demonstration of all its features to client.
- The working of Network Management storage box and demonstration of all its features.
- Searching of video history of particular camera.

e. If any component, cable segment, software feature is not found working same shall be made functional by replacement / repair of that equipment / software.

f. After completion of integrated testing and successful completion of it the test run shall be commenced which will last for 15 days in continuous operation round the clock. In the test run all important parameters shall be monitored and tabulated at regular interval and jointly signed by client and contractor representative. During the test run the complete system availability should be 100% including that of individual camera output. If the system availability is less than 100% for 15 days then the exercise shall be extended till we get 100% availability for continuous 15 days. Here availability means clear output from individual camera with PTZ control from control room monitor and functioning of Network Video Recorder system with all its functions.

g. After completion of test run the trial run will start for 15 days during which the performance of system shall be monitored. Although performance data shall not be tabulated during this period but availability of all Cameras, Network Video Recorder, Client Software on terminals of client LAN should be 100%. In case these components are not available 100% then trial run shall be extended till availability of 100% is achieved for continuous 15 days. After this the system shall be accepted by client.

h. After completion of trial run, the warranty period shall start which will be 36 months from date of completion of trial run and system acceptance by client.

18. OTHER REQUIREMENTS: TECHNICAL MANUALS / DOCUMENTATION:

All manuals and documents shall be in English language and in such a way that a qualified engineer / technician is able to fully understand and do the preventive as well as break down maintenance with the help of these manuals.

The contractor at the time of installation shall provide TWO complete sets of the following documents conforming to the proposed system: -

- a.** Detailed specifications.
- b.** Block diagram of the systems with brief descriptions.
- c.** Schematic circuit diagram as also unit /module wise diagram and stage-by-stage detailed description. The complete wiring details are also to be provided by the vendor.
- d.** Data flow chart with data at different points during operations & testing.
- e.** Component layout & position chart /photograph for ease of locating the components.
- f.** Servicing/Maintenance Instructions including preventive maintenance schedule. Indicate type of test equipment to be used for maintenance.
- g.** Trouble shooting chart with proper test sequence, voltage and data at various test points.
- h.** Detailed operation and technical manuals of all equipment and the system programming details.
- i.** Original Licenses for all supplied software.

19. TRAINING TO THE CLIENT PERSONNEL:

On job training at site on all aspects of operation, programming and maintenance shall be provided by the contractor or his authorized representative to the concerned client officials / users for a period of at least 5 days during the warranty period.

Cost of all training has to be borne by the vendor.

Vendor has to agree for imparting the training as mentioned above and non-compliance of same by the vendor shall be liable for rejection of the vendor's bid.

20. WARRANTY PERIOD:

The contractor shall guarantee that the system including units, assemblies, and sub-assemblies shall be free from any defects due to the defective material, bad workmanship and that the system shall not be less than the guaranteed values.

The guarantee shall be valid for a period of 36 months for the entire system from the date of successful completion of trial run and the system acceptance by client.

21. TERMS & CONDITIONS:

- The Bidder should produce authorization certificate directly from the OEM and not its agents or dealer for cameras proposed. Manufacturer should provide after sales service support to its agent or dealer for its offered camera for minimum period of 5 years.
 - The OEM should have existence in India and also have well equipped service centre in same State or nearby site.
 - The Cameras (Fixed & PTZ) and software should be from single OEM brand and should be UL, certified.
 - The CCTV system shall comply with all currently applicable status, regulations and safety EMC standards.
- The equipment shall confirm to latest applicable international standards.

Equipment SpecificationsVoice Alarm Controller

The Voice Alarm Controller is the heart of the voice alarm system. It is the basis of the Voice Alarm System, and should have the essential functionality for compliance with the EN 60849 and 54-16 standards, including full system supervision, loudspeaker line impedance supervision, a supervised emergency microphone on the front panel and a supervised message manager.

A built-in 240 W amplifier provides the power for the emergency call channel and BGM. Additional Amplifiers can be added to provide two-channel operation. All amplifiers should be supervised. The audio output uses standard analog audio 100 V line switching for full compatibility with the family of public address equipment and EVAC-compliant loudspeakers.

The powerful 240 W output section has six transformer isolated 100 V constant-voltage outputs for driving 100 V loudspeakers in six separate zones. The 100 V-technique reduces line losses on longer distances and provides easy parallel connection of multiple loudspeakers. All zones may be individually selected from the front panel, and the BGM Output level in each zone can be individually set in six steps.

Six configurable volume-override output contacts are available for overriding local volume controls during priority calls. Both four-wire and three-wire schemes are supported. An LED meter monitors the output.

The controller should support up to 60 zones. Up to 255 messages can be stored in the internal 16 MB flash ROM, without a need for battery backup. Each message can have any length within the total available capacity. Messages and configurations are uploaded from a PC via USB into the memory, after which the unit operates without a PC connection.

The unit has 12 contact trigger inputs for business and emergency (EMG) calls. Each can be configured for a message consisting of a sequence of up to eight wav files. In this way some wav files may be used in various combinations with other messages, optimizing flexibility and the amount of storage space used. The Controller should also have two RS232 ports of which one should be reserved for product development and the other can be used to integrate to a third party digital device supporting RS232 protocol and can be used as a soft trigger input, in that way the number of trigger inputs (both emergency and business trigger inputs) can be increased to minimum of 150. Multiple messages can be merged to form one integrated message. The controller should have dip switches to adjust the system settings. The controller should have impedance calibration button for matching to the speaker impedance. The controller should have the VOX activation feature. A zone selection, together with this sequence can be configured for each trigger input. The specifications of the product should be similar to M/s Bosch Limited make LBB1990/00.

Technical Specifications are as follows:

Voltage	230VAC, 50/60 Hz
Max power consumption	600 VA
Battery power supply Voltage	24 VDC, +15% / -15%
Output power (rms/maximum)	240 W / 360 W
Frequency response	60 Hz to 18 kHz
Distortion	<1% at rated output power, 1 kHz
Programmable Trigger Inputs	12
Speech filter	-3 dB at 315 Hz, high-pass, 6 dB/oct
Messages Data format	WAV-file, 16-bit PCM, mono
Memory capacity	16 MB Flash ROM
Loudspeaker outputs	12
Number of messages	255 max
Volume override outputs	6
Dimensions (H x W x D)	144 x 430 x 370 mm
Operating temperature	-10 °C to +55 °C (14 °F to +131 °F)

Storage temperature	-40 °C to +70 °C (-40 °F to +158 °F)
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Voice Alarm Audio Router

The Voice Alarm Router has a set of relays for zone-switching the power amplifier output(s) to different loudspeaker groups. The Voice Alarm Router is an expansion unit that can add six zones as well as 12 input and eight output contacts to the Voice Alarm System. It can use the built-in amplifier on the Voice Alarm Controller, and provides inputs and outputs for one or two amplifiers in a multi-amplifier one or two-channel system. It provides dual channel operation for calls and BGM simultaneously to a maximum of six different zones, using two amplifiers. Additionally, single channel operation is possible with only one amplifier. An overload protected 24 VDC output provides power for driving external relays, making an external power supply unnecessary. The Product shall be certified according to EN 60065, EN 54-16 / EN 60849. The technical specifications shall be similar to M/s. Bosch limited make LBB1992/00.

Technical Specifications are as follows:

Supply Voltage	230/115 VAC, ±10%, 50/60 Hz
Max power consumption	50 VA
DC Voltage supply	24 VDC, +15% / -15%
Trigger Inputs(Programmable)	12 x (6 EMG, 6 business)
Loudspeaker outputs	12 x (2 x 6 zones)
Operating temperature	-10 °C to +55 °C (14 °F to +131 °F)
Storage temperature	-40 °C to +70 °C (-40 °F to +158 °F)

Voice Alarm Call Station

Stylish six-zone call station for the Voice Alarm System. Six zone selection keys, all-call key and momentary. Push To Talk-key for calls. Selectable gain, speech filter, limiter, and output level for improved intelligibility. LED indications for zone selection, fault, and emergency state. Call station extension provides seven additional zone and zone group keys. Up to eight keypads can be added with each keypad adding seven zone or zone-group keys. This call station features selectable gain, a selectable speech filter, and a limiter for improved intelligibility. The call station has a balanced line level output, making it possible to position it up to 1000 meters from the controller, using CAT-5 extension cables. With shielded cable, the call station can also be used in an EMC level 5 (heavy industry) environment.

The specifications of the product shall be similar to the M/s Bosch Limited make LBB1956/00.

The Call station shall be certified according to EN 60065 and Emergency according to EN 54-16 / EN 60849.

Technical Specifications are as follows:

Voltage range	24 VDC
Current consumption	<30 mA
Nominal sensitivity	85 dB SPL
Nominal output level	700 mV
Input sound level (max)	110 dB SPL
Distortion	<0.6%
Input noise level	25 dB SPLA
Frequency response	100 Hz to 16 kHz
Output impedance	200 ohm

Voice Alarm Call Station Extension Keypad

The keypad is an extension to the Voice Alarm Call Station that adds seven additional zone-select keys with LED indications for zone selection. It has the same stable metal base as the call station. In addition to tabletop use, the special design allows it to be neatly flush-mounted in desktops. The specifications of the product shall be similar to the M/s Bosch Limited make LBB 1957/00.

The keypad shall be compliant to EN 54-16 and EN 60849.

Technical Specifications are as follows:

Power Supply	24 VDC supplied by call station.
Current consumption	<15 mA.
Base dimensions	40 x 100 x 235 mm
Operating temperature	-10 °C to +45 °C (14 °F to +113 °F)
Storage temperature	-40 °C to +70 °C (-40 °F to +158 °F)

Mixing Amplifier

The Mixing Amplifier is capable of connecting to the Booster Amplifier, BGM source and the Microphone, or any other auxiliary source. The unit should have specifications similar to the product LBD 1916 manufactured by M/s.Bosch Limited.

The functional specifications are as follows:

The unit has, on its front panel, separate volume controls for each microphone input, a music selector switch for the music sources together with a volume control for the selected music source, a master volume control, as well as bass and treble shelving tone controls.

A telephone or emergency input with VOX activation is provided that takes overall priority, and has its own preset volume control.

The amplifiers have a separate 70 V / 100 V Call Only output for addressing areas and Mix Only output for areas where no priority announcements.

Priority is given upon contact closure on the 5-pin DIN connector or if the signal level on input 1 exceeds a predefined value (VOX).

All microphone inputs shall have internally selectable speech filters (-3dB at 315Hz) for improved intelligibility.

A 2-tone chime can be selected to precede a priority announcement.

The technical specifications are as follows:

RMS Power output	240W
Power Supply	115Vac or 230Vac
Frequency response	50 Hz to 18 kHz
Battery Power Supply	24V
Voltage Output(Line)	100V / 70V
Line impedance	4 ohm / 8 ohm
Inputs	4 balanced inputs / 3 stereo line inputs
Sensitivity	1.0mV (mic. inputs)
Phantom power	Yes
Signal to noise ratio	>80dB
Operating Temperature	-10 to +45°C
Dimensions (H x W x D)	88 x 432 x 250 mm(19" wide, 2U high)

Loudspeakers

6.1. Ceiling Type Loudspeaker

A flush-mounting ceiling loudspeaker is available for general application. These full range loudspeakers are suitable for both speech and music reproduction .The speaker assembly consists of a single piece, 6 W loudspeaker and frame with a 100 V matching transformer mounted on the back. The product should be similar to the M/s Bosch Limited make LBD 0606/10

Technical Specifications are as follows:

Maximum power	9 W
Rated power	6W (6 – 3 – 1.5-0.75 W)
Sound pressure level at 6 W / 1 W (1 kHz, 1 m)	98 dB / 90 dB (SPL)
Effective frequency range (-10 dB)	90 Hz to 20 kHz
Rated voltage	100 V
Rated impedance	1667 Ω
Opening angle at 1 kHz/4 kHz (-6 dB)	180° / 50°

VII TECHNICAL SPECIFICATION OF ACCESS CONTROL SYSTEM

The system equipment and installation shall comply with all provisions and

The basic components of the Security Access Control and Alarm Monitoring (SACAM) System shall include:

1. SACAM File Server system complete with computer CPU, keyboard, color monitor, all required database management, configuration software, database storage system software and hardware, as well as complete browser based Access Control and Alarm Monitoring.

Software package including a dynamic and interactive graphical user interface. The SACAM system shall also support a fully integrated Video Badging System, CCTV Subsystem Interface, Elevator Control, High Integrity Dial-up, Intrusion Detection Functionality and other.

Subsystem functions as defined in the specifications and contract documents. SACAM File Server shall communicate with SACAM Client Workstations over an industry standard Ethernet Local Area Network (LAN). Location of SACAM File Server shall be as specified in contract documents and drawings.

2. SACAM Client workstation, color monitor and keyboard for database entry, operator requested reports and alarm/event reporting. Operator interface shall be browser-driven through easy to understand, screens with point and click buttons. SACAM Client Workstations shall communicate with SACAM File Server over an industry standard Ethernet Local Area Network (LAN). Quantity and location of Operator Terminals shall be as specified in contract documents and drawings.

3. Dynamic and Interactive Color Graphics user interface with full graphic map/floor plan import and display capability. The system shall have the capability to simultaneously display floor plan maps or photos with coded interactive alarm, reader, camera and relay icons and Indications, together with audible alarm, descriptive text and operator.

4. Networked intelligent controllers (NIC) shall be capable of utilizing both central processing and true distributed processing technology. Local processing shall be based on the full local storage of cardholders, access groups, time zones, input and output information in controller RAM. In the event that database information has not been downloaded, is corrupted or is insufficient to make necessary local transaction decisions, the NIC shall access the SACAM server directly. The ACAM server shall take over the functions of making access decisions, controlling doors, monitoring alarms, activating relays and performing the functions of remote control and time activated actions. This shall continue until such time as the full database of the NIC has been correctly downloaded from the ACAM server. This function shall ensure that during database downloads to the NIC; operation of the field panel would be the same as though a proper download had been completed. In addition, it ensures that in the event of a corruption of the NIC database, all actions which would have been carried out by the NIC in response to transaction requests and alarm or data inputs will still be performed under the control of the ACAM server. The NIC shall be a microprocessor-based device, which utilizes a 32-bit processor and a 32-bit bus structure. The controller shall have a minimum clock speed of 90 MHz, and shall be configured with at least 16 Mbytes of battery backed dynamic RAM. The controller shall feature a direct LAN/WAN connection to the controller bus structure in addition to an RS-232 and an RS-485 connection, all of which shall be designed for use in communication with the ACAM server. The NIC shall be capable of supporting up to 4 directly connected readers as well as combined reader/keypads.

The NIC shall be capable of dynamically allocating its memory between database information and transaction history, which shall be stored if the controller has lost communication with the ACAM server or if the NIC is operating in a Dial-up mode. Such transaction history shall be automatically uploaded to the ACAM server once communication has been restored. In its maximum configuration, the NIC shall be capable of storing 16,000 cardholders, and its memory utilization shall be such that if storing database information for 10,000 ardholders, it shall also be capable of storing one million

transactions. The NIC shall have an additional RS-485 port for connection to remote alarm monitoring (RI M) and relay output (RRM) modules.

IMs and RRM's shall be capable of connection in a multi-drop configuration up to 4,000 feet from the NIC.

5. Card Readers, Keypads and Access Control Cards shall be provided in the proximity encoding technology and quantities specified in the contract documents and drawings. Door contacts switches, request-to-exit devices, electric locks, local alarm horns, status indicators and other Devices shall also be provided as shown on Contract Drawings. The readers shall be smart card technology ready in case of future migration.

The access control system software shall, as a minimum, support the following features:

- a. Cardholder records -16,000
- b. Card readers –As per BOQ
- c. Alarm input points – 1,024 maximum
- d. Relay outputs - 1,024 maximum.
- e. Client workstations - 4 additional
- f. Operator passwords – 64.
- g. 127 time schedules
- h. 16 alarm priorities.
- i. 16 user-defined alarm categories.
- j. Local, hard, soft and timed anti-pass back / anti-tailgate Configurable alarm-to-relay linking, downloaded to field Controllers for local operation.
- k. Configurable automatic time zone controlled commands, downloaded to the field controller for automatic local operation.
- l. History/audit trail.
- m. Ability to respond to access requests/alarm conditions before Automatic card activation and deactivation
- n. Alarm masking by operator or cardholder
- o. High integrity dial-up capability to support access control panels and readers at remotely located.
- p. Capability to define within the system variable card formats.
- q. Integrated video imaging/photo-badging system incorporating a Complete multi-layer, drag and drop, WYSIWYG, database Keyed badge design facility, editor, and drawing package. The System must be capable of allowing enrollment facilities at any Designated workstation, and displaying photo-images of Cardholders at any workstation on an individual system.
- r. The system shall be capable of interfacing through NICs to Keypads or card reader/keypad combinations with LCD displays allowing the system to operate as a proprietary burglar alarm System

for designated security areas. The system shall provide delayed alarm reporting and masking facilities using these devices so that arming and disarming of security areas is Delayed for a preset period. This will allow personnel entering an area to have the opportunity to disarm (mask) the alarm

6. TECHNICAL SPECIFICATIONS OF THE SUB-UNITS:

a. BARRIERS

1. Electromechanical Automatic Barrier

a. The actuator shall operate on 230V 50 Hz single phase AC power supply and shall consume not more than 300 W during any and all operation modes. The control panel shall operate on 230 V 50 Hz single-phase power supply and shall not consume more than 100 mA.

b. The opening time of the system shall not be more than 12 seconds for 6 mtr & above Boom length and not more than 4.5 seconds for 4.5 mtr. & below Boom length.

c. The aluminium bar shall be of hollow rectangular type (Minimum size 100x70mm) with reflective stickers. The length of the bar shall be as specified. It should be possible to have an articulated or fenced bar.

d. The system shall incorporate electric limit switches. These shall be housed within the actuator unit and shall be adjustable.

e. The ingress protection for the actuator shall be IP24 and the ingress protection for the control panel shall be IP54.

f. The system shall operate properly in environmental temperatures -5° C to +55° C.

g. The system shall have a quick release key for manual operation during power failure or emergency , fork rest to support during closed position.

h. The system shall be capable of being operated 600 times in 24 hours.

i. The system should be UL/CE approved and shall be manufactured by a reputed manufacturer who shall be certificated under the ISO 9001 series quality procedures.

2. Flap Barriers for pedestrians entry and exit

a. The Automatic Flap barrier shall have UL & CE Certifications.

b. The flap barriers shall be SS finish as approved.

c. The Flap barrier should incorporate photo beam detector for protection.

d. The flap barrier shall have the torque of 3Nm with the protection of IP 54.

e. The flap barrier shall have the opening time of 0.4 Sec with Built in Thermo Protection.

f. Operation through switch and access control reader.

B. READERS

1. Long-Range Reader

a. The card reader shall be a Long Range proximity card/ Prox-Linc WS tag reader.

- b. The card reader shall read the encoded data from the access card and/or transponder and transmit the data back to the controller, giving an audible and visual indication of a properly read card.
- c. The reader shall not be larger than 12.0" x 12.0" x 1.0".
- d. The reader shall have a typical read range of 9 to 11 feet with 1.0A at 6.5V DC, 0.4A at 15V DC.
- e. The reader shall be provided with an internal tamper switch that will indicate an alarm condition if an unauthorized attempt is made to disassemble the unit.
- f. The card reader shall be sealed to a NEMA rating of 4X, and all internal electronics will have conformal coating to provide a high degree of environmental protection.
- g. The reader shall be listed under UL 294 as an access control system accessory, and shall have the following certifications: Canada/UL 294, Canada/UL 1604 (Hazardous Location Model only) FCC, Canada Radio, EU and CB Scheme Electrical Safety, EU – R&TTE Directive, CE Mark, Australia C-Tick, New Zealand.
- h. The reader shall have separate terminal control points for the green LED, the red LED, and the audible indicator.
- i. The reader shall be fully weatherproof, and shall have an operating temperature of -5 to 55 degrees Celsius, and shall have an operating humidity of 5-95% non-condensing.
- j. The reader shall be made from polycarbonate material, and shall be charcoal gray or as approved.
- k. The reader shall transmit data at a 125 kHz frequency.
- l. The reader shall communicate in a Wiegand protocol interface, and be compatible with all standard access control systems.
- m. Reader shall be programmable read repetition rate for one shot or multiple reads prevent.
- n. Reader shall utilizes passive tag technology.(Without battery)
- o. Reader shall be of industry standard Wiegand and RS-232 data output.
- p. Reader shall be compatible with the control module& software as specified.
- q. The reader shall have automatic tuning capability to continuously optimize antenna tuning for environmental changes to provide consistent read range.

2. Standard Card Readers with Wiegand Communications

The card readers with Wiegand Communications shall be provided with or without a keypad. The standard card reader must offer the following features:

- a. UL 294, ULC, and CE Certified.
- b. Low Power/Surface Mount Card Reader.
- c. 600,000 pass read head.
- d. Bi-directional card swipe.
- e. Weatherized Finishes.
- f. LEDs for access and card reader status.
- g. Card and PIN data shares same output lines.
- h. 12VDC or 5VDC Input Power.

3. Proximity Cards

- a.** The access card shall have up to 84 programmable bits of Wiegand formatted information for universal compatibility with all Wiegand interface reader applications.
- b.** The access card shall be "Passive" (non-battery operated) proximity technology.
- c.** The access card shall have a permanent ink jet or laser engraved identification number printed onto it. The card numbering options shall be Sequential Matching i.e. The internal identification numbers and the external ink jet numbers shall both be sequential and shall match (i.e. internal numbers 1-100, external ink jet numbers 1-100).
- d.** The access card shall be slot punched on the short edge of the card for a vertical/ portrait oriented photo, shall be offered with multicolor custom graphics.
- e.** The access card shall have an operating temperature of -5 to 55 degrees Celsius, and shall have an operating relative humidity of 5-95% non-condensing.
- f.** The read range of the access card shall be extremely consistent, and not be affected by body shielding or variable environmental conditions

4. Passive long range cards for the vehicles (wind-screen)

- a.** Cards shall have the read range of 9 feet to 11 feet when WS tag is attached by self-adhesive to the inside of the vehicle's windshield.
- b.** Cards shall be Passive proximity at 902-928 MHz Frequency-hopping limits interference and requires no FCC license.
- c.** Cards shall have Prox-Linc WS tags can be programmed with trillions of unique codes for the security.
- d.** Cards shall have no battery; capable of an infinite number of reads to assure years of maintenance-free operation.
- e.** Cards shall have Wiegand format up to 2K user-definable bits; field programming capabilities available.

1 STANDARDS

Relevant British and/or IEC Standards shall be applicable. BIS certified equipment shall be used as a part of the Contract.

2 TECHNICAL PARAMETERS

Technical parameters given in Annexure-I give requirement of various parameters as per tender. Tenderers shall fill in their item wise confirmation/comments in the column provided for the purpose in this annexure. Deviations, if any, from tender requirements shall be clearly brought out in this annexure, failing which it shall be presumed that the offer conforms to the tender requirements fully. Tenders in which Annexure-I is not duly filled in by the tenderers are liable to be summarily rejected.

3 DRIVING MECHANISM

3.1 Lift Machine

The lift machine shall be suitable for 415 volt 3 phase 50 Hz AC supply with a voltage variation of +10% and -20% and shall be placed directly above the hoist way on steel beams resting on machine room floor slab.

The lift machine shall have high efficiency and low power consumption and shall be designed to withstand peak currents in lift duties. Resilient anti vibration mountings of suitable design shall be provided to minimise vibration transmission to the building structure.

The lift machine shall be worm geared reduction type and shall consist of a motor, electromechanical brake worm-gear, sheave shaft and sheave all completely mounted on a common bed plate. The worm shall be provided with ball bearings to take the end thrust and roller bearings shall be provided for the sheave shaft to ensure alignment and long bearing life. The hard alloy cast iron or steel sheave shall have rope grooves to ensure proper traction and minimum rope wear. Adequate means of lubrication shall be provided for all bearings and worm gear.

Means for manual operation of the lift car shall be made by providing winding wheel suitably marked to indicate the direction of the movement to enable the lift car to be brought to the nearest landing. There shall be a warning display for switching off electrical supply before the manual operations.

3.2 Brake

The electromagnetic brake shall be spring applied and electrically released. It shall come into action after the lift has come to a complete halt to hold the car in position. The brake shall operate automatically with the safety devices and failure of the mains. It shall be released electrically. It shall be possible to release the brake manually - such release requiring the action of manual force to move the lift in short stops.

3.3 A C Motor

The AC self-lubricating motor shall be suitable for lift use with high starting torque and low starting current. Thermistors shall be embedded in the stator windings to indicate the temperature rise in the motor. The A C motor shall have Class F insulation and suitable for 180 starts per hour with a maximum temperature rise of 50 degree C over the ambient.

4 CONTROL

The Lifts shall have state of art microprocessor based AC Variable Voltage Variable Frequency (ACVVVF) drive. All elevators shall be provided with full collective control.

a)	Starting Current -	1.2 – 1.5 time full
load running Current		
b)	Power saving -	50 – 55%
c)	Leveling accuracy -	± 3 mm
d)	Acceptable Voltage Fluctuation -	+ 10
to -20%		
e)	Rate of acceleration/deceleration (M/S^2) -	0.6 – 1.5 (Adjustable at site)
f)	Maximum jerk (M/S^3) -	0.7 – 1.5
(Adjustable at site)		
g)	Maximum vibration in car horizontal/vertical -	20/18 dBA
h)	Maximum noise level in car during travel -	48 dBA
i)	Maximum noise level in machine room at 1 mtr from machine -	62 dBA
j)	Maximum door noise level while closing and opening at a distance of 1 mtr from car door -	52 dBA
& 1.5 mtr from floor level		

The controller shall be wall/floor mounted, vertical, totally enclosed cubicle type with hinged doors on the front and the rear to provide easy access to all components in the controller. The cubicle shall be well ventilated such that the temperature inside never exceeds the safe limits of the components at ambient room conditions in the machine room.

The controller shall operate within the supply voltage variation of (+) 10% to (-) 20% of the nominal voltage.

The Controller shall be complete with relay protection against the following:

- a) Overcurrent
- b) Under voltage
- c) Overvoltage
- d) Single phasing
- e) Phase reversal
- f) Earth leakage

The controller shall be designed to cut off the power supply, apply the brake and bring the car to a rest in the event of any of the above failures occurring.

The tenderer shall state clearly the forms of protection provided for each equipment.

If any devices of the electro mechanical type are used the same shall be equipped with arc chutes to prolong the life of contacts. Tenderers shall stipulate the type of devices used and the material of the contacts.

Tenderers shall support their offers with complete details of experience, number of lifts installed and operational in India, collaboration for equipment design and manufacture etc.

5 COUNTER WEIGHT

The counter weight shall be made of cast iron and shall travel between rigid guides and steel frames capable of withstanding buffer impacts. Suitable metallic counter weight guard of required length shall be provided at the bottom of the hoist way.

6 GUIDES

Car and counterweight guide shall be machined T section as per relevant Indian Standards IS-14665-2000 revised up to date. The guides shall be capable of withstanding forces resulting from the application of the car or counter weight safety devices.

7 HOIST ROPES

Round standard steel wire ropes as per Indian Standards shall be used for lift suspension. The number and size of the hoist way ropes shall be so selected to ensure proper factor of safety (minimum 10) and adequate traction for the lift. The governor ropes shall also be wire ropes.

8 DOORS

9

8.1 Car & Landing Door

Car & Landing doors shall have fire resistant rating of one hour.

8.2 Car & Hoistway Door Protection

A multiple infra-red cell electronic door detector shall be provided to regulate the closing motion of the doors for entry of the passengers. When a person is entering the car while the doors are closing the detector shall sense the same and hold the doors to permit entry.

8.3 Car & Hoistway Door Operation

The equipment shall be complete with electric door operator for opening and closing of Car & Hoistway landing door. The equipment shall consist of a motor on the lift car to operate the door when the car is stopping at a landing. The car & Hoistway doors shall be mechanically connected such that both move simultaneously for opening and closing.

The Hoistway landing door shall be provided with an interlock such that:

- a) It shall not be possible for the car to be started or kept in motion until all the landing doors and the car door are locked in the closed position.
- b) It shall not be possible to open the landing door from the landing unless the lift car is within the particular landing zone.
- c) The car doors & Hoistway landing doors open automatically as the car is stopping at a landing. The closing of the car and landing door must occur before the car is set in motion.

8.3 Door Hangers and Tracks

The car and the landing doors shall be provided with two point suspension sheave type hangers complete with tracks. Sheaves and rollers shall be steel with moulded nylon collar and shall include shielded ball bearings. Tracks shall be of suitable steel section with smooth surface. The landing doors shall be complete with headers, sills, frames etc. as required.

9 CABIN FAN

A noiseless pressure fan shall be provided in the lift cabin.

10 EMERGENCY LIGHT

An emergency light unit using sealed Nickel/Cadmium maintenance free battery power pack with charger and fluorescent lamp to operate automatically and to illuminate the car for minimum 30 minutes in case of power failure shall be provided in each lift car.

11 ALARM BELL

An emergency alarm bell, including wiring shall be provided and connected to a plainly marked push button in the car operating panel. The alarm shall be located in the Control and the Security Room.

The alarm unit shall be solid-state siren type, operated by Nickel/Cadmium maintenance free batteries to give a waxing and waning siren when the alarm button in the car is pressed momentarily.

12 OPERATION BUTTONS AND INDICATIONS

The following operation buttons and indications shall be provided:

12.1 In each Lift Car

Stainless steel panel of suitable thickness flush mounted shall be provided on one side of the door having:-

- a) LED Illuminated push buttons of micro pressure type corresponding to the floors served
- b) Door open/close button
- c) Emergency stop button
- d) Emergency alarm button
- e) Ventilation fan ON/OFF switch with auto OFF when there is no call after 120 seconds.
- f) Built in intercom of the hands free type.
- g) Dynamic car direction display
- h) Car position indicator
- i) Audio/Visual overload warning indicator

12.2 At Landings:

Terminal Landings

LED Illuminated type single push buttons with travel indication arrow in satin finish stainless steel fascia plate

Digital car position indicator with gong in stainless steel fascia plate

Intermediate Landings

Two No. LED illuminated type UP/DOWN push buttons with travel indication arrow in satin finish stainless steel fascia plate

Digital car position indicator with gong in stainless steel fascia plate

13 SAFETY DEVICES

All safety devices statutorily required by Lift Inspector, including but not restricted to the following shall be provided.

13.1 AUTOMATIC RESCUE DEVICE:

Each elevator shall be provided with an electronic state of art Emergency Battery Drive for automatically rescuing trap passengers from the elevator during power failure. The rescue device shall automatically bring the elevator car to the nearest landing and open the door so that the trapped persons can walk out of the elevators. The elevators shall resume normal operation on restoration of power supply

13.2 Self Leveling

The Lifts shall be provided with self-leveling features of ± 3 mm accuracy.

13.3 Terminal and Final Limits

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings, and final limit switches shall be furnished to automatically cut off power should the car travel beyond the terminal landings.

13.4 Terminal Buffers

Suitable spring buffers shall be installed mounted on steel channels as a means of stopping the car

13.5 Interlocking

Adequate interlocking is to be provided so that the car shall not move if the landing doors are even partially open and also the lift is overloaded.

13.6 Car Safety and Governor

The car safety shall be provided to stop the car whenever excessive descending speed is attained.

13.7 Emergency Stop Switches

An emergency stop for use by maintenance personal shall be provided in each lift car.

14 ASSOCIATED CIVIL & STRUCTURAL ITEMS

All civil and structural items of work associated with erection and operation of lifts shall be provided by the Contractor at his cost including (but not restricted to) the following.

- Temporary Scaffolding and safety barricades during lift installation in and around lift hoist ways
- Bearing plates
- Buffer supports
- Checquered plates
- Facia plates
- Ladder in pits
- Safety railing in car
- Channels, separators, stretchers etc.
- Structural works for foundations of machine etc.
- Breaking, fixing and making good spaces for leveling switches and any other erection work.

Lifting hook embedded in machine room roof slab in the center of the hoistway shall be provided by Owners.

The Contractor shall ensure erection and fixing of steel work in such a manner that no RCC wall or any other structural member is damaged and if damaged, the contractor shall be responsible for making good the damage to original finish.

15 FIREMAN SWITCH

Each independent lift shall have a Fireman switch with glass front for access by the Firemen. The operation of this switch shall cancel all calls to this lift and will stop at the next nearest landing if traveling upwards. The doors will not open at this landing and the lift will return to the ground floor. In case the lift is traveling downwards when the fireman's switch is operated it will go straight to the ground floor bypassing all calls enroute. The emergency stop button inside the car shall be rendered inoperative.

IX TECHNICAL SPECIFICATION OF LIGHTING

Referenced Standards:

1. BS 800 Limits and methods of measurement of radio interference characteristics of household electrical appliances, portable tools and similar electrical apparatus
2. BS 3677 High pressure mercury vapour lamps
3. BS 4533 Luminaires
4. BS 5225 Photometric data for luminaires
5. BS 60400 Lamp holders for tubular fluorescent lamps and starter holders
6. BS EN 60081 Tubular fluorescent lamps for general lighting service
7. BS EN 60238 Edison screw lamp holders
8. BS EN 60529 Degrees of protection provided by enclosures
9. BS EN 60662 (IEC 662), High pressure sodium vapour lamps
10. BS EN 60947-1 General rules for low voltage switch gear and control gear
11. BS EN 61167 Metal halide lamps
12. BS EN 6118.
13. CISPR 15.
14. IEC 60061.
15. IEC 60081.
16. IEC 60238.
17. IEC 60598.
18. IEC 60598-1 LED luminaires

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Project Manager.

SCOPE

Scope of work under this section shall include inspection at suppliers/manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc. as required.

LIGHT FITTINGS GENERAL REQUIREMENTS:

- a) Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead

fittings shall be provided with IP-54 protection.

- b) Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/ ballasts.
- c) All fittings shall be supplied complete with lamps. All mercury vapour and sodium vapour lamp fittings shall be complete with accessories like ballasts, power factor improvement capacitors, starters, etc. Outdoor type fittings shall be provided with weather proof junction boxes (IP-55) and IP-54 Control gear boxes.
- d) Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires up to 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.
- e) All hardware used in the fitting shall be suitably plated or anodized and passivated.
- f) Earthing: Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.
- g) Painting/Finish: All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.
- h) The housing shall be powder coated/stove-enameled or anodized as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia. mandrel.
- i) Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture. _

X TECHNICAL SPECIFICATION OF UPS

Make : As per List of make

Model :

Rating : As per B.O.Q.

Technology : True on-line double conversion: Microprocessor based rectifier Charger, Unique Free Frequency PWM IGBT Technology for Inverter, Static & Manual bypass switch and Galvanic Isolation Transformer at inverter Output.

Input

Voltage Range : 380/400/415 V $\pm$ 15%

Frequency Range : 50 Hz. $\pm$ 5%

Output

Voltage : 380V / 400V / 415V (site selectable)

Voltage transient : $\pm$ 2% for load change of 0% to 100% and 100% to 0% stepload, recovery within 4 ms.

Frequency : 50 Hz. + 0.1% in free running mode
Adjustable up to + 4% in Synchronized with mains mode

Voltage distortion : THDU < 2% for 100% non-linear load

Crest Factor : Up to 3.5 : 1

Overall efficiency (AC/AC) : 93% at 100% load, 93.5% at 75% load, 93.5% at 50% load, 91% at 25% load

Noise level : $\leq$ 60 dBA

MTBF (Mean time between failure) 4,75,000 hours

Battery Monitor : Battery monitoring software to optimize battery life/operation provided as standard

UPS Dimension : 1400 (H) x 825 (D) x 715 (L) mm per 40 KVA UPS

Battery MCCB : Housed in Battery MS cabinet.

Standards : UPS meets the following standards:

IEC 146-4

IEC 801-2/3/4 & IEC 1000-4-2/3/4

EN 50 091-1

IEC 1000-2-2

TUV Rheinland

Battery : Sealed maintenance free Global / Panasonic make

Battery autonomy : 30 minutes at full load

XI TECHNICAL SPECIFICATION LIGHTNING PROTECTION SYSTEM (ESE TECHNOLOGY)

1.1 Scope of Work

The work to be done under this section comprises the supply & installation necessary for the complete installation of the lightning protection system.

The design of components shall be traceable to field research, laboratory testing, fundamental analysis, and statistical levels of the lightning event.

The design of the components shall be traceable to long practical field studies laboratory testing, fundamental scientific principles and statistical levels of the lightning event as documented in international standard.

The lightning protection system should comply in accordance with NFC 17-102 standard and shall be installed strictly to the manufacturer's instructions.

The advance lightning protection system shall include components as follows:

ESE Air Terminal
Mechanical Supports
Down Conductors
Lightning Strike Recorder
A low impedance chemical gel earthing system

1.2 Standards

(i) Complete installation shall be engineered and constructed in accordance with the latest revision of the following:

- NFC 17 102
- IEC 61024
- IEC 60-1:1989

Test Certificates & Approvals:

The ESE air terminal shall be tested & certified by CPRI (Central Power Research Institute, Govt. of India) for a minimum impulse current of 45 KA (8/20 micro sec) with 5 positive & 5 negative impulse.

The ESE air terminal shall be approved from DGMS (Directorate General of Mines Safety, Govt. of India)

As per IEC 60-1:1989, the ESE air terminal should successfully withstand minimum 4 current impulse equivalent to 150 KA (8/20 micro sec waveform).

As per NF C 17 – 102, the ESE air terminal should be tested with the “Switching Impulse Voltage” of 700 KV & “Direct Voltage” of 70 KV

The details of the lightning protection system shall also conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this specification and drawings, whichever is more stringent and acceptable to the engineer.

1.3 Air Terminal

The ESE air terminal shall be of the type that responds dynamically to the appearance of a lightning down leader by creating free electrons between outer floating four panels and an earthed central finial

rod. The lightning air terminal shall be configured as a spheroid which is comprised of separate electrically isolated panels surrounding an earthed central finial. The central finial shall be elevated above the spheroid to a length of 90mm. The Insulation material used to electrically isolate the panels shall be comprised of a base polymer which provides high Ozone & UV resistance with a di-electric strength of 24-38 KV/mm tested as per NFC 17-102 & IEC 60-1:1989

The unit shall detect the lightning when it approaches and emit an electronically controlled streamer within few micro seconds. ESE air Terminals shall be manufactured as per NFC 17-102 standard. A dedicated wired ESE tester should be available for maintenance purpose. The manufacturer should be ISO 9001 certified. Performances of the air-termination should have been tested in High Voltage Laboratory (CPRI) as well as in the international laboratories as per IEC 60-1:1989.

The Air terminal should work under Early Streamer Emission (ESE) Technology and the attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics. The ESE air terminal shall have no moving parts, no electronic circuits and will have no dependence on external power supply or batteries. The ESE air terminal shall not have any solar panels.

The ESE air terminal should deliver a unique gain time in efficiency, anticipating the natural formation of an upward leader. The ESE air terminal generates a leader that propagates rapidly to capture the Lightning stroke and conduct it towards the ground.

Arcing is not to be continuous and shall only occur during the progress of the lightning leader.

The air termination shall not cause high frequency radio interference except during the millisecond intervals associated with the progress of the lightning leader and during the main return strike of lightning events in the region.

The Materials of the air termination shall be non –corroding in normal atmosphere.

The Height of the air terminal support mast should be minimum 2mts and the height will be increase as per the coverage design.

The support shall be securely installed and guy wires shall be used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

Air Termination Support: The Air Termination shall be fixed at the top of a GI or FRP elevation pole so as to be at least 2 meters above the top of the structure to be protected. The elevation pole should have a minimum dia of 35mm to 50mm with a thread at the top to fix the unit. Guy wires may be used in order to ensure the stability of the installation.

1.4 Down Conductor

The down conductor should be used 70 sq mm copper cable or 25x 3 mm copper strip. Two down conductors shall be used in case of the structure height is above 28mts and both should be connected with maintenance- free Grounding system.

The down conductor shall be routed as directly as possible to the ground avoiding electrical shafts and sharp bends (minimum bending radius of 0,5m). Any metallic object located less than 1 meter shall be connected to it as per IEC 62305 standards.

The main copper conductor shall be connected directly to the air termination.

The down conductor shall be installed in accordance with the manufacturer's instructions and should not be subject to sharper bends.

The down conductor must be kept in constant physical contact with the structure via conductive mounting clamps.

1.5 Lightning Strike Recorder

The Lightning systems shall be installed complete with the lightning strike recorder.

The lightning strike recorder shall contain a mechanical 6 digit display which will register all lightning discharges with a sensitivity of 1500A 8/20 μ s peak current impulse.

The lightning strike recorder shall be housed in a IP 65 rated enclosure and operate without reliance on batteries or on any other external power source.

As per IEC 60-1:1989, the lightning strike recorder should withstand a maximum current impulse equivalent to 450 KA (8/20 micro sec waveform)

1.6 Grounding System

The Lightning arrestor grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the specifying engineer or manufacturer of the lightning protection system.

Grounding will be done by 10 feet 5/8" mm dia copper bonded (250 microns) steel core ground rods especially designed for lightning grounding.

Bonding of the grounding system to metallic parts of the building, the structural reinforcing steel of the building to arriving services is recommended. Electrically conductive, non soluble LPI RESLO (mixture of Sulphate, Silica, Alumina, Iron Oxide, Titanium Oxide, Calcium Oxide, Potassium Oxide, Chloride, Magnesium Oxide, Sodium Oxide, Zinc Oxide, etc) Resistance Lowering Grounding Minerals. The Chemical compound RESLO shall be tested and certified by an International accredited and BIS (Bureau of Indian Standards) accredited laboratory. The testing laboratory shall be ISO 9001 & ISO 14001 certified.

XII TECHNICAL SPECIFICATIONS OF EARTHING

1. GENERAL

All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits, trunking, cable sheaths, switchgear, distribution fuse boards, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing shall be in conformity with Indian Electricity Rules.

The Earthing System shall in totally comprise the following:-

- a) Earth Electrodes
- b) Earthing Leads
- c) Earth Conductors

All three phase equipment shall have two separate and distinct body earths and single phase equipment shall have a single body earth.

2. STANDARDS

IEC 60364: Electrical Installation of Buildings.

BS 1432: Specification for copper for electrical purposes: high conductivity copper rectangular conductors withdrawn or rolled edges.

BS 1433: Specification for copper for electrical purposes. Rod and bars.

BS 2871: Specification for copper and copper alloys.

BS 4360: Specification for weldable structural steel.

BS 6360: Specification for conductors in insulated cables and cords.

BS 6651: Code of practice for protection of structures against lightning.

BS 6746: Specification for PVC insulation and sheath of electric cables.

BS 7430: Code of Practice for Earthing

3. EARTHING MATERIAL

Materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the schedule of quantities and shall comply to the following requirements:

- Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian standard specifications.
- Galvanised Steel - Galvanised steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309:1969.
- The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

4 EARTH ELECTRODES

- Plate Earth Electrode

The plate electrodes shall be of copper/ GI as called for in the schedule of quantities. The minimum dimensions of the electrodes shall be 600 mm x 600 mm. Thickness of copper electrodes shall not be less than 3 mm and of GI electrodes not less than 6 mm.

The electrode shall be buried in ground with its face vertical and top not less than 4 meters below ground level.

- Earth Electrode Pit
Method of Installing Watering Arrangement

In the case of plate earth electrode, a watering pipe of 20 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 1000 x 500 x 600 mm. A precast RCC frame & cover shall be suitably embedded in the masonry enclosure.

Location Of Earth Electrode

The following guidelines shall be followed for locating the earth electrodes

An earth electrode shall not be situated less than 5 metres from any building.

The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.

The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.

Entrances, pavements and road ways shall not be used for locating the earth electrode.

Number Of Earth Electrodes

In all cases the relevant provision of rule 33, 61 & 67 of the Indian Electricity Rules 1956 as amended shall be complied with.

Metallic covers or supports of all medium or H.T. apparatus or conductors shall, in all cases be connected to not less than two separate and distinct earth electrodes.

5. EARTHING LEADS

The strip earthing leads shall be connected to the Earth Electrode at one end and to the metallic body of the main equipment at the other end. The earthing lead shall connect to the earthing network in the installation.

- Earthing Lead Sizes
Strip earthing leads shall be of copper/GI and as per specifications.

- Earthing Lead Installation
The length of buried strip earthing lead shall be not less than 15 metres and shall be buried in trench not less than 0.5 m deep.

If conditions necessitates use of more than one earthing lead they shall be laid as widely distributed as possible preferably in a single straight trench or in a number of trenches radiating from one point.

- Method Of Connecting Earthing Lead To Earth Electrode

In the case of plate earth electrode the earthing lead shall be securely bolted to the plate with two bolts, nuts, checknuts and washers as required by IS 3043 : 1987.

All materials used for connecting the earth lead with electrode shall be GI in case of GI Pipe and GI plate earth electrodes or tinned brass in case of Copper plate electrode.

- **Protection Of Earthing Lead**

The earthing lead from electrode onwards shall be suitably protected from mechanical injury and corrosion by a 15 mm dia GI pipe in case of wire and 100/40 mm dia medium class GI Pipe

The portion of the G.I. pipe within ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing or pavements). The portion within the building shall be recessed in walls and floors to adequate depth.

6. EARTHING CONDUCTORS

Earthing conductors shall form the earthing network throughout the installation for earthing of all non-carrying metal parts.

- **Connection Of Earthing Conductors**

- Main earthing conductors shall be taken from the earth connections at the main switch boards to all other switchboards in the network.

- Sub-mains earthing conductors shall run from the main switch board to the sub distribution boards and to the final distribution boards.

- Loop earthing conductors shall run from the distribution boards and shall be connected to any point on the main/sub-main earthing conductor, or its distribution board or to an earth leakage circuit breaker.

- Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing, Switches, accessories, lighting fitting etc shall be effectively connected to the Loop Earthing Conductors. These though rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered earthed, even though the run of metallic conduit is earthed.

- **Earthing Conductor Installation**

The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size.

Joints shall be revetted and brazed in approved manner.

Sweated lugs of adequate capacity and size shall be used for termination. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned.

- **Sizing Of Earthing Conductors**

All fixtures, outlet boxes and junction boxes shall be earthed with Bare copper wires as specified.

All 3 phase switches and distribution boards upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper/6 mm dia GI wires. All 3 phase switches and distribution boards upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper/8 mm dia GI wires. All switches, bus bar, ducts and distribution boards of rating 200 amps and above shall be earthed with a minimum of 2 Nos. separate and independent 25 mm x 3 mm copper/25mm x 6 mm GI tape.

7. PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system.

8. RESISTANCE TO EARTH

No earth electrode shall have a greater ohmic resistance than 3 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be upto 5 ohms. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuses or circuit breakers, and shall not exceed 1 ohm.

XIII ROUTINE AND COMPLETION TESTS

1 INSTALLATION COMPLETION TESTS

At the completion of the work, the entire installation shall be subject to the following tests:

1. Wiring continuity test
2. Insulation resistance test
3. Earth continuity test
4. Earth resistivity test

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

2 WIRING CONTINUITY TEST

All wiring systems shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energised.

3 INSULATION RESISTANCE TEST

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all fuses in place and all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 megohms divided by the number of points provided on the circuit the whole installation shall not have an insulation resistance lower than one megohm.

The insulation resistance shall also be measured between all conductors connected to one phase conductor of the supply and shall be carried out after removing all metallic connections between the two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant Standard specification or where there is no such specification, shall not be less than half a megohm or when PVC insulated cables are used for wiring 11.5 megohms divided by the number of outlets. Where a whole installation is being tested a lower value than that given by the above formula subject to a minimum of 1 Megohms is acceptable.

4 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same alongwith the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

5 TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCHES

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three or four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Architect as well as the local authorities.

6 EARTH RESISTIVITY TEST

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

7 PERFORMANCE

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.

8 TESTS AND TEST REPORTS

The Contractor shall furnish test reports and preliminary drawings for the equipment to the Architect/owners for approval before commencing supply of the equipment. The Contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc., required by the local Inspectors or any other Authorities would be supplied by the Contractor without any extra charge.

XIV SPECIAL INSTRUCTIONS TO TENDERERS

1 GENERAL

- Only the approved makes of material as stipulated shall be accepted.
- Installation of light fittings shall be with the use of two junction boxes placed 600 mm apart for 36/40-watt fixtures and 300 mm apart for 20-watt fixtures. The junction boxes shall form a part of the conduiting and shall be placed in the slab at the time of concreting.
- For any fixtures and fittings required to be fixed to the RCC slab, the Contractor shall drill the required holes with the use of an appropriate drilling machine with drill bits and no extra charges shall be payable on this account.
- The rates quoted shall be for work to be carried out at all heights and levels as at site and no extra payment shall be made for the same.
- The rates quoted for wiring shall be applicable for concealed or surface conduiting as required

2 CONDUITING

The rates to be quoted by tenderers shall include any or all of the following. No additional costs shall be paid for tools etc. as required to complete the work.

- All cutting of chassis in brick walls shall be with chase cutting tools.
- Whenever required chases shall be cut in stone walls with a chase cutting machine and with specific tools as required prior to plastering.
- In case of exposed stone walls the conduits shall be laid alongwith the construction of the wall and co-ordinated with civil activity.

3 POINT WIRING

- The Point Wiring shall commence from the Distribution Board and shall include the circuit wiring of length as required via the switch to the fitting/socket outlet as called for unless otherwise specified.
- The Circuit Wiring shall be with 2 nos 2.5 sq mm PVC insulated stranded copper conductor 1100 volt grade wires in MS / PVC Conduit.
- The rates for all point wiring shall include the supplying and fixing of:
 - a) ISI approved & marked MS / PVC conduits.
 - b) Conduit accessories conforming to IS
 - c) MS draw, inspection and junction boxes.
 - d) Zinc chromate passivated switch boxes, outlet boxes etc.
 - e) All fixing accessories such as clips, brass screws etc.
 - f) Embedding conduits and accessories in walls and floors etc during construction and/or cutting chases and making good as necessary in the case of concealed conduit work and/or providing and fixing saddles, hangers, stirrups etc. and grouting of the same as required for surface conduiting.
 - g) Switches, wiring accessories and moulded cover plate as required.
 - h) Insulated copper earth wire for fixture, switch, outlet box and third pin of socket outlet to common earth.

- i) All work necessary for wiring a point circuit of any length from the Final Distribution Board to ceiling rose or connector via switch including circuit wiring with 2 x 2.5 sq mm PVC insulated stranded copper conductor 1100 volt grade wires in conduit as required.
- j) Painting all conduits, outlet boxes and junction boxes.

4 EXHAUST FAN WIRING

The wiring shall be as for point wiring above and including provision for a 6 amp shuttered socket outlet located adjacent to the exhaust fan and the controlling 6 amp switch located at the Switch plate position in the room.

5 GEYSER POINT WIRING

The wiring shall be as for point wiring above and including provision for 16 amp shuttered socket outlet located adjacent to the Geyser and the controlling 16 amp moulded switch located at the Switch plate position in the room.

6 SWITCHES, OUTLETS AND ACCESSORIES

All switches, socket outlets and other accessories shall be approved by the Owners prior to installation. The Contractor shall furnish samples of all materials within 7 days of the award of the work.

7 MAINS AND SUB-MAINS

The rate for all items shall include:

- a) ISI approved & marked MS / PVC conduits.
- b) Conduit accessories conforming to IS
- c) MS draw, inspection and junction boxes.
- d) Providing and fixing approved saddles, hangers, trays, etc., and grouting the same as required for exposed conduits.
- e) Embedding conduits and accessories in walls and floors etc during construction and/or cutting chases and making good as necessary in the case of concealed conduit work and/or providing and fixing saddles, hangers, stirrups etc. and grouting of the same as required for surface conduiting.
- f) Providing and fixing junction boxes with 3-mm thick Perspex sheet covers including painting covers on inner side to match the colour of the surrounding walls.
- g) Insulated copper earth wire for fixture, switch, outlet box and third pin of socket outlet to common earth.
- h) Effecting adequate and proper connections at termination.
- i) Providing all fixing accessories such as clamping devices, nuts, bolts and screws.
- j) Providing sealing compound thimbles, crimping etc., at joints and terminations as called for.

8 DISTRIBUTION BOARDS

The rates for the distribution boards apart from the switches, and instruments shall also include:

- a) Supporting rigid steel framework.
- b) Cubicle type 2-mm thick M S sheet enclosure with 1.6 mm thick MS sheet door.
- c) Interconnections.
- d) Proper bonding of earth.
- e) Touching up all damaged paint with one coat of red oxide primer and two finishing coats of approved synthetic enamel paint.
- f) Painting/lettering on switches and distribution boards, the location they serve, providing on each board its circuit diagram.

- g) Termination of incoming cables at the incoming unit in the distribution boards.

9 EARTHING

The rates for earthing items include:

- a) All fixing accessories such as brass saddles, brass screws rawl plugs, etc.
- b) Jointing by riveting and soldering after tinning.
- c) Cutting chases, holes and making good the same wherever required.
- d) Effecting adequate and proper interconnections.
- e) Use of tinned copper thimbles.
- f) Excavation of earth, refilling, watering and ramming and making good as approved.

10 FIXING OF LIGHTING FIXTURES

The rates shall include the following:

- 1. All components that may be required to make the installation complete in all respects such as :
 - a) Suitable length of down rod, hanger and connecting wires where called for. The Down rod shall be paid for separately on a running metre basis.
 - b) Internal wiring between accessories.
 - c) Wiring for connecting the fixtures to the point through connection blocks.
 - d) All metal blocks to serve as base of fixtures.
 - e) Bonding with earth wires.
- 2. Drilling holes in supports where required.
- 3. Fixing clamps, GI bolts and nuts, brass screws, saddles, rawl bolts and other fixing accessories as required.

11 DRAWINGS

General Arrangement drawings with constructional details shall be submitted to the Owner for all Distribution Boards etc and their approval obtained prior to commencement of fabrication. Equipment shall not be accepted unless the drawings have been approved by the Owner. These drawings shall be prepared and submitted within one month of the award of work.

12 WIRES AND CABLES

ALL WIRES AND CABLES USED SHALL BE OF THE STIPULATED MAKE. THE CONTRACTOR SHALL PROVIDE A CERTIFICATE FROM THE MANUFACTURER CONFIRMING THAT ALL WIRES AND CABLES SUPPLIED TO SITE ARE OF THEIR MAKE, IRRESPECTIVE OF WHETHER THE WIRES/CABLES ARE PURCHASED FROM THE MANUFACTURER DIRECTLY OR THROUGH A DEALER.

PAYMENT FOR WIRES/CABLES SHALL NOT BE MADE WITHOUT THE MANUFACTURER'S CERTIFICATE BEING FURNISHED TO THE OWNERS.

We confirm that the Special Instructions to Tenderers have been understood and our tender complies to the above in its entirety.

EXTERNAL ELECTRICAL

EXTERNAL ELECTRICAL WORKS

INDEX

SECTION	DESCRIPTION
I	HIGH VOLTAGE & MEDIUM VOLTAGE CABLE
II	MEDIUM VOLTAGE SWITCHGEAR
III	15 KV SWITCH BOARDS
IV	OIL TYPE TRANSFORMERS
V	DG SET
VI	STREET LIGHTING POLE
VII	EARTHING

I TECHNICAL SPECIFICATIONS OF HIGH VOLTAGE & MEDIUM VOLTAGE CABLE

1. GENERAL

Technical specifications in this section covers supplying of :

- 15 kV cables
- Medium voltage cables.

2. GENERAL

2.1 Cables and Wires shall comply with the following standards as appropriate:

B.S. 1442	:	Galvanized Mild Steel wire for armouring cables.
B.S. 2897	:	Aluminium strip armour for cables
B.S. 6234	:	Polyethelene insulation and sheath for cables.
B.S. 6360 + IEC 228	:	Copper conductor for cables.
B.S. 6746 + IEC 540	:	P.V.C. Insulation and sheath for cables.
B.S. 6346	:	P.V.C. Insulated Cables
B.S. 5467 IEC 502	:	Armoured cables with Thermosetting Insulation
B.S. 5468 IEC 502	:	Cross linked polyethelene Insulation.
B.S. 6004 + IEC 227	:	P.V.C. insulated cables for power and lighting.
B.S. 6500 IEC 227	:	Insulated Flexible Cords.
B.S. 6207 IEC 245	:	Mineral Insulated Cables.

3. CABLES

3.1 15 kV Cables

15 kV cable shall be aluminium conductor with cross linked polyethylene (XLPE) insulation, galvanized steel armouring and PVC sheathing. Conductors shall be sector shaped, made from electrical purity aluminium of 3 x 4 H or H temper XLPE insulation of high purity shall be extruded on the conductors with screen a layer of semi-conducting material shall be applied over the XLPE insulation to prevent partial discharge at insulation surface. This shall be followed up by metallic aluminium tape screen the cores shall be discharged tested. Built up cores shall then be laid up and filler codes added. Combined core shall be provided with extruded PVC sheathing. Galvanized steel wire of strip armouring shall then be provided protected by an overall extruded black PVC sheet. The outer sheath shall bear the manufacturer's name and trade mark at every meter length.

3.2. Medium Voltage Cables

Medium cables shall be aluminium conductor XLPE insulated, XLPE sheathed armoured conforming to B.S. 6346. Cables shall be rated for a 1100 Volts. The conductor of cables from 16 Sq. mm. to 50 Sq. mm. shall be stranded. Sector shaped stranded conductors shall be used for cables of 50 sq. mm and above. Conductors shall be made of electrical purity aluminium 3/4 H or H temper. Conductors shall be insulated with high quality XLPE base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanised compound. Armouring shall be applied over outer sheath of XLPE sheathing. The outer sheath shall bear the manufacturer's name and trade mark at every meter length. Cores shall be provided with following colour scheme of XLPE insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Core	:	Red and Black
3 Core	:	Red, Yellow and Blue
3 1/2 /4 Core	:	Red, Yellow, Blue and Black

Current ratings shall be based on the following conditions.

a)	Maximum conductor temperature	70° C
b)	Ambient air temperature	45° C
c)	Ground temperature	30° C
d)	Depth of laying	1000 mm

Short circuit rating of cables shall be as specified in British standard.

Cables have been selected considering conditions of maximum connected loads, ambient temperature, grouping of cables and allowable voltage drop. However, the contractor shall recheck the sizes before cables are fixed and connected to service.

4. DELIVERY, STORAGE AND HANDLING

Cable drum shall be stored on a well drained, hard surface, preferably of concrete, so that the drums do not sink in ground causing rot and damage to the cable drum. The cable drum shall conform to IS 10418. During storage, periodical rolling of drums, in the direction of arrow marked on the drum, shall be done once in 3 month through 90o C Both ends of cables shall be properly sealed to prevent moisture ingress Drums shall be stored in well ventilated area protected from sun and rain. Drums shall always be rested on the flanges and not on flat sides. Damaged battens of drums etc. shall be replaced. Movement of drums shall always be in direction of the arrow marked on the drum. For transportation over long distance, the drums shall either be mounted on drum wheels and pulled by ropes or they shall be mounted on trailers etc. drums shall be unloaded preferably by crane otherwise they shall be rolled down carefully on suitable ramps. While transferring cable form 1 drum to another, the barrel of the new drum shall have diameter not less than the original drum. Cables with kinks or similar visible defects like defective armouring etc shall be rejected. Cables shall be supplied at site in cut pieces as per actual requirements.

II TECHNICAL SPECIFICATIONS OF MEDIUM VOLTAGE SWITCHGEAR

1. GENERAL

This section covers specification of Medium Voltage Switchboards incorporating items of switchgear like Circuit Breakers, SFUs, metering and protection

2 STANDARDS AND CODES

Codes and Standards: Comply with the latest issue of:
construction Specifications 2010

IEC 60068-2-11 Basic environmental testing procedures-

Part 2: Tests- test Ka: Salt mist.

IEC 60068-2-30 Basic environmental testing procedures- Part 2: Tests- test Db

And guidance : Damp heat.

IEC 60529 Degrees of protection provided by enclosure (IP Code)

IEC 61439-

1 & 2: Low Voltage Switchgear and Control Gear Assemblies:

Type-Tested and Partially Type-Tested Assemblies.

IEC 60947-2: Low Voltage Switchgear and Control Gear: Circuit Breakers.

IEC 60831-1 & 2 for power factor correction capacitors.

IEC 61641 for internal arc faults.

Relevant IEC Standard for other components, where not otherwise specified.

BS EN 60529 Specification for classification of degrees of protection provided by enclosures

3. SWITCHGEAR

3.1 Medium Voltage Air Circuit Breakers

3.1.1 Technical Parameters

- The circuit breaker shall be of the air break type, robust and compact design suitable for indoor mounting and shall comply with the requirement of IEC CODE. Rupturing capacity shall be 31 MVA at 415 Volts or as per schedule of quantities.

3.1.2 Constructional Features

- The Circuit Breaker shall be flush front, metal clad, horizontal draw-out pattern, three/four pole as required and fully interlocked. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

- The Circuit Breaker cradle shall be designed and constructed to permit smooth withdrawal and insertion. The movement shall be free of jerks, easy to operate and positive.

- All current carrying parts in the breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts which shall be separate from the main contacts and easily replaceable. In addition, Arc chutes shall be provided for each pole, and these shall be suitable for being lifted out for the inspection of the main and the arcing contacts.

- Self aligning cluster type isolating contacts shall be provided for the Circuit Breaker, with automatically operated shutters to screen live cluster contacts when the Breaker is withdrawn from the cubicle. Sliding connections including those for the auxiliary contacts and control wiring shall also be of the self aligning type. The fixed portion of the sliding connections shall have easy access for maintenance purposes.

- The cubicle for housing the Breaker shall be free standing dead front pattern, fabricated from the best quality sheet steel.

3.1.3 Operating Mechanism

- The Circuit Breaker shall be trip free with independent manual spring operated or motor wound spring operated mechanism as specified and with mechanical ON/OFF indication. The operating mechanism shall be such that the circuit breaker is at all times free to open immediately the trip coil is energised.

- The operating handle and mechanical trip push button shall be at the front of and integral with the Circuit Breaker.
- The Circuit Breaker shall have the following four distinct and separate positions which shall be indicated on the face of the panel.

"Service" -- Both main and secondary isolating contacts closed

"Test" -- Main isolating contacts open and secondary isolating contacts closed

"Isolated" -- Both main and secondary isolating contacts open

"Maintenance" -- Circuit Breaker fully outside the panel ready for maintenance

- The tests shall be carried out with a breaking performance during operation (Ics) and admissible short time withstand (Icw) equal to the ultimate breaking capacity (Icu). i.e. $I_{cu} = I_{cs} = I_{cw}$ for 3 Sec.
- All Air circuit breakers can be reverse fed without reduction in performance

3.1.4 Circuit Breaker Interlocking

- Sequence type strain free interlocks shall be provided to ensure the following:
- It shall not be possible for the Breaker to be withdrawn from the cubicle when in the "ON" position. To achieve this, suitable mechanism shall be provided to lock the Breaker in the tripped position before the Breaker is isolated.
- It shall not be possible for the Breaker to be switched "ON" until it is either in the fully inserted position or, for testing purposes, it is in the fully isolated position.
- It shall not be possible for the Circuit Breaker to be plugged in unless it is in the OFF position.
- A safety latch shall be provided to ensure that the movement of the Breaker, as it is withdrawn, is checked before it is completely out of the cubicle, thus preventing its accidental fall due to its weight.
- Mechanical and electrical antipumping devices shall be incorporated in the ACB's as required.

3.1.5 Circuit Breaker Auxiliary Contacts

The Circuit Breaker shall have minimum 6 NO/NC auxiliary contacts rated at 16 amps 415 volts 50 Hz. These contacts shall be approachable from the front. They shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is Drawn Out of the cubicle.

3.1.6 Protective Devices

- The Circuit Breaker shall have protective devices as specified in the Schedule of Quantities. These will in general be:
- C.T. operated thermal overload releases with magnetic instantaneous short circuit release. The overload releases shall be such that each phase can be individually set depending on the phase unbalanced currents. The releases shall have inverse time current characteristics and the magnetic release shall be time delayed with a minimum setting of 25 ms varying upto 300 ms for discrimination without effecting the breaking current capacity of the ACB.
- Over voltage relay.
- Under/no voltage trip coil or Relay as required.
- Over current and earth fault IDMT relays with shunt/series trip coil operation as specified.
- The Circuit Breakers shall be suitable to accommodate one or more types of protection as specified.

3.1.7 Instrument Transformers

The Circuit Breaker shall have the required Current Transformers as specified for metering and protection mounted outside the Circuit Breaker compartment but within the free standing cubicle. The transformers shall comply to the relevant Indian Standards and the Class of Accuracy required for metering and protection. Separate sets of Current transformers shall be provided.

3.1.8 Metering

The metering required to be provided for each Circuit Breaker shall be as per the Schedule of Quantities. Such metering shall not be provided on the front panel of the Circuit Breaker compartment. A separate compartment shall be provided for the metering and Protective relays as required. Square pattern flush mounting meters complying with the requirements of the relevant Indian Standards shall only be used.

Selector switches of the three way and OFF pattern complying to the relevant Indian Standards shall be used.

3.1.9 Indicating Lamps

Neon type indicating lamps shall be provided for indication of phases and Breaker position as required in the Schedule of Quantities.

3.1.10 Control Wiring

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

All control circuits shall be provided with protective MCB. Instrument testing plugs shall be provided for testing the meters.

3.1.11 Earthing

The frame of the Circuit Breaker shall be positively earthed when the Circuit Breaker is racked into the cubicle.

3.1.12 Type Test Certificates

The Contractor shall submit type test certificates from a recognised test house for the Circuit Breakers offered.

3.2. Moulded Case Circuit Breakers

Moulded case circuit breakers (MCCB) or fuse free breakers, incorporated in switchboards wherever required, shall conform to IEC 60947-2. in all respects. MCCBs shall be suitable either for single phase 240 Volts or 3 Phase 415 Volts AC 50 HZ supply.

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

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

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

- Under voltage trip
- Shunt trip
- Alarm switch
- Auxiliary switch

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

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

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

MCCBs shall be designed to prevent access to live parts when the cover is removed, means main current path of the circuit breaker should be isolated from auxiliary section i.e MCCB shall offer class-II front face.

3.3. Metering, Instrumentation And Protection.

Ratings, type and quantity of meters, instruments and protective devices shall be as per drawings and schedule of quantities.

Current Transformers

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

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

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

Potential Transformer

PTs shall confirm to IEC code in all respects.

Measuring Instruments

Direct reading electrical instruments shall conform to IEC code or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -10o C and +50oC. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould . Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from out side. Direction of deflection shall be from left to right. Selector switches shall be provided for ammeters and volt meters used in three phase system.

Ammeters

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

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

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

Voltmeters

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

Watt meter

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

Power factor meters

3 phase power factor meters shall be of electro dynamic type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% readings. Phase angle accuracy shall be +40.

Energy and reactive power meters

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

Relays

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

Over current relays

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

Earth fault relay

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

Under voltage relay

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

3.4. Power Factor Correction Capacitors

Unless specified otherwise the capacitor banks shall conform in design, material, construction and performance to the latest editions of the IEC standards, their corresponding British/European (BS EN) standards and in particular to the following publications :

IEC 60831-1 & 2 : Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V.

IEC 61921 : Power capacitors – Low voltage power factor correction banks.

IEC 60076-6 : Power transformers - Part 6: Reactors

IEC 60747-6 : Semiconductor devices. Discrete devices. Part 6: Thyristors.

IEC 60085-1 : Electrical insulation – Thermal evaluation and designation.

IEC 60664 : Insulation coordination for equipment within low-voltage systems.

IEC 60439-1 : Low-Voltage Switchgear and Controlgear Assemblies - Part 1: Type-Tested and Partially Type-Tested Assemblies.

IEC 60947-1 : Low-voltage Switchgear and Controlgear - Part 1: General Rules

IEC 60947-2 : Low-voltage Switchgear and Controlgear - Part 2: Circuit-Breakers.

IEC 60947-4-1 : Low-voltage Switchgear and Controlgear – Part 4-1

IEC 60529 : Degree of protection provided enclosures (IP code)

IEEE 519-1992 : IEEE Recommended Practices and requirements for Harmonic Control in Electric Power Systems.

Capacitors shall be suitable for 3 phase 415 volts 50 HZ supply and shall be available in single and three phase units of 5, 10, 15, 25, 50 & 100 kVAR sizes as specified. Capacitor shall be usable for indoor use, permissible overloads being as below.

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

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

4. MEDIUM VOLTAGE SWITCH BOARDS

4.1 General

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

4.2 Switch Board Configuration

- The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipment as called for in the Schedule of Quantities.
- The MCCB's shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.
- The Switch Boards shall be of adequate size with a provision of 10% spare space to accommodate possible future additional switch gear.

4.3 Equipment Specifications

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

4.4 Constructional Features

- The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.
- The Switch Boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as specified. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.
- The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 1.6 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.
- All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.
- Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switch Boards.

4.5 Switchboard Dimensional Limitations

- A base channel 100 x 50 x 6 mm thick shall be provided at the bottom.
- A minimum of 200 mm blank space between the floor of switch board and bottom most unit shall be provided.
- The overall height of the Switch Board shall be limited to 2300 mm
- The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

4.6 Switch Board Compartmentalisation

The Switch Board shall be divided into distinct separate compartments comprising

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

- Each circuit breaker, and MCCB shall be housed in separate compartments enclosed on all sides.
- Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "on" and "off" position.
- For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.
- A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
- Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.
- Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top.
- Adequate and proper support shall be provided in cable compartments to support cables.

4.7 Switch Board Bus Bars

- The Bus Bar and interconnections shall be of electrolytic Copper/Aluminium and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. The maximum current density for copper shall be 1.6 amps per sq. mm. and for Aluminium shall be 1 amp per Sq. mm. and suitable to withstand the stresses of a 31 MVA fault level or at 415 volts for 1 second or as per schedule of quantities. .
- The bus bars and interconnections shall be insulated with insulation tape/ fiber glass.
- The bus bars shall be extensible on either side of the Switch Board.
- The bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.
- All bus bars shall be colour coded.
- All bus bar connections in Switch Boards shall be bolted with brass bolts and nuts. Additional cross section of bus bars shall be provided wherever holes are drilled in the bus bars.
- All TRIP/CLOSE/INDICATION circuit shall be compatible on 24V DC. Accordingly all relay & CTs etc shall be 24 V DC.

4.8 Switch Board Interconnections

- All connections between the bus bars/Breakers/cable terminations shall be through solid tinned copper strips of adequate size to carry full rated current and PVC/fibre glass insulated.
- For unit ratings upto 100 amps PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of all such interconnections shall be crimped and aluminium lugs shall be used.

4.9 Drawout Features

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

4.10 Instrument Accomodation

- Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switch Board.
- For MCCB's instruments and indicating lamps can be provided on the compartment doors.
- The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.

4.11 Wiring

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

4.12 Cable Terminations

- Knockout holes of appropriate size and number shall be provided in the Switch Board in conformity with the location of incoming and outgoing conduits/cables.
- The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear of the panel.
- The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.
- The Switch Boards shall be complete with tinned brass cable sockets, tinned brass compression glands, gland plates, supporting clamps and brackets etc for termination of 1100 volt grade aluminium conductor PVC/PVCA cables.

4.13 Space Heaters

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

4.14 Ventilation Fans

The Switch Board shall be provided with panel mounting type ventilation fans in each panel with switchgear rated for 2500 amp and above. The fan shall be interlocked with switchgear operation.

4.15 Earthing

A main earth bar of G.I./copper as required shall be provided throughout the full length of the Switch Board with a provision to make connections to the sub-station earths on both sides.

4.16 Sheet Steel Treatment And Painting

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

4.17 Name Plates And Labels

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

5. OUTDOOR TYPE DISTRIBUTION FEEDER PILLARS

The feeder pillar shall be of the floor mounting type, totally enclosed, and weather proof, conforming to ISI IP 54. The feeder pillar shall be suitable for 440 volts 3 phase 4 wires, 50 cycles AC supply.

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

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

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

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

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

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

6. TESTING AT WORKS

Copies of type test carried out at ACB/MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Project Manager reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the routine tests.

7. INSTALLATION

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

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

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

8. TESTING AT SITE

Pre-commissioning tests as required and as per manufacturers recommendations shall be carried out on each switchboards at site before energizing the switchboards including but not restricted to the following.

- Physical checking of the switchboards including checking alignment of panels, interconnection of Bus bars, tightness of bolts/connections and evidence of damage/cracks in any components.
- Physical checking and inspections of Inter panel wiring
- Checking free movement of ACBs/MCCBs/SFUs
- Checking of operation of breakers
- Insulation tests of bus bar supports and control wiring etc. with 1.1 kV megger.
- Primary & secondary injection tests of relays and CTs.
- Checking of Interlocking function.

III TECHNICAL SPECIFICATIONS OF 15 KV SWITCH BOARDS

1. GENERAL

The technical specifications cover the equipment to be supplied for a 15 kV Switchboards suitable for 15 kV 3 phase earthed system. 50 HZ AC supply with a fault level of 350 MVA at 15kV. The equipment shall be suitable for continuous operation at the ambient conditions (Temperature from 0 to 50°C , Relative Humidity 10% to 100%).

2. STANDARDS AND CODES

Relevant British and/or IEC Standards shall be applicable.

BS certified equipment shall be used as a part of the Contract in line with Government Regulations. Necessary Test Certificates in support of the certification shall be submitted prior to supply of the equipment.

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

IEC 62271-100

CEI-EN 62271

ANSI/IEEE C37.54-C37.09- C37.04-C37.55 Standards

3. 15000 VOLT CIRCUIT BREAKERS

3.1 Technical Parameters

The 15000 volt circuit breakers shall be triple pole Vacuum type suitable for indoor mounting and shall comply with the requirements of the relevant Indian Standards. The Circuit Breakers shall be suitable for operation at 15000 volts 3 phase 50 Hz supply system and shall have a certified symmetrical breaking capacity of 350 MVA at 15000 volts or as stipulated in schedule of quantities.

3.2 Technical Specifications

The Circuit Breakers shall be Vacuum type and shall consist of three identical single pole vacuum interrupter units which shall comprise of a pair of butt contacts enclosed within a sealed ceramic body with SS end plates. The moving contacts shall be sealed into the enclosure via a SS steel bellow which shall permit axial movement of the contact. The contact arrangement shall be surrounded by SS sputter shield to prevent condensation of metal on the inside of the insulating envelop and also to provide good voltage grading across the gap and the outer envelope. The contact material and the contact geometry shall be suitable for the purpose so as to attain current chopping at minimum current to prevent build-up of unduly high over voltages and to prevent the arc to cause localised high spots on the contact.

The Circuits Breaker shall be suitable for switching duty of Transformers

4. CIRCUIT BREAKER CONSTRUCTIONAL FEATURES

The 15000 volt circuit breaker shall be flush front, metal clad, truck mounted , drawout type and fully interlocked. The truck that carries the Circuit Breaker shall be of rigid fabricated construction. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

Each withdrawable truck shall have its own Circuit Breaker.

All electrical connections on the truck shall be brought to secondary plugs which engage similar sockets in the housing.

The Circuit Breakers shall be of the double break type. Interphase barriers and tank lining of insulating material shall be provided.

The drawout mechanism shall be so designed and constructed as to permit smooth withdrawal and insertion. The movement shall be free of jerks, easy to operate and positive.

All current carrying parts in the Circuit Breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts.

Isolating contacts of the spring loaded self aligning pattern shall be provided for the Circuit Breaker. Suitable arc control devices shall be mounted around the fixed contacts.

Terminal insulators of synthetic resin bonded paper shall be provided suitable for the specified short circuit level

Sheet steel barriers shall be provided between

- Instrument Panel and Potential Transformer
- Instrument Panel and Current Transformers
- Busbar chamber and Circuit Breaker compartments

5. CIRCUIT BREAKER OPERATING MECHANISM

The Circuit Breaker shall be trip free and equipped with a motor power operated closing mechanism. The operating mechanism shall be such that the Circuit Breaker is at all times free to open immediately the trip coil is energised.

Mechanical ON/OFF position indication shall be provided on the front of the circuit breaker.

The operating mechanism shall be mounted on the front panel of the truck.

The operating handle and the mechanical trip push button shall be at the front of and integral with the Circuit Breaker.

The operating mechanism shall provide four distinct and separate positions of the Circuit Breaker on the cradle

- Service
- Test
- Isolated
- Maintenance

6. CIRCUIT BREAKER INTERLOCKING

Each Circuit Breaker shall be provided with the following mechanical safety interlocks to ensure protection to the equipment and the operator.

The Circuit Breaker cannot be closed unless it is in the 'PLUGGED IN' position.

The Circuit Breaker cannot be withdrawn from or pushed into the housing unless the main contacts are open.

The Circuit Breaker cannot be put into service without making the secondary connections between the truck and housing.

The cover of the drawout voltage transformer cannot be opened unless the transformer is isolated.

7. CIRCUIT BREAKER AUXILIARY CONTACTS

The Circuit Breaker shall have a minimum of 6 N.O. and 6 N.C. auxiliary contacts rated at 5 amps. These contacts shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is lowered.

8. PROTECTIVE RELAYS

The Circuit Breaker shall have overcurrent, earth fault protection and auxiliary relay devices as specified in the Schedule of Quantities. These relays shall be mounted flush on a separate compartment with access from the rear for wiring and maintenance.

9. POTENTIAL AND INSTRUMENT TRANSFORMERS

A drawout type cast resin voltage transformer shall be mounted in the panel and connected to the line. The tank shall be arranged for horizontal isolation.

The Circuit Breaker shall have the required current transformers as specified in the Schedule of Quantities for metering and protection mounted outside the Circuit Breaker compartment but within the free standing cubicle. The transformers shall comply to the relevant British Standards. All current transformers for metering shall be Accuracy Class I and of capacity and ratio as required. Separate sets of current transformers shall be provided for metering and protection.

10. INSTRUMENTATION

Instruments and indicating lamps as required in the Schedule of Quantities shall not be mounted on the Circuit Breaker compartment door. A separate adequate compartment shall be provided. The instruments and relays shall be accessible for testing and maintenance without danger of accidental contact with live parts in the Switchgear Panel.

Square pattern flush mounting meters and selector switches of the three way and OFF pattern complying with the requirements of the relevant Indian Standards shall be used.

The current transformers for metering and protection shall be mounted on the solid copper busbars with proper supports.

Neon type indicating lamps shall be provided for phase and other operational indications.

11. TRIP COIL POWER PACK

A power pack (AC to DC converter) shall be provided to supply 110 volts DC for operating shunt trip coils. The power pack shall draw AC supply from the potential transformer and convert this into 110 volts DC supply. The power pack comprising of transformer, rectifier unit and bank of capacitors shall be housed in a sheet metal enclosure. The input transformer shall be provided with 2 taps on the

primary to connect it to either 110 volts AC or 240 volts AC supply. The AC input shall be suitably transformed by the input transformer and rectified by a full wave rectifier which shall charge a set of capacitors. The stored energy of the capacitors at 110 volts shall be available as output from the unit to energize trip coil of the VCB. An auxiliary relay connected to the input of the transformer shall be provided with its output wired externally to alarm/indications to denote AC supply failure. Two separate LEDs and push buttons are provided to indicate on demand DC output healthiness and trip circuit healthiness.

The power pack units shall work satisfactorily at variations of 80% to 110% of the rated AC input. The output of the power pack units in watt sec. shall be suitable to provide energy required to trip the shunt trip coils in maximum 60 milliseconds. At least 2 operations of the breaker shunt trip coil shall be possible within 10 minutes of failure of AC input supply. VA burden shall match with power consumed by the trip coil.

The units shall be complete with all accessories, DC healthy push buttons with indications, trip healthy push buttons with indication, interconnections etc. as required.

12. 15 KV SWITCHGEAR PANEL

12.1 General

The switchgear panels shall be suitable for operation at 15000 volt 3 phase 50 Hz supply system with a short circuit withstand of 350 MVA at 15,000 volts and a corresponding short time rating for 3 second.

The Switchgear panels shall comply with the requirements of the latest edition with upto date amendments of the relevant British Standards.

12.2 Switchgear Configuration

The panel shall be configured with 15,000 volt Circuit Breakers, associated metering and protective devices and other equipment as called for in the Bill of Quantities.

Each 15,000 volt Circuit Breaker shall be housed in an individual panel in single tier formation.

12.3 Equipment Specifications

All equipment used to configure the Switchgear Panel shall comply to the relevant Standards and Codes IEC or British Standards and the detailed technical specifications as included in this tender document.

12.4 Constructional Features

The 15000 volts Switchgear Panel shall be totally enclosed, dead front, metal clad, cubicle pattern, floor mounting, extensible on both sides and suitable for indoor use.

The Switchgear Panels shall be totally enclosed and completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.

The Switchgear Panels shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA Sheet Steel of thickness not less than 1.6 mm. Joints of any kind in sheet steel shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.

Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switchgear Panels.

12.5 Switchgear Panel Limitations

A base channel of 100 x 50 x 6 mm thick shall be provided at the bottom.

The Switchgear Panel height shall normally be restricted to a maximum of 2300 mm.

12.6 Switchgear Panel Compartmentalisation

The Switchgear Panels shall be divided into distinct separate compartments comprising

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

Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

Separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, protective relays, control fuses etc as required. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts.

A horizontal wireway with screwed covers shall be provided at the top to take interconnecting control wiring between vertical sections.

Cable compartment shall be of adequate size for easy termination of all incoming and outgoing cables. Adequate and proper supports shall be provided in the compartment for supporting the cables.

12.7 Switchgear Panel Busbars

The main horizontal and vertical interconnection busbars shall be of hard drawn high conductivity electrolytic copper and of rectangular cross sections suitable for full rated current. The current density for copper shall be 1 amps per sq. mm. and suitable to withstand the electromagnetic and thermal stresses of a 350 MVA fault level at 15,000 volts for 3 second.

The busbars and interconnections shall be insulated with fibre glass sleeves.

The busbars shall be extensible on either side of the Panels.

The busbars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals to withstand the stresses of a 350 MVA fault level.

All busbars and interconnections shall be colour coded.

The main horizontal busbars shall run through the entire length of the Switchgear Panels.

12.8 Switchgear Panel Interconnections

All interconnections shall be with solid electrolytic copper of adequate size to carry the full rated current and fibre glass insulated.

12.9 Drawout Features

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

12.10 Switchgear Panel Interlocks

Each group of busbars and feeder connections shall be fitted with automatically operated safety shutters with positive opening and closing when the Circuit Breaker is raised or lowered.

Facility shall be provided for hand operation of the shutters and latching in either open or closed position.

Padlocking provision of the shutter in the closed position shall be included for maintenance purposes.

12.11 Instruments And Protection Relays

Instruments, indicating lamps and all protection and control relays shall not be mounted on the Circuit Breaker compartment door. A separate adequate compartment shall be provided. The instruments and relays shall be accessible for testing and maintenance without danger of accidental contact with live parts in the Switchgear Panel.

LED type indicating lamps shall be provided for phase and other operational indications.

The current transformers for metering and protection shall be mounted on the solid copper busbars with proper supports.

12.12 Switchgear Panel Internal Wiring

All wiring for relays and metering shall be with PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 2.5 sq.mm.

All control circuits shall be provided with 10 kA MCB's Instrument testing plugs shall be provided for testing the meters.

12.13 Cable Terminations

Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the location of the incoming and outgoing cables.

The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located in the cable chamber at the rear of the panels.

12.14 Space Heaters

The Switchgear Panel shall have in each panel thermostatically controlled space heaters with a controlling 16 amp 230 volt socket outlet with MCB to eliminate condensation.

12.15 Earthing

Two main earth bars of G.I./copper as required shall be provided throughout the length of the Switchgear Panels with a provision to make connections on both sides to the sub-station earths.

12.16 Designation Labels

Suitably engraved white on black name plates and identification labels of metal for all Panels and circuits shall be provided. These shall indicate the feeder number and the designation

12.17 Sheet Steel Treatment And Painting

Sheet steel materials used in the construction of the Switchgear Panels should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The sheet steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

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

13. TEST AT MANUFACTURERS WORKS

Copies of type test carried out at VCB manufacturers works for the VCB and of routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Project Manager reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the routine tests, for which purpose the contractor shall provide the necessary facilities and also give due notice.

14. TESTS AT SITE

Pre-commissioning tests as per manufacturers recommendations shall be carried out on the switchboard a site after installation including but not restricted to the following.

- Physical checking of the switchboard including checking for damage or cracks in components, bolt tightness, gasketing etc.
- Checking of vacuum bottles to ensure leak tightness
- Insulation testing of Bus bar supports by 2.5 kV megger
- Insulation testing of Control wiring by 1.1 kV megger.
- Testing of relays and CTs with secondary injection kit.
- Checking of breaker operation.
- Checking of earth continuity.

IV TECHNICAL SPECIFICATIONS OF OIL TYPE TRANSFORMERS

1.0 SCOPE :

This specification generally describes the power transformers and associated auxiliary equipment for use on the electrical power distribution system and covers the design, manufacture, testing at works, supply and delivery, testing and commissioning aspects of the same. The details are given in the data sheet.

2.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES:

2.1 All materials used shall be of best quality and of the class most suitable for working under the site conditions and shall withstand the variations of temperature and atmospheric conditions, overloads, over-excitation, short circuits as per applicable standards, without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

2.2 The design shall be such that the risk of accidental short-circuit due to birds or vermin's are obviated. All apparatus, including bushing insulators and fittings shall be so designed that water cannot collect at any point. Marshaling kiosks, boxes etc. shall be adequately ventilated to prevent condensation of moisture and so treated internally as to prevent growth of fungi on any coils, wires and insulating materials used.

2.3 The transformers shall operate with minimum noise and vibration. The cores, tank and other structural parts shall be properly constructed so that the mechanical vibrations are kept to the minimum, thus reducing the noise.

2.4 The design of the transformer shall be such that changes in transformer connection can be made by a simple change of link connection inside the tank. The transformers shall be designed to suppress harmonic voltages, specially the third and fifth, so as to eliminate distortion in wave form, and the possibility of circulating currents between the neutrals at different transformer stations.

2.5 All transformers shall be of the latest design, oil filled as called for in the main specification. Unless otherwise specified, all transformers shall be suitable for indoor installation. The type of cooling and the corresponding ratings for each transformer shall be as indicated in the main specification.

2.6 The magnetic circuit of each transformer shall be so designed as to minimise eddy-current and hysteresis losses in the core.

2.7 All electrical connections and contacts shall be of ample section for carrying the rated current without excessive heating.

2.8 All mechanisms shall be of stainless steel, brass, gunmetal, or other suitable material to prevent sticking due to rust or corrosion.

2.9 TANK :

2.9.1 The transformer tank shall be made of steel plate, shaped in such a way that minimum of welding is required. The tank shall be electrically welded and all welding stresses shall be properly relieved. Tank walls shall be reinforced by adequate stiffeners to ensure mechanical rigidity permitting hoisting of complete transformers filled with oil and also to damp transformer-noise. The tank shall be sufficiently strong to withstand shocks likely to be encountered during transport of the transformer without any deformation or weakening of joints. The joints shall be oil-tight. Guides shall be welded on the inner side of the tank to facilitate tanking and untanking of the transformer core and coil assembly.

2.9.2 Tank cover shall be bolted on to the flanged rim of the tank with a suitable weather-proof, hot-oil-resistant gasket in between for oil-tightness. The bolted tank cover shall be so arranged that it can be removed and the core inspected without removal of the radiators. All requisite access and inspection holes shall be provided with bolted oil-tight, gasket-seated cover-plates. Bushing-turrets, covers of access holes, covers of pockets to prevent leakage of water into the tank shall be provided.

2.9.3 The exterior of tank and other steel surface exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather resistant nature preferably of distinct colour from the prime and finish coats. The final coat shall be of a glossy, oil and weather resisting non-fading paint of specified shade. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant and oil insoluble paint.

2.9.4 Steel bolts and nuts exposed to atmosphere shall be galvanised however, surfaces of the transformer or other parts of the transformer or auxiliary equipment which are in contact with oil shall not be galvanised.

2.9.5 The transformer tank, auxiliary equipment and fittings shall be provided with necessary devices for lifting and haulage facilities. The tank shall be mounted on a substantial under-carriage.

2.9.6 Unless otherwise stated the tank together with radiators, conservator, bushings and other fittings shall be designed to withstand without permanent distortion the following conditions.

a) Full vacuum of 760mm of Hg for filling oil by vacuum.

b) Internal gas pressure of 0.35 Kg/Sq.cm. with oil at operating level.

Valves shall not leak nor any welded joints sweat under above conditions.

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

3.00 CORE:

3.1 The magnetic circuit shall be built of transformer grade cold rolled grain oriented low loss steel stampings having high permeability and conforming to adopted standards. Stampings shall be insulated from each other with material having high inter-lamination insulation resistance and rust inhibiting property and also capable of withstanding pressure, mechanical vibration and action of heat and oil, thus reducing the possibility of sludge formation to a minimum.

3.2 The framework, clamping arrangement and general structure of the cores of each transformer shall be of robust construction and shall be capable of withstanding any shock to which they may be subjected during transport, installation and service. The assembled core shall be securely clamped, on the limbs and the yoke, to build up a rigid structure. The clamping pressure shall be uniform over the whole of the core and so adjusted as to minimize noise and vibration in the core when the transformer is in service. The framework and the core bolts shall be efficiently insulated from the core so as to reduce the circulating currents to a minimum.

3.3 The core clamping frame shall be provided with lifting eyes for the purpose of tanking and untanking the core with winding mounted thereon and shall have ample strength to take the full weight of the core and winding assembly.

3.4 An approved type of core grounding system shall be used; the grounding connections being located at the top of the core for easy access from the inspection hole.

3.5 WINDING:

3.5.1 The coils used for transformer winding shall be circular in shape, made of paper insulated, continuous and smooth, tinned or enameled electrolytic copper conductors of high conductivity.

3.5.2 The transformer winding shall be designed for basic impulse insulation level not lower than that specified in the main specification.

3.5.3 Liberal ducts shall be provided to prevent any hot spot temperature in the winding that may adversely affect the life of the transformer. Adequate supports, wedges and spacers of hard insulating material shall be so fitted that they will neither move nor permit relative movement of any part of winding during transit of normal service or under terminal short-circuit, nor damage the winding insulation in any way. All leads and connections shall be robust, adequately insulated, protected and clamped. The winding assembly shall be dried in vacuum with tested insulating oil of approved standard. The windings shall be subjected to a thorough shrinking and seasoning process so that no further shrinkage of windings occur during service at site. However adjustable devices shall be provided for taking up any possible shrinkage of coils in service. The assembly shall be held in position under adequate axial compression to withstand the axial thrust likely to occur under terminal short-circuit.

3.5.4 The end turns on the high voltage winding shall have reinforced insulation to take care of the voltage surges likely to occur during switching or any other abnormal system condition.

3.5.5 The transformers shall be suitable for operation at full rated power on all tapplings without exceeding the specified temperature rise as indicated in the applicable standards.

3.6 INSULATING MATERIALS:

3.6.1 The insulating oil shall conform to British standard or IEC and shall be suitable in all respects for operating the transformer at the rating and under conditions specified in the main equipment specification. Sufficient oil shall be supplied for the first filling of transformer, the oil circulating equipment and the tank containing tap-changing mechanism and an extra 10% shall be supplied in non-returnable drums. The tender shall contain information about the grades of oil recommended by the transformer manufacturer for use in the transformer. Test certificates for the oil shall be furnished before dispatch of transformer and acceptance by owner.

3.6.2 Class F insulating materials specified in latest IEC shall be used. Paper insulation shall be new and free from punctures. Wood insulation, where used shall be well seasoned and treated.

3.7 TRANSFORMER TAPPINGS :

Transformer shall be provided with ON Load Tap Changer arrangement in steps of 1.25% with range from + 5% to – 15%.

3.8 COOLING EQUIPMENT:

3.8.1 Natural cooling by means of banks of detachable type radiators made from pressed/round tubes around transformer tank shall be provided. The tubes shall be of seamless mild steel sheet with clean bright internal surface and shall be suitably braced to protect them from shock.

3.8.2 The radiators shall be provided with butterfly type of shut off valves.

3.8.3 Cooling tubes/radiators shall permit every part of the cooling surface to be cleaned by hand.

3.9 TERMINAL ARRANGEMENT

3.9.1 High Voltage Side (15 KV)

Cable box shall be provided suitable for terminating one no. 3C x 240 sq.mm XLPE insulated armoured 15 KV cable complete with disconnecting chamber, compression glands, tinned copper lugs, Armour earth clamp and body earth terminal.

Cable box shall be fitted with bushing insulators for H.T. cable termination side.

3.9.2 Low Voltage Side (433 V)

LT Termination shall be suitable for 1000A.

3.9.3 Disconnecting Chamber

The disconnecting chamber shall be air insulated and complete with seal off bushing, removable flexible connectors / links and removable covers. It shall be possible to trail out the transformer without having disconnecting the bus duct.

Phase to phase and phase to ground clearances within the chamber shall be such as to enable either the transformer or cable to be subjected separately to H.V. test.

3.9.4 Bushing :

Bushings shall confirm to latest IEC and other relevant standards.

Bushings shall be supplied with terminal connector clamp suitable for connecting the bushing terminal to the owner's conductor.

Creepage distance of bushing shall be (41mm/kv phase ground) adequately,

3.10 MARSHALLING BOX

3.10.1 Whenever optional fittings, temperature indicators, with auxiliary contacts, Buchholtz Relay and Bushing CT's are specified then the bidder shall provide a Marshalling box and Marshall to it all the contact terminals of electrical devices mounted on the transformer. It shall be in the contractor's scope to provide:

a) The interconnection cabling between the Marshalling box and the accessory devices either by PVC insulated copper wire in G.I. conduits or PVC insulated copper conductor armoured cables.

b) Necessary compression type brass cable glands at the Marshalling box for above cables.

3.10.2 The Marshalling box shall be tank mounted, water/dust tight sheet steel (2mm thick) enclosed with hinged door having padlocking facility. All doors, covers and plates shall be fitted with neoprene gaskets. Top surface shall be sloped and bottom shall be atleast 600mm from floor and provided with gland plate and cable glands as required.

3.10.3 Terminals shall be clipon type rated for 10A. All contacts for alarm/trip indication shall be potential free, wired up to the terminal block. Wiring shall be done with stranded copper conductor wires of sizes not less than 1.5 sq.mm for control and 2.5 sq.mm for CT circuits. C.T. terminals shall be provided with shorting facility.

4.0 ELECTRICAL & PERFORMANCE REQUIREMENT :

a) Transformer shall operate without injurious heating at the rated KVA at any voltage within +/- 10% of the rated voltage of that particular tap.

b) Transformer shall be designed for 110% continuous over fluxing withstand capability.

c) The neutral terminals of the winding with star connection shall be designed for the highest over current that can flow through the winding.

d) Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tapchangers or other auxiliary equipment shall apply.

e) Temperature Rise shall be continuously rated for full load. The temperature rise shall not exceed 50 degree C by thermometer in oil or 55 degree centigrade by resistance over an ambient of 38 degree C.

5.0 EARTHING :

5.1 Two separate earthing terminals to be provided at the bottom of the tank on opposite sides. The terminals shall be of clamp type suitable for connection to owners grounding strip (50x6mm copper).

5.2 Internal Earthing :

The frame work and clamping arrangements of core and oil shall be securely earthed inside the tank by adequately sized copper strip connections to the tank.

6.0 FITTINGS AND ACCESSORIES :

The transformer shall be provided with all standard fittings and accessories specified in the applicable standard for the size and type of transformer concerned. The accessories and fittings shall generally be as specified below:

Oil Conservator :

The transformer to be provided with an oil conservator with welded end plates. It is to be bolted to the cover and can be dismantled for purpose of transport. It shall be provided with plain oil level gauge with marking for minimum level and an oil filling hole with a cap which can be used for filling oil. For draining purpose a plug shall be provided. An equiliser pipe between the conservator and the main tank is to be provided, which projects inside conservator.

Breather:

The transformer shall be provided with an indicating dehydrating silica-gel breather with glass window for inspection of sufficient capacity.

Explosion Vent.

An explosion vent with diaphragm shall be provided for relieving the pressure within the transformer.

Diagram and Rating Plate:

Diagram and rating plate of stainless steel shall be provided indicating the details of transformer, connecting diagram, vector group, tap changing diagram etc.

Earthing Terminals

Two earth terminals of adequate mechanical and electrical capacity shall be provided. One separate earthing terminal shall also be provided on each separate radiator banks.

Buchholtz Relay

Double float Buchholtz relay where specified shall have two separate sets of contacts, one for alarm and other for circuit breaker trip. The relay shall have a test cock. A small window in the wall of the relay shall be provided to show the amount of the trapped gas, if any. The construction of the transformers shall be such that all rising gas will be readily reach the Buchholtz relay. Gas sampling device at an accessible height and an air release cock for Buchholtz relay shall be provided.

Dial type Thermometer (OTI)

Dial type thermometer (150mm dia) with maximum set pointer at 75 degrees c and electrical contacts for electrical alarm at high temperature with thermometer pocket shall be provided.

Winding Temperature Indicator (WTI)

Shall comprise of :

- i) Temperature sensing element
- ii) Image coil
- iii) Bushing or turret mounted
- iv) C.T. Local indicating instrument with electrically independent trip/alarm contact brought out to separate terminals.

Lifting Lugs :

The arrangement for lifting the active part out of the transformer tank along with cover by means of lifting lugs without disturbing the connections shall be provided.

Swivel Type Rollers :

The transformer to be provided with 4 Nos. bi-directional rollers fitted on cross channels to facilitate the movement of transformer in both directions.

Air Release Plugs :

An air release plug shall be provided on the top of the tank cover/radiators to facilitate the release of the entrapped air and filling of oil.

Drain-cum-oil Filter Valves with Plug on Cover Plate:

The transformer shall be provided with a drain-cum-oil filter valve with blanking plate & locking arrangement of 1 1/2" BSP size at the bottom of the tank.

Filter valve of 1 1/4" BSP at top with blanking plate.

Sample valve with blanking plate (1/2").

Inspection cover.

Oil filling hole with cap.

Jacking Pads

Skids

Neutral bushing terminals complete with connector for earth conductor.

7.0 DRAWINGS AND O & MANUALS:

7.1 Four copies of manual of complete instructions for the installation, operation, maintenance and repairs circuit diagrams, foundation and trenching details shall be provided with the transformers. List of spare parts shall also be indicated.

7.2 Two copies of the drawings incorporating the following particulars shall be submitted with the offer for preliminary study.

- a) GA drawing showing dimension, net weight and shipping weight, quantity of insulating oil etc.
- b) Crane requirements for assembly and dismantling of the transformer.
- c) Drawing indicating GA of cable box and its dimension for cable entry cut out requirements etc.

7.3 The drawings in (four sets) to be furnished by the supplier for approval after acceptance of his order shall include the following.

- a) GA showing front and side elevations and plan of transformer and all accessories and external features, detailed dimensions, crane lift for untanking, oil quantity, H.T./L.T. clearances etc.
- b) Drawings of Bus duct/cables termination arrangement.
- c) HV cable box arrangement & disconnecting chamber GA & details drawings.
- d) Drawing of each type of bushing.
- e) Name plate and terminal making and connection diagram.
- f) Control wiring & schematic diagram showing polarity and vector group of windings, CTs and OTI, WTI, circuits, Alarm/trip circuits etc.
- g) Assembly of ON Load Tap Changing gear mechanism & details of mechanism parts, limits, contours of wearing parts, timing gear adjustments etc.

7.4 Reproducible copy of the above drawings for records

8.0 TESTING:

The transformer shall be subjected to all routine tests in accordance with latest IEC at the factory before dispatching the same and test certificates shall be furnished.

- a) Measurement of winding resistance.
- b) Ratio polarity and phase relationships.
- c) Impedance voltage.
- d) Load losses
- e) No-load losses and No load current
- f) Insulation resistance (Before & after carrying out all tests)
- g) Induced over voltage withstand test
- h) Separate source voltage withstand test
- i) Bidders may quote for the HV impulse test. Alternatively they may submit the test certificate for the test conducted on the similar transformer.

9.0 TEST REPORTS

Four copies of the test reports in bound volume shall be submitted for approval.

10.0 SPARES

The bidder shall quote item wise prices for his recommended spares for the period of operation of transformer for 5 years.

TRANSFORMER DATA SHEET

1.0 GENERAL

1.1	Application	:	Distribution Transformer
1.2	Quantity Required	:	As mentioned in BOQ
1.3	Installation	:	Out door type

2.0 RATINGS

2.1	Rating KVA	:	630
2.2	Number of phases & Frequency	:	3 Phase, 50Hz
2.3	Type of cooling	:	ONAN
2.4	No Load Voltage		
	HV	:	15000 V
	LV	:	433 V
2.5	Vector Group	:	Dyn11
2.6	Percentage Impedance	:	As per I.S. (without negative tolerance)

3.0 VOLTAGE

3.1	Nominal System Voltage		
	HV	:	15000 V
	LV	:	433 V
3.2	Highest System Voltage		
	HV	:	15000 V
	LV	:	433 V

4.0 TAPCHANGING GEAR

4.1	TAPS ON/OFF LOAD	:	OFF LOAD FULL RATING
4.2	Tapping on windings HV/LV	:	HV
4.3	Total tapping range	:	+5% to – 15%
4.4	Steps	:	1.25%

5.0 TEMPERATURE RISE

5.1	Ref. Ambient °C	:	50°C
5.2	Oil by thermometer °C	:	45 Degree
5.3	Winding by Resistance °C	:	55 Degree

6.0 INSULATION WITHSTAND

6.1 Impulse (1.2x50 micro second wave): 75 KV

6.2 Power Frequency (Dry & Wet)

HV : 28 KV
LV : 3 KV

7.0 NEUTRAL EARTHING

7.1 SYSTEM NEUTRAL
Effectively Earthed/Resonant
Non effectively Earthed/
Isolated : Effectively Earthed

7.2 TRANSFORMER NEUTRAL : Effectively Earthed

8.0 VACUUM WITHSTAND CAPABILITY

Main Tank with bushing,
Radiator, fittings & accessories : Full Vacuum

9.0 ACCESSORIES

9.1 Dial type thermometer with
Alarm and trip contacts : Yes

9.2 Magnetic Oil gauge with
Alarm contact : Yes

9.3 Buchholtz Relay (Double float) : Yes

9.4 Winding Temperature Indicator : Yes

9.5 Wheels Plain/Flanged/
bi-directional/unidirectional : Plain, Bi-directional

9.6 Explosion Vent diaphragm : Yes

9.7 Silicagel Breather : Yes

9.8 Valves : Drain valve, Filter valve, Sampling valve etc., complete set with blanking plate/plugs.

10.0 TERMINATION ARRANGEMENT

10.1 H.V. SIDE
(CABLE BOX) : Cable box and disconnecting chamber suitable for 3C
x 240 Sqmm 15 KV XLPE cable.

10.2 L.V. SIDE
(CABLE BOX) : Cable box and disconnecting chamber suitable for 4
Nos. 3.5C x 300 Sqmm XLPE Al. Arm. cable.

DATA TO BE FURNISHED BY BIDDER:

1.0 POWER TRANSFORMER:

- 1.1 Name of Manufacturer :
- 1.2 Standards followed in design
manufacture and testing :
- 1.3 Continuous maximum rating in KVA :
- 1.4 Transformer no-load voltage :
 - 1.4.1 High voltage :
 - 1.4.2 Low voltage :
- 1.5 Vector group reference :
- 1.6 Temperature rise over specified
ambient temperature in degree C :
 - 1.6.1 In oil by thermometer :
 - 1.6.2 In winding by resistance :
 - 1.6.3 Maximum hot spot temperature
in degree C :
- 1.7 Terminal Arrangement.
 - 1.7.1 H.V. Side :
 - 1.7.2 L.V. Side :
- 1.8. One-ninute dry power frequency
test withstand voltage in KV :
 - 1.8.1 High voltage :
 - 1.8.2 Low voltage :
- 1.9 Impulse test withstand voltage
with 1.2 x 50 microseconds wave in KV :
- 1.10 Type of tap changer :
 - 1.10.1 No. of plus taps :
 - 1.10.2 No. of minus taps :
- 1.11 Iron losses in KW at rated
voltage and frequency :
- 1.12 Copper losses in KW at
rated full load current and
frequency at 75 degree C :

- 1.13 Reactance voltage with guaranteed tolerance in percent at rated full load current and frequency 75 Deg C :
- 1.14 Impedance voltage with guaranteed tolerance in percent at rated full load current and frequency at 75 Deg C :
- 1.15 Regulation in percent of no-load voltage at full load current at 75 degree C and with power factors of :
- 1.15.1 Unity :
- 1.15.2 0.8 lagging :
- 1.16 Efficiency in percent at 75 degree C and unity power factor for :
- 1.16.1 100 percent load :
- 1.16.2 75 percent load :
- 1.16.3 50 percent load :
- 1.17 No-load current in amperes at rated voltage and frequency :
- 1.18 Inrush magnetizing current in percent of normal full load current. :
- 1.19 Details of winding insulation :
- 1.19.1 Class of insulation materials :
- Turns insulation high voltage in meg ohm :
- 1.19.3 Turns insulation low voltage in meg ohms :
- 1.19.4 Insulation core to low voltage in meg ohms :
- 1.19.5 Insulation high voltage to low voltage in mega ohms :
- 1.20 Details of 415 V neutral current transformer :
- 1.20.1 Name of manufacturer :

1.20.2	Current ratio	:
1.20.3	VA capacity	:
1.20.4	Accuracy & performance characteristics	:
1.21	Quantity in liters and grade of oil	:
1.22	WEIGHTS :	
1.22.1	Core and windings in kg	:
1.22.2	Tank and fittings in kg	:
1.22.3	Oil	:
1.22.4	Complete transformer filled with oil	:
1.23	OVERALL DIMENSIONS :	
1.23.1	Length in mm	:
1.23.2	Breadth in mm	:
1.23.3	Height in mm	:
2.0	TESTS:	
2.1	List of tests proposed to be carried out at the factory	:
2.2	List of tests proposed to be carried out at the site before commissioning.	:

INFORMATION TO BE FURNISHED BY THE VENDOR AFTER AWARD OF CONTRACT

Information to be furnished within 2 weeks of award of contract.

- 1.0 Positive sequence impedance at maximum voltage tap.
- 2.0 Positive sequence impedance at maximum voltage cap.
- 3.0 Zero sequence impedance at principal tap.
- 4.0 Efficiency at 75⁰C winding temperature:
 - 4.1 At full load
 - 4.2 At 75% full load
 - 4.3 At 50% full load
- 5.0 Maximum efficiency and load at which it occurs.
- 6.0 Regulation at full load at 75⁰C winding temperature at:
 - 6.1 Unity power factor
 - 6.2 0.85 power factor lag.
- 7.0 Resistance per phase of :
 - 7.1 H.V. winding : Ohms
 - 7.2 L.V. winding : Ohms
- 8.0 Conductor area (sq.cm) and current density (Amps/cm²)
 - 8.1 HV winding
 - 8.2 LV winding
- 9.0 Type of windings
 - 9.1 HV
 - 9.2 LV
- 10.0 Insulating materials for interterm insulation :
 - 10.1 HV winding
 - 10.2 LV winding
- 11.0 Insulating materials for winding insulation
- 12.0 Insulating materials
 - 12.1 Winding and core

12.2 Laminations of the core.

13.0 Make, type, dial rise, number of contacts and contact ratings (current following items, if provided).

13.1 Magnetic oil level gauge.

13.2 Dial type thermometer.

13.3 Winding temperature indicator.

13.4 Gas and oil actuated relay.

14.0 Thermal withstand capability under full short circuit conditions in terms of number of times of calculation of short circuit and corresponding anticipation percentage reduction in transformer life. Relevant calculations shall be submitted.

15.0 DRAWINGS

The following drawings shall be submitted for the PURCHASER'S approval in the stipulated time.

Weeks after award of contract

15.1 General outline drawings showing plan, front elevation, rear elevation, cable boxes/disconnecting chamber section views, locating dimensions of cable entries, terminals foundation floor fixing details and weights.

15.2 Bushings: Plan, elevation terminals details, mounting details make and type number, current and voltage rating, Creepage distances and principal characteristics.

15.3 Rating and diagram plate

15.4 Marshalling box terminal connections, wiring diagram

16.0 TEST REPORTS

Test results shall be corrected to a reference temperature of 75 Deg C.

16.1 Two copies of test results shall be submitted for the Owner's/Consultants approval before dispatch of transformer.

16.2 Additional bound copies, as required by the Owners/Consultants contract, of complete test results including all tests on transformer, bushing, current transformer (if provided), shall be furnished with the transformer.

V TECHNICAL SPECIFICATIONS OF DG SET

A) DG SET WORKS

1.0 INTENT OF SPECIFICATION:

1.1 This specification covers the design, manufacture, assembly, packing, dispatch, transportation to site, supply, erection, testing, commissioning, performance and guarantee testing of Diesel Gen-Sets, complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under.

2.0 SCOPE OF WORK:

2.1 Scope of erection :

General Scope of work shall include design, manufacture, assembly, packing, dispatch, transportation to site, and commissioning of the following:

Diesel engine complete with all accessories, an Alternator directly coupled to the engine through flexible/rigid coupling complete with all accessories for starting, regulation and control, including base frame all accessories, power and control cable, glands and lugs etc.

D.G. Local/Remote control panel including all type of control cables, special cables (if any) between D.G. Set's, instrument panel, PLC control panel and Main LT panel etc.

Equipment necessary for engine cooling system (Radiator Cooled).

Equipment necessary for fuel storing and distribution, day oil tank (990 Lt.), piping, pumps, valves, level indicators etc.

Exhaust piping, flexible connections and residential type silencer of exhaust system, including thermal lagging, cladding etc.

Batteries with good quality iron battery stand and battery charging equipment, including their connections as necessary, along with tools & accessories for battery maintenance. (Contractor shall submit the list of tools along with Tender)

Anti Vibration Mountings etc.

Power & Control cabling, cable tray etc.

Preparing all related shop drawings for approval from client/consultant and all statutory bodies as required and as applicable.

Obtaining statutory approval of the installation including permission for operation of Diesel Generators by the Electrical Inspectorate, Pollution Control bodies and any other statutory bodies as applicable.

Minor civil works like chasing, grouting etc. for execution of jobs.

Carrying out performance and guarantee test at site at available load which shall not be more than the capacity of D.G. Set.

2.2 Specific Exclusions:

Following items of works are excluded from the scope of works under this specification:

- a) **All civil works relating to DG Sets.**

3.0 CODES AND STANDARDS:

IEC 60034: Rotating electrical machines - Part 14

IEC 60085: Electrical insulation - Thermal evaluation and designation

BS 5514: Reciprocating internal combustion engines.

CISPR: Comite International Special des Perturbations Radioelectriques.

ISO 3046: Reciprocating internal combustion engines.

ISO 8528: Reciprocating internal combustion engine driven alternating current generating sets.

NFPA 70 - National Electrical Code

NFPA 99 - Essential Electrical Systems for Health Care Facilities

NFPA 110 - Emergency and Standby Power Systems

UL 2200 – Stationary Engine Generator Assemblies

UL 508- Industrial Control Equipment

BS 5514 Engines

BS 4999 Alternators

4.0 ENGINE:

4.1 Type:

The diesel engine shall be of stationary type four stroke (prime duty), with vertical in line or (V) type cylinder arrangement, Turbo-charged, cooled with radiators.

4.2 Rating:

a) Prime power BHP rating of the engine shall be such that the DG set deliver the specified net electrical output while supplying power/driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft at specified site conditions and ambient temperature of 50OC. (The bidder shall submit the deration calculations if the engine is not designed for 50deg C. ambient temperature).

b) It shall also be capable of satisfactorily driving the alternator at 10% over load at the rated speed for one hour in any period of 12 hours of continuous running.

The bidder shall have to furnish copy of deration chart from the original manual of the engine manufacturer and supporting calculations to arrive at diesel engine rating.

4.3 Speed and Vibration Levels:

a) Speed shall be 1500 revolutions per minute. Speed governor/over speed protection shall be provided. At due running conditions, speed shall be stabilized at plus or minus 2% nominal speed, regardless of load. At transient condition, engine speed shall vary not more than 10% plus or minus. Governor class shall be A1 (4% drop) for normal application unless otherwise specified.

- b) The engine vibration level shall be as latest upto date amended BS standard.

4.4 Lubrications:

- a) The engine shall have a closed cycle forced & splash lubricating system with positive oil pressure and a crank chamber for collection/storage of the lubricating oil during circulation. Lubricating oil shall be circulated in the engine by an engine driven pump.
- b) A lubricating oil filter of an efficient full flow type of ample capacity shall be provided for operation under normal conditions for a period of 300 hours without the necessity of its replacement or cleaning. Filters shall be capable of removing all foreign matter above a particle size of 5 microns.
- c) In case lubricating oil coolers are required it shall be supplied as an integral part of the Diesel Generator Set.
- d) Necessary temperature and other instruments shall be supplied and fitted on the lubrication system.
- e) A lubricating oil level dipstick suitably graduated shall be provided and located in the accessible position.
- f) The tenderers shall state the guaranteed lubricating oil consumption in litres per hour.

4.5 Fuel System:

- a) The engine shall be capable of satisfactory running on all types of diesel fuel oil normally available locally.
- b) The fuel consumption of the engine shall be expressed by the Contractor in the bid in litres per gross/net kWh output from the alternator (after supplying the requirements of auxiliaries) at full, three quarters and half of its rated power output and at 0.8 and unitary power factor.

If guaranteed fuel consumption is exceeded, the contractor shall make such amendments or alterations as are necessary to bring the consumption to within the guaranteed figures. Tolerance of +5% as defined in latest upto date BS shall be allowed.

- c) A fuel service tank of 990 liters capacity with each D.G. Set shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in liters, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints should be brazed/welded.

4.6 Air Intake System:

The diesel engine shall be provided with special dry type air filters having low resistance to air passage, high dust retaining efficiency and provision for easy cleaning. Filters shall be suitable for achieving satisfactory engine operation and ensuring the engine life under tropical humid conditions, with sulphur dioxide fumes, abrasive dust and coal particles of 5 to 100 microns present in the atmosphere. The minimum efficiency of filters shall be 90% down to 5 micron size.

4.7 Cooling:

The diesel engine should be Radiator Cooled. The cooling system should include temperature gauge with high temp., alarm/trip corrosion resistor etc.

4.8 Engine Governor:

The governor shall be Electronic EFC to maintain zero speed rate or regulation and shall be AI type as per latest BS in order to take care of heavy motor starting. It shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit. The governor shall be suitable for operation without external power supply.

4.9 Turbo Charger:

It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

4.10 Quietness of Operation:

- a) The engine shall be designed to achieve maximum quietness of operation.
- b) Efficient residential silencer shall be provided as per engine manufacturer's approved make only for the exhaust.
- c) Noise level of the DG set shall be as per the BS.

4.11 Engine Starting:

- a) Engine starting shall be by electric starting motor complete with manual/automatic starting arrangement. The starter motor shall conform to latest BS and shall be of adequate power for its duty and be of inertia or pre-engaged type. The pinion shall positively disengage when the engine starts up or when the motor is de-energized. The engine cranking shall be only from the panel both for AMF & DG sets (Manual) and any engine starting devices etc. that are given as original fitment on the engine by engine manufacturers shall be either removed or padlocking arrangement given for this so that all normal start/stop operations could be done only from panel whether the set is AMF or manual.

The engine wiring shall be appropriately modified, ferruled to totally match with schematic drawings of the panel.

- b) Time for Run-up to Speed:
From the initial operation of the starting device, the engine shall start, run up to normal speed and be capable of accepting 60% of full load within a maximum time of 20 seconds, and full load within a further 20 second.

4.12 Starter Battery:

- a) The battery shall conform to the requirement of latest IS. Starting battery each of 24V, heavy duty high performance approved make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery set shall be capable of performing at least (5) five normal starts without recharging.
- b) The battery shall be provided with good quality iron battery stand painted with acid proof black paint with min 3mm thick rubber mat below the battery.
- c) Batteries shall be of load container type only and not with PVC moulded sealed container so that each individual cells are available for individual monitoring during its life span. Each cell shall be provided with electrolyte filling cap with level floats for easy monitoring of electrolytic level.
- d) The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty rubber/PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at

battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.

e) The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.

f) The batteries Set shall be supplied fully filled and first charged ready to use.

g) Batteries set shall be supplied with spring type hydrometer, thermometer with specific gravity correction scale and cell testing voltmeter etc.

4.13 Battery Charging System:

a) Float rate charging and quick rate charging system shall be provided at the generator panel with appropriate bridge charger system, LC network, rate selector switch and generously rated charging transformer and silicon one rectifier bridge, so that the cranking battery system can be kept fully charged at all times from E.B. supply network with quick charging rate limited to 0.8 times rated discharge current with provision in control transformer and Si rectifier present to enable boost charging the battery at 2 times rated discharge current in case of emergencies. To this and in the mode selector switch boost charge position shall be present which however shall be kept disconnected at mode selector switch normally.

b) DC ammeters to clearly indicate float charging current and quick/boost charging current shall be provided.

c) Dropper resistor network on the load side of battery charger system shall be provided so that higher charger voltages in quick or boost conditions does not get impressed on the I/L and Contactor coils, which voltage shall remain well within +10% of rated voltage.

d) Battery charging subsystem shall be designed for continuous operation at cubicle ambient of 55°C corresponding to 50°C ambient outside and should be designed to operate at 1.5 times rated maximum current corresponding to boost charge current which can reach in practice as high as 2.5 times or 3 times rated discharge current.

e) Any charger dynamo and dynamo charging current network present on the set shall be made in operative so that both for AMF and manual application the cranking battery system is kept charged from the charger at the panels at all times during or shut down periods of the set.

f) To the above and in case of manual DG sets, the input to charger subsystem viz., 240 V AC is foreseen to be provided from customer network from the portion that is normally supplied by manual DG Set during DG operation or being fed by E.B. System.

4.14 Engine Fitments:

The engine shall be provided with but not limited to following essential basic fitments:

- Crank case breather - Dry type element (Breather outlet shall be fitted with a filter cap capable of preventing entry of dust).
- Air Cleaner - Dry type.
- Corrosion resistor - To control acidity and impurities from coolant.
- Filters - Lube oil & fuel oil, paper element type.
- Coolant Pump - Gear Driven.
- Fuel Pumps - Priming & Transfer
- Governor - Electronic Class A1.
- Turbo Charger - Exhaust gas driven in case of turbo

charged engines.

- | | | |
|---|---|----------|
| • Flywheel with flywheel housing | - | SAE Type |
| • Vibration dampers | - | One Set |
| • Exhaust/Intake manifolds | - | |
| • Oil Sump (crank case) with dip stick | | |
| • Engine Supports | | |
| • Residential type silencer in exhaust system | | |
| • Electrical starter 24 V | | |
| • Safety controls & instruments | | |
| • Flexible coupling with guard | | |
| • Lubricating Oil Cooler | | |

4.15 Engine Instrumentation:

The following instruments mounted on instrument panel shall be essentially present as minimum:

- Engine speed tachometer with service hour counter
- Lube oil pressure gauge
- Coolant temperature gauge

The instrument panel shall be mounted on engine using rubber dampers for vibration isolation.

The gauges shall have clear red marking to identify the limiting dangerous levels, 'Zone Markings' on the scale to indicate the normal healthy & abnormal operating zones for the parameters concerned.

The metering shall be electronic digital type only.

The engine control panel must be supplied by the engine manufacturer only.

4.16 Mountings and Foundations:

The engine and direct coupled attenuator shall be rigidly secured to a common rigid base frame fabricated from MS section.

The DG set shall be placed on the RCC floor with approved make anti-vibration mountings. A lifting hook of required capacity shall be provided above the finalized location of the DG set to facilitate installation and subsequent maintenance of the DG Sets.

The design of mounting arrangement with anti-vibration mountings shall be as recommended by the DG manufacturers and shall be such that a maximum of 2% vibration are transmitted to the structure.

The tenderer shall confirm the type & design of mountings provided and the vibration isolation efficiency in the tender.

The design of RCC foundation shall be scope of DG Set Vendor.

4.17 Exhaust Piping:

The engine shall be fitted with a residential type silencer (design approved by manufacturer) to reduce the noise level. Silencer outlet shall be connected to exhaust piping carried to the top of the through steel structure. Exhaust piping shall be fabricated from class 'B' MS pipes of size suitable to limit back pressure to within permissible limit (2.5" of Hg.). **Tenderer shall submit design calculation in support of the back pressure being within limits along with the tender.**

It is important to ensure that the surface temperature of the exhaust piping does not exceed 50°C. For this purpose, the entire length of exhaust piping shall be treated as mentioned in the Bill of Quantities.

Exhaust piping shall be connected to the engine by means of flexible section or an expansion joint.

4.18 Tools:

Two sets of standard tools kit for maintenance shall be provided by Contractor. Tenderer shall submit a list of the tools along with the tender. (Cost shall be inclusive in the quoted rates)

4.19 Safety Controls:

Low Lubricating Oil Pressure:

Pressure sensors shall be fitted such that in the event of a fall in the lub oil pressure, an alarm and indication shall be actuated. In addition, the engine shall be automatically shut down in the event of lub oil pressure dropping to a predetermined low value.

Over Seed:

Speed control shall be so arranged that a 10% increase over normal rated speed shall cut off fuel supply, thus stopping.

Overload Protection:

The engine shall be adequately protected against operating under overload conditions. The requirements shall be met by the provision of a fixed overload limit stop on the fuel pump rack control rod to prevent the set being subject to a load exceeding the site rating plus 10%.

Excess Starting Time:

The starting circuit for the automatic mains failure diesel generator sets shall be arranged to attempt upto three starting cycles, each not exceeding 10 seconds duration with a similar OFF period between each cycle. If the set fails to start upon completion of the third attempt the starting circuit shall be locked out until it is restored manually. An alarm shall be given and "Set failed to start" indication given on the panel.

Fuel Level Protection:

A level sensor shall be provided in the day fuel tanks to give visual and audible alarms if the level in the tank falls to below $\frac{1}{4}$ of full.

5.0 ALTERNATOR:

5.1 The alternator shall have brushless type with rotating field and static excitation circuit controlled by field control unit suitably compounded for voltage and load current for a self excited self regulated system.

5.2 The alternator shall be in SP-DP enclosure, foot mounted with ball and roller bearings on end shields.

5.3 The alternator shall conform to latest BS and shall be suitable for tropical conditions.

5.4 The alternator shall comply with the following specifications:

Rating	-	As mentioned in the BOQ (Shall be capable of 10 % over loading at the rated speed for one hour in 12 hours continuous operation without exceeding permissible temperature rise.
Phase	-	3 phase, 4 wire
Voltage	-	415 V
Regulation	-	To be filled by the Tenderer
Speed	-	1500 RPM
Frequency	-	50 Hz.
P.F.	-	0.8 lag

Enclosure	-	IP:23
Insulation	-	'H'
Execution	-	Self excited, self regulated with brushless system and separately excited with PMG static voltage control unit suitably compounded for voltage and current to maintain terminal voltage constant at $\pm 5\%$ at all load for p.f. not less than 0.8. lag.
Terminal Box run.	-	Cable Chamber for aluminium XLPE cable of suitable
Earthing Studs	-	2 Nos. for each DG Set.

5.5 Neutral Point:

The winding of the alternator shall be star-connected with the neutral connection brought out to a separate terminal.

5.6 Terminal Box and Connection:

The alternator output terminals shall be enclosed in a terminal box mounted in an accessible position on the alternator frame. As far as possible, connections between the exciter and alternator shall be contained within the machine frame and connections carrying A.C. and D.C. shall be segregated from each other. The terminal box shall be of sufficient size to conveniently terminate the size and number of the Owner's cables, which shall be intimated during detailed engineering. Suitable tinned copper pads shall be provided for power cable termination along with all necessary hardware and cable lugs. Glands and lugs shall be provided for control cables also. For single phase cables, gland plate shall be of non-magnetic material. Gland plate shall be removable type.

5.7 The generating set shall be so designed that it is capable of reaching its full voltage and frequency and shall be ready to take full load within 30 seconds of a remote starting impulse being received.

6.0 ENGINE SAFEGUARDS:

Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:

- a) Energizing a solenoid coupled to the stop lever on the fuel injection pump rack.
- b) De-energizing the "fuel on" solenoid
- c) Energizing the "fuel - cut off" solenoid.

The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.

The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel.

At the set at a easily accessible place an "EMERGENCY STOP" mushroom head stay put type P.B shall provided to stop the set in emergency mode.

The safe guard to "STOP THE SET" shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator ckt.

- a) Emergency stop P.B's operation
- b) Over speed.
- c) Low lube oil pressure.
- d) Earth fault
- e) Over current
- f) High temperature

7.0 TESTS:

7.1 The alternator of each type and rating shall be type tested for the following tests as per latest BS. Test certificates to be provided for routine and type tests from the manufacturers.

8.0 ERECTION, TESTING, COMMISSIONING AND PERFORMANCE & GUARANTEE TESTS/ PROCEDURE AT SITE:

The entire work of erection, testing and commissioning of equipment supplied under this package shall be carried out by contractor and performance and guarantee tests to be conducted at site are also included under the scope of this specification. For this purpose the contractor shall depute suitable qualified technical supervisor to site on advance intimation to the Owner along with all special testing equipment required for testing and performance and guarantee tests. The supervisor(s) shall be responsible for the installation, testing, commissioning checks and performance & guarantee tests mentioned in relevant clauses of this volume and the checks recommend by the contractor.

The contractor shall ensure that the equipment supplied by him are installed in a neat workman like manner such that they are leveled, properly aligned and well oriented. The tolerances shall be established in Contractors drawings and/or as stipulated by the Owner.

All special tools and tackles and spares required for erection, testing and commissioning of equipment shall be supplied by the contractor.

Erection, testing and commissioning manuals and procedures shall be supplied, prior to dispatch of the equipment.

The contractor shall ensure that the drawings, instruction and recommendations are correctly followed while handling, setting, testing and commissioning the equipment.

8.1 Commissioning Check Tests/Performance and Guarantee Test:

In addition to the checks and test recommended by the manufacturer, the contractor shall supervise the following acceptance tests to be carried out on each test at site.

i. Load Test:

The DG Set shall be given load test at site for a period of at least 6 hours depending upon the actual power factor of the load and set shall be subjected to the maximum achievable load without exceeding the engine or alternator capacity.

This full load test is to be followed immediately by a 10% overload run for one hour. The performance of the engine, alternator shall be satisfactory at the end of this overload run.

During the load test half hourly records of the following shall be taken:

- a) Ambient temperature
- b) Cooling temp.
- c) Lubricating oil pressure.
- d) Speed
- e) Voltage, wattage and current output.
- f) Oil tank level

ii. Speed and Governing:

The speed of the engine shall be verified to ensure that it conforms to the requirement of latest BS.

iii. Check of Fuel Consumption:

A check of the fuel consumption shall be made through out the test run of constant full load and constant overload.

iv. Noise Level:

The noise level shall be as per latest BS.

9.0 RADIO INTERFERENCE:

All equipment provided under this specification shall be so designed that it will not cause interference with radio equipment. In the event of the inherent characteristics of the equipment being such that radio interference is possible, efficient devices to nullify the same shall be provided. Suppressors shall be as per the relevant latest BS Standards. Nothing extra shall be paid to the contractor on this account.

10.0 PRE-COMMISSIONING CHECKS:

All standards checks including the ones elaborated in the specifications to ensure that the installation of the DG sets and associated systems has been carried out satisfactorily shall be done on completion of installation. These shall include:

a) DG Sets:

Checking of fuel piping interconnections
Checking of electrical interconnections
Checking of insulation resistance
Checking of earthing
Checking of instruments and controls
Checking of alignment
Checking of vibration transmission to building a structure
Checking of expansion joints

b) Exhaust System:

Checking of silencer operation
Checking of surface temperature of exhaust piping
Checking of back pressure.

c) Fuel System:

Checking of automatic operation of fuel transfer pumps

11.0 PERFORMANCE TESTING AND TYPE TESTS:

11.1 Performance Testing:

DG sets shall be tested at varying loads at manufacturers works prior to dispatch of the sets to site. The performance tests at the works shall be carried out in presence of authorized representative from the Owners to enable them to arrange for their representatives for his inspection to be at manufacturers works for this inspection and testing. **Inspection waiver shall be solely as per owner wish.**

The performance test on each DG sets shall be of minimum 8 hours duration.

All instruments, materials, consumables (fuel oil, lube oil etc.) load and labour required for carrying out of the test shall be provided by the Contractor.

Following test acceptance criteria shall be applicable:

1.	Fuel consumption at 50%, 75%, 100% and 110% load	±5% of guaranteed performance. Actual alternator efficiencies as determined in the manufacturers works tests shall be used as the basis of calculation of specific fuel consumption ratio.
2.	Voltage regulation from no load to full load	±1%
3.	Frequency regulation from no load to full load	±0.5%
4.	Maximum temperature	±5% of guaranteed performance
5.	Maximum Lube Oil temperature	±5% of guaranteed performance
6.	Minimum Lube Oil pressure	±5% of guaranteed performance
7.	Lube Oil Consumption	±5% of guaranteed performance

11.2 Type Test:

Copies of manufacturers type test for the engine and the alternator of all ratings shall be enclosed along with the dispatch of the DG sets.

12.0 ACOUSTIC ENCLOSURE:

12.1 Description :

The acoustic enclosure shall be of free standing, floor mounting type integral with the DG set. The enclosure shall be provided with rugged heavy-duty structural steel base frame with chequered plate flooring on which the DG set is to be mounted. The enclosure shall be prefabricated factory-built and modular in construction, so that it can be easily assembled at site around the DG set. The enclosure shall consist of acoustically treated panels housed in rugged steel frames, which shall be bolted together to form the body of the enclosure. Hinged type doors shall be provided, on either side, which shall also be acoustically treated, thereby providing easy access to the DG set while minimizing the operating space requirements. The construction of the acoustic enclosure shall be such that with both the acoustic doors open on the either side, full access is available to the engine and alternator. For fresh air inlet into the system a parallel baffle air inlet silencer shall be provided. Additionally, to augment the fresh air inlet requirements, a forced air ventilation duct with associated silencer shall be provided above the alternator. For hot air discharge, an acoustic discharge plenum shall be provided in front of the engine radiator, for discharge of hot air into the surroundings through a parallel baffle air outlet silencer. The enclosure shall have suitable openings in the roof module for exhaust piping.

12.2 Constructional Features :

- a. The construction and design of the Acoustic enclosure shall be very rugged, durable and shall be virtually maintenance free.
- b. The acoustic panels shall be filled with a special grade high-density mineral wool retained on the inside by perforated GI sheets specially designed for optimum sound attenuation.
- c. The outer surface of the Acoustic Panels shall be fabricated of performed 16G corrugated CRCA sheet steel of a SAIL make only. All sheet steel frames shall be of 16G CRCA sheets of SAIL make only.
- d. All structural members such as angles / channels used in the construction of the enclosure frame shall of TISCO / SAIL make only.
- e. All materials used for Acoustic Enclosure shall be fire resistant / fire retardant grade.
- f. The sheet steel treatment shall consist of degreasing, derusting and phosphating followed by two coats of zinc chromate primer, followed by two coats of Zinpholite surface for superior corrosion resistance and two coats of finish paint.
- g. For effective Acoustic sealing, necessary gasketing material shall be provided.
- h. All hardware and fittings used shall be passivated with zinc.

12.3 Performance:

With the above Enclosure, the sound pressure levels when measured at a distance of 1 meter outside the Acoustic Enclosure shall be around 75 dB (A) under free field conditions.

Notes:

- i. The above noise level is defined with all background ambient noise levels from any other source being less than 75 db (A) so as not to influence this noise level.

ii. The section of the exhaust piping within the acoustic enclosure from the engine exhaust manifold onwards upto and including the Residential silencer, must be adequately clad with thermal insulation to limit surface temperature as also reduce noise level to less than 75 db (A).

12.4 Dimensions:

The enclosure shall be provided with suction fans to ensure that the adequate cooling and combustion air is made available to the engine and the temperature within the enclosure is limited to 5 deg. C above ambient. The fan shall be designed with sufficient static to draw the requisite quantity of air from the duct provided for this purpose. Calculations shall be furnished to prove the adequacy of the ventilation system offered. The suction fans shall start automatically when the temperature in the enclosure reaches 40 °C and shall continue to run for 5 to 10 minutes after the load is disconnected. A temperature controller shall be provided for this purpose housed in sheet steel enclosure.

Necessary openings shall be made for the entry of power cable and control cables, fuel piping, exhaust piping, air inlet pipe etc.

With the installation of the acoustic enclosure, there shall not be any de-rating of the DG set. The maximum temperature of oil and water shall not exceed the limits prescribed by the manufacturer of the engine. The DG set shall give rated output continuously.

13.0 AUTOMATIC LOAD MANAGEMENT, START/STOP OF DG SET

The Load management of the DG Set to be done by controlling the Bus coupler contactor and the incomer contactor to the Emergency Panel. The Following function shall be carried out by the PLC based Auto Load Management and Start / OFF of DG Set.

- a) Automatic Starting of DG Sets on Loss of Mains
- b) Starting and stopping of DG Sets as Per Load Requirement.
- c) Monitoring of Mains.

The Control Functions shall available as follows :

- a) Engine pre glow control.
- b) Fuel Solenoid control.
- c) Engine starter Control..
- d) KVA Control cool down timer.
- e) Speed Monitoring.
- f) Overspeed monitoring.
- g) Oil Pressure Monitoring.
- h) Temperature Monitoring.
- i) Battery Voltage monitoring.

Engine Protection Feature

- a) High / Low Coolant Temperature.
- b) High / Low Oil Pressure.
- c) Over Speed
- d) Start Failure.

Automatic Generator Sequencing

- a) Automatically start & stop gensets based on plant bus on process demand.
- b) Configurable plant bus demand start / stop levels and timers.

VI TECHNICAL SPECIFICATION OF STREET LIGHTING POLE

The GRP Poles should be manufactured through the unique Dual Helical Winding in four axis CNC winding machine. The continuous Glass Roving should be impregnated with suitable grade of Polyester Resin (depending on application requirement) while passing through a Resin Bath and then wound on a Taper rotating Mandrel at an even tension resulting in Glass: Resin ratio of 70:30 (approx) and thereby making optimum use of superior Tensile Strength of Glass Filaments which is more than that of Mild Steel or Aluminium. Once the wound composite mass on the mandrel is cured under ambient conditions, the cured structure should further be machined by a proprietary special purpose machine for surface finish to receive two coats of UV resistant Polyurethane Paint of color of choice after priming with suitable primer system that ensures proper adhesion of the PU Paint system on the GRP Pole.

GRP POLES SHOULD ADHERE THE FOLLOWING:

NON CORROSIVE: GRP Poles should be Totally Non Corrosive

ELECTRIC INSULATOR: GRP Poles should be Electric Insulator

GRP Poles should possess an Excellent dielectric property to prevent accidental electrocution in case of faulty wiring

NON CONDUCTIVE: GRP Poles should be non conductive

SHOCK PROOF: GRP Poles should be shock proof

DYNAMIC LOADING: GRP Poles should have High Bending Strength & should be Designed in conformance with **BS EN 40-7:2002**

GRP Poles should be engineered to withstand **180 km/hr Wind Speed**.

BRACKET ARM: GRP Top Bracket Arm should be designed as per BS EN 40-2:2004 Table 3 & Table 9.

IMPACT RESISTANCE: GRP Poles should have inherent property of absorbing high impact energy and thus minimize probabilities of personal injury and vehicle damage in case of road accidents.

UV PROTECTION – GRP Poles should be UV stabilized.

Mix of UV inhibited Polyester Resins, Pigments and final finish coat of High Gloss Polyurethane Paint all put together offer excellent weathering resistance in harshest climatic conditions.

JUNCTION BOX: The JB should be integral type.

PROTECTION: The JB housing should be IP54 & the access door should be weather proof..

The Cable access, exit & leads should be securely locked by a saddle clamp coated with Silicone Rubber grommets.

ELECTRICAL: The JB should be fitted with 4 Way connector suitable for cable upto 3Cx16sq mm.

BASE MOUNTING: GRP Poles should have following mounting arrangement:

FLANGE BASE type: Metallic base frame integrated with the pole by in-situ bonding & should be covered with GRP Coating.

Embedded Type

VII TECHNICAL SPECIFICATIONS OF EARTHING

1. GENERAL

All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits, trunking, cable sheaths, switchgear, distribution fuse boards, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing shall be in conformity with Indian Electricity Rules.

The Earthing System shall in totally comprise the following:-

- a) Earth Electrodes
- b) Earthing Leads
- c) Earth Conductors

All three phase equipment shall have two separate and distinct body earths and single phase equipment shall have a single body earth.

2. STANDARDS

IEC 60364: Electrical Installation of Buildings.

BS 1432: Specification for copper for electrical purposes: high conductivity copper rectangular conductors withdrawn or rolled edges.

BS 1433: Specification for copper for electrical purposes. Rod and bars.

BS 2871: Specification for copper and copper alloys.

BS 4360: Specification for weldable structural steel.

BS 6360: Specification for conductors in insulated cables and cords.

BS 6651: Code of practice for protection of structures against lightning.

BS 6746: Specification for PVC insulation and sheath of electric cables.

BS 7430: Code of Practice for Earthing.

3. EARTHING MATERIAL

Materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. The material shall be as specified in the schedule of quantities and shall comply to the following requirements:

- Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 98% conductivity when annealed, conforming to Indian standard specifications.
- Galvanised Steel - Galvanised steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

4 EARTH ELECTRODES

- **Plate Earth Electrode**

The plate electrodes shall be of copper/ GI as called for in the schedule of quantities. The minimum dimensions of the electrodes shall be 600 mm x 600 mm. Thickness of copper electrodes shall not be less than 3 mm and of GI electrodes not less than 6 mm.

The electrode shall be buried in ground with its face vertical and top not less than 4 meters below ground level.

- **Earth Electrode Pit**

Method of Installing Watering Arrangement

In the case of plate earth electrode, a watering pipe of 20 mm dia of medium class G.I. Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 1000 x 500 x 600 mm. A precast RCC frame & cover shall be suitably embedded in the masonry enclosure.

Location Of Earth Electrode

The following guidelines shall be followed for locating the earth electrodes

An earth electrode shall not be situated less than 5 metres from any building.

The excavations for electrode shall not affect the column footings or foundations of the buildings. In such cases electrode may be further away from the building.

The location of the earth electrode shall be such where the soil has reasonable chance of remaining moist, as far as possible.

Entrances, pavements and road ways shall not be used for locating the earth electrode.

Number Of Earth Electrodes

Metallic covers or supports of all medium or H.T. apparatus or conductors shall, in all cases be connected to not less than two separate and distinct earth electrodes.

5. EARTHING LEADS

The strip earthing leads shall be connected to the Earth Electrode at one end and to the metallic body of the main equipment at the other end. The earthing lead shall connect to the earthing network in the installation.

- **Earthing Lead Sizes**

Strip earthing leads shall be of copper/GI and as per specifications.

- **Earthing Lead Installation**

The length of buried strip earthing lead shall be not less than 15 metres and shall be buried in trench not less than 0.5 m deep.

If conditions necessitates use of more than one earthing lead they shall be laid as widely distributed as possible preferably in a single straight trench or in a number of trenches radiating from one point.

- **Method Of Connecting Earthing Lead To Earth Electrode**

In the case of plate earth electrode the earthing lead shall be securely bolted to the plate with two bolts, nuts, checknuts and washers as required.

All materials used for connecting the earth lead with electrode shall be GI in case of GI Pipe and GI plate earth electrodes or tinned brass in case of Copper plate electrode.

- **Protection Of Earthing Lead**

The earthing lead from electrode onwards shall be suitably protected from mechanical injury and corrosion by a 15 mm dia GI pipe in case of wire and 100/40 mm dia medium class GI Pipe

The portion of the G.I. pipe within ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing or pavements). The portion within the building shall be recessed in walls and floors to adequate depth.

6. EARTHING CONDUCTORS

Earthing conductors shall form the earthing network throughout the installation for earthing of all non-carrying metal parts.

- **Connection Of Earthing Conductors**

- Main earthing conductors shall be taken from the earth connections at the main switch boards to all other switchboards in the network.

- Sub-mains earthing conductors shall run from the main switch board to the sub distribution boards and to the final distribution boards.

- Loop earthing conductors shall run from the distribution boards and shall be connected to any point on the main/sub-main earthing conductor, or its distribution board or to an earth leakage circuit breaker.

- Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing, Switches, accessories, lighting fitting etc shall be effectively connected to the Loop Earthing Conductors. These though rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered earthed, even though the run of metallic conduit is earthed.

- **Earthing Conductor Installation**

The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size.

Joints shall be revetted and brazed in approved manner.

Sweated lugs of adequate capacity and size shall be used for termination. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned.

- **Sizing Of Earthing Conductors**

All fixtures, outlet boxes and junction boxes shall be earthed with Bare copper wires as specified.

All 3 phase switches and distribution boards upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper/6 mm dia GI wires. All 3 phase switches and distribution boards upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper/8 mm dia GI wires. All switches, bus bar, ducts and distribution boards of rating 200 amps and above shall be earthed with a minimum of 2 Nos. separate and independent 25 mm x 3 mm copper/25mm x 6 mm GI tape.

7. PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system.

8. RESISTANCE TO EARTH

No earth electrode shall have a greater ohmic resistance than 3 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be upto 5 ohms. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuses or circuit breakers, and shall not exceed 1 ohm.

INTERNAL PLUMBING

LIST OF CONTENTS : PLUMBING/SANITARY WORKS

TECHNICAL SPECIFICATIONS:

SECTION-I :: BASIS OF DESIGN

1. BASIS OF DESIGN

The internal Plumbing, Sanitary, Drainage System for the project is designed keeping in view the following:

- 1.1 Gail Gas Management Center at Belapur, Mumbai.
- 1.2 Requirement of adequate and equal pressure availability of hot and cold water lines in Public/common toilet, Kitchen will be existing as it is already installed.
- 1.3 Adequate storage of water in under ground raw + treated domestic water tanks, are already exists at site.

The execution of works and materials used shall be as per the latest relevant I.S. specifications.

Wherever reference has been made to International Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities.

2. CONCEPT OF THE SYSTEM

The following services are envisaged for the tender:

- 2.1 Install soil/waste & water supply lines are already exist at the fixture level.
- 2.2 All sanitary item to be supplied & installed considering drawings & site conditions.
- 2.3 The Contractor shall visit the site and shall satisfy himself as to the conditions under which the work is to be performed. He shall also check and ascertain the location of any existing structure or equipment or any other situation which may affect the work. No extra claim as a consequence of ignorance or on ground of insufficient description will be allowed at a later date.

A) PLUMBING/SANITARY WORKS:

1.0 GENERAL:

1.1 The work shall be carried out in the accordance with the drawings and design as would be issued to the Contractor by the Design Consultant duly signed and stamped by him. The Contractor shall not take cognizance of any drawings, designs, specifications etc. **not** bearing Design Consultant signature and stamp. Similarly the Contractor shall not take cognizance of instructions given by any other Authority except the instructions given by the Client's Representative in writing.

1.2 The work shall be executed and measured as per metric dimensions given in the Bill of Quantities, drawings etc.

1.3 The Contractor shall acquaint himself fully with the partial provisions for supports that may or may not be available in the structure and if are available then utilize them to the extent possible. In any case the Contractor shall provide all the supports regardless of provisions that they have been already made. Nothing extra shall be payable for situations where insert plates (for supports) are not available or are not useful.

1.4 Shop coats of paint that may be damaged during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with paint to match the finish over the adjoining shop painted surface.

1.5 The Contractor shall protect / handle the material carefully and if any damage occur while handling by the Contractor then the sole responsibility shall be of the Contractor. Such damages shall be rectified/recovered by the Contractor at no extra cost whatsoever.

1.6 The Contractor shall, within twenty one (21) days of receipt of the Notice of Award for the Project, where applicable, complete the submission of shop drawings to the Client's Representative for approval by the Design Consultants in order to conform to the contract schedule.

1.7 Measurements:

All measurements shall be taken in accordance with relevant NFPA codes, unless otherwise specified.

Section-II SANITRY FIXTURE & PIPE FITTINGS

SCOPE:

 Work under this section shall consist of transportation, furnishing, installation, testing and commissioning and all labour as necessary as required to completely install all sanitary fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Bill of Quantities.

General Requirements

 All fixtures and fittings shall be fixed with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Bill of Quantities, specifications, drawings.

 All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural design requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.

 Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required as per directions of Client's Representative.

 All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shown on the drawings and in accordance with the manufacturers recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, wall or ceiling surfaces shall be made good at Contractors cost.

 All fixtures of the similar materials shall be by the same manufacturers.

 All fittings shall be of the chromium plated materials.

 Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.

 Whether specifically mentioned or not all fixtures and appliances shall be provided with approved fixing devices, nuts, bolts, screws, hangers as required. These supports shall have the necessary adjustment to allow for irregularities in the building area construction.

 For the installation of the CP fittings, teflon tape shall be used.

1. EUROPEAN W.C:

 European W.C. of glazed vitreous china shall be wash down, single or double siphonic type, floor or wall mounted set, flushed by means of flush valve as specified in Bill of Quantities. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair.

 Each W.C. seat cover shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Seat cover shall be of white solid plastic, elongated open front with heavy duty hinges. Exposed fixture trims shall be Chrome plated, and trims of similar function shall be by the same manufacturer.

 Flush valves shall be of the best approved quality procurable with C.P. control valve and C.P. flush pipe.



The flush pipe/bend shall be connected to the WC by means of a suitable rubber adopter.

2. FLUSHING CISTERN:

Alternatively if flushing cistern to be used shall conform to the requirements. High level cisterns shall be of cast iron unless otherwise specified. Low level cistern shall be of the same material as the water closet or as instructed by the Owner/Architect/ Consultant. The cisterns shall be mosquito proof & shall fulfill the requirements of the local Authority.

The levels of the WC should be checked by placing spirit level on the W.C. W.C. should be tested on completion of fixing by putting small paper balls and flushing out. If all the paper balls are not flushed out. The fixing will have to be rectified / re-aligned.

3. URINALS:

Half stall wall hung urinals of glazed vitreous china shall be provided with 15mm dia, C.P. brass spreader, 32mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange and shall fixed to wall by one C.I. bracket and two C.I. clips as recommended by manufacturers complete as directed by the Client's Representative.

Urinals shall be flushed by means of "NO-TOUCH" infrared operated flush valves.

Waste pipes for urinals shall be any one of the given material as directed by the Client's Representative:

- G.I. Pipes
- Rigid PVC/High density polyethylene.

Waste pipes may be exposed on wall or concealed in chase as directed by the Client's Representative.

4. URINAL PARTITIONS:

Urinal partitions shall be white glazed vitreous china, marble, granite or any other material selected by the Project Manager.

Urinal partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S. Clips as recommended by the manufacturer and directed by Project Manager..

5. WASH BASINS:

Wash basin shall be of white vitreous china of best quality manufactured by an approved firm and sizes as specified in the Bill of Quantities.

Wash basin shall be of under counter drop in type shall be supported on a pair of rolled steel brackets of approved design and shall be mounted on a countertop. So that rim and basin bowl is exposed from top.

Wash basin shall be provided with single lever mixer with chain and rubber plug, chromium plated brass bottle trap of approved quality, design and make where hot water required. Single tap where hot water is not required.

Wash basin shall be fixed at proper location and height and truly horizontal as shown on drawing or as directed by Client's Representative.

6. BOTTLE TRAPS

- ◆ Bottle trap (for wash basins, sinks, urinals etc.,) shall be deep seal (minimum 60mm water seal) cast brass
- ◆ bottle, heavy chromium plated. All bottle traps shall be provided with suitable cleaning eye, extension
- ◆ piece, flare nuts all chromium plated. Bottle traps shall be of approved make and design.
- Traps for
- ◆ washbasins, urinal and sinks shall be 32mm

7. PILLAR COCK

- ◆ As per OEM (Original equipment manufacturer) / Manufacturer's standards.

8. SINKS:

- ◆ Sinks shall be of stainless steel material as specified in the Bill of Quantities/Drawings.
- ◆ Each sink shall be provided with R. S. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia Chromium Plated waste with chain and plug or P.V.C. waste with Escutcheon plates. Fixing shall be done as directed by Client's Representative.
- ◆ Supply fittings for sinks shall be mixing fittings or C.P. taps, angle cocks etc. all as specified in the Bill of Quantities/Drawings.

9. SINK BIB COCK

- ◆ These shall be chromium plated brass heavy quality and shall be easy type with capston head. The size shall be as specified in the Bill of Quantities.

10. Hand Drier

- ◆ The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.
- ◆ The hand drier shall be fully hygienic, rated for continuous repeat use.
- ◆ The rating of hand drier shall be such that time required to dry a pair of hands upto wrists is approximately 30 seconds.
- ◆ The hand drier shall be wall mounting type suitable for 230 volts, single phase, 50 Hz, A.C. power supply.

11. Liquid Soap Dispenser

- ◆ Liquid Soap Dispenser shall be wall/counter mounted suitable for dispensing liquid soaps, lotions, detergents. The cover shall lock to body with concealed locking arrangement, opened only by key provided.
- ◆ Liquid soap dispenser body and shank shall be of high impact resistance material.

12. TOWEL RING

- ◆ These shall be of CP specified in the Schedule of quantities. These shall be fixed by means of stainless
- ◆ steel screws to wooden / plastic cleats firmly embedded in the wall.

13,14. ACCESSORIES:

◆ Accessories shall be of the following types:

- Coat hooks
- Air purifier container

◆ Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good the walls.

◆ Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work. The flange of the recessed fixture shall cover the recess in the wall fully.

15. HEALTH FAUCET/SPRAY (OPTIONAL)

◆ A chromium plated spray with integral hand control valve and connected to a flexible pipe and angle valve with wall flange and hook are fixed as shown on the drawings or directed by the Project Manager. The angle valve and flange shall be paid under relevant item.

16. TOILET PAPER HOLDER

◆ Toilet paper holder shall be white glazed vitreous china or chrome plated of size, shape and type specified in the Schedule of Quantities.

◆ Porcelain toilet paper holder shall be fixed in walls and set in cement mortar 1:2 (1 cement : 2 coarse sand) and fixed in relation to the tiling work.

◆ The latter (chrome) shall be fixed by means of screws/capping having finish similar to the toilet paper holder in wall/temper partitions with raw l plugs or nylon sleeves. When fixed on timber partition, it shall be fixed on a solid wooden base member provided by the Owner's Site Representative.

17. ANGLE VALVE

◆ As per OEM (Original equipment manufacturer) / Manufacturer's standards.

18. COCKROACH TRAP

◆ Wherever specified in the drawings, and/or found necessary by Project Manager to provide approved cockroach trap (multi trap or plain floor traps specified) having a minimum water seal of 50mm, suitable for fully vented one pipe system shall be provided. When buried in floor, the traps shall be encased in cement concrete 1:2:4 mix after jointing and testing for support and stability.

19. HOSE CONNECTION

◆ As per OEM (Original equipment manufacturer) / Manufacturer's standards.

20. 2 WAY BIB TAP

◆ These shall be chromium plated brass heavy quality of "EGO" type or equivalent, and shall be easy type with capstone head. The size shall be as specified in the Bill of Quantities.

21. ROBE HOOK

◆ As per OEM (Original equipment manufacturer) / Manufacturer's standards.

22. GLASS MIRROR

◆ The mirrors shall be of size specified in the material schedule with or without bevelled edges. The mirrors glass shall be free from all defects & shall give clean undisturbed image at any distance & angle. The mirror shall be mounted on Asbestos sheets or 6mm plywood with brass counter sunk screws with washers and detachable G.P. caps.

23,24. uPVC Pipes & Fittings

◆ Soil, Waste and Anti-siphon age pipes and fittings shall be uPVC. All pipes shall be straight and smooth as specified in Schedule of Quantities.

◆ Pipes and fittings for main vertical stacks & branches 110 mm, & 75 mm dia shall be Soil, Waste & Rainwater System known in the short form as SWR drainage system with injection moulded fittings with approved type of socket & 'O' rubber ring joints.

◆ Joints shall be done as per the manufacturer's recommendations. The pipes and fittings must have matching dimension for perfect joints in the system. 'O' ring fittings must have sufficient gap (approx. 10 mm) for thermal expansion of pipes.

◆ uPVC pipes shall be clamped to the wall with approved type uPVC saddle clamps/U clamps and G.I. rod fixed to the angle iron support system within the shaft.

◆ Use proper uPVC pipe adapters for connections between cast iron pipes, traps & uPVC pipes where necessary. Such joints shall be made of an approved type of 'Putty'.

25. SS GRATING

◆ Floor gratings shall be hinged type cast / sheet stainless steel grating with matching recessed rim. Each grating will be provided with a cockroach trap. Each floor drain shall be provided with a specially fabricated sheet metal stainless steel double anti-cockroach internal grating to prevent ingress of cockroaches inside the building.

26. CLEAN OUT PLUG

◆ Clean out plug for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, "Y's" and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor levels. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be Cast Brass screwed to a G.I. socket. The socket shall be lead caulked to the drain pipes.

27. INLET FITTING

◆ Traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type cast iron or uPVC inlet hopper without or with one or two or three inlet sockets to receive the waste pipe. Joint between uPVC waste pipe and hopper inlet socket shall be Drip seal joint. Hopper shall be connected to a uPVC 'P' or 'S' trap with at least 50mm seal (hopper and traps shall be paid for separately). Floor trap inlet hoppers and the traps shall be set in cement concrete blocks/and supports as specified under clause 7.1 Floor trap above without extra charge.

28. P TRAP

◆ P traps where specified shall be of multi inlet uPVC traps (SWR) having a minimum 50 mm deep seal. The trap and waste pipes when buried below ground shall be set and encased in cement

concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

◆ Contractor shall provide all necessary shuttering and centring for the blocks. Size of the block shall be 30x30 cms of the required depth.

29. FLOOR DRAIN

◆ As per OEM (Original equipment manufacturer) / Manufacturer's standards.

30,32. RAIN WATER PIPES

◆ All open terraces shall be drained by rain water down takes.

◆ Rainwater down takes are separate and independent of the soil and waste system and will discharge into the open ground Storm water Drainage system of the Complex.

◆ Rain water in open courtyards shall be collected in catch basins and connected to the storm water drainage line.

◆ uPVC Pipes & Fittings

◆ Pipes and fittings shall be uPVC. All pipes shall be straight and smooth as specified in Schedule of Quantities.

◆ Pipes and fittings for main vertical stacks & branches 110 mm, & 160 mm dia shall be Rainwater System known in the short form as drainage system with injection moulded fittings with approved type of socket & 'O' rubber ring joints.

◆ Joints shall be done as per the manufacturer's recommendations. The pipes and fittings must have matching dimension for perfect joints in the system. 'O' ring fittings must have sufficient gap (approx. 10 mm) for thermal expansion of pipes.

◆ uPVC pipes shall be clamped to the wall with approved type uPVC saddle clamps/U clamps and G.I. rod fixed to the angle iron support system within the shaft.

◆ Use proper uPVC pipe adapters for connections between traps & uPVC pipes where necessary. Such joints shall be made of an approved type of 'Putty'.

31. KHURRA

As per OEM (Original equipment manufacturer) / Manufacturer's standards.

◆ MEASUREMENT:

◆ Sanitary fixtures shall be measured by numbers.

◆ Rates for all items mentioned above shall be inclusive of cutting holes and chases and making good the same, stainless steel screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

◆ Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

End of Section II

Section-III WATER SUPPLY SYSTEM

Scope of work

 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

 Distribution system from main supply headers to all fixtures and appliances for cold & hot water.

 Cold water supply lines from city water connections to Under Ground Water Tank.

 Garden irrigation system

 Excavation and refilling of pipes trenches.

 Pipe protection and painting.

 Control valves, masonry chambers and other appurtenances.

 Connections to all plumbing fixtures, tanks, appliances and municipal mains

 Inserts for R.C.C. tanks

General requirements

 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.

 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

 Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

 Clamps, hangers and supports on RCC walls, columns & slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.

 All pipe clamps, supports, nuts, bolts, washers shall be galvanised MS steel throughout the building. Painted MS clamps & MS nuts, bolts & washers shall not be accepted.

 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

Water Supply System

 Contractor should study the site plan and the water supply systems one for domestic water supply.

 Source Water supply will be acquired from Municipal Corporation water mains (as available) to a service connection and collected in water storage tanks located underground.

◆ The system has been connected to a gravity feed system from overhead tanks to all parts of the building

◆ It is proposed to provide flushing cistern for all WCs. Infra red NO-TOUCH flush valves shall be provided for Urinals. These will be fed from over head tank by gravity.

◆ Domestic water supply shall be provided with cold water system only. Hot water provisions to kitchen and all toilets connected to a local electric hot water storage geyser other than add on solar system at terrace for inlet of geyser in kitchen etc.

33,34,35. (CPVC) G.I. pipes & fittings

◆ All pipes inside the buildings for domestic hot and cold water supply shall be CPVC conforming to CTs SDR-13.5 at a working pressure of 320 PSI at 23 deg.C. and 80 PSI at 82 deg. C.

◆ Solvent welded CPVC fittings etc. tees, elbows, couplers, unions, reducers, brushing etc. including transition fittings (connection between CPVC and metal pipes/G.I. ie. Brass adapters conforming to ASTM D-2846) shall be provided.

◆ All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I. pipes inside toilets shall run above false ceiling with vertical drop in wall chases for all fixtures. No pipes to run inside sunken floor as far as possible. Pipes may run under the ceiling or floors and other areas as shown on drawings.

◆ Joining Pipes & Fittings

Cutting

◆ Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut. All burrs should be removed for proper contact between pipe and fittings during jointing.

◆ Solvent Cement Application

◆ Only CPVC solvent cement conforming to ASTM-F-493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket.

◆ Assembly

◆ After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up.

◆ Testing

◆ The system should be hydrostatically pressure tested at 150 psi (10 Bar) for one hour. During pressure testing, the system should be fitted with water and if a leak is found, the joint should be cut out the replaced with new one.

◆ Transition of Flow guard CPVC in metals

◆ When making a transition connection to metal threads, special brass/plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torque.

Threaded sealants

Teflon tape shall be used to make threaded connections leak proof.

Solvent Cement

Only CPVC solvent cement conforming to ASTM F 493 should be used for joining pipe with fittings and valves.

Hangers and supports

For Horizontal runs, support should be given at 3 feet (90 cms) intervals for diameters of one inch and below and at 4 feet (1.2 m) intervals for larger sizes.

Supports should be as per the below mentioned table:

Size of pipe	20°C	49°C	71°C	82°C
Inch	Ft.	Ft.	Ft.	Ft.
½"	5.5	4.5	3.0	2.5
¾"	5.5	5.0	3.0	2.5
1"	6.0	5.5	3.5	3.0
1¼"	6.5	6.0	3.5	3.5
1½"	7.0	6.0	3.5	3.5
2"	7.0	6.5	4.0	3.5

Anchor Fasteners

 All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the DPL for any damage that may be caused by such failures.

Unions

 Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Project Manager.

Flanges

 Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by the Project Manager. Connections shall be made by correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Project Manager. Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve and C.I. butterfly valve.

Trenches

 All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:-

Dia of pipe	Width of trench	Depth of trench
-----	-----	-----
15 mm to 50 mm	30 cms	75 cms
65 mm to 150 mm	45 cms	100 cms

Sand filling

 G.I. pipes in trenches shall be protected with fine sand 15 cms all round before filling in the trenches.

Painting (Painting for CPVC pipes not required)

 All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code given in this documents or specified by Project Manager.

Pipe protection (Protection for CPVC pipes not required)

 All G.I. pipes in wall chase /below floors or laid under ground shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.

 G.I. waste pipes buried in ground or sunken slab shall be protected with multilayer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. Pypkote or equivalent.

36. Ball Valves

 Valves upto 40 mm dia. shall be screwed type Ball Valves with stainless steel balls, spindle, teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm², and accompanying couplings and steel handles.(to BS 5351)

37. Butterfly Valves

 Valves 50 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

38. Motorised Water Valve:

 The Motorized Water Valve shall consist of gunmetal valve body with stainless steel trim and equal percentage flow characteristics, modulating motor and linkage.

Testing

 All pipes, fittings and valves after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg/cm² whichever is more.

 Pressure shall be maintained for a period of at least thirty minutes without any drop.

 A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Project Manager.

 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

 After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

Measurement

 CPVC or G.I. pipes above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of

- ◆ all fittings e.g. coupling, tees, bends, elbows, unions, flanges and U clamps with nuts, bolts & washers fixed to wall or other standard supports.
- ◆ Jointing with teflon tape, white lead and insertion gasket of appropriate temperature grade.
- ◆ Cutting holes, and chases in walls, floors, any pipe support required for pipes below ground & making good the same.
- ◆ Excavation, back filling, disposal of surplus earth and restoring the ground & floor in original condition.

◆ **Pipe Supports.**

- ◆ Fabricated and galvanised supports shall be measured by weight. Weight for each type of clamp shall be calculated on basis of the quantity of structural and MS used from the theoretical weight calculated on basis of the components theoretical weight of the sections.
- ◆ Rate quoted for supports & hangers shall be inclusive of:-
 - ◆ Expandable anchor fastens.
 - ◆ Galvanising of all supports & hangers.
 - ◆ Cutting holes in walls, ceilings on floors and making good where permitted.
 - ◆ Nuts, bolts and washers for fixing and assembling.
 - ◆ Wooden/PVC pipe saddles for vertical or horizontal runs.

End of Section III

EXTERNAL PLUMBING

PLUMBING SUPPRESSION WORKS

INDEX

SECTION	DESCRIPTION
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I	SEWERAGE & STORM WATER DRAINAGE
II	GARDEN IRRIGATION SYSTEM
III	SPECIFICATION FOR WATER SUPPLY, DRAINAGE PUMPS & EQUIPMENT
IV	SPECIFICATION FOR WATER TREATMENT EQUIPMENT
V	SPECIFICATION FOR REVERSE OSMOSIS SYSTEM
VI	INSTALLATION, COMMISSIONING & GUARANTEES

A. TECHNICAL SPECIFICATIONS FOR PLUMBING WORKS

Section I Sewerage and Storm Water drainage.

1 Scope of work

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all the drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the drainage system shall include:-

a) Sewer lines including excavations, pipe lines, manholes, drop connections and connections to the Sewage Treatment Plant.

b) Storm water drainage, excavation, pipe lines, manholes, catch basins, drain channels, recharging pits and overflows to external low areas

2 General requirements

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the

2.2 Drainage lines and open drains shall be laid to the required gradients and profiles.

2.3 All drainage work shall be done in accordance with the local municipal bye-laws.

2.4 Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.

2.5 Location of all manholes, etc. shall be as per site plan drawings. No drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Project Manager.

3 Excavation

3.1 Alignment and grade

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Project Manager. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Project Manager.

3.2 Excavation in tunnels

The excavation for sewer works shall be open cutting unless the permission of the Project Manager is obtained for laying pipes in tunnel where sewers have to be constructed along narrow passages or difficult ground.

3.3 Opening out trenches

In excavating the trenches, etc. the solid road metalling, pavement, kerbing, etc. and turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully sifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Project Manager.

The Contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Project Manager.

3.4 Obstruction of roads

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Project Manager.

3.5 Removal of filth

All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and removed to a suitable place to be provided by the Contractor.

3.6 Excavation to be taken to proper depths

The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating there to and so that the inverts may be at the levels given in the sections.

3.7 Refilling

After the sewer or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and upto 75 cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15 cms layers with materials taken from the excavation, each layer being watered to assist in the consolidation..

3.8 Contractor to restore settlement and damages

The Contractor shall, at his own costs and charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces etc. whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also, at his own expense and charges, repair and make good any damage done to buildings and other property if in the opinion of the Project Manager the damage is due to his negligence.

3.9 Disposal of surplus soil

The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

3.10 Timbering of sewer and trenches

a) The Contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed timbered in loose or sandy strata and below the surface of the sub soil water level.

- b) All timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.
- c) The Contractor shall be held responsible and will be accountable for the sufficiency of all timbering, bracings, sheeting and piling used as also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

3.11 Shoring of buildings

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

3.12 Removal of water from sewer, trench etc.

a) The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.

b) If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope, the full width of the trench shall be filled with concrete by the Contractor at his own expenses and charges to the requirements of the Project Manager.

3.13 Width of trench

3.13.1 Recommended width of trenches at the bottom shall be as follows:-

100 mm dia pipe	55 cms
150 mm dia pipe	55 cms
225-250 cms dia pipe	60 cms
300..400 mm dia pipe	75 cms

Maximum width of the bed concrete shall also be as above. No additional payment is admissible for widths greater than specified.

4 Salt glazed stoneware pipes (Where applicable)

4.1 Stoneware pipes shall be of first class quality salt glazed and free from rough texture inside and outside and straight. All pipes shall have the manufacturers name marked on it and shall comply with approved makes.

4.2 Laying and jointing of stoneware salt glazed pipes

a) Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before despatch each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.

b) The pipes shall be laid with sockets leading uphill and rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

c) Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If

excavation has been carried too low it shall be made up with cement concrete at the Contractor's cost and Charges.

d) If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed to ensure even bearing.

4.3 Jointing of pipes

a) Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

b) The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement : 1 clean sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45° with the barrel of the pipe. The mortar shall be mixed as needed for immediate use and no mortar shall be beaten up and used after it has begun to set.

c) After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper of "badger". The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials which can be kept damp shall be used. The joints shall be exposed and space left all round the pipes for inspection by the Project Manager. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

4.4 Testing

a) All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5 metre head of water. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

b) Sewer lines shall be tested for straightness by: (i) inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end, (ii) means of a mirror at one and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstruction or deviation will be apparent.

c) The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Project Manager.

d) A test register shall be maintained which shall be signed and dated by Contractor,

4.5 Gully traps

Gully traps shall be of the same quality as described for stoneware pipes in clause 4.1 above and used where shown on drawings.

Gully traps shall be fixed in cement concrete 1:5:10 mix and a brick masonry chamber 30x30 cms inside in cement mortar 1:5 with 15x15 cms grating inside and 30x30 cms C.I. sealed cover and frame weighing not less than 7.3 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size (1 cement : 5 coarse sand : 10 stone aggregate 40 mm nominal size)

5 Reinforced cement concrete pipes

5.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun S & S RCC pipes of specified class. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

5.2 Laying

R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. Cradles or concrete bed may be omitted, if directed by the Project Manager.

5.3 Jointing

After setting out the pipes the socket shall be centred over the spigot and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools. All joints shall be finished at an angle of 45° to the longitudinal axis of the pipe on both sides of the collars neatly.

5.4 Testing

All pipes shall be tested to a hydraulic test of 1.5 m head for at least 30 minutes at the highest point in the section under test. Test shall also be carried out similar to those for stoneware pipes given above the smoke test shall be carried out by the Contractor, if directed by the A test register shall be maintained which shall be signed and dated by Contractor,/ Project Manager.

6 Cement concrete and masonry works (for manholes and chambers etc.)

6.1 Materials

a) Water

Water used for all the constructional purposes shall be clear and free from oil, acid, alkali, organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered good enough for constructional purpose.

b) Aggregate for concrete

The aggregate for concrete shall be in accordance with NFPA. In general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of Project Manager. The size of the coarse aggregate shall be done as per NFPA.

c) Sand

Sand for various constructional purposes and its grading shall comply in all respects with NFPA. It shall be clean, coarse hard and stone, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated particles, alkali, organic matters, salt, loam and other impurities which may be considered by the Project Manager.

d) **Cement**

The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement.

d) **Mild steel reinforcement**

The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements.

f) **Bricks**

Brick shall have uniform colour, thoroughly burnt but not over burnt, shall have plain rectangular faces with parallel sides and sharp right angled edges. They should give ringing sound when struck. Brick shall not absorb more than 20% to 22% of water, when immersed in water for 24 hours. Bricks to be used shall be approved by the Project Manager.

g) **Other materials**

Other materials not fully specified in these specifications and which may be required in the work shall conform to the NFPA. All such materials shall be approved by the Project Manager.

6.2 **Cement concrete (plain or reinforced)**

a) Cement concrete for pipes bedding, cradles, foundations and R.C.C. slabs for all works shall be mixed by a mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the Project Manager. Rate for cement concrete shall be inclusive of all shuttering and centring at all depth and heights.

b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.

c) All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny bags at all times.

6.3 **Masonry work**

Masonry work for manholes, chambers, septic tanks, and such other works as required shall be constructed with bricks as specified in the Schedule of quantities in cement mortar of mix as specified in schedule of quantities. All joints shall be properly raked to receive plaster.

6.4 **Cement concrete for pipe support**

a) Wherever specified or shown on the drawings, all pipes shall be supported in bed all round or haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Width of the bedding shall be the width of the trench as specified.

a) Unless otherwise directed by the Project Engineer, cement concrete for bed, allround or in haunches shall be laid as follows :-

	upto 1.5 m depth	upto 3 m depth	beyond 3 m depth
Mix of concrete (no sub soil water)	(1:4.8)	(1:4:8)	(1:4:8)
Stone ware pipes	Al round	upto Haunches	Alround

RCC Pipes Under sub-soil water Mix of concrete	Alround (1:3:6)	upto Haunches (1:3:6)	upto Haunches) (1:3:6)
R.C.C. Pipes or SW.pipes	All round	All round	All round
Under the building	(1:3:6)	(1:3:6)	(1:3:6)
RCC Pipes or SW pipes	Alround	Alround	Alround

(Concrete mix refer to cement : coarse sand: stone aggregate 40 mm nominal size)

c) R.C.C. pipes or C.I. pipes may be supported on brick masonry or precast R.C.C. or in situ cradles. Cradles shall be as shown on the drawings.

d) Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

7 Manholes and chambers

7.1 All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:5 (1 cement : 5 coarse sand) or as specified in the Schedule of Quantities.

7.2 All manholes and chambers etc. shall be supported on base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the drawings.

Where not specified manholes shall be constructed as follows:-
(all dimensions internal clear in cms)

Size of manhole type	90x80 Rect.	120x90 Rect.	90 dia at bottom Conical	122 dia at bottom Conical
Maximum depth	150	240	167	239
Average thickness of R.C.C slab	15	15	-	-
Size of cover and frame mm	60x45	50 dia	50 dia	50 dia
Weight of cover and frame	38 kg	116 or 225 kg	116 or 225 kg	116 or 225 kg

7.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nom. Size) The benching shall have a slope of 10 cms towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement. as per standard details.

7.4 All manholes shall be plastered with 12/15 mm thick cement mortar 1:3 (1 cement : 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster mixed with water proofing compound.

7.5 All manholes with depths greater than 0.8m shall be provided with 20 mm square or 25 mm round rods aoristic coated catch rings set in cement concrete blocks 25x10x10 cms in 1:2:4 mix 30 cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.

7.6 All manholes shall be provided with cast iron/steel fibre reinforced plastic (SFRC) covers and frames and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or given above.

7.7 Road gullies, ramp drains, gratings in basement shall be cast iron with M.S. frame or Steel Fibre Reinforced Concrete (SFRC) with frame as specified in the Schedule of Quantities.

8 Making connections

8.1 Contractor shall connect the sewer line of the building to the main manhole by providing making holes and channels etc.

9 Measurement

9.1 Excavation

9.1.1 Measurement for excavation of pipe trenches shall be made per linear metre correct up to 1 cm. separately for
a) all soil
b) rocks

9.1.2 Trenches shall be measured between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth upto 1.5 m or as given in the Schedule of Quantities.

9.1.3 Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the schedule of quantities and above the rate for depth up to 1.5 m.

9.1.4 Timbering and Shoring

Timbering and shoring as described above shall be measured per m² and paid for as per the type of timbering or shoring done at site and as per the relevant item in the Schedule of Quantities. Rate for timbering and shoring shall be for all depths and types of soil classifications including saturated soil.

9.1.5 Saturated Soil

No extra payment for pumping and bailing out water shall be made for excavation with an average depth of 1.5 m in saturated soil, surface water from rain falls or broken pipes lines, or sieves and other similar sources. An extra rate as quoted in the schedule of quantities shall be paid for excavation in saturated soil for pipe trenches above average depth of 1.5 m. No payment is admissible for water collected from surface sources and broken pipe lines or sewers.

9.1.6 Refilling, Consolidation and Disposal of Surplus Earth

Rate quoted for excavation of trenches shall be inclusive of refilling, consolidation and disposal of surplus earth within a lead of 200 m.

9.2 Stoneware Pipes/RCC/C.I. pipes

Stoneware R.C.C./C.I. pipes shall be measured for the finished length of the pipeline in running metres nearest to a centimetre.

(a) Lengths between manholes shall be recorded from inside of one manhole to inside of other manhole,

(b) Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside of manhole. Rate shall include all items given in the schedule of quantities and specifications.

9.3 Gully Traps

Gully traps shall be measured by the number and rate shall include all excavation, foundation, concrete brick masonry, cement plaster inside and outside, C.I. grating and sealed cover and frame.

9.4 Cement Concrete for Pipes

Cement concrete in bed and all round or in haunches shall be paid per running metre between the outside wall of manholes at bottom of the trench. No additional payment is admissible in respect of concreting done for widths greater than specified, for shuttering or centering and concreting in sub soil water conditions.

9.5 Manholes, Catch basins & Ramp drains

a) All manholes and catch basins shall be measured by numbers and shall include all items specified above and necessary excavation, refilling & disposal of surplus earth.

b) Manholes with depths greater than specified under the main item shall be paid for under "extra depth" and shall include all items as given for manholes. Measurement shall be done to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.

c) Ramp drains shall be measured per metre length.

9.6 Making Connections

Item for making connection to municipal sewer shall be paid for by number and shall include all items given in the Schedule of Quantities and specifications.

End of Section I

Section II Garden Irrigation System

1 Scope of work

1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to install garden hydrants and sprinklers and drip irrigation water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

- a) Pipe work with connections to hydrants.
- b) Garden hydrants.
- c) Excavation and refilling of pipes trenches.
- d) Control valves, masonry chambers and other appurtenances.
- e) Connections to all pumps & appliances.

2 The System

2.1 The garden hydrant system should be executed for a total working system.

2.2 System components shall be pipes, valves, controllers, various types of sprinklers and drip irrigation lines with emitters as approved by the Project Manager.

3 General requirements

3.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.

3.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

3.3 Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

3.4 Pipes shall be laid in a manner as to provide as far as possible easy accessibility for repair and maintenance. Pipes under roads shall be laid in RCC pipe sleeves.

3.5 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

4 uPVC Pipes & Fittings

4.1 Garden hydrant mains shall be rigid uPVC pipes. If class is not mentioned in the schedule of quantities the same shall be class IV (10 kg/cm²).

4.2 Fittings for uPVC pipes shall be injection moulded fitting with spigot & sockets suitable for solvent weld joints. Fittings must have suitable provision for expansion.

4.3 Solvent shall be of make and type approved by pipe and fittings manufacturer. Joint shall be made in an approved manner as recommended by the manufacturer.

4.4 uPVC flanges at intervals of 20-25 m for all pipes 65 mm dia and above shall be provided for easy maintenance.

4.5 Suitable uPVC thread adapter for connection between pipes & valves shall be provided.

4.6 Cement concrete supports and anchor blocks shall be provided at all bends, tees and other locations as directed by the Project Manager. Connections at garden hydrant outlet, near valves must also be anchored.

4.7 G.I. Pipes & Fittings

Vertical connection for garden hydrant points shall be galvanised steel tubes (medium class) with matching malleable iron fittings of approved make.

5. Garden Hydrants

Garden hydrants shall be 25 mm dia gunmetal valves installed on G.I. pipes as per details.

6 Valves

Valves shall be as specified in section for Water Supply.

7. Trenches

All pipes below ground shall be laid in trenches with a minimum cover of 100 cms. The width and depth of the trenches shall be as follows:-

Dia of pipe	width of trench	depth of trench
-----	-----	-----
15 mm to 50 mm	30 cms	100 cms
65 mm to 100 mm	45 cms	100 cms

This will not apply to drip irrigation pipes which may be laid just below the surface or on surface.

8. Testing

8.1 All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 7 kg/cm² or 1.5 times the working pressure, whichever is higher. Pressure shall be maintained for a period of at least thirty minutes without any drop. A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and the Project Manager.

8.2 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the pumping system. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the contractor during the defects liability period without any cost.

8.3 After commissioning of the water supply system, Contractor shall conduct performance test to ensure that the system operates as specified. The test shall be conducted over a period of 15 days.

9. Measurement

9.1 Pipes shall be measured in running meter (to the nearest cm) and shall be inclusive of fittings, e.g. couplings, tees, bends, elbows, unions. Deductions for valves shall be made. Rates quoted shall be inclusive of all fittings.

9.2 Excavation, back filling & disposal of surplus earth is included in the rates for laying pipes.

9.3 Gunmetal, cast iron valves, sprinklers, emitters and masonry chambers shall be paid by numbers.

End of Section II

Section III Specification for Water Supply, Drainage Pumps & Equipment

1. Scope of work

Work under this section shall consists of furnishing all labour, materials, equipment and appliances necessary and required to supply install and commission the water supply and drainage pumps as described hereinafter and given in the schedule of quantities and/or shown on the drawings.

2. General requirements

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Project Manager.

2.2 All equipment shall be of the best available make manufactured by reputed firms.

2.3 All equipment shall be installed on suitable foundations true to level and in a neat workmanlike manner.

2.4 Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.

2.5 Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.

2.6 Each pumping set shall be provided with a butterfly valve on the suction and delivery side and a flap type non return valve on the delivery side

2.7 All pump couplings and belt guards for air compressors shall be totally enclosed with 5 mm mesh.

3.0 System of Water Supply

3.1 The water supplied by the authorities will be chlorinated on line and stored in the domestic U.G. tank.

3.2 Tube well water shall be stored in a separate tank and after treatment in filter, softener and chlorination will be stored in the same domestic tank.

3.3 Water from this common U.G. tank shall be pumped to O.H. Tanks at terrace of each of the tower by separate pumps.

3.4 Each toiler and kitchen shall be fed with water from terrace tanks by gravity. Pressure reducing valves shall be provided wherever required.

3.5 To maintain proper pressure in the top two floors, hydropneumatic system has been provided.

Specifications for Pumps

4 Water Transfer Pumps (Imported Stainless Steel Pumps)

4.1 Water supply pumps shall be suitable for clean filtered water. Pumps shall be single stage, monobloc vertical/horizontal, centrifugal pumps with stainless steel body and stainless steel (DIN W-Nr .1.4301) impeller, stainless steel shaft and mechanical seal and coupled to a TEFC electric motor. Each pump should be operating to a curve required by the operating conditions.

4.2 All parts in contact with water shall be corrosion resistant stainless steel DIN-Nr.1.4401.

4.3 Each pump shall be provided with a totally enclosed fan cooled induction motor of suitable H.P. The motors shall be suitable for 410 volts, 3 phases, 50 cycles A.C. power supply and operating at 2900 RPM nominal speed.

4.4 Each pumping set shall be provided with 100-mm dia gunmetal "Borden" type pressure gauge with gunmetal valve and connecting piping.

4.5 Pump or the whole set shall be stable on rubber vibration eliminating pads appropriate for each pump as recommended by the manufacturer and accepted by the Project Managers..

5 Submersible pumps

5.1. Submersible pumps for sewage/drainage shall be single stage, single entry pump. Pump shall be with C.I. casing and C.I. two vane open type dynamically balanced impeller connected to a common shaft to the motor. The vane for sewage pump will be open type, while for drainage pump etc. It will be of semi open type.

5.2 Stuffing box shall be provided with mechanical seals

5.3 Each pump shall be provided with water cooled squirrel cage induction motor suitable for 415 volts, 3 phase, 50 cycles AC power supply.

5.4 Each pump shall be provided with liquid level controller for automatic operation of the pump between predetermined levels. Operation of level controller shall be similar to as discussed in subsequent paras below.

5.5 The pumping set shall be for stationary application and shall be provided with pump connector in it. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation, without disturbing delivery pipe the pump unit shall have a back pull out design. A rust proof chain shall be provided for each pump.

5.6 Pump shall be provided with all accessories and devices necessary and required for the pump to make a complete working system.

6 Level Controllers

6.1 Level controllers shall be electronic low voltage type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe. The level controller will be used for following applications: -

6.2 Water transfer pump.

To cut off all operating pumps when:-

a) Water level is low in storage water tanks with low water level audible alarm.

b) To cut off water transfer pump when water in O.H. Tank is full.

6.3 Sump Pump level controller & high water alarm

To cut off the drainage sump pump when the sump is empty and to start when:-

a) Duty pump No. 1 at pre-determined level No.1

b) Duty pump No.2 at a higher pre-determined level.No.2 and also to sound alarm

7 Pipe & Fittings (for Headers and Connections)

7.1 Pump suction and delivery headers shall be Galvanized iron pipes/MS heavy class with matching fittings. The pipe joints shall be threaded as per manufacturer's instructions.

7.2 Vibration Eliminators

All suction and delivery lines as shown on the drawings shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

7.3 Valves

7.3.1 Butterfly Valves

Butterfly Valves shall be cast iron body with following details:-

- a) Disc shall be CI heavy duty electrolyses nickel plated abrasion resistant.
- b) The shaft be EN-8 Carbon Steel with low friction nylon bearings.
- c) The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.
- d) Built in flanged rubber seals.
- e) Actuator to level operated for valves above ground and T Key operated for valves below ground.
- f) Built in flanges for screwed on flanged connections.

Manufacturer's details on fixing and installation will be followed.

7.3.2 Non Return Valves (NRV)

- a) Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.
- b) NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges.

8 Painting and cleanup

- a) On completion of the installation contractor shall scrub clean all pumps, piping, filters and equipment and apply one coat of primer.
- b) Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes.
- c) Provide painted identification legend and direction arrows on all equipment and piping as directed by engineer-in-charge.
- d) On final completion of the work, contractor should cleanup the site, filter room of all surplus materials rubbish and leave the place in a broom-clean condition.

9. Cables

9.1. Contractor shall provide all power and control cables from the motor control centre to various motors, level controllers and other control devices.

9.2. All power and wiring cables shall be aluminum conductor PVC insulated armoured and PVC sheathed of 1100 volts grade.

9.3. All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 volts grade.

9.4. All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

9.5. All cable joints shall be made in an approved manner as per standard practice.

10. Cables trays

10.1. Contractor shall provide M.S. Slotted cable trays at locations as shown on the drawings and of sizes as given in the schedule of quantities.

10.2. Cables trays shall be supported from the bottom of the slab at intervals of 30 cms at both ends by welding support rods with insert plates or to reinforcement bars. Cutting of holes in the slab for exposing of reinforcement bars and making good the same after welding of support rods shall be included in the rate of the tray and no separate payment shall be made on this account.

10.3. Cost of clips, bolts, nuts, supports rods and any other materials required to fix the trays in proper manner shall be included in the rate for trays.

11. Earthing

All equipment installed by the contractor shall be suitably earthed by making proper connection by means of G.I. Wires to the main earthing system laid by the electrical contractors.

12. Motor control centres

12.1. Switchboard cubicles of approved type shall be fabricated from 16 gauge M.S. Sheet with dust and vermin proof construction. It shall be painted with stove enamelled paint of approved make and shape. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following:- (switchgear as given in the schedule of quantities).

- a) Incoming main switch fuse unit of required capacity.
- b) Isolation switch fuse unit, one for each motor.
- c) Fully automatic DOL/star delta starters suitable for motor H.P. with push buttons one for each motor and on/off indicating neon lamps.
- d) Single phasing preventer of appropriate rating for each motor.
- e) Rotary duty selector switch.
- f) Panel type ampere meters one for each motor.
- g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.
- h) Neon phase indicating lamps and indicating lamp for each motor.
- i) Rotary switch for manual or auto operation for each pump.
- j) Fully taped separate aluminium bus bars of required capacity for normal and emergency supply where specified.
- k) The panel shall be prewired with colour coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switch board panel.

12.2 All switch gears and accessories shall be approved make.

12.3. Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers.

13 Measurement

13.1 General

13.2 Unit rate for individual items, e.g, Pumps, MCC and level controller are for purposes of payments only. Piping, headers, valves, accessories, cabling and MCC to measured separately in this contract only.

13.3 All items must include all accessories fittings as described in the specifications, BOQ and shown on the drawings.

13.4 Recirculation water pumps

Pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

13.5 Drainage Pumps

Drainage pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

13.6 Level controllers & Alarms

Level controllers for each set of pumps shall be measured by number and inclusive of probes, cabling unto surface box near the pump and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

13.7 Piping Work

13.7.1 Suction and delivery headers for each pumping system shall be measured per linear meter of finished length and shall include all items as given in the schedule of quantities. Painting shall be included in rate of headers.

13.7.2 G.I. pipes between various equipment's shall be measured per linear meter of the finished length and shall include all fittings, flanges, jointing, clamps for fixing to walls or hangers and testing. Flanges shall include 3 mm thick insertion rubber gasket, nuts, bolts and testing.

13.7.3 Water Tank, Vibration eliminators, "Y" strainers, butterfly valves, slim non return valves shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications.

End of Section III

Section IV Specification for Water Treatment Equipment

1. General requirements

- 1.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Project Manager.
- 1.2 All equipment shall be of the best available make manufactured by reputed firms.
- 1.3 All equipment shall be installed on suitable foundations, true to level and in a neat workmanlike manner.
- 1.4 Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.
- 1.5 Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.
- 1.6 Each pumping set shall be provided with a butterfly valve on the suction and delivery side and a flap type non return valve on the delivery side
- 1.7 All pump couplings and belt guards for air compressors shall be totally enclosed with 5 mm mesh.

2.0 Corrosion Resistant Material

- 2.1 All piping, valves and accessories from outlet of raw water to inlet of treated water tank shall be of material fully resistant to internal and external corrosion. Such material may be stainless steel, PVC, rubber or other type of lining material accepted in international water works engineering practice.

3. Water filters for water supply

- 3.1 Filter shall be designed in accordance with the code of unfired pressure vessel.
- 3.2 Water filter shall be pressure quartz pressure filter with graded sizes of pure quartz media. Design may be altered to suite contractor's own design of the most efficient performance.
- 3.3 Specification shall apply for water filtration system

Pressure filters shall be manufactured with factory made bobbin wound polyester fibre glass multilayer filters fitted with internal uPVC distribution pipe with polypropylene diffusers on top, collector pipes and arms, inlet and outlet header vertical water pressure dished ends complete with initial charge of filter media, uPVC/G.I. face piping, accessories testing and commissioning complete. Working Pressure 2.4 kg/cm^2 (Test pressure 3.75 kg/cm^2).

Each vessel will be provided with suitable pressure tight manhole cover appropriately located for inspection and repairs.

3.4 Multi Port Valves

Each vessel will be provided with multi port valves to operate and regulate the normal flow, backwash and rinsing, rapid washing, on the face piping.

Provide suitable sampling cocks to draw water samples for raw water and treated water.

3.5 Face Piping

- a) Each vessel shall be provided with non-corrosive face piping from the inlet to the outlet. Face piping shall be uPVC 10 kg/cm² class with injection moulded fittings and solvent weld and flanged joints
- b) All valves shall be butterfly valves as specified in the piping section over 65 mm dia and for pipe dia below 50 mm dia shall be provided with ball valves.

4. Chemical Dosing Pump

4.1 Pump applications

- a) Chlorination of raw water from tubewells,
- b) Chlorination of drinking water transfer pump

4.2 Dosing system comprising of an electronic metering pump with, 100 lit capacity uPVC/HDPE solution tank with level gauge and lid on top.

4.3 Electronic driven metering pumps with mechanically actuated diaphragm with oil lubricated gear mechanism. The output of the pump should be adjustable for operation from 10-100%. Pump construction shall be corrosion resistant polypropylene or similar material. Pump electrical circuit shall be interlocked with the main raw water /pool recirculation pumps so that they operate only when the pumps are operating.

9. Pipe & Fittings (for Headers and Connections)

9.1 Pump suction and delivery headers shall be of approved corrosion resistant material with matching fittings. The pipe joints shall be threaded or as per manufacturer's instructions.

9.2 Vibration Eliminators

Provide on all suction and delivery lines as shown on the drawings double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

9.3 Valves

Valves 50 mm dia and above shall be rubber lined butterfly valves.

Non return valves shall be rubber lined cast iron slim type of approved make.

10. Flow measurement

10.1 Provide rota meter reading "LPH" or "LPM" on delivery line of the plant.

10.2. Provide one direct reading flanged type water meter with strainer on outlet of water softener or water filter.

11. Painting and cleanup

11.1 On completion of the installation contractor shall scrub clean all pumps, piping, filters and equipment and apply one coat of primer.

11.2 Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes.

11.3 Provide painted identification legend and direction arrows on all equipment and piping as directed by engineer-in-charge.

11.4 On final completion of the work, contractor shall cleanup the site, filter room of all surplus materials rubbish and leave the place in a broom-clean condition.

12. Cables

12.1. Contractor shall provide all power and control cables from the motor control centre to various motors, level controllers and other control devices.

12.2. All power and wiring cables shall be aluminium conductor PVC insulated armoured and PVC sheathed of 1100 volts grade.

12.3. All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 volts grade.

12.4. All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

12.5. All cable joints shall be made in an approved manner as per standard practice.

13. Cables trays

13.1. Contractor shall provide M.S. Slotted cables trays at locations as shown on the drawings and of sizes as given in the schedule of quantities.

13.2. Cables trays shall be supported from the bottom of the slab at intervals of 30 cms at both ends by welding support rods with insert plates or to reinforcement bars. Cutting of holes in the slab for exposing of reinforcement bars and making good the same after welding of support rods shall be included in the rate of the tray and no separate payment shall be made on this account.

13.3. Cost of clips, bolts, nuts, supports rods and any other materials required to fix the trays in proper manner shall be included in the rate for trays.

13.4. Cables trays shall be of Mek or Dexion make.

14. Earthing

All equipment installed by the contractor shall be suitably earthed by making proper connection by means of G.I. wires to the main earthing system laid by the electrical contractors.

15. Motor control centres

15.1. Switchboard cubicles of approved type shall be fabricated from 16 gauge M.S. sheet with dust and vermin proof construction. It shall be painted with stove enamelled paint of approved make and shape. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following:- (switchgear as given in the schedule of quantities).

a) Incoming main switch fuse unit of required capacity.

b) Isolation switch fuse unit, one for each motor.

c) Fully automatic DOL/star delta starters suitable for motor H.P. with push buttons one for each motor and on/off indicating neon lamps.

d) Single phasing preventer of appropriate rating for each motor.

- e) Rotary duty selector switch.
 - f) Panel type ampere meters one for each motor.
 - g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.
 - h) Neon phase indicating lamps and indicating lamp for each motor.
 - i) Rotary switch for manual or auto operation for each pump.
 - j) Fully taped separate aluminium bus bars of required capacity for normal and emergency supply where specified.
 - k) The panel shall be prewired with colour coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switch board panel.
- 15.2 All switchgears and accessories shall be approved make.
- 15.3. Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers.

End of Section IV

Section V REVERSE OSMOSIS SYSTEM

Design Brief:- The System is designed considering Bore-well Water as the Feed Source.

The Basis of Design considered is, as per the quality of water of 1000 ppm TDS.

Parameter		Value
Raw Water Flow Rate	:	1.5 M3/Hr
Product Water Flow Rate	:	500 LPH
Design Recovery	:	33 %
Reject Flow	:	1.00 M3/Hr
Operating Pressure	:	12.5 bar

Plant has been designed at water temperature of 25 degrees.

You are requested to check and revert back in case of any deviation.

Please note that the recovery of Reverse Osmosis plant shall directly depend on critical parameters like silica, SDI, hardness, Iron, Chlorine and fluorides. Assuming them to be within range , the recovery works out to be 33%.

Treated water quality at the outlet of RO Plant:

Total Dissolved Solids : < 50 ppm

LIMITING CONDITIONS IN FEED WATER FOR R.O. PLANT OPERATION:					
Ph	:	7-8	Temperature	:	25- 35° C
Turbidity	:	< 1 NTU	SDI	:	< 3
Free Chlorine	:	NIL	Iron as Fe	:	<0.1 ppm
Manganese as Mn	:	< 0.1 ppm	Oil & Grease	:	< 1 ppm

Process Description:- The treatment scheme comprises of pre-treatment and reverse osmosis block. The process description is as follows:

Pre-Treatment:

Dual Media Filter- The system is provided with a Dual Media Filter. The main purpose of the filter is to remove the Suspended Solids & reduce Turbidity. The Filter is provided with Inlet Distributor, Bottom Collector & various Filtration Media like pebbles, gravels, sand and anthracite to achieve effective filtration. Externally, the filter has either a Multiport Valve or mesh of valves to assist in various service requirements like Filtration, Backwash & Rinse.

Activated Carbon Filter- The system is provided with an activated carbon Filter. The main purpose of the filter is to remove the free chlorine, organics, colour or odour etc. The Filter is provided with Inlet Distributor, Bottom Collector & Filtration Media like Activated carbon of high i-value and supporting media to achieve effective filtration. Externally, the filter has either a Multiport Valve or mesh of valves to assist in various service requirements like Filtration, Backwash & Rinse.

Micron Cartridge Filter: A micron filter of 5 micron is included in the system to prevent passage of particulates to the high pressure pump and membrane. The micron filter is of PP housing. The micron cartridge will be polypropylene.

Reverse Osmosis System:

High Pressure Pump: The system is provided with a high pressure pump of suitable flow rate, head & material of construction. The pump is provided with low pressure switch to ensure smooth operation.

Reverse Osmosis Block: The RO Block comprises of membranes encased inside the pressure tubes. The membranes considered are thin film composite in spiral wound construction. The feed water at high pressure enters the RO block and gets separated in to permeate (product) and reject (waste) streams. The product water is usually taken to a tank & pumped for further use. The reject water is drained in nearby drain. The RO Block is provided with adequate instrumentation & interlocks to ensure smooth operation. The RO block is also provided with automatic flush valve on reject line. This valve ensures the flushing of accumulated salts & maintains the clean membrane surface.

Post Treatment:-

UV system : The system is provided with an ultraviolet based system for final disinfection of treated water before entering into treated water tank. The UV system comprises of a quartz based UV lamp, SS housing and display panel.

PH Correction Dosing Set (optional): The system is provided with a tank (HDPE) & dosing pump to dose the appropriate solution to increase the PH. Usually Sodium Hydroxide (non drinking applications) or Soda Ash (for drinking application) solution is used. The pump has provision to change the dosage rate by manually controlling the knob.

Termination into Treated water tank

The Treated water will be sent to the treated water tank capacity 500 litres holding capacity. The RO plant will be synchronized with the treated water tank to facilitate auto operation of the plant.

End of Section V

Section VI Installation, Commissioning & Guarantees

1. Installation

1.1. Contractor shall supply three copies of foundation drawings giving weight, vibration and other loads required for the proper designing of the foundations.

1.2. All equipment shall be installed in a true workman like manner true to level and grade in accordance with the best current practice.

1.3. Contractor shall employ sufficient and proper equipment for lifting and placing of heavy equipment and in a manner which shall not strain or cause damage to the existing structures. If any damage is done, the same shall be made good to the satisfaction of the Project Manager without any additional cost.

1.4. All equipment and pipes shall be painted with one coat of red oxide before dispatch to the site.

2. Commissioning

2.1. On completion of the work in all its aspects, the contractor shall start up the equipment in a manner normally done for the continuous operation for a period of not less than 48 hours and shall rectify and adjust the equipment for leakages and balancing the system.

2.2. After satisfactory commissioning of the plant, the contractor shall conduct performance tests on the equipment to satisfy the Project Manager that all equipment is performing to the rated outputs. Any or all equipments shall be rectified or replaced if the same is are not performing in accordance with the specifications.

3. Guarantees

3.1. On completion of the work contractor shall submit a guarantee covering the quality and performance of all materials supplied and installed under the contract. This guarantee shall cover each and every material whether manufactured by the contractor or not.

3.2. Contractor shall specify a suitable procedure to test the rated performance of the equipments and shall provide all necessary equipments, gauges etc. for conducting such tests.

3.3. The guarantee shall cover a period of one year from the date of installation and handing over.

4. Completion

4.1. On completion of the job, the contractor shall hand over to the Project Manager the following:-

4.2 One flow chart drawn in ink on thick paper and mounted in a glass frame showing the flow diagram of the process including legend showing valves to be normally open or closed and instructions for back washing, operation and maintenance of chlorination & other chemical feeding pumps and other equipments.

4.3 Five sets of operating and maintenance instructions with spare parts list and their manufactures and/or suppliers.

4.4 Five sets of catalogues and drawings for all equipment supplied.

End of Section IV

FIRE FIGHTING WORKS

FIRE SUPPRESSION WORKS INDEX

SECTION	DESCRIPTION
I.	TECHNICAL SPECIFICATIONS
I	FIRE HYDRANT SYSTEM & SPRINKLER SYSTEM
II	HAND APPLIANCES
III	FIRE PUMPS & ANCILLARY EQUIPMENT
IV	COMMISSIONING & GUARANTEES

A. TECHNICAL SPECIFICATIONS FOR PLUMBING WORKS

Section I Fire Hydrant System and Sprinkler System

1 Scope of work

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install wet riser fire hydrant and sprinkler system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing, the work shall include but not limited to the following:-

- a) Piping for wet riser hydrant systems and for yard hydrants.
- b) Landing valves, canvas hose pipes, hose reels, hose cabinets & connections to mains.
- c) Fully automatic sprinkler system
- d) Isolation valves, non-return valves, installation valves, flow control switches and accessories.

2. General

2.1 All materials shall be new of the best quality conforming to the specifications and subject to the approval of the Project Manager.

2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

2.4 Pipes shall be securely fixed to walls, and ceilings by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.

2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

2.6 The rules and regulations of Local Fire Authority as per the statutory regulations applicable for obtaining the occupation certificate from the Local Development / Fire Authority.

2.7 Drawings issued with the tenders are schematic and indicate the concept. Contractor shall make his shop drawings on basis of Architectural and Interior design drawings issued by the Engineer-in-Charge. Work will be executed only as per approved shop drawings.

2.8 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.

3 Pipes

All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. pipes conforming to NFPA-14 of Heavy Class.

4 Pipe Fittings

Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. and all such connecting devices that are needed to complete the piping work in its totality.

Screwed fittings shall be approved type malleable or cast iron with reinforced ring on all edges of the fittings suitable for screwed joints.

Forged steel fittings of approved type with "V" groove for welded joints.

Fabricated fittings shall be not being permitted for pipe diameters 50 mm and below. When used, they shall be fabricated, welded and inspected in workshops whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler System under the supervision of Project Manager. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

5 Jointing

5.1 Screwed (50 mm dia pipes and below)

Joint for black steel pipes and fittings shall be metal to metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked.

5.2 Welded (65 mm dia and above)

Joints between M.S. and pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Butt welded joints are not acceptable.

5.3 Flanged

- a) Flanged joints shall be provided on:
- b) Straight runs not exceeding 30 m on pipe lines 80 mm dia and above.
- c) Both ends of any fabricated fittings e.g. bend tees etc. of 65 mm dia or larger diameter.
- d) For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as per good engineering practice.
- e) Flanges shall be as per NFPA with appropriate number of G.I. nuts and bolts, 3 mm insertion neoprene gasket complete.

5.4 Unions

Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges.

6 Excavation

6.1 Excavation for pipe lines shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipe lines shall be buried to a minimum depth of 1.2 meter or as shown on drawings.

6.2 Wherever required contractor shall support all trenches or adjoining structures with adequate timber supports.

6.3 On completion of testing and pipe protection, trenches shall be refilled with excavated earth in 15 cms layers and consolidated.

6.4 Contractor shall dispose off all surplus earth within a lead of 200 m or as directed by Project Manager.

4 Anchor Thrust Blocks

- a) Contractor shall provide suitably designed anchor blocks in cement concrete to encounter excess thrust due to water hammer & high pressure.
- b) Thrust blocks shall be provided at all bends & tees & such other location as determined by the Project Manager.
- c) Exact location, design, size and mix of the concrete block shall be approved by the Project Manager prior to execution of work.

7 Valves

7.1 Gunmetal Valves

8.1.1 Valves 65 mm dia & below shall be heavy gunmetal full way valves or globe valves with female screwed ends.

7.1.2 All valves shall be approved by the Project Manager before they are allowed to be used on work.

7.2 C.I. Iron Butterfly Valves/Sluice Valves

7.2.1 All valves 80 mm dia and above shall be C.I. double flanged butterfly valves. Each sluice valve shall be provided with wheel for valves in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for Sluice Valves with cap tops.

7.2.2 Butterfly valves shall be of best quality conforming NFPA of class specified and sluice valves shall conform to NFPA.

7.3 Non-return valves (Check Valves)

Non-return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to NFPA.

7.4 Air valves

25 mm dia screwed inlet cast iron single acting air valve shall be provided on all high points in the system or as shown on drawings.

7.5 Orifice Flanges

Orifice flanges fabricated from 6 mm thick stainless steel plate shall be provided to reduce pressure on individual hydrants to restrict the operating pressure to 3.5 kg/cm^2 and allow a discharge of 560 lpm. The contractor shall submit design of the orifice flanges for approval before installation.

7.6 Drain Valve

50 mm dia black steel pipe (heavy class) with 50 mm gunmetal fullway valve shall be provided for draining any water in the system in low pockets.

7.7 Pressure Gauge

Pressure gauge shall be provided near all connections to hydrant system and isolation valves of sprinkler system and where required. Pressure gauge shall be 100 mm dia gunmetal Bourden type with gunmetal isolation cock, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate level and height for easy readability.

8 Hydrant/valve chambers

8.1 Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 15 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete.

8.2 Valve chambers shall be of following size:-

for depths 100 cms and beyond 120x120 cms.

9 Fire brigade connections

As shown on drawings separate gunmetal 2-3 way collecting head Fire brigade connection each with two or three 63 mm instantaneous type inlets with built in check valves and 150 mm dia inlet/outlet connected to the fire and sprinkler main as given in BOQ shall be provided. Both shall be installed on a stand post and provided with horizontal C.I. reflux valve and location to be approved by Project Manager. Etched gunmetal label plates with 80 mm high letters shall be fixed along with necessary enclose cabinet. The plates should be firmly fixed to the FB connection and any support system.

10 Fire hydrants

10.1 External hydrants

10.1.1 Contractor shall provide stand post type external hydrants. The hydrants shall be controlled by a cast iron sluice valve installed in underground lockable chambers. Hydrants shall have instantaneous type 63 mm dia outlets. The hydrants valve shall be single outlet conform to NFPA-14 with C.I duck foot bend and flanged riser of required height to bring the hydrant to correct level above ground.

10.1.2 Contractor shall provide for each external fire hydrant two numbers of 63 mm dia. 15 m long controlled percolation type hose pipes with gunmetal male and female instantaneous type couplings machine wound with G.I. wire, gunmetal branch pipe with nozzle.

10.2 Internal hydrants

10.2.1 Contractor shall provide on each landing and other locations as shown on the drawings one single headed gunmetal oblique landing valves with 63 mm dia outlet mounted on a common 80 mm inlet conforming to NFPA-14. Landing valve shall have flanged inlet and instantaneous type outlets as shown on the drawings.

10.2.2 Instantaneous outlets for fire hydrants shall be of standard pattern approved and suitable for fire brigade hoses.

10.2.3 Contractor shall provide for each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric linen hose pipes with gunmetal male and female instantaneous type coupling machine wound with G.I. wire, fire hose reel conforming to NFPA-14, gunmetal branch pipe with nozzle and Fire man's axe.

10.2.4 Each hose box shall be conspicuously painted with the letters "FIRE HOSE".

11 Fire hose reels

Contractor shall provide standard fire hose reels with 20 mm dia high pressure Dunlop or equivalent rubber hose 36.5 m long with gunmetal nozzle and control valve, shut off valve, all mounted on circular hose reel of heavy duty mild steel construction and cast iron brackets. Hose reel shall be connected directly to the wet riser.

12 Hose Cabinets

12.2 All internal fire hydrants shall be enclosed in M.S. glazed cabinet. Hose cabinets shall be fabricated from 16 gauge M.S. sheet of fully welded construction with hinged double front door partially glazed with locking arrangement stove enameled fire red paint with "FIRE HOSE" written on it prominently. (Sizes are as given in the Bill of Quantities).

13 Pipe protection

a) All pipes above ground and in exposed locations shall be painted with one coat of zinc chromate primer and two or more coats of synthetic enamel paint of approved shade.

b) Pipes in chase or buried underground shall be painted with two coats of zinc chromate primer and wrapped with one layer of 4 mm thick PYPKOAT multilayer sheet as per standard manufacturer's specifications.

14 Pipe Supports

2.16.1 All pipe clamps and supports shall be galvanised steel. When fabricated from M.S. steel sections, the supports shall be factory galvanised before use at site. Welding of galvanised clamps and supports will not be permitted.

2.16.2 Pipes shall be hung by means of expandable anchor fastener of approved make and design (Dash Fastners or equivalent). The hangers and clamps shall be fastened by means of galvanised nuts and bolts. The size/diameter of the anchor fastener and the clamp shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

15 Installation Valve

15.1 Installation valves shall be installed on the sprinkler circuits as shown on the drawings.

15.2 Contractor shall submit his detailed shop drawings showing the exact location, details of installation of the valve and alarm in all its respects.

15.3 Installation valve shall comprise of a cast iron sluice valve with gunmetal trim, pressure gauge, double seated clapper check valves as alarm valve with pressure gauge, test valve and orifice assembly and drain pipe with pressure gauge, bye pass on check valve to regulate differential pressure and false alarm, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system.

16 Testing

16.1 All piping in the system shall be tested to a hydrostatic pressure of 1.5 times the working pressure or 14 kg/sq.cm(whichever is more) without drop in pressure for at-least 2 hours.

16.2 Rectify all leakages, make adjustments and retest as required and directed.

16.3 drill.

17 Annunciation Panel

- a) Provide one solid state electronic annunciation panel, fully wired with visual display unit to indicate:
- b) Flow condition in any flow indicating valve
- c) The panel should give a visual and audible alarm for any of the above conditions.
- d) The panel should be standard manufacturer's factory made. All details shall be submitted with the tender.

18 Cables

18.1 Contractor shall provide control cables from supervisory valves and switches to the annunciation panels.

18.2 All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 volt grade.

18.3 All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

18.4 All cable joints shall be made in an approved manner as per standard practice.

19 Cable Trays

19.1 All cables shall be routed in approved locations in coordination with all other services in a proper manner.

19.2 Cable trays shall be of galvanized steel and hung from the ceiling by galvanised rods supported by appropriate size and type of expandable expansion fasteners drilled into the slabs and walls by an electric drill.

20 Measurement

20.1 Mild steel pipes shall be measured in linear metres of the finished length correct upto one cm. and shall include all fittings, flanges, welding, jointing, clamps for fixing to walls or hangers, anchor fasteners, painting and testing complete in all respects.

20.2 Sluice and fullway valves, check valves, installation valves, air valves & flow switches shall be measured by numbers and shall include all items necessary and required for fixing and as given in the specifications and bill of quantities.

20.3 Fire hydrants, hose reels, fire brigade connections, orifice flanges shall be measured by number and include all items given in the specifications and bill of quantities.

20.4 Fire hose and boxes specified shall be measured by number and include all items given in specifications and Bill of Quantities.

20.5 Cables and cable trays shall be measured in linear metre correct upto cm shall include clamps, hangers, anchor fasteners complete in all respects.

End of Section I

Section II Hand Appliances

1 Scope of work

1.1 Work under this section shall consist of furnishing all labour, material, appliances and equipment necessary and required to install fire extinguishing hand appliances.

1.2 Without restricting to the generality of the foregoing the work shall consist of the following:-

 Installation of fully charged and tested fire extinguishing hand appliances CO₂ foam, dry chemical powder type as required by these specifications and/drawings.

2 General requirements

2.1 Fire extinguishers shall conform to the following International Standard Specifications and shall be with NFPA-10 approved stamp as revised and amended up to date :-

2.2 Fire extinguishers shall be installed as per International Standard "Code of Practice for Selection, Installation and Maintenance of Portable First Aid Appliances".

2.3 Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners.

2.4 Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

2.5 All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

3 Measurement

 Fire extinguishers shall be measured by numbers and include installation and all items necessary and required and given in the specifications.

End of Section II

1. Scope of Work

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel engine driven pumps as required by the drawings and specified hereinafter or given in the schedule of quantities.

1.2 Without restricting to the generality of the foregoing, the pumps and ancillary equipment shall include the following:-

- a) Electrically operated and diesel engine driven pumps with motors, base plates and accessories.
- b) Alarm system with all accessories wiring and connections
- c) Pressure gauges with isolation valves & piping,.
- d) M.S. pipes, valves, suction strainers, delivery and suction headers & accessories.
- e) Foundations, vibration eliminator pads and foundation bolts.

2 General Requirements

2.1 Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in the concrete foundations.

2.2 Pumps and motors shall be truly aligned by suitable instruments.

2.3 All pump connections shall be standard flanged type with appropriate number of bolts. In case of non standard flanges companion flanges shall be provided with the pumps.

2.4 Manufacturer's instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.

2.5 Contractor shall provide necessary test certificates and performance charts with NPSH requirement of the pumps from the manufacturer. The Contractor shall provide facilities to the Project Manager or their authorised representative for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the DPLs.

2.6 Each pump shall be provided with a 150 mm dia pressure gauge, isolation cock and connecting piping, bleed and block valve.

2.7 Adequate vibration eliminating pad and connectors for each pump shall be provided.

2.8 The Contractor shall submit with this tender a list of recommended spare parts for two years of normal operation and quote the prices for the same.

3 Fire & Jockey Pumps

3.1 Pumping Sets

3.1.1 Pumping sets shall be single stage horizontal centrifugal single outlet with cast iron body and bronze dynamically balanced impellers. Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.

3.1.2 Pumps shall be connected to the drive by means of spacer type love joy couplings which shall be individually balanced dynamically and statically.

3.1.3 The coupling joining the prime movers with the pump shall be provided with a sheet metal guard.

3.1.4 Pumps shall be provided with approved type of mechanical seals.

3.1.5 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of the rated head.

3.1.6 The pump shall meet the requirements of the Tariff Advisory Committee and the unit shall be design proven in fire protection services.

4 Electric drive

4.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps the motors should be rated not to draw starting current more than 3 times normal running current.

4.2 Motors for fire protection pumps shall be atleast equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.

4.3 Motors shall be wound for class B insulation and winding shall be vacuum impregnated with heat and moisture resistant varnish glass fibre insulated.

4.4 Motors for fire pumps shall meet all requirements and specifications of the Tariff Advisory Committee.

4.5 Motors shall be suitable for 415 $\pm$ 10% volts, 3 phase 50 cycles a/c supply and shall be designed for 38°C ambient temperature.

4.6 Motors shall be designed for two start system.

4.7 Motors shall be capable of handling the required starting torque of the pumps.

4.8 Contractor shall provide inbuilt heating arrangements for the motors for main pumps to ensure that motor windings shall remain dry.

4.9 Speed of the motor shall be compatible with the speed of the pump.

5. Air Vessel

5.1 One air vessel fabricated from 10 mm M.S. plate with dished ends and suitable supporting legs shall be provided. Air vessel shall be provided with a 100 mm dia flanged connection from pump, one 25 mm dia drain with valve, one gunmetal water level gauge and 15 mm sockets for pressure switches. The vessel shall be 450 mm dia x 2000 mm high and tested to 20 kg/sq cm pressure.

5.2 The fire pumps shall operate on drop of pressure in the mains as given in para 7 below. The pump operating sequence shall be arranged in a manner to start the pump automatically but should be stopped manually by starter push buttons only.

6 Operating conditions for fire pumps.

	Cut in	Cut out
6.1 Operating pressure	<----- 15.0 kg/cm ²	>15.0 Kg/cm ²
6.2 Jockey pump	14.5 kg/cm ²	15.0 kg/cm ²
6.3 Fire Electric Pump	13.5 kg/cm ²	manual
6.4 Diesel engine driven pump	13.0 kg/cm ²	manual

Notes:

- a) Jockey pump shall start and stop through pressure switch automatically.
- b) Jockey pump shall stop when main pump starts.
- c) Main pump shall start automatically on fall of pressure but stopping shall be manual.

5 Vibration Eliminators

On all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors shall be provided. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connector shall be as per manufactures details.

6 Measurements:

8.1 Fire pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities.

8.2 Air vessel, fire alarm, sluice valves, non return valves, vibration eliminators, flanges and suction strainer shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications.

8.3 Pump headers, shall be measured per linear metre and shall include all items given in the specifications and schedule of quantities.

End of Section III**Section IV Commissioning and Guarantees****1 Scope of work**

Work under this section shall consist of pre-commissioning, commissioning, testing and providing guarantees for all equipment, appliances and accessories supplied and installed by the contractor under this contract.

2 General requirements:

2.1 The rates quoted in this tender shall be inclusive of the works given in this section.

2.2 Contractor shall provide all tools equipment, metering and testing devices required for the purpose.

2.3 On award of work, contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

3 Pre-commissioning

3.1 On completion of the installation of all pumps, piping, valves, pipe connections, and water level controlling devices the contractor shall proceed as follows:-

A Fire protection system:

- i) Check all hydrant valves and close if any valve is open. Also check that all suction and delivery connections are properly made.
- ii) Test run and check rotation of each motor and correct the same if required.

B Pipe work

- i) Check all clamps, supports and hangers provided for the pipes.
- ii) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specifications. If any leakage is found, rectify the same and retest the pipes.

4 Commissioning & testing

A. Fire hydrant system

1 Pressurise the fire hydrant system by running the main fire pump and after attaining the required pressure shutoff the pump.

2 Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts out at the pre-set pressures. If necessary adjust the pressure switch for the jockey pump. Close bye-pass valve.

3 Open hydrant valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump should cut-in at the pre-set pressure and should not cutout automatically on reaching the normal line pressure. The main fire pump should stop only by manual push button. However the jockey pump should cut-out as soon as the main pump starts.

4 Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump.

5 When the fire pumps have been checked for satisfactory working on automatic controls, open five hydrant valves simultaneously and allow the hose pipes to discharge water into the fire tank to avoid wastage. The electrically driven pump should run continuously for eight hours so that its performance can be checked.

6 Check each landing valve, male and female couplings and branch pipes for compatibility with each other. Any fitting which is found to be incompatible and does not fit into the other properly shall be replaced by the contractor. Landing valves shall also be checked by opening and closing under pressure.

B. Handing over

1. All commissioning and testing shall be done by the contractor to the complete satisfaction of the Project Manager, and the job handed over to the Project Manager, or his authorised representative.

2. Contractor shall also handover, to the Project Manager, all maintenance & operation manuals and all other items as per the terms of the contract.

C. Guarantees

1. The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.
2. The form of warranty shall be as approved by the Project Manager.
3. The warranty shall be valid for a period of one year from the date of commissioning and handing over.
4. The warranty shall expressly include replacement of all defective or under capacity equipment. Project Manager may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.
5. The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Project Manager.

End of Section IV

TECHNICAL SPECIFICATION OF HVAC

TECHNICAL SPECIFICATIONS

SPECIFICATION - VARIABLE REFRIGERANT VOLUME SYSTEM

SCOPE

The scope of this section comprises the supply, erection testing and commissioning Variable Refrigerant Volume System with **Scroll Compressor** conforming to these specifications and in accordance with the requirements of Drawing and Schedule of Quantities

TYPE

Units shall be air cooled, variable refrigerant volume air conditioner of **R-410A** gas based consisting of one outdoor unit and multiple indoor units. Each indoor units having capability to cool or heat independently for the requirement of the rooms.

It shall be possible to connect multiple indoor units on one refrigerant circuit. The indoor units on any circuit can be of different type and also controlled individually. Following type of indoor units shall be connected to the system:

- Ceiling mounted ductable type
- Floor mounted ductable type
- Ceiling mounted cassette type
- Wall mounted type (Hi-Wall)

Compressor installed in outdoor unit shall be equipped with at least one inverter compressor up to 18 HP, two inverter compressors up to 36 HP and above this, three inverter compressors. The system shall be capable of changing the rotating speed of inverter compressor by inverter controller to follow variations in cooling and heating load.

Outdoor unit shall be suitable for mix match connection of all type of indoor units.

The refrigerant piping between indoor units and outdoor unit shall be extended up to **165m with maximum 50m** level difference **without any oil traps**.

Both indoor units and outdoor unit shall be factory assembled, tested and filled with first charge of refrigerant before delivering at site.

1. OUTDOOR UNIT

The outdoor unit shall be factory assembled, weather proof casing, constructed from heavy gauge mild steel panels and coated with baked enamel finish. The unit should be completely factory wired tested with all necessary controls and switch gears:

- All outdoor units above 8 HP shall have minimum two scroll compressors and be able to operate even in case one of compressor is out of order.
- In case of outdoor units above 18HP, the outdoor unit shall have at least 2 inverter compressors so that the operation is not disrupted with failure of any compressor.
- It should also be provided with duty cycling for switching starting sequence of multiple outdoor units.
- The noise level shall not be more than 68 dB(A) at normal operation measured horizontally 1m away and 1.5m above ground level.
- The outdoor unit shall be modular in design and should be allowed for side by side installation
- The unit shall be provided with its own microprocessor control panel.

The outdoor unit should be fitted with low noise, aero spiral design fan with large airflow and should be designed to operate compressor-linking technology. The unit should also be capable to deliver 78 Pa external static pressure to meet long exhaust duct connection requirement.

The condensing unit shall be designed to operate safely when connected to multiple units, which have a combined operating nominal capacity up to **130 %** of indoor units for outdoor units up to **84 HP**.

COMPRESSOR

The compressor shall **be highly efficient scroll type** and capable of inverter control. It shall change the speed in accordance to the variation in cooling or heating load requirement:

- The inverter shall be IGBT type for efficient and quiet operation.
- All outdoor units shall have at least 10 steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.
- Oil heater shall be provided in the compressor casing.

HEAT EXCHANGER

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil.

- **The Indoor unit shall be both Cooling and Heating system.**
- The aluminum fins shall be covered **by anti-corrosion resin film**.
- The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

REFRIGERANT CIRCUIT

The refrigerant circuit shall include liquid & gas shut-off valves and a solenoid valves at condenser end.

All necessary safety devices shall be provided to ensure the safely operation of the system.

SAFETY DEVICES

All necessary safety devices shall be provided to ensure safe operation of the system.

Following safety devices shall be part of outdoor unit; high pressure switch, fuse, crankcase heater, fusible plug, over load relay, protection for inverter, and short recycling guard timer.

OIL RECOVERY SYSTEM

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths.

2. INDOOR UNIT

This section deals with supply, installation, testing, commissioning of various type of indoor units confirming to general specification and suitable for the duty selected. The type, capacity and size of indoor units shall be as specified in detailed Bill of Quantities

GENERAL

Indoor units shall be either ceiling mounted cassette type, or ceiling mounted ductable type or wall mounted type or other as specified in BOQ. These units shall have electronic control valve to control refrigerant flow rate respond to load variations of the room.

a) The address of the indoor unit shall be set automatically in case of individual and group control

b) Incase of centralized control, it shall be set by liquid crystal remote control.

The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.

The cooling coil shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Each coils shall be factory tested at 21kg/sqm air pressure under water.

Unit shall have cleanable type filter fixed to an integrally molded plastic frame. The filter shall be slide away type and neatly inserted.

Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling and heating.

Each unit shall be with wired LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flat individually as per requirement.

3. DIRECT EXPANSION PRECISION PACKAGED UNITS

Scope

The scope of this section comprises of supply; installation, testing and commissioning of self contained direct expansion type Precision air conditioning units suitable for operation on R410a

refrigerant & should have advanced microprocessor and electronically communicated motors conforming to these specifications and in accordance with the Schedule of Quantities.

General

Modular construction Precision air conditioning unit suitable for operation on R-410a refrigerant with bottom discharge arrangement consisting of inlet filter, blow through direct drive Electronically communicated Motors and Backward curved Plug fans, fan motor assembly to deliver desired air quantity, Direct Expansion Cooling Coil, Multistage Heater banks Variable capacity Humidifier, condensate drain pan of aluminum construction, Microprocessor panel, programmable control complete with LCD display. The unit shall be suitable for operation on 415 V, 50 Hz, AC supply.

Unit Base & Casing

Base panel shall be constructed out of sandwich panels of galvanized steel and painted with epoxy powder. All four side panels (including front door) shall be double skinned sandwiched panels. The panels shall be insulated on the inside with minimum 32 Kg/ cum glass wool, for fire insulation class A0. Unit shall be complete with space for refrigeration equipment, fans, cooling coils, liquid receiver and multistage strip heaters and modulating Humidifiers. Unit shall be provided with welded tubular steel floor stand with adjustable legs and requisite vibration isolation pads.

Fan

The units should be equipped with direct driven backward curved EC radial fans with electronically commutated brushless motors; the technology employed by these motors allows straightforward control of fan speed by means of the electronic controller in order to obtain step less adjustment of air flow rate and static pressure to ensure correct distribution of the treated air. The motor's high efficiency should make for less energy absorption, especially at partial loads and during starting (lowering of peak current), which means a reduction in power consumption of approximately 30% compared to AC motor. The motor shall have minimum IP54 Protection.

Filters

The filter chamber shall be an integral part of the system and withdraw able from the front of the unit. Filtration shall be provided by deep V form G4 performance dry disposable media to AS1324.

Evaporator Coil

Precision packaged unit shall comprise of cooling coil of copper tubes expanded into aluminium fins with corrugated profile and hydrophilic treatment. Face and surface areas shall be such as to assure rated capacity and the air velocity across the coil and Filter shall not exceed 2.5 m/s. The cooling coil shall be minimum of 3/4 rows deep and the fin spacing shall not exceed 1.8 mm. Coil selection to be suitable for SHF > 0.95 and provided with hydrophilic coating to minimize / eliminate water carry over into the airflow stream. Drain pan shall be made of stainless steel.

Compressorised systems
Scroll Compressor

The compressor shall be of the high efficiency scroll design operating with R410A refrigerant and 400V/3~50 Hz supply. Compressors, the humidifier shall be isolated from the air flow in the version with downward flow, and in the air flow in versions with upward output. The compressor shall be charged with mineral oil and designed for operation on environment friendly refrigerant R410a. Each compressor shall have internal motor protection and be mounted on vibration isolators.

Refrigeration Circuit

The refrigeration system shall be of the Single/ Multiple circuit direct expansion type and incorporate hermetic scroll compressors, complete with crankcase heaters. The system shall include a manual reset high pressure control; auto reset low pressure switch, safety valve, electronic expansion valve, high sensitivity refrigerant sight glass, liquid receiver, filter drier, solenoid valve for interception of liquid refrigerant, and charging/access ports in each circuit. Each refrigeration circuit shall include rigidly mounted isolation valves in the discharge and liquid lines to aid servicing and installation.

Expansion device: Electronic Expansion Valve (EEV)

The unit should have Electronic Expansion Valve, which offers the following advantages:

- Fast, high precision adjustment of refrigerant flow;
- Fast arrival of the unit at steady-state conditions;
- Superheating value remains constant in variable thermal load conditions;
- Efficient operating conditions of the compressor, especially in the presence of low room temperatures;
- Wide working range with consequent extension of the unit's operating limits.

These properties result in enhanced performance of the unit and make it possible to obtain very significant energy savings.

Air Cooled Condenser

Condenser shall be air-cooled type, suitable for outdoor installation and shall be suitable for operating at high ambient of 44 deg C db and at low ambient of upto 5 deg C db temperatures. Condenser shall be in copper tube & aluminum fins construction. Condenser coil shall be of maximum 4 rows deep and the fin spacing shall not exceed 2mm.

The condenser fan/s shall be of propeller type with max 1000 RPM variable voltage electric motor complete with IP-54 protection. Motor shall be speed controlled to ensure a stable operation for varying ambient; by a factory fitted direct acting head pressure activated stepless variable speed drive. The condenser shall be complete with provisions for refrigerant piping connections, shut off valves and any other standard accessories necessary with the equipment supplied.

Electric Strip heaters

Each packaged unit shall be provided with multistage electric heaters with heating elements constructed from a non-oxidizable material. Electric strip heaters shall be of the low temperature totally enclosed strip type fitted with radiation fins and suitable for operating at black heat. If overheating occurs, a safety thermostat should cut off the voltage supply to the heaters and triggers an alarm.

Humidifier

Boiling water in a polypropylene steam generator shall provide humidification. The humidifier shall be capable of providing continuous auto modulation in steam generation from 30-100% as per the steam requirement per hour. The humidifier shall be fully serviceable with replaceable electrodes. Waste water shall be flushed from the humidifier by initiation of water supply valve via U-trap. The microprocessor should be able to display the current drawn and actual steam output in the microprocessor.

De-Humidification

De-humidification cycle shall operate by reducing the speed of EC fan to reduce ADP of coil. Hence, by reduction of fan speed there shall be additional power saving.

Water Sensor :

The system shall be provided with relevant water detection kit which shall have sensors with wire of minimum 2 mtrs and each of the sensor must be capable to detect individually any water below the false floor near the unit, the sensor must be connected to the unit microprocessor thus enabling the controller to give an alarm incase of wet floor.

Microprocessor Control System**Logic Circuitry :**

A microprocessor shall continuously monitor operation of each Server room air-conditioning unit continuously digitally display room temperature and room relative humidity, alarm on system malfunction and simultaneously display problem. When more than one malfunction occurs, flash fault in sequence with room temperature, remember alarm even when malfunction cleared, and continue to flash fault until reset.

Malfunctions :

Power Loss, Loss of Airflow, High Room Temperature, Low Room Temperature, High Humidity, Low Humidity, Supply Fan Overload, and Water Under Floor / Fire alarm.

The standby unit should immediately come in action in the event of any alarm/failure of the working unit without waiting for the temperature to increase to the high temperature limit thereby controlling the temperature of the data Centre.

The unit should also be capable of starting the standby unit incase the temperature is not able to achieve with the working units.

Automatic lead unit sequencing to extend equipment life and automatic rotation of standby unit should be part of the microprocessor itself. Microprocessor must be suitable to control multiple units if required with hard wiring which can be done at a later date.

In case of power failure the precision packaged unit shall start automatically without any body's intervention. Controllers shall be Microprocessor based with capability to generate alarm and networking of all units to rotate (working + standby) units, equalized run time capability (for 2 or 3 packaged units), programmable timer, with display of all parameters.

Computer Generated Selection sheet shall be attached along with the offer. The same needs to be demonstrated incase required at the time of finalization.

CEILING MOUNTED DUCTABLE TYPE UNIT (TFA)

Unit shall be suitable for ceiling mounted type. The unit shall include pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel. The unit shall have high static fan for ductable arrangement with outdoor unit.

FLOOR MOUNTED DUCTABLE TYPE UNIT (TFA)

Unit shall be suitable for floor mounted type. The unit shall include pre filter, fan section & DX coil section. The unit shall be light weight powder coated galvanized steel and weather proof put on terrace. The unit shall have high static fan for ductable arrangement with outdoor unit.

AXIAL FLOW FANS

Axial flow fan shall be of vane axial type and shall be suitable for mounting in duct or floor/slab as required/indicated on the tender drawings.

Impellers:

Single piece cast aluminium or steel impeller shall be with blades of aerofoile design to give maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Single piece fan and hub shall be statically and dynamically balanced. Maximum clearance between blade tip and the fan housing at the specified speed shall be 5 mm. Impellers blades shall be whirl tested to a speed 25% above the design operating speed. Extended grease leads for external lubrication shall be provided. The fan blade shall be adjustable type so that actual

air flow can be achieved at site as per indicated in Drawings & BOQ.

Casing:

Casing shall be constructed of 14 gauge sheet steel, properly reinforced for rigidity. Fan casing, motor mount and straightening vanes shall be of welded steel construction motor mounting plate shall be minimum 20 mm thick and machined to receive motor flanges. Casing shall be provided with two nos. wide, hinged doors which open easily. Inspection doors with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspensions shall be welded to casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be bondorized, primed and finish coated with enamel paint.

Motor:

Motor shall be squirrel cage, totally enclosed, fan cooled, constant speed, suitable for $415 \pm 10\%$ volts, 50 Hz, 3 phase power supply, motor nameplate horsepower shall be more than brake horse power by a minimum of 10%. Motor speed shall not exceed 1450 R.P.M (4 pole). The fan and motor combination selected for particular requirement shall be of the most efficient type so that sound level and energy consumption is minimum. Motor conduit box shall be mounted on exterior of the casing. Wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit. The motor shall have 'E' class insulation.

Drive:

For Duct/Wall Mounted Fan:

For duct/wall mounted fans the impeller shall be mounted directly on the motor. Drive unit and impeller shall be totally enclosed inside the duct.

For Floor/Ceiling Mounted Fan:

The fan shall be provided with belt drive and adjustable motor sheave, standard sheet steel belt guard with vented front for heat dissipation. Belt shall be of the oil resistant type.

Vibration Isolation:

Base shall be provided for each fan. Base for both fan and motor shall be built as an integral part and shall be mounted on a concrete foundation through spring type of vibration isolators. The concrete foundations shall be at least 15 cm above the finished floor level and shall be further isolated from the structural floor through 5 cm. Thick layers of sand all around, topped with bitumen. In case ceiling hung fan within the ceiling shall be provided Vibration Isolation Suspension (VIS) shall be provided in each of string.

IN-LINE FANS

In-line fans shall be Centrifugal type direct/belt driven complete with motor, belt guard, motor mount and vibration isolation type suspension arrangement mounted within/end of duct.

PROPELLER FANS

The exhaust fans shall be propeller type with steel hub and blades, mounted directly on the shaft of a totally enclosed motor.

The fan blades shall be of pressed steel of aerofoil design for high efficiency and static pressure.

The mounting frame shall be of cast /sheet steel brackets to connect the frame, with the fan/motor assembly. Rubber mounts shall be provided between the mounting frame and the mounting brackets.

The fan motor shall be totally enclosed squirrel cage type. All wall mounted exhaust fans shall be provided with gravity back draft louvers

LINEAR SUPPLY AND RETURN AIR GRILLS:

The linear continuous supply / return air grills shall be made of powder coated extruded aluminum construction with fixed horizontal bars. The thickness of fixed bar louvers shall be 5mm in front and the

flange shall be 20mm wide with round edges. The register shall be suitable for concealed fixing and horizontal bars of the grills shall mechanically crimped from the back to hold them.

The colour of grills shall be as per the approval of the Engineer in Charge. The volume control device made of extruded aluminum construction in black anodised finish shall be provided in supply air duct collars only.

FRESH & EXHAUST AIR GRILLE

The Exhaust & Fresh air grilles shall be fabricated from MS powder coated sections. The grilles shall have single louvers. The front horizontal louvers shall be of extruded section, fixed/adjustable type. The rear vertical louvers where required shall be of MS extruded sections and adjustable type. The grille shall have single horizontal extruded section fixed louvers. The grilles shall have an outer frame on all four sides.

FRESH & EXHAUST AIR LOUVERS WITH BIRD SCREEN:

The fresh air intake louvers at least 50mm deep will be made of powder coated extruded aluminum construction. Bird / insect screen will be provided with the intake louvers. The blades shall be inclined at 45 degree on a 40mm blade pitch to minimize water ingress. The lowest blade of the assembly shall be extended out slightly to facilitate disposal of rain water without falling on door / wall on which it is mounted.

The intake louvers shall be provided with factory fitted aluminum construction volume control dampers in black anodized finish.

DUCT FABRICATION

All Galvanized ducts shall be **factory fabricated** from lock form grade galvanized sheet steel zinc coated, coating grade 120 or aluminum sheets (wherever aluminum ducts are specified) and installed in a workman like manner.

Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made airtight by applying sealant during the assembly of the ductwork, Sealing of the seams shall be accomplished by using approved sealant. Transverse joints shall be made using sponge rubber sulphur-free foam rubber gasketing (3mm thick and 20mm wide) All exposed ducts within conditioned spaces shall have only slip joints and no flanged joints. The internal ends of slip joints shall be made in the direction of Air flow.

Changes in dimensions and shape of ducts shall be gradual. Curved elbows, unless otherwise approved, shall have a center line radius equal to one and half times the width of the duct. Air turns shall be installed in all abrupt elbows and shall consist of curved metal blades or vanes, arranged to permit the air to make the turns without appreciable turbulence.

All ducts shall be rigid and shall be adequately supported and braced where required with standing seams to keep the ducts true to shape and to prevent buckling, vibration or breathing.

All sheet metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans, shall be constructed out of 18 gauge galvanized steel sheet, thoroughly stiffened with 25mm x 25mm x 3mm angle iron braces and fitted with all necessary doors, to give access to all parts of the apparatus. Doors shall not be less than 45cm x 45cm in size. Volume control dampers wherever indicated on the drawings shall be installed as a minimum. The final duct design may call for additional volume control dampers based on final duct configuration

INSULATION OF DUCT:

NITRILE RUBBER OR POLYETHYLENE EXTERNAL THERMAL INSULATION

The duct insulation with Nitrile Rubber or Cross linked polyethylene external thermal insulation shall be provided.

Duct surfaces shall be cleaned to remove all grease, oil, dirt, etc. prior to carrying out insulation work. Measurement of surface dimensions shall be taken properly to cut rubber sheets to size with sufficient allowance in dimension. Material shall be fitted under compression and no stretching of material shall be permitted. A thin film of adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface. When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations. The adhesive shall be strictly as recommended by the manufacturer.

ACOUSTIC LINING OF DUCT:

Material shall be resin bonded fibre glass of 32kg/m³ density. Thickness of the material shall be as specified for the individual application.

Ducts so identified and marked on drawings and included in Schedule of Quantities shall be provided with acoustic lining of thermal insulation material for a distance of minimum 5 meters as follows:

The inside surface for the ducts shall be cleaned, and provided with 22 gauge GI Channels 25 x 25 mm scrolled back to back and fixed on the inside of duct, spaced not more than 60 cm center to center to form a frame work of 60 x 60 cms square. Cut panels 60 x 60 cms of fiber 25 mm thick shall be fitted in the squares. The insulation panels shall be fixed to the sheet metal with cold setting adhesive compound and covered with fibre glass tissue paper.

The inner most surface shall be covered with 28 gauge perforated aluminium sheet having at least 15 percent perforations. The aluminium sheet shall be scrolled to GI channels using cup washer and neatly finished to give true inside surface.

MOTORIZED FIRE & SMOKE DAMPERS:

All supply and return air ducts at AHU room crossings and at all floor crossings shall be provided with Motor operated Fire & smoke damper of at least 90 minutes rating. These shall be of multi-leaf type and provided with Spring Return electrical actuator having its own thermal trip for ambient air temperature outside the duct and air temperature inside the duct. Actuator shall have Form fit type of mounting, metal enclosure and guaranteed long life span.

Fire damper blades and outer frames shall be of 16G galvanized steel construction fitted with 18 gauge extended sleeves on both sides. The damper blade shall be pivoted on both ends using chrome plated spindles in self lubricated bronze bushes. Stop seals shall be provided on top and bottom of the damper housing made of 16G galvanized sheets steel. For preventing smoke leakage metallic compression seals will be provided.

The electric actuator shall be energized either upon receiving a signal from smoke detector installed in AHU room supply air duct / return air duct or temperature sensor. The fire damper shall also close upon sensing temperature rise in supply air ducts thru the electronic temperature sensor.

Each damper shall be provided with its own control panel, mounted on the wall and suitable for 240 VAC supply. This control panel shall be suitable for spring return actuator and shall have at least the following features

- a. Potential free contacts for AHU fan ON/ Off and remote alarm indication.
- b. Accept signal from external smoke / fire detection system for tripping the electrical actuator.
- i. Test and reset facility.
- ii. Indicating lights / contacts to indicate the following status:
- iii. Power Supply On
- iv. Alarm
- v. Damper open and close position.

REFRIGERANT PIPING

Refrigerant piping from outdoor to indoor of liquid/Gas flare of copper insulated with nitrile rubber.

All refrigerant piping for the air conditioning system shall be constructed from soft seamless up to 19.1mm and hard drawn copper refrigerant pipes for above 19.1mm with copper fittings and silver-soldered joints. The refrigerant piping arrangements shall be in accordance with good practice within the air conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.

All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. Before jointing any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using nitrogen. After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 38Kg per sq.cm. Pressure shall be maintained in the

system for 24 hours. The system shall then be evacuated to minimum vacuum if 700mm hg and held for 24 hours.

The air-conditioning system supplier shall be design sizes and erect proper interconnections of the complete refrigerant circuit.

The thickness of copper piping shall not be less than mentioned below:

Pipe Size in mm dia (OD)

- | | |
|---------|---------|
| a) 41.3 | f) 15.9 |
| b) 34.9 | g) 12.7 |
| c) 28.6 | h) 9.5 |
| d) 22.2 | j) 6.4 |
| e) 19.1 | |

PIPING SUPPORTS:

Rigid supports shall be used in conjunction with Gripple hangers to assist with alignment of services. Rigid support must also be used in conjunction with Gripple hangers with pipe work at each change of direction or connection. For insulated pipe, provide protective sleeve to protect the entire circumference of the pipe insulation. Support piping in accordance with Schedule II at the end of this Section.

PIPE INSULATION

Refrigerant Pipe Insulation

The whole of the liquid and suction refrigerant lines including all fittings, valves and strainer bodies, etc. shall be insulated with 19mm /13 mm thick elastomeric nitrile rubber.

Drain Pipe Insulation

Drain pipes carrying condensate water shall be insulated with 6 mm thick elastomeric nitrile rubber insulation.

For proper drainage of condensate, U Trap shall be provided in the drain piping (wherever required). All pipe supports shall be of pre fabricated & pre painted slotted angle supports, properly installed with clamps etc.

CONTROL

Computerized PID control shall be used to maintain correct room temperature. Units shall be equipped with self-diagnosis for easy and quick maintenance and service. The LCD remote controller shall memorize the latest malfunction code for easy maintenance. It shall be possible to control all the indoor units and change fan speed and angle of swing flap individually in the group.

APPROVED MAKES

LIST OF BRANDS TO BE USED IN

CEMENT	- OPC –43 Grade of JK / BIRLA / ACC
REINFORCEMENT STEEL	- RATHI / SAIL / TISCO
STRUCTURAL STEEL	- SAIL / TISCO / IISCO
TILES	- KAJARIA/SOMANY/ORIENT/
JOHNSON/RESTILE	
GLASS	- MODI FLOAT/
SAINT GOBAIN/ASAHI	
ALUMINUM DOORS/WINDOWS	- JINDAL/HINDALCO/INDALCO
PAINTS	- ASIAN / JOHNSON &
NICHOLSON / BERGER	

NOTE: In the items of work or the specifications of work the brand names are mentioned, otherwise to be followed as mentioned above.

LIST OF APPROVED MAKES FOR EXTERNAL ELECTRICAL WORKS

S.No.	Item Description	Make
1	GI Pipes	Jindal Hissar Surya Prakash
2	MS Pipe	Tata Jindal Atul
3	PVC Pipes/Conduits	BEC AKG Atul
4	Copper conductor PVC Insulated Wires	Batra Henlay RPG Skytone
5	Miniature Circuit Breakers(C-Curve)	Legrand Siemens Hager Schneider Electric
6	Earth Leakage Circuit Breakers	Legrand Siemens Hager Schneider Electric
7	Molded case circuit breaker (with rotary	L&T (D Sine)

S.No.	Item Description	Make
	handle)	Schneider Electric (NSX) Legrand (DPX)
8	MCB Distribution Boards	Legrand Siemens Electric (MG) Hager Schneider Electric
9	HRC fuses	L&T Siemens Legrand Schneider Electric
10	Air Circuit Breakers	L&T (U –Power) Schneider Electric (Masterpact NW) Siemens(3WT) Legrand (DMX3)
11	Protective Relays/IDMT Relays	L&T Alstom Siemen

LIST OF APPROVED MAKES FOR INTERNAL ELECTRICAL WORKS

S.No.	Item Description	Make
A	Internal Electrical Works	
1	MS black enameled/ galvanized ERW conduits.	BEC Atul Pipe AKG
2	M.S.Conduit Accessories	BEC Atul Pipe AKG
3	GI pipes	Surya Prakash Jindal Hissar
4	PVC conduit & accessories	BEC Atul Pipe AKG
5	Copper conductor PVC insulated wires	Batra Henlay RPG Sky tone
6	Modular Switches, Socket outlets & wiring accessories with moulded cover plate	Legrand Siemens Hager
7	Heavy duty metal clad socket outlets with MCB in MS housing	Legrand Siemens Hager
8	Weather proof socket outlets with MCB	Legrand Siemens Hager
9	Miniature Circuit Breaker	Legrand Siemens Hager

S.No.	Item Description	Make
10	Earth Leakage Circuit Breaker	Legrand Siemens Hager Schneider Electric
11	Timers & contactors to be mounted in DB	Legrand Siemens Hager Schneider Electric
12	MCB distribution boards in sheet steel housing (double door)	Legrand Siemens Hager Schneider Electric
B	Low Tension System	
13	Telephone Wires	LAPP RPG Skytone Batra Henlay
14	Telephone Tag Block	Krone Pouyet TVS
15	TV Co-axial Cable	LAPP RPG Skytone Batra Henlay
16	Cat 6 Cable & optical fiber cable	LAPP RPG Skytone Batra Henlay
17	Fire Detection System (Complete system)	Schrack (U.L. Listed 9th Edition) Hochiki (U.L. Listed 9th Edition) Ravel (U.L. Listed 9th Edition)
18	Access Control	Bosch Honeywell GE
19	CCTV(Complete system)	Honeywell Sony CP PLUS
E	Miscellaneous	
22	Exhaust Fan	Alstom Crompton Greaves Havels
22	Lamps	Philips Wipro Bajaj Polycab
23	Laminated sheet	Hylam Formier
24	Splitters for SMATV System	Netgear Catvision

S.No.	Item Description	Make
25	XLPE L.T.Cable,1.1 KV Grade(FRLS)	Batra Henlay RPG Skytone
26	Light Fixtures	Philips Wipro Bajaj Polycab
27	UPS	Uniline Powertron Luminous BPE
28	CVT	Logicstat Bluebird Selvon
29	Aviation Obstruction Light(LED Type)	Philips Wipro Bajaj Polycab
30	Exchange/Console Panel	Tata Telecom Panasonic Matrix
31	Handset	Panasonic Beetel Siemens
32	Rubber Mats	Syntax Tycoon Elastomeric
33	Tape Off	Cat Vision Shyam
34	Horn Speakers/Wall Speakers	Philips Bosch Ahuja Bose
35	PVC Pipe	Supreme Finolex Atul
36	Occupancy Sensor	Lutron Legrand
37	LCD	Samsung Philips Sony
38	Jack panel	D-link Cisco
39	Rack	Val rack

LIST OF APPROVED MAKES FOR PLUMBING

S. No.	Details of Materials / Equipment	Manufacturer's Name
1	EWS / IWC	Hindware , Jaquar, Parryware
2	W.C. seat cover	Hindware , Jaquar, Parryware
3	Flushing Cistern	Hindware , Jaquar, Parryware
4	Urinal / Sensor type urinal	Hindware , Jaquar, Parryware
5	Urinal partitions	Hindware , Jaquar, Parryware
6	C.P. brass flush valve for WC and Urinals	Hindware , Jaquar, Parryware
7	Automatic flushing system for Urinals	Hindware , Jaquar, Parryware
8	Wash basin	Hindware , Jaquar, Parryware
9	Toilet paper holder	Hindware , Jaquar, Parryware
10	C.P. brass fittings such as bib cock, two way bib cock, pillar cocks, stop cocks, angular stop cocks, C.P. flexible pipes / hose connection, C.P. brass waste, C.P. brass cast bottle trap, C.P. brass shower rose / shower assembly, long body bib taps, C.P. brass health faucets, single lever mixing fittings, sink mixture etc.	Hindware , Jaquar, Parryware
11	Automatic hand drier	UTEC
12	Stainless Steel Kitchen Sink	Nirali, Anupam
13	Soap dish	Hindware , Jaquar, Parryware
14	Liquid soap dispenser	Hindware , Jaquar, Parryware
15	Towel ring / Towel rail	Hindware , Jaquar, Parryware
16	Air Purifier	UTEC
17	Coat hook / Robe hook	Hindware , Jaquar, Parryware
18	Glass Mirror	Modi Guard, Century
19	P- Trap (Floor Trap)	Supreme, Finolex
20	Floor Drain	Supreme, Finolex
21	Stainless Steel Grating for P- Trap / Cockroach Trap	Sanjay Chilly
22	C.P. Grating for Floor P - Trap	Hindware , Jaquar, Parryware
23	Rain Water Outlets Gratings	
24	GI Pipes (IS : 1239 and IS : 3589)	Astral, APL Apollo, Tata Steel / Jindal

S. No.	Details of Materials / Equipment	Manufacturer's Name
		(Hissar)
25	GI pipes fittings	Unik / Zoloto M
25	PVC / uPVC Pipe & Fittings	Supreme, Finolex, AKG pipes
26	Cast Iron Pipes & Fittings	
27	RCC Pipe	Pragati, Super Wire
28	Stoneware Pipes	Anand, Rota, Jindal
29	CI Manhole covers and frames	Neco, SKF, SRIF
30	SFRC Manhole covers and frames	SFMC, Jindal, Supreme
31	FRP Manhole covers and frames	Products Unlimited, Supreme, Jain
32	Gully Traps	Supreme
33	GM / Forged Brass Ball Valves	AIP, C & R, V.K. Valve
34	Sluice Valves	AIP, C & R, V.K. Valve
35	Butterfly Valve	AIP, C & R, V.K. Valve
36	Non Return Valve / Check Valve	AIP, C & R, V.K. Valve
37	Motorised Butterfly Valve	AIP, C & R, V.K. Valve
38	Air Release Valve	AIP, C & R, V.K. Valve
39	Y Strainer	Zoloto, Emaraal, Venus
40	Hydropneumatic Pumps and other pumps	Mather Platt, Grundfoss, Wilo
41	Variable Frequency Drives	Honeywell, Siemens, Schneider
42	Drinking Water Cooler	Blue star, Carrier
43	Anti Vibration Mounting	Dunlop / Resistoflex
44	Pressure Gauge	FIEBIG, GURU
45	Water Meter (Mechanical Type)	C & R, Lahri
46	Level Controller (Water)	Sant, Active Controls / Technika
47	Level Indicator (Water)	Sant, Active Controls / Technika
48	Paints	Naralac, Asian, Burger
49	MH / Water Tank Plastic Steps	KGM
50	Water Treatment Plant / RO Plant / Sewage Treatment Plant	Anky water, Ion exchange, Thermax
51	Ultra Violet Water Purifier	Anky water, Ion exchange, Thermax
52	Dosing Pumps	

S. No.	Details of Materials / Equipment	Manufacturer's Name
53	Insulation for Hot Water Pipes	Armacel – Armaflex (UK) / Eurobatex – Union Foam (Italy) / K-Flex
54	Electric Water Heater / Gyser	Venus, AO Smith, KEPL,
55	Flanges	To be on site
56	Pypcoat for Burried Piping	IWL / Coaltek
57	Welding Rods	Advani
58	Garden Irrigation system	Jain, Harvel
59	CPVC Pipes & Fittings	Astral, Ashirwad, SFMC
60	PP-R Pipes & Fittings	SFMC, Supreme / Fusion
61	Stainless Steel Pipes & Fittings	Tata, Jindal Hisar
62	CI (LA) Pipes and fittings	Electrosteel / Kesoram
63	Solar Heating System	Solpower, Solarhat

BILL OF QUANTITIES