

**Indian Pharmacopoeia Commission
GHAZIABAD, U.P.**

(An Autonomous Institution of Ministry of Health & Family Welfare)

Tender No. IPC/GZB/HLL/ID/2015

Request for Proposal (RFP)

For

**Construction of State of Art Laboratory Building for Indian
Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh**

THE COMPLETE TENDER DOCUMENTS CONSIST OF THE FOLLOWING:

- **Volume- I (NIB & ITB)**
- **Volume-II (GCC & SCC)**
- **Volume-III (Tech. Specs)**
- **Volume-IV (BOQ)**



B-14A, Sector – 62,
NOIDA (UP) -201307

Phone no: 0120-4071500, Fax no: 0120-4071513

(May, 2015)

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Volume- I

- **Notice inviting Bidders**
- **Instructions to Bidders**



B-14A, Sector – 62,
NOIDA (UP) -201307

Phone no: 0120-4071500, Fax no: 0120-4071513

(May, 2015)

**Indian Pharmacopoeia Commission,
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Tender No. IPC/GZB/HLL/ID/2015

**Request for Proposal (RFP)
for**

**Construction of State of the Art Laboratory Building for Indian
Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh**

NOTICE INVITING TENDER

The Infrastructure Development Division of HLL Lifecare Limited for and on behalf of Indian Pharmacopoeia Commission invites Item Rate Tenders from eligible contractors/firms for **Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh.**

Tender No.	Name of work & Location	Estimated cost (Rs.)	Completion period	Date of issue of tender document from	Last date of submission (at HLL Noida)	Bid Security / EMD (Rs.)
IPC/ GZB/ HLL/ID/ 2015	Construction of State of the Art Laboratory Building for IPC at Raj Nagar, Ghaziabad, Uttar Pradesh	Rs 28.67 Crs.	15 months	14.05.2015 to 27.05.2015	08.06.2015	Rs.38.67 Lakhs

The complete set of Tender Documents comprising four Volumes (Vol. I to IV) including Pre-qualification Criteria (Vol-I) has been made available at HLL website www.lifecarehll.com and CPP Portal. The interested applicant contractors/firms may check their eligibility for the tender. Complete set of Tender Documents along with Tender Drawings are available at the office of HLL Lifecare Limited, B-14A Sector-62, Noida-201307.

The interested applicant contractors/firms after checking their prequalification status should purchase the complete set of tender documents comprising of Volumes I,II, III, and IV and CD containing Tender Drawings in person or through Post from the office of HLL Lifecare Limited, B-14A Sector-62,Noida-201307 on any working day as mentioned above on written request mentioning the name & description of work along with a non-refundable fee of Rs.10,000/- (Rupees Ten thousands only), including service tax, through demand draft in favour of HLL Lifecare Limited payable at New Delhi. Interested applicant contractors/firms may like to attend the pre bid meeting which is scheduled to be held at 11:00 hrs on 01.06.2015 at HLL Office B-14A Sector-62, Noida.

The tender documents obtained from HLL Lifecare Limited Noida office, signed by the authorised representative of the applicant contractors/ firms shall only be submitted

complete in all respects along with requisite Earnest Money Deposit /Bid Security in the form of Bank Guarantee from a Scheduled Bank as per format given in the Tender Documents in favour of HLL Lifecare Limited /Demand Draft of a Scheduled Bank in favour of HLL Lifecare Limited Payable at New Delhi on or before due date and time as mentioned above at HLL Office B-14A Sector-62, Noida-201307. IPC/HLL reserves the right to accept or reject any application without assigning any reason or incurring any liability whatsoever.

Prospective bidders are advised to regularly scan through HLL & IPC web sites as corrigendum / amendments etc., if any, will be notified on the HLL & IPC web sites and separate advertisement will not be made for the same.

For and on behalf of
Indian Pharmacopoeia Commission

Principal Chief Engineer (ID-N),
HLL Lifecare Limited
Infrastructure Development Division
B-14-A, Sector -62, NOIDA-201307 (UP).

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DISCLAIMER

This document has been prepared by HLL Lifecare Limited, on behalf of Indian Pharmacopoeia Commission (IPC). The information is provided to prospective Bidders, who are interested to Bid for **“Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh”**.

This document is neither an agreement, nor an offer or invitation to perform work of any kind to any party. The purpose of this document is to provide interested parties with information to assist the preparation of their Bid. While IPC/HLL have taken due care in the preparation of the information contained herein, and believe it to be complete and accurate, neither any of their authorities or agencies nor any of their respective officers, employees, agents or advisors give any warranty or make any representations, expressed or implied as to the completeness or accuracy of the information contained in this document or any information which may be provided in association with it.

Further, IPC/HLL does not claim that the information is exhaustive. Respondents to this document are required to make their own inquiry/ survey and will be required to confirm, in writing, that they have done so and they did not rely solely on the information given herein.

IPC/HLL reserves the right not to proceed with the Project or to change the configuration of the Project, to alter the timetable reflected in this document or to change the process or procedure to be applied. It also reserves the right to decline to discuss the Project further with any respondent. No reimbursement of cost of any type or on any account will be made to persons or entities submitting their Bid.

**Indian Pharmacopoeia Commission,
GHAZIABAD, U.P.
(An Autonomous Institution of Ministry of Health & Family Welfare)**

**Construction of State of the Art Laboratory Building for Indian
Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh**

Definitions:

1. **“Application”** shall mean the response submitted by interested parties.
2. **“BID/ Tender”** shall mean documents issued by IPC/HLL to the prospective Bidder. The word “Tender” is synonymous with “Bid”
3. **“Project”** shall mean **“Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh”**.
4. **“Site”** shall mean the place where the works under the Project are to be carried out and the details of which are provided in this document.
5. **“Bid Security/ Earnest Money”** shall mean the amount to be deposited by the Tenderer with the Tender.
6. **“Bid Validity”** shall mean the period for which the Bids shall remain valid.
7. **“Bidder”** shall mean the party participating in the Tendering process pursuant to and in accordance with the terms of this document.
8. **“Contract Agreement”** shall mean the agreement to be signed between the Successful Tenderer and the competent authority on behalf of IPC/ their authorized representative.
9. **“Contract Price”** shall mean the financial bid of the Successful Tenderer as accepted by the Client.
10. **“Client/Owner/IPC”** shall mean **Indian Pharmacopoeia Commission (An Autonomous Institution of Ministry of Health & Family Welfare) Raj Nagar, Ghaziabad, Uttar Pradesh**
11. **“Employer/Principal Employer”** shall mean **Indian Pharmacopoeia Commission (An Autonomous Institution of Ministry of Health & Family Welfare) Raj Nagar, Ghaziabad, Uttar Pradesh**.
12. **“HLL”** shall mean **HLL Lifecare Limited** appointed by IPC as Project Consultant for the project.
13. **Engineer in Charge (EIC)** means the authorized representative nominated by IPC/ HLL.

14. **“Evaluation Committee”** shall mean the committee constituted by IPC/ HLL for the evaluation of the bids.
15. **“Successful Tenderer”** shall mean the Tenderer declared technically and financially successful for the Project and with whom, the Contract Agreement shall be signed.
16. **“Letter of Award”** shall mean the letter issued by the Client/HLL to the Successful Tenderer inviting him to sign the Contract Agreement.
17. **“Date of commencement of work”** shall mean the date of Start as specified in the Schedule “F” or the date of handing over of the site, whichever is later in accordance with the phasing if any, as indicated in the tender document.
18. **“Performance Security”** shall mean the amount to be paid by the Successful Tenderer as per relevant clause mentioned elsewhere.
19. **“Similar Works”** as defined in qualifying criteria.
20. **“NIT”** means Notice Inviting Tender. The word “Notice Inviting Tenders” is synonymous with “Notice Inviting Bids (NIB)”.
21. **“Defects Liability Period/ Maintenance Period”** means the period after completion of the Project during which the Client /HLL or their authorized representative / Engineer-in –charge that will notify to the Contractor any defect noticed in the work and the Contractor is liable for rectification of such defects. Proof of dispatch of letter notifying the defect/ intimating the representative of Contractor at site on the last date of Defect liability period will make the Contractor liable for rectify all such defects.

SECTION-I NOTICE INVITING TENDER

Indian Pharmacopoeia Commission, Ghaziabad, U.P. (An Autonomous Institution of Ministry of Health & Family Welfare)

Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh

- 1.0** Item Rate Tenders are invited on behalf of the Indian Pharmacopoeia Commission from eligible contractors as per eligibility criteria laid down, for the work of **“Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh”**.
- 1.1** The work is estimated to cost as given in Table - I. This estimate, however, is merely a rough guide. Pr. Chief Engineer (Pr. CE), Infrastructure Development Division (ID-N), HLL Lifecare Limited, B-14-A, Sector-62 Noida-201307 will deal with all the matters relating to invitation of tenders. Any clarification shall be sought from Pr. CE (ID-N), HLL Lifecare Limited on Tele-Fax 0120-4071627. The NIT and other details are also available on the following websites: www.lifecarehll.com, www.ipc.gov.in and CPP Portal
- 1.2** Pre bid conference will held on 01.06.2015 at 11 AM in the Conference Room, HLL Lifecare Ltd. B-14, Sector-62, NOIDA-201307 or any other venue as decided in future for which intimation will be published on web site. Pr.CE (ID-N), HLL Lifecare Ltd. may also be contacted.

1.3 TABLE– I

Tender No.	Name of work & Location	Estimated cost (Rs.)	Completion period	Date of issue of tender document from	Last date of submission (at HLL Noida)	Bid Security / EMD (Rs.)
IPC/ GZB/ HLL/ID/ 2015	Construction of State of the Art Laboratory Building for IPC at Raj Nagar, Ghaziabad, Uttar Pradesh	Rs 28.67 Crs.	15 months	14.05.2015 to 27.05.2015	08.06.2015	Rs.38.67 Lakhs

1.3.1. Tenders will be issued to all intending & eligible Contractors/Firms.

1.4 Eligibility Criteria:

The Tenderer should meet the following minimum eligibility criteria:

Bidder who fulfills the following requirement shall be eligible to apply. Joint ventures of whatsoever kind are not accepted.

- (a) Experience should be in the name of the bidding company and not in subsidiary/ associate company/ Group Company etc.
- (b) (i) Experience of having successfully completed works during the last 7 years ending last day of the month previous to the one in which applications are invited. The works completed upto previous day of last date of submission of tenders shall also be considered.

Three similar completed works each costing not less than the amount equal to (amount in Rupees of 40% of the estimated cost to be mentioned).

Or

Two similar completed works each costing not less than the amount equal to (amount in Rupees of 60% of the estimated cost to be mentioned).

Or

One similar completed work of costing not less than the amount equal to (amount in Rupees of 80% of the estimated cost to be mentioned).

And

- (ii) One Completed work of any nature (either part of (i) or a separate one) costing not less than the amount equal to (amount in Rupees of 40% of the estimated cost to be mentioned) with some Central/State Government department /Central Autonomous Body/ State Autonomous Body/ Central Public Sector Undertaking/ State Public Sector Undertaking.
- (c) ***“Similar Works”** shall mean a Project comprising Construction of any multistoried RCC framed structure of height 15 metres above ground level or multistoried RCC framed structure having 4 stories (minimum) above ground level (basement, machine room and mumty shall not be counted as a storey) including internal water supply, sanitary installation, Internal electrical installation and internal firefighting system all composite executed under one agreement.
- Own works / work under the same management / own certification of the bidder shall not be considered for pre-qualification.
- (ii) In case the bidder does not have the experience of major specialized works like Plumbing, HVAC, Electrical etc., such specialized works shall be carried out by specialized agencies as detailed in Clause 1.16 & 1.26 of this NIT. However, the bidder should have completed work(s) including finishing, internal & external services like Plumbing etc. of equivalent amounts as per eligibility criteria at (b) above.
- (iii) Bidder should either himself meet the eligibility conditions for the respective E&M components including internal Electrical works or otherwise he will have to associate a specialized agency of appropriate class meeting the eligibility requirements as per CPWD norms eligible to

bid for these respective components individually. For lifts, associated agency shall be from category "A" as per approved list by CPWD.

- (d) The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to the last date of receipt of applications for tender.
- (e) To become eligible to bid, the bidders shall have to submit an affidavit with their bids and as per Form L.
- (f) **Turnover:** Average annual financial turnover on construction works should be at least 100% of the estimated cost during the immediate last three consecutive financial year ending 31st March 2014. Bidding Company and not for group company or subsidiary company etc.
- (g) **Profit / loss:** The Company should have a positive Net Worth and should have incurred loss in not more than Two years in last Five years ending FY 2013-14. This should be duly certified by the Chartered Account.
- (h) **Solvency Certificate:** Solvency of the amount equal to 40% of the estimated cost of the work.
- (i) **Bidding Capacity:** The bidding capacity of the contractor should be equal to or more than the estimated cost of the work. The bidding capacity shall be worked out by the formula:

$$\text{Bidding Capacity} = (A * N * 2) - B$$

Where

- A= Maximum turn over in construction works executed in any one year during the last 7 years taking in to account the completed as well as work in progress. The value of completed work shall be brought to current costing level by enhancing at a simple rate of 7% per annum.
- N= Number of years prescribed for completion of work for which bids has been invited.
- B= Value of existing commitments and ongoing works to be completed during the period of completion of work for which bids have been invited.

- (j) Direct / indirect Joint Ventures (JV)/ Consortium of any kind are not permitted.

1.5 The time allowed for carrying out the work will be as mentioned in Table-I above effective from the date of start as defined in schedule 'F' or from the first date of handing over of the site, whichever is later & in accordance with the phasing / milestones, indicated in the tender documents.

1.6 (i) The site for the work is available.

(ii) The tender architectural and structural drawings for the work are available. The working architectural and structural drawings shall be made available in phased

manner, as per requirement of the same as per approved programme of completion submitted by the contractor after award of work.

- 1.7 Tender documents consisting of plans, specifications, the schedule of quantities of the various classes of work to be done and the set of terms & Conditions of contract to be complied with by the contractor whose tender may be accepted and other necessary documents can be obtained from the office of HLL Lifecare Ltd., B-14A, Sector-62, NOIDA-201307 between 11.00 A.M. & 04.00 P.M. from 14.05.2015 to 27.05.2015 every day except Saturday, Sunday and Public Holidays. Tender documents, will be issued from above office, during the hours specified above, on payment of Rs.10,000/- (including service tax) as cost of tender by DD in favour of HLL Lifecare Limited payable at New Delhi.
- 1.8 Applications for issue of tenders shall be received till 27.05.2015 (15: 00 Hrs.) and tender documents shall be issued by 27.05.2015 (16:00 Hrs.).
- 1.9 The interested applicants/contractors/firms after checking their prequalification status should purchase the complete set of tender documents comprising of Vol. I, II, III, and IV and CD containing Tender Drawings in person or through Post from the office of HLL Lifecare Limited, B-14A Sector-62, Noida-201307 on any working day as mentioned above on written request mentioning the name & description of work along with a nonrefundable fee of Rs.10,000/- (Rupees Ten Thousands only) (including service tax) through demand draft in favour of HLL Lifecare Limited payable at New Delhi.
- 1.10 Interested applicant contractors/firms may like to attend the pre bid meeting which is scheduled to be held at HLL Office B-14A Sector-62, Noida-201307 on 01.06.2015 at 11.00 Hrs.
- 1.11 The tender documents obtained from HLL Lifecare Limited Noida office , signed by the authorized Representative of the Applicant/ Contractor/ Firm shall only be submitted in complete in all respect along with requisite Bid Security in the form of Bank Guarantee from a Scheduled Bank as per format given in the Tender Documents in favour of HLL Lifecare Limited /Demand Draft of a Scheduled Bank in favour of HLL Lifecare Limited Payable at New Delhi on or before due date and time as mentioned above at HLL Office B-14A Sector-62, Noida-201307.
- 1.12 The tenders are invited in two bid systems i.e. Technical Bid and Financial Bid placed in separate envelopes, the Earnest Money (EMD) shall be placed in separate sealed envelope, and, each marked "Technical Bid", "Financial Bid" and "Earnest Money" respectively. All three envelopes shall be submitted together in another sealed envelope with the name of work and due date of opening written on envelope, which will be received up to 15: 00 Hrs. on 08.06.2015. The Bids will be opened, at 15: 30 Hrs. on the same day, in the presence of bidders or their authorized representatives who may choose to attend, in the office of HLL Lifecare Limited, B-14A, Sector-62 Noida-201307. If such nominated date for opening of bid is subsequently declared as a public holiday, the next official working day shall be deemed as the date of opening of the bids. Technical Bid of only those tenderers/bidders shall be opened, whose earnest money, placed in the EMD envelope, is found to be in order.

- 1.13 The bidder, whose bid is accepted, will be required to furnish performance guarantee for a value of 5% of the accepted tendered amount within the period in the schedule-'F'. This Bank Guarantee shall be in the given format in the favour of HLL Lifecare Limited, Noida as per form C.
- 1.14 In case the contractor fails to deposit the said performance guarantee within the period as indicated in schedule -'F', including the extended period, if any, the earnest money deposited by the contractor shall be forfeited automatically without any notice to the contractor.
- 1.15 Evaluation of performance: - Evaluation of past performance of contractors forming part of the eligibility criteria quoted by them in their Technical Bid shall be done by Client/HLL. If required, the works executed by the bidders who otherwise qualify may be inspected by a committee or any other authority as decided by Client/HLL.
- 1.16 The brief description of the work is as follows:-

Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh involves Building construction including internal & external services like Plumbing, Electricals, HVAC and Lifts etc.

The work includes a number of specialized Civil/ Electrical/ HVAC/ Mechanical/ Electronic services **etc.** to be executed as integral parts of the project by engaging specialized agencies as provided for in the latest CPWD Works Manual. Some of the specialized services are:

- Electrical (Substation, DG Sets, Internal & External Electrification)
- Comprehensive HVAC Works
- Lifts
- Comprehensive Fire Fighting/Protection /Alarm System
- PA, CCTV & Security Systems, EPABX/ Communication Systems, NET/LAN Systems, BMS, UPS System
- Solar Power Panel
- EPABX/ Communication System
- LAN system
- Glazing and Façade works

- 1.17 Copies of other drawings and documents pertaining to the works will be open for inspection by bidders at the office of HLL Lifecare Ltd B14A, Sector 62, NOIDA-201307 from 14.05.2015 to 27.05.2015 from 10.00 Hrs. to 16.00 Hrs. on all working days.
- 1.18 Tenderers are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their tenders as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other

circumstances which may influence or affect their tender. A bidder shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charges consequent on any misunderstanding or otherwise shall be allowed. The bidder shall be responsible for arranging and maintaining at its own cost all materials, tools & plants, water, electricity, access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a tender by a bidder implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the works to be done and of conditions and rates at which stores, tools and plant, etc. will be issued to him by the Client/ HLL and local conditions and other factors having a bearing on the execution of the work.

- 1.19 The competent authority of Client/HLL does not bind itself to accept the lowest or any other tender and reserves to itself the authority to reject any or all the tenders received without the assigning of any reason. All tenders in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the bidder shall be summarily rejected.
- 1.20 Canvassing whether directly or indirectly, in connection with tenders is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable to rejection.
- 1.21 The competent authority of IPC/ HLL reserves the right to accept or reject any or all the tenders without assigning any reason, No Bidder shall have any cause of action or claim against the IPC/ HLL for rejection of his tender.
- 1.22 The competent authority of IPC/HLL reserves to himself the right of accepting the whole or any part of the tender and the bidder shall be bound to perform the same at the rate quoted.
- 1.23 The contractor shall not be permitted to tender for works in case his near relative is Gazetted officer in Ministry of Health and Family Welfare / IPC or in the Managerial cadre of HLL and is directly dealing with the Project. Any breach of this condition by the contractor would disqualify him from tendering.
- 1.24 No Engineer of Gazetted rank or other Gazetted officer employed in Engineering or Administrative duties in an Engineering Department of the Government of India is allowed to work as a contractor for a period of one year after his retirement from Government service, without the prior permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the tender or engagement in the contractor's service.
- 1.25 The tender for the works shall remain open for acceptance for a period of 180 days from the date of opening of tenders. If any bidder withdraws his tender before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the tender which are not acceptable to the department, then the IPC/ HLL shall, without prejudice to any other right or remedy, be at liberty to forfeit 100% of the said earnest money as aforesaid. Further

the bidder shall not be allowed to participate in the re – tendering process of the work.

- 1.26 Bidder should either himself meet the eligibility conditions for the respective E&M components including internal Electrical works or otherwise he will have to associate a specialized agency of appropriate class meeting the eligibility requirements as per CPWD norms eligible to bid for these respective components individually. However if an approved contractor list is available for any specialized work in CPWD within the estimated cost of said specialized work or sub-head then the successful bidder/ contractor shall have to select a subcontractor for the said specialized work from the CPWD list for approval of IPC/HLL. For lifts, associated agency shall be from category “A” as per approved list by CPWD. The bidder should submit an undertaking as per **form ‘H’** in their technical bids for his association towards undertaking respective E&M components mentioned in para 1.16 above.
- 1.27 Before undertaking any of the specialized works e.g. placing supply orders for Lifts/ HVAC equipment etc., written approval of EIC shall be required.
- 1.28 **Registration/License:** The tenderer/bidder should have Works Contract Tax/VAT Registration with the appropriate Authorities. In case of non-registration at the time of submission of bid, they will have to submit an undertaking that they will get themselves registered with the concerned authorities if they are awarded work.
- 1.29 The tenderer/bidder will indemnify IPC/HLL, as the case may be, against all penal action that may be levied/effectuated by any concerned authority for default in any labour regulation/ PF/ ESI and other statutory requirements of the relevant Acts/ Laws related to the work of the contractor and will bear the legal charges, if any, and will pay the legal charges/dues directly to the concerned authority. An undertaking in this regard is required to be submitted by applicants’ along with prequalification.
- 1.30 The Contractor must not have been blacklisted/ penalized by any government agency or public sector undertaking or judicial authority/arbitration body.

1.31 **Submission of Bids**

A Bid document consists of :

- a. **Volume – I (Notice Inviting Tender(NIT),Instruction to Bidders(ITB))**
- b. **Volume – II (General Conditions of Contract (GCC)&Special Conditions of Contract (SCC))**
- c. **Volume-III(Technical Specifications(TS))**
- d. **Volume – IV (Bill of Quantities(BOQ))**

Tenderer/bidder may obtain clarification, if any, in respect of this document from the office of the Principal Chief Engineer (ID-North) HLL Lifecare Ltd B14A, Sector 62, NOIDA-201307 till two days before Pre bid meeting.

- ##### **B Sealing and Marking of Bids:**
- The Tenderers shall submit their Tenders in two parts i.e. TECHNICAL BID and FINANCIAL BID in two separate sealed envelopes. Both these envelopes with Earnest Money Deposit(EMD) envelope will be kept in another sealed envelope duly marked as Tender for work of

“Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh” due for opening on 08.06.2015 at 15:30.hours. The documents forming part of Technical bid and Financial bid has been explained in clause 2.3.6 & 2.3.7 of Instruction to Bidders (ITB) here-in-after.

- 1.32 This Notice Inviting bid shall form a part of the contract document. The successful Tenderer / contractor, on acceptance of his tender by the Accepting Authority, shall, within 15 days from the stipulated date of start of the work, sign the contract consisting of :-

The notice inviting tender, all the documents including General Conditions of the Contract, Special Conditions of Contract, Specifications, Bill of Quantities and drawings, if any, which form part of the tender as issued at the time of invitation of tender and acceptance thereof together with any correspondence leading thereto.

For & On behalf of
The Secretary-cum-Scientific Director,
Indian Pharmacopoeia Commission, Ghaziabad (U.P.)

Pr. Chief Engineer (ID-N&E),
Infrastructure Development Division (ID-N),
HLL Lifecare Limited,
B-14-A, Sector-62 Noida-201307

SECTION-II**INSTRUCTIONS TO BIDDERS (ITB)****2.0 Introduction:**

The existing main building was constructed in 1975 and occupies about 35,000 square feet of area for administrative and laboratory space. The laboratory spaces are inadequate to perform modern analytical testing in a GMP environment and this facility itself needs to be renovated for its intended purpose. The layout of the existing building is not designed as a modern analytical laboratory and even with substantial and expensive renovation it would be difficult to accommodate chemical laboratories meeting international standards for safety.

Indian Pharmacopeia Commission desired to modernize its facilities and organize its staff in order to revise the Indian pharmacopeia and to add reference materials for monographs. The subject work i.e. **“Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh”** is part of this programme.

2.1 Eligibility Criteria: As per Notice inviting Bids

2.2 Disqualification. Even if a Contractor meets the eligibility criteria, IPC may, at their discretion and at any stage during the selection process or execution of the Project, order disqualification of the contractor, if the Contractor has:

- 2.2.1 Made misleading or false representations in the forms, statements and attachments submitted; or
- 2.2.2 The Contractor has been blacklisted by any government agency even after bids have been opened.

2.3 BID Documents:**2.3.1 Contents of BID Documents**

BID Document shall consist of the documents listed in this document along with any schedules, addendum or corrigendum etc issued by IPC/HLL for the purpose.

2.3.2 Pre-Bid Conference

The purpose of the Pre bid meeting will be to clarify issues/ doubts on any matter that may arise before bidding. IPC/HLL shall conduct pre-Bid meeting(s) at the time and venue mentioned in Notice Inviting Bid.

2.3.3 Clarifications

A prospective Contractor requiring any clarification with regards to the BID document may notify the Principal Chief Engineer (ID-North) HLL Lifecare Ltd B14A, Sector 62, NOIDA, in writing or by tele-fax at the mailing address indicated in Notice Inviting Bid. Principal Chief Engineer (ID-North) will respond in writing to any request for clarification which

should be received at least two days prior to the date of Pre bid meeting. Copies of the response (including an explanation on the query but without identifying the source of the inquiry) will be sent to all prospective Bidders to whom, the BID has been issued and also uploaded on the HLL website <http://www.lifecarehll.com> and CPP Portal. Only written communications/clarifications shall be considered as valid.

2.3.4 Amendment to BID Document

- i. At any time prior to the submission of Bids, IPC / HLL may, for any reason, whether at its own initiative or in response to a clarification or query raised by prospective Bidders, modify the BID by an amendment.
- ii. The said amendment in the form of the addendum/ corrigendum will be sent to all prospective Bidders to whom, the BID has been issued on or before the last date mentioned in Notice Inviting Bid. This communication will be in writing or by tele-fax and the same shall be binding on the Bidders. Prospective Bidders should promptly acknowledge receipt of the addendum/ corrigendum by Tele-fax/courier to client. The amendments would also be available on the HLL website <http://www.lifecarehll.com> and CPP Portal. The prospective Bidders are advised to regularly visit these websites to ensure that they are aware of the amendments. The addendum (s) / corrigendum(s) issued will form part of the BID documents.
- iii. In order to afford prospective Bidders reasonable time for preparing their Bids after taking into account such amendments, the IPC may, at its discretion, extend the deadline for the submission of Bids.
- iv. The above information will be placed on the HLL website <http://www.lifecarehll.com> and CPP Portal and it will be the responsibility of the bidders to read.

2.3.5 Preparation of Bid:

a) Bidder's responsibility:

- i. The Bidder is solely responsible for the details of his Bid
- ii. The Bidder is expected to examine carefully all the contents of BID document as mentioned in Notice Inviting Bids including instructions, conditions, forms, terms, etc and take them fully into account before submitting his bid. Bids, which do not satisfy all the requirements, as detailed in these documents, are liable to be rejected as being unresponsive.
- iii. The Bidder shall be deemed to have inspected the Site and its surroundings and taken into account all relevant factors pertaining to the Site, while preparing and submitting the Bid.

b) Project Inspection and Site Visit

Any Site information given in this BID is for guidance only. The Bidder is advised to visit and examine the Site of works and its surroundings at his/their cost and obtain at his/their own responsibility, any information that they may consider necessary for preparing the Bid and entering into a Contract with the Client, including availability of electricity, water and drainage, where applicable.

IPC/HLL shall not be liable for such visits costs, regardless the outcome of the selection process.

c) Documents Comprising the Bid

d) Bidder shall submit their Bids in two packages namely the technical package and the financial package. The contents of the technical and financial package are as mentioned hereinafter i.e. Clause 2.3.6 & 2.3.7.

e) **Alternative Proposal by bidders:**

Bidders shall submit offers that comply with the requirement of the bidding documents, including basic technical design as indicated in the drawing and specifications. Alternative bids/proposals will not be considered.

2.3.6 Contents of Technical Package:

The Technical package, clearly labeled as **“TECHNICAL PACKAGE”**, has to be submitted in two parts, Part-I shall consist of information for responsiveness and other information about Bidder, as required and Part - II shall be the Technical Bid.

a) Part –I shall comprise the following :

- i. **Form of Bid and Appendix (Form A) for the Bid**
- ii. **Checklist for the enclosed documents as per the format attached (Annexure I)**
- iii. **Bid Security, in original, in a separate envelope, sealed and duly marked “Bid Security” as per the format attached (Form B),**
- iv. **Format for Performance Guarantee (Form C)**
- v. **Format for Contract Agreement (Form D)**
- vi. **Power of attorney (Form E) in favour of the person signing the Bid**
- vii. **Litigation History (Form G)**
- viii. **Affidavit for engaging specialized agencies (Form H)**
- ix. **Affidavit by Bidder (Form K)**

b) Part –II shall comprise the followings :

- i. Form “T-1” (**Financial Information**)
 - ii. Form “T-1-B”(Certificate from a Scheduled Bank)
 - iii. Form “T-2” (**Details of works.....**)
 - iv. Form “T-3” (**Project under execution or awarded**)
 - v. Form “T-4” (**Performance Report of Works**)
 - vi. Form “T-5” (**Structure and Organization**)
 - vii. Form “T-6” (**Details of Technical & Administrative personnel**)
 - viii. Form “T-7” (**Details of Construction Plant for carrying out the work**)
- c) Initialed BID document, as listed in Notice Inviting Bids excluding the Bill of Quantities (Volume–IV) including amendment(s)/addendum(s)/Corrigendum(s)/Clarification(s) issued, if any, related to other than the Bill of Quantities.

2.3.7 **Contents of Financial Package**

The financial package VOLUME IV- BILL OF QUANTITY including amendment(s) / addendum(s)/ Corrigendum(s) / Clarification(s) issued, if any, related to the Bill of Quantities, clearly labeled as “FINANCIAL PACKAGE” will contain the following:

i. **Financial Bid**

The financial package should be submitted, in a separate sealed envelope. These prices should include all costs associated with the Project including any out of pocket / mobilization expenses, taxes, charges, levies, cess, VAT, including Service tax etc. as applicable till the date of NIT. In case Government levies/modifies any tax subsequently, the same will be adjusted plus/ minus as the case may be.

2.3.8 **Bid Submission**

i. **Language of Bid**

The Bid and all related correspondence and documents relating to the Project shall be in English language.

ii. **Currency of Bid**

Bid prices shall be quoted in Indian Rupees only. The amount mentioned elsewhere in the bid document will also deemed to be in Indian Rupees unless otherwise mentioned.

iii. **EMD/Bid Security**

- a) The Bidder shall enclose EMD with their Bid for an amount, as mentioned in Notice Inviting Bids.
- b) The EMD will be in the form of a bank guarantee from a scheduled commercial bank in India. The format of the bank guarantee shall be as per Form C. Bank guarantees should be irrevocable and

operative for a period as mentioned in Notice inviting Bid. The Bid Security shall be endorsed/pledged in favour of HLL Life Care Limited, B-14A, Sector -62 Noida-201307 and should be valid for a period of six months from date of submission of bids and shall be submitted in a separate envelope super-scribed **“Bid Security /Earnest Money Deposit for Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh”**

- c) Bids not accompanied by EMD, shall be treated as non-responsive, and will be summarily rejected by the IPC.
- d) The Bid Security of the Successful Bidder shall be returned upon the Bidder executing the Contract Agreement and submitting the required Performance Security.
- e) The Bid Security shall be forfeited if a bidder withdraws his bid during the period of bid validity or in the case of the successful bidder, if he fails to furnish the necessary performance Guarantee or enter into the Contract within the specified time limit.

iv. **Extension of Bid Validity**

Prior to the expiry of the original Bid Validity Period, IPC may, at its discretion, request Bidders to extend the Bid Validity Period for a specified additional period.

v. **Format and Signing of Bid**

- a. Bid documents (technical package/ bid Part I and II and financial package/ bid) shall be stamped and signed on all pages by a person duly authorized to sign the Bid documents. The Bidder shall also submit a power of attorney authorizing the person signing the documents.
- b. Entries to be filled in by the Bidder shall be typed or written in indelible ink.
- c. The complete Bid shall be without alterations, overwriting, interlineations or erasures except those to accord with instructions issued by IPC/ HLL, or as necessary to correct errors made by the Bidder. All amendments/corrections shall be initialed by the person or persons signing the Bid.
- d. All witnesses and sureties shall be persons of status and probity and their full names, occupations and addresses shall be written below their signatures.

vi. **Sealing and Marking of Bids**

The Bid shall be submitted in accordance with the procedure detailed herein. Specified documents shall be enclosed in envelope of appropriate size each of which shall be sealed.

- a. Each Bid will be submitted in two sets one marked “Original” **and** the other marked “Copy” (Copy should be the photocopy of ‘original’).

Each set containing the two packages, TECHNICAL BID and FINANCIAL BID shall be sealed in two separate envelopes **clearly** marked as “TECHNICAL BID” and “FINANCIAL BID “.The two envelopes along with envelope of EMD/ Bid Security shall be wrapped in an outer envelope addressed to The Principal Chief Engineer (ID-North) HLL Lifecare Ltd.,B14A, Sector 62, NOIDA-201301, duly super scribing on top “**Bid for Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh**” and date and time of opening of the Bid _____”,. The envelope should also bear the name and address of the Bidder.

vii. **Submission of Bids**

Bids should be submitted to:

**Principal Chief Engineer (ID-North)
HLL Lifecare Ltd
B14A, Sector 62, NOIDA-201307
Uttar Pradesh**

The last date for submission of completed Bids is given in Notice Inviting Bids. The IPC may, at their discretion, extend this date, in which case all rights and obligations of the IPC and the Bidder shall thereafter be subjected to the revised date as extended. If revised date for submission of Bid is subsequently declared as a public holiday, the next official working day shall be deemed as the date for submission of Bid.

- viii. The bids shall be submitted by hand or through registered post or courier service at the address mentioned above so as to reach before scheduled Date & time of submission of tenders. IPC/HLL shall not take any cognizance and shall not be responsible for any delay/ loss in transit or non-submission of the Bid in time.
- ix. The bids sent telegraphically or through other means of transmission (Tele-fax, E-mail etc.), which cannot be delivered in a sealed envelope, shall be treated as defective, invalid and shall stand rejected.
- x. Modifications / Substitution / Withdrawal of Bids
- (a) No modification or substitution of the submitted Bid shall be allowed.
- (b) A Bidder may withdraw its submitted Bid, provided that written notice of the withdrawal is received by IPC/HLL before the last date for submission of Bids. In case a Bidder wants to resubmit his Bid, he shall submit a fresh Bid following all the applicable

conditions. Re-submission will not be permitted more than once and till last date and time of submission as notified.

- (c) Only a single copy of the withdrawal notice shall be prepared and each page of the notice shall be signed and stamped by the authorized signatory. The notice shall be duly marked "WITHDRAWAL". This withdrawal notice will be opened at the time of opening of bid and not earlier. The signature of GPA holder will be verified and in case both are same then only withdrawal will be considered.

xi. **Bid Due Date**

- a. Bids should be received in the office of the **Principal Chief Engineer (ID-North) HLL Lifecare Ltd., NOIDA** at the address mentioned in this document, on or before the stipulated/ extended time and date as specified in Notice Inviting Bids.
- b. IPC may, in exceptional circumstances, and at its sole discretion, extend the receipt & opening of Bids by issuing an addendum.

xii. **Late Bids**

Any Bid received in office of the Principal Chief Engineer(ID-North) HLL Lifecare Ltd., NOIDA at the address mentioned above after the deadline prescribed for submission of Bids in Notice Inviting Bids/extended data as the case may be, will not be considered and will be returned unopened to the Bidder.

2.3.9 Power of Attorney:

Bidders shall submit, along with Part 1 of the technical Bid, a power of attorney (PoA), on a stamp paper of appropriate value , in favour of the person signing the Bid documents authorizing him to sign the Bid documents, make corrections/ modifications thereto and interacting with IPC/ HLL and act as the contact person. The format for the power of attorney shall be as per form E of BID. In case bids are signed by Managing Director/ Director/Partner/ Proprietor himself, power of attorney is not required.

2.3.10 Bid Opening and Evaluation:

Bid Opening

- i. The Bids will be opened in the presence of Bidders or their authorized representatives who may choose to attend on date & time as mentioned in Notice Inviting Bids. If such nominated date for opening of Bid is subsequently declared as a public holiday, the next official working day shall be deemed as the date of opening of the Bid.
- ii. Bids for which an acceptable notice of withdrawal has been submitted shall not be opened.

- iii. Bids which have not complied with one or more of the foregoing instructions may not be considered.
- iv. On opening of the main Bid envelopes, it will be checked if they contain Technical & Financial Bids and envelope of EMD/ Bid Security as detailed above.
- v. First technical package of the Bid will only be opened which will be checked for completeness and confirmation of submission of Bid Processing Fees and the requisite Bid Security. If the documents do not meet the requirements of the BID, a note will be recorded.
- vi. After technical evaluation of all bids, the financial bid of all responsive Bidders will be opened on date & time considered appropriate by IPC/HLL after notifying all concerned.

2.3.11 Determination of Responsiveness

- i. Prior to opening & evaluation of Financial Bids, IPC/HLL will determine whether each Technical Bid is responsive to the requirements of NIB.
- ii. For the purpose of this clause, a responsive Bid is one which:
 - a. Is packed, signed, sealed and marked
 - b. Is accompanied by the power(s) of attorney if required
 - c. Contains all the information as requested in NIB
 - d. Contains information in same/similar formats as those specified in NIB
 - e. the validity period of the offer is as per NIB
 - f. Is accompanied by the Bid Processing Fee (in case not paid in cash in advance).
 - g. Is accompanied by the Bid Security/ EMD,
 - h. Conforms to eligibility criteria and all the terms, conditions and specifications of NIB without material deviation or reservation. "Deviation" may include exceptions and exclusions. A material deviation or reservation is one which affects substantial way, the scope, quality, performance or administration of the works to be undertaken by the Bidder under the Contract, or which limits in a substantial way, Client's rights or the Bidder's obligations under the Contract as provided for in NIB and/ or is of an essential condition, the ramifications of which would unfairly affect the competitive position of other Bidders.
- iii. If a Technical Bid is not substantially responsive to the requirements of NIB, it will be rejected by IPC/HLL. The decision of the IPC/HLL in this regard shall be final and binding. The financial Packages of non-responsive Bidders shall be returned unopened.

2.3.12 Evaluation of Bids

- i. IPC/HLL would subsequently examine and evaluate Financial Bids of responsive Bidders, as per the criteria set out in this document. Form “T-8”
- ii. IPC/ HLL reserves the right to reject any Bid if:
 - a. At any time, a material misrepresentation is made or uncovered; **or**
 - b. The Bidder does not respond within the stipulated time to requests for supplemental information/ clarifications required for the evaluation of the Bid.
 - c. It is found that the information provided is not true or incorrect or facts/ material for the evaluation have been suppressed.
 - d. If the bidder has not quoted rates for any part of the bid.

2.3.13 Clarification of Bids

- i. Evaluation of technical Bids submitted by Bidders shall be undertaken based on details submitted therein only. Bidder shall not be allowed to submit on their own, additional information or material subsequent to the date of submission and such material / information, if submitted, will be disregarded. It is therefore essential that all details are submitted by the Bidder comprehensively, accurately and specifically in their technical Bid, avoiding vague interpretations. However, Evaluation Committee, if it so desires, reserves the right to seek any clarification from the Bidders on the information provided in the technical package. The request for clarifications and the response shall be in writing, or by tele-fax. No change / addition in the information or substance of the Bid shall be sought, offered or permitted.
- ii. To assist in the examination, evaluation and comparison of the financial Bid, Evaluation Committee may ask Bidders individually for clarifications. The request for clarification and the response shall be in writing or by tele-fax. No change in the price or substance of the Bid shall be sought, offered or permitted except as required to confirm correction of arithmetical errors observed by the Evaluation Committee during the evaluation of Bids. IPC/HLL reserves the right to negotiate with the lowest bidder, if considered appropriate.

2.3.14

(a) Process to be Confidential

- i. Except the public opening of the Bids, information relating to the examination, clarification, evaluation and comparison of Bids and recommendations concerning the award of Contract shall not be disclosed to Bidders or other persons not officially concerned with such process.
- ii. Any effort by a Bidder to influence IPC/HLL Evaluation Committee in the process of examination, clarification, evaluation and comparison

of Bids and in decisions concerning award of Contract, shall result in the rejection of the Bid.

- (b) Client/HLL's right to accept any Bid and to reject any or all Bids
 - i. Notwithstanding anything above, IPC/HLL reserves the right to accept or reject any Bid at any time prior to award of Contract without thereby incurring any liability to the affected Bidder or Bidders.
 - ii. IPC/HLL reserves the right to cancel/annul the selection process, at any stage prior to the award of the Contract, in larger public interest, on account of the following:
 - a) In case no Bid/ a single Bid is received.
 - b) Occurrence of any event due to which it is not possible to proceed with the selection process
 - c) An evidence of a possible collaboration/mischief on part of Bidders, impacting the competition and transparency of the selection process,
 - d) Any other reason, which in the opinion of the Client necessitates the cancellation of the selection process.
 - iii. On occurrence of any such event, IPC/HLL shall notify all the Bidders within 7 days of such decision. IPC/HLL shall also promptly return the Bid Security submitted by the Bidders within 15 days of issue of such notice. IPC/HLL is not obligated to provide any reason or clarification to any Bidder on this account. IPC's liability under this clause is restricted to returning the Bid Security and no other reimbursements of costs/ expenses of any type shall be made by the Client/HLL on this account.
 - iv. The Client further reserves the right to re-Bid the process or get the work done by a Government agency or Quasi Government agency if the Client is of the opinion that the Bids received are not economically or otherwise feasible or not acceptable due to reasons in sub clauses (a) to (d) above.

2.3.15 Award of Contract

a. Award Criteria

IPC/HLL or its assignees or any agency appointed by them will declare the Bidder ranked L1 as Successful Bidder and proceed to issue Letter of Award (LOA) as per the procedure mentioned in the NIB and terms and conditions set out in this NIB document.

b. Notification of Award

- i. IPC/HLL will issue the Letter of Award to the Successful Bidder, notifying him of being declared successful and the intent to sign the Contract Agreement with him. This letter (hereinafter and in the Conditions of Contract called 'the Letter of Award') shall mention the sum which IPC/HLL

will pay to the Contractor in consideration of the completion and guarantee of the work to be performed by them, as prescribed therein (hereinafter and in the conditions of Contract called 'the Contract Price'). No correspondence will be entertained by IPC/HLL from the unsuccessful Bidders.

- ii. The Letter of Award shall form part of the Contract.
 - iii. Upon submission of Performance Guarantee by the Successful Bidder, IPC/HLL will promptly notify the other Bidders and discharge / return their Bid securities.
- c. Performance Guarantee
- i. The Successful Bidder shall furnish to IPC/HLL or its assignees or any agency appointed by them, towards Performance Guarantee, a bank guarantee for an amount of 5% of the total Contract Price, in accordance with the provisions in the General Conditions of Contract. The Performance Guarantee shall be furnished within the time limit specified in Notice Inviting Bids.
 - ii. Failure of the Successful Bidder to submit the required Performance Guarantee shall constitute sufficient grounds for the annulment of decision to award the Contract and forfeiture of the Earnest Money Deposit /Bid Security.
- d. Signing of Agreement
- (i) Prior to the signing of the Contract Agreement, the Successful Bidder shall submit Performance Guarantee.
 - (ii) IPC/HLL shall prepare the Contract Agreement in the Proforma (Form D) included in this document, duly incorporating all the terms of agreement between the two parties. The Successful Bidder will be required to execute the Contract Agreement within 30 days from the date of issue of the Letter of Award.
 - (iii) The Contract Agreement should be duly signed by IPC/HLL or its assignees or any agency appointed by them and Contractor through their authorized signatories.
 - (iv) The Contractor shall also be required to sign the integrity agreement with the IPC/HLL or its assignees.
 - (v) In case the Successful Bidder does not sign the Contract Agreement, IPC/HLL reserves the right to cancel the further process, forfeit any Bid Security and/or Performance Guarantee, as the case may be, submitted by the Successful Bidder and either re-Bid or proceed in any other manner as it may deem fit.
- e. Sub-contracting
- i. The Contractor shall not sub-contract the whole of the works. The Contractor shall not subcontract any part of the work without notifying and getting prior approval from the IPC/HLL.

- ii. The Contractor shall be responsible for observance, by all sub-contractors, of all the provisions of the Contract Agreement. The Contractor shall be responsible for the acts or defaults of any sub-contractor, his representatives or employees, as fully as if they were the acts or defaults of the Successful Bidder, his representatives or employees. The Contractor shall provide IPC/HLL the details of all the sub contracts including terms and conditions of the contracts entered with them. The Contractor shall be solely responsible for the performance of the sub-contractors and for making payments to them.
- f. **Defects Liability Period**
 - i. The Defects Liability Period shall be up to 12 months from the date of issue of taking over/ completion certificate by IPC/HLL.
 - ii. The Contractor shall, at its own risk and cost, make good, any defects, complete any leftover work as noticed and notified by IPC/HLL during defects liability period.
- g. **Ownership of the Designs and Drawings**
 - i. All copyright and other proprietary rights in the Works shall vest and stand assigned to IPC/HLL and IPC/HLL shall consequently own, absolutely and exclusively on a worldwide basis, the whole of property, rights, title and interest including all copyright in the Works, present or future, vested or contingent, generally and without limitation, for the whole term of the copyright, including the right to modify and/or make any alterations to the Works and all the above rights shall not lapse even if such rights are not exercised by IPC/ HLL during the terms of the copyright and the Contractor shall be required/obliged to execute any deeds/ documents, as may be required or considered necessary, by IPC/HLL to give effect to and secure the above mentioned rights for IPC/HLL in the Works. For the purpose of this clause, the term “Works” shall include all “works” covered by the copyright Act 1957 created by the Contractor at the inception of, during the course of and until the completion of the Project and also includes any work created directly or indirectly in the performance of the obligations of the Contractor in connection with the Project.
 - ii. The Contractor shall not use or allow anyone to use these drawings, designs, documents and software without the prior written permission of the Client/HLL and any such act without the permission of the Client/HLL shall constitute violation of Intellectual Property Rights.
 - iii. Even in the event of stoppage / cancellation of the selection process, all documents /designs/ drawings submitted by the contractor/ Bidder to the IPC/HLL on or before the cancellation of the selection process shall become the property of the Client and the Bidders shall have no claim on such documents/design.

h. Right to modify the design

The Client/HLL shall have the right to modify the design prepared by the Contractor. The Contractor shall comply with any such instructions by the Engineer-in-Charge or the Client/HLL and suitably modify the design and submit the same to the Client for approval.

- i. All amendments/ addendum shall be made available at IPC's and HLL's Web site. It will be the responsibility of the bidder to see the web site regularly and update.

SECTION-III
INTEGRITY PACT

To,

.....,

.....,

.....

Sub: Tenders for the Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh
(NIT No. IPC/GZB/HLL/ID/2015)

Dear Sir,

It is hereby declared that IPC/HLL is committed to follow the principle of transparency, equity and competitiveness in public procurement.

The subject Notice Inviting Tender (NIT) is an invitation to offer made on the condition that the Bidder will sign the integrity Agreement, which is an integral part of tender/bid documents, failing which the tenderer/bidder will stand disqualified from the tendering process and the bid of the bidder would be summarily rejected.

This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the IPC/HLL.

Yours faithfully

Principal Chief Engineer (ID-N) HLL
The Secretary-cum-Scientific Director,
Indian Pharmacopoeia Commission,
Ghaziabad (U.P.)

To

**The Principal Chief Engineer (ID-North)
HLL Lifecare Ltd
B14A, Sector 62, NOIDA-201307**

Sub: Submission of Tenders for the Construction of State of the Art Laboratory Building for
Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh
(NIT No. IPC/GZB/HLL/ID/2015)

Dear Sir,

I/We acknowledge that IPC/HLL is committed to follow the principles thereof as enumerated in the Integrity Agreement enclosed with the tender/bid document.

I/We agree that the Notice Inviting Tender (NIT) is an invitation to offer made on the condition that I/We will sign the enclosed integrity Agreement, which is an integral part of tender documents, failing which I/We will stand disqualified from the tendering process. I/We acknowledge that THE MAKING OF THE BID SHALL BE REGARDED AS AN UNCONDITIONAL AND ABSOLUTE ACCEPTANCE of this condition of the NIT.

I/We confirm acceptance and compliance with the Integrity Agreement in letter and spirit and further agree that execution of the said Integrity Agreement shall be separate and distinct from the main contract, which will come into existence when tender/bid is finally accepted by IPC/HLL. I/We acknowledge and accept the duration of the Integrity Agreement, which shall be in the line with Article 1 of the enclosed Integrity Agreement.

I/We acknowledge that in the event of my/our failure to sign and accept the Integrity Agreement, while submitting the tender/bid, IPC/HLL shall have unqualified, absolute and unfettered right to disqualify the tenderer/bidder and reject the tender/bid in accordance with terms and conditions of the tender/bid.

Yours faithfully

(Duly authorized signatory of the Bidder)

**To be signed by the bidder and same signatory competent / authorised to
sign the relevant contract on behalf of IPC/HLL.**

INTEGRITY AGREEMENT

This Integrity Agreement is made at on thisday of 20.....

BETWEEN

The Secretary-cum-Scientific Director, Indian Pharmacopoeia Commission, (An Autonomous Institution of MoHFW, GOI), Ghaziabad (U.P.) (Hereinafter referred as the '**Principal/Owner**', which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

AND

.....(Name and Address of the Individual/ firm/Company) through..... (Hereinafter referred to as the (Details of duly authorized signatory) "**Bidder/Contractor**" and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

Preamble

WHEREAS the Principal/Owner has floated the Tender (NIT No. IPC/GZB/HLL/ID/2015) (hereinafter referred to as "**Tender/Bid**") and intends to award, under laid down organizational procedure, contract for the **Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh** (Name of work) hereinafter referred to as the "**Contract**".

AND WHEREAS the Principal/Owner values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Bidder(s) and Contractor(s).

AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter into this Integrity Agreement (hereinafter referred to as "**Integrity Pact**" or "**Pact**"), the terms and conditions of which shall also be read as integral part and parcel of the Tender/Bid documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the parties hereby agree as follows and this Pact witnesses as under:

Article 1: Commitment of the Principal/Owner

- 1) The Principal/Owner commits itself to take all measures necessary to prevent corruption and to observe the following principles:
 - (a) No employee of the Principal/Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
 - (b) The Principal/Owner will, during the Tender process, treat all Bidder(s) with

equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.

- (c) The Principal/Owner shall endeavour to exclude from the Tender process any person, whose conduct in the past has been of biased nature.
- 2) If the Principal/Owner obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal code (IPC)/Prevention of Corruption Act, 1988 (PC Act) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal/Owner will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

Article 2: Commitment of the Bidder(s)/Contractor(s)

- 1) It is required that each Bidder/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the Government / Department all suspected acts of **fraud or corruption or Coercion or Collusion** of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.
- 2) The Bidder(s)/Contractor(s) commit himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:
 - a) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal/Owner's employees involved in the Tender process or execution of the Contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the Contract.
 - b) The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to cartelize in the bidding process.
 - c) The Bidder(s)/ Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Bidder(s)/Contract(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal /Owner as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
 - d) The Bidder(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/representatives in India, if any. Similarly Bidder(s)/ Contractor(s) of Indian Nationality shall disclose names and addresses of foreign agents/ representatives, if any. Either the Indian agent on behalf of the foreign principal or the foreign principal directly could bid in a tender but not both.

Further, in cases where an agent participate in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tender for the same item.

- e) The Bidder(s)/Contractor(s) will, when presenting his bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract.
- 3) The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.
- 4) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice means a willful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the Government interests.
- 5) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm use Coercive Practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/ her reputation or property to influence their participation in the tendering process).

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal/Owner under law or the Contract or its established policies and laid down procedures, the Principal/Owner shall have the following rights in case of breach of this Integrity Pact by the Bidder(s)/Contractor(s) and the Bidder/ Contractor accepts and undertakes to respect and uphold the Principal/Owner's absolute right:

- 1) If the Bidder(s)/Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Principal/Owner after giving 14 days' notice to the contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from the Tender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and determined by the Principal /Owner. **Such exclusion may be forever or for a limited period as decided by the Principal /Owner.**
- 2) **Forfeiture of EMD/Performance Guarantee/Security Deposit:** If the Principal / Owner has disqualified the Bidder(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to terminate/determine the Contract according to Article 3(1), the Principal/ Owner apart from exercising any legal rights that may have accrued to the Principal/ Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit of the Bidder/ Contractor.
- 3) **Criminal Liability:** If the Principal/Owner obtains knowledge of conduct of a Bidder

or Contractor, or of an employee or a representative or an associate of a Bidder or Contractor which constitutes corruption within the meaning of IPC Act, or if the Principal/ Owner has substantive suspicion in this regard, the Principal/Owner will inform the same to law enforcing agencies for further investigation.

Article 4: Previous Transgression

- 1) The Bidder declares that no previous transgressions occurred in the last 5 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the Tender process.
- 2) If the Bidder makes incorrect statement on this subject, he can be disqualified from the Tender process or action can be taken for banning of business dealings/ holiday listing of the Bidder/ Contractor as deemed fit by the Principal/ Owner.
- 3) If the Bidder/Contractor can prove that he has resorted / recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal/Owner may, at its own discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Bidders/Contractors/Subcontractors

- 1) The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact. The Bidder/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its Sub- contractors/sub-vendors.
- 2) The Principal/Owner will enter into Pacts on identical terms as this one with all Bidders and Contractors.
- 3) The Principal/Owner will disqualify Bidders, who do not submit, the duly signed Pact between the Principal/Owner and the bidder, along with the Tender or violate its provisions at any stage of the Tender process, from the Tender process.

Article 6- Duration of the Pact

This Pact begins when both the parties have legally signed it. It expires for the Contractor/Vendor 12 months after the completion of work/handing over of works under the contract or till the continuation of defect liability period and Operation & Maintenance period, whichever is more and for all other bidders, till the Contract has been awarded.

If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged/determined by the Competent Authority, IPC/HLL.

Article 7- Other Provisions

- 1) This Pact is subject to Indian Law, place of performance and jurisdiction in the National Capital Territory of DELHI.
- 2) Changes and supplements need to be made in writing. Side agreements have not been made.
- 3) If the Contractor is a partnership or a consortium, this Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partners and consortium members. In case of a Company, the Pact must be signed by a

representative duly authorized by board resolution.

- 4) Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.
- 5) It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Agreement / Pact, any action taken by the Owner/Principal in accordance with this **Integrity Agreement/ Pact or interpretation thereof shall not be subject to arbitration.**

Article 8- LEGAL AND PRIOR RIGHTS

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender/Contact documents with regard any of the provisions covered under this Integrity Pact.

IN WITNESS WHEREOF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

..... (For and on behalf of Principal/Owner)

..... (For and on behalf of Bidder/Contractor)

WITNESSES:

1..... (signature, name and address)

2..... (signature, name and address)

Place:

Dated :

SECTION-IV

SCOPE OF WORK

1. Project constitutes **“Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh”** including Civil, Electrical Services, HVAC, Lifts, Plumbing and Fire Fighting System etc.
2. The Project site is available and located at **Sector-23, Raj Nagar, Ghaziabad-201 002**.
3. The Contractor is to build as per detailed engineering design and drawing prepared separately.
4. Detailed engineering design including architectural design, structural design, design for all services, landscaping design, electrical services design & drawings, internal telecommunication and networking, fire detection and protection systems design (where required) & drawings and design & drawings for water supply & PHE etc will be supplied by the client/HLL or agency nominated by the client/HLL.
5. The surveyed site plan and Master plan along with the report of geotechnical investigation will be made available to finally selected Contractor.
6. The activities to be carried out for the completion of the Project shall include the following and any additional activities incidental to these:
 - i. Buildings as specified.
 - ii. Internal and external services as per drawings
 - iii. Co-ordination with concerned statutory authorities for obtaining all approvals / permissions / NOCs/ permits of the statutory / local / governmental agencies as required during construction and upon completion.
 - iv. Submission of the completion (i.e. ‘as-built’) drawings and other related documents, both a hard copy and the soft copy in Auto CAD pertaining to service lines for all the components of the building e.g. Water supply, sewer lines, internal electrification, Fire Fighting, HVAC etc. or any other IT application used for the purpose.
 - v. Co-ordination with statutory authorities/ local bodies/Governmental agencies for obtaining occupancy certificate and related NOC’s from statutory/ local/ governmental agencies related to service connections. Payments for statutory approvals as per the approved norms will be reimbursed by the IPC/HLL as per actual payments on production of payment receipts.
 - vi. On account of security consideration and residential areas in the vicinity, there could be some restrictions on the working hours, movement of vehicles for transportation of materials and location of labour camp. The contractor shall be bound to follow all such restrictions and adjust the programme for execution of work accordingly.
 - vii. The contractor has to ensure co-ordination with the authorities to maintain smooth disruption free working during the execution of work. This may require working rescheduling the normal working hours, working in restricted period etc. Nothing extra shall be payable on this account.

- viii. He shall also ensure that all work sites within the complex are properly cordoned off by means of barricades and screens upto a height of 3.0 m above ground level. The contractor shall use painted CGI sheets which are in good condition mounted on steel props.
- ix. Stacking of materials and excavated earth including its disposal shall be done as per the directions of the Engineer-in-Charge. Double handling of materials or excavated earth if required shall have to be done by the contractor at his own cost.

7. Approvals Required

The Contractor shall co-ordinate with relevant statutory authorities for obtaining all necessary approvals from Municipal and other local bodies including Municipal bodies, Water supply agencies concerned, Electric Supply and inspectorate. Agencies concerned, Police and Security Agencies, Chief Controller of Explosives, Fire Department, Civil Aviation Department, concerned in accordance to prevailing rules, Building Bye-Laws etc., as the case may be w.r.t Construction/Completion. Statutory payment on this account will be reimbursed by the client at actual on production of payment receipts.

The approvals shall include the following in addition to any other approvals which may be required for the project.

- Construction Permit if required
- NOC from Chief Fire Officer
- NOC from Lift Inspector where lifts are provided
- Occupancy certificate

Client/HLL may, at the written request of the Contractor, assist him in obtaining the approvals from relevant authorities. However any such request by the Contractor shall not bind the Client/HLL in any manner.

SECTION V

EVALUATION PROCESS

5.1 Evaluation Process:

The Bids will be evaluated in the following stages:

- i. Stage 1- Technical Evaluation
- ii. Stage 2- Financial Evaluation.

5.2 Stage 1-Technical Evaluation

- i. The technical Bids shall be evaluated as per criteria mentioned in the NIB.
- ii. The technical Bid shall be evaluated by the Evaluation Committee based on the qualification criteria laid down. The financial Bid of only those Bidders who are technically qualified shall be opened.
- iii. The financial Bids of Bidders whose technical Bids are found unacceptable shall be returned unopened.
- iv. IPC/HLL shall notify all the technically qualified Bidders of their technical qualification indicating the date, time and venue for opening of financial Bids.

5.3 Stage II-Financial Evaluation

- i. The financial bid of all the eligible bidders i.e. whose technical bids are found in order, shall be opened the decision of IPC/HLL will be final and binding.
- ii. The date and time of opening of financial bids shall be decided by the client/HLL which will be intimated to all eligible bidders.
- iii. Evaluation Committee shall open the financial Bid of the technically qualified Bidders in the presence of the Bidders/their authorized representative, who choose to attend, at the scheduled date and time.
- iv. On opening the financial Bids, the Evaluation Committee shall read out the financial Bid to all the Bidders and note the same.
- v. The Evaluation Committee shall correct arithmetic errors, if any and sign the same. If any discrepancy is found between the amount in figures and the amount in words, the amount in words shall prevail, for calculating/ correcting amounts of such items.
- vi. Only rates quoted shall be considered. Any tender containing percentage below/above the rates quoted is liable to be rejected. Rates quoted by the contractor in item rate tender in figures and words shall be accurately filled in so that there is no discrepancy in the rates written in figures and words. However, if a discrepancy is found, the rates, which correspond with the amount worked out by the contractor, shall, unless otherwise proved, be taken as correct. If the amount of an item is not worked out by the contractor or it does not correspond with the rates written either in figures or in words then the rates quoted by the contractor in words shall be taken as correct. Where the rates quoted by the contractor in figures and in words tally but the amount is not worked out

correctly, the rates quoted by the contractor will, unless otherwise proved, be taken as correct and not the amount.

- vii. Use of correcting fluid, anywhere in tender document is not permitted. Such tender is liable for rejection.
- viii. In event no rate has been quoted for any item(s), leaving space both in figures(s), word(s), and amount blank, it will be presumed that the contractor has included the cost of this/these item(s), in other items and rate for such item(s) will be considered as zero and work will be required to be executed accordingly.
- ix. All rates shall be quoted on the tender form. The amount for each item should be worked out and requisite totals given. Special care should be taken to write the rates in figures as well as in words and the amount in figures only, in such a way that interpolation is not possible. The total amount should be written both in figures and in words. In case of figures, the word 'Rs.' should be written before the figure of rupees and word 'P' after the decimal figures, e.g. 'Rs. 2.15 P' and in case of words, the word, 'Rupees' should precede and the word 'Paise' should be written at the end. Unless the rate is in whole rupees and followed by the word 'only' it should invariably be upto two decimal places. While quoting the rate in schedule of quantities, the word 'only' should be written closely following the amount and it should not be written in the next line.
- x. In the case of any tender where unit rate of any item/items appear unrealistic, such tender will be considered as unbalanced and in case the tender is unable to provide satisfactory explanation, such a tender is liable to be disqualified and rejected.
- xi. All the financial Bids shall be ranked according to the financial Bid with the Bidder quoting the least amount ranked L1, Bidder quoting next higher figure as L2 and so on.
- xii. L1 will be treated as Successful Bidder and his offer will be processed further.

5.4 Letter of Award:

The Successful Bidder would be notified in writing by IPC/HLL by issuing the Letter of Award (LOA) in favour of the successful Bidder.

Annexure -I Checklist

CHECK LIST OF DOCUMENTS TO BE SUBMITTED WITH THE BID

TECHNICAL PACKAGE - Part 1			
Sl.No.	Name of Document	No. of sets to be submitted	No. of sets submitted
1	Form of Bid and Appendix thereof (Form A)	Original	
2	Bid Security (Form B) in separate sealed envelope	Original & Copy	
3	Power of attorney for individuals signing on behalf of Bidders(Form E)	Original & Copy	
4	Initialed BID documents	Original	
TECHNICAL PACKAGE - Part 2			
1	Form “T-1” (Financial Information)		
2	Form “T-2” (Details of works..... as on 29 Feb 2012)		
3	Form “T-3” (Project under execution of award)		
4	Form “T-4” (Performance Report of Works)		
5	Form “T-5” (Structure and Organization)		
6	Form “T-6” (Details of Technical & Administrative personnel)		
7	Form “T-7” (Details of Construction Plant for carrying out the work)		
8	Form T-8 Criteria for Evaluation of Performance		
FINANCIAL PACKAGE COMPRISING OF:			
1	Financial bid in separate sealed cover		
Note:- Number of sets to be submitted under technical package- Part-II (Sr. Nos. 1 to 8) and Financial Package shall be “Original & Copy” i.e. two numbers.			

Form A- Form of Bid and AppendixFORM OF BID

Name of the Work: Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh

To

The Principal Chief Engineer (ID-North)
HLL Lifecare Ltd
B14A, Sector 62, NOIDA-201307
For & on behalf of
The Secretary-cum-Scientific Director,
Indian Pharmacopoeia Commission, Ghaziabad (UP)

Sub : Submission of Proposal

Having visited the Site, ascertained the Site conditions and examined the General Conditions of Contract as well as Special Conditions of Contract, Notice Inviting Bids, Instructions to Bidders etc. and addenda for the above project, we the undersigned, are pleased to submit our technical and financial Bid along with relevant documents.

1. We acknowledge that the Appendix forms an integral part of the Bid.
2. While preparing this Bid, we have gathered our own information and conducted our own inquiry/survey to our satisfaction and we did not rely solely on the information provided in this BID. We shall not hold IPC/HLL responsible on any account in this regard.
3. We undertake, if our Bid is accepted, we shall commence the works within the stipulated time and to complete the whole of the works comprised in the Contract within the stipulated time calculated from the start date.
4. If our Bid is accepted, we will furnish a bank guarantee as Performance Guarantee for the due performance of the Contract. The amount and form of such guarantee or bond will be in accordance with as given in the General Conditions of the Contract.
5. We are aware that in the event of delay in execution of the Project, beyond the agreed timelines due to reasons attributable to us, liquidated damages shall be recovered from us as per the conditions of the contract.
6. Our Bid is valid for your acceptance for a period of ONE HUNDRED AND EIGHTY DAYS (180 days) from the last date of submission of the Bid or any extension thereto by us.
7. We agree to the General Conditions of Contract and Special Conditions of Contract and the terms and conditions mentioned in the Bid Documents.
8. We hereby certify that all the statements made and information supplied and accompanying statements are true and correct.

9. We declare and confirm that before submission of this Bid, no agent, middleman or any intermediary has been, or will be engaged to provide any services, or any other item of work related to the award of this Contract. We further confirm and declare that no agency commission or any payment, which may be construed as an agency commission has been, or will be, paid and that the Bid price does not include any such amount. We acknowledge the right of IPC/HLL to declare our Bid to be non-compliant and if the Contract has been awarded to declare the Contract null and void, if it finds anything contrary to this declaration.
10. We understand that you are not bound to accept the lowest or any Bid you may receive.
11. If our Bid is accepted we understand that we are to be held solely responsible for the due performance of the Contract.
- 12. We enclose;**
- All documents as per the checklist
 - Bank guarantee for Rs _____ (Rupees _____ only) issued by _____ (name of the bank) valid until _____ towards EMD/Bid Security.

- Note:
- The Appendix forms part of the Bid
 - Bidders are required to fill up all the blank spaces in this form of Bid and Appendix.

Dated this.....day of.....**2015**

Signature

Name..... in the capacity of

duly authorized to sign Bids for and on behalf of.....

Address

.....

.....

Witness – Signature

Name

Address

.....

.....

Appendix**Form A****APPENDIX TO THE FORM OF BID**

i.	a. Amount of Performance Guarantee to be deposited by financially successful bidder.	As per Clause 1 of GCC
	b. Amount of Security Deposit	As per Clause 1A of GCC
ii.	Date for commencement of work	30 days from letter of award.
iii.	Time for completion	15 Months from date of Commencement of work
iv.	Amount of liquidated damages in case of extension of completion date due to delays by the Contractor	As Given in G.C.C.
v.	Defects Liability Period from the date of issue of "Taking-over certificate"	12 months
vi.	Period of validity of Performance Security	6 months beyond Defects Liability Period
vi.	c. Period of validity of Performance Guarantee	As per Clause 1 of GCC
	d. Period of validity of Security Deposit	As per GCC

Signature
(Authorized Signatory)

Date

Name

Place

Address

Form BFORMAT FOR EMD(BID SECURITY)

KNOW ALL MEN by these presents that we (Name of Bank) having our registered office at (Name of country) (hereinafter called “the Bank”) are bound unto HLL Lifecare Limited, B-14A, Sector-62, Noida-201307 U.P., in the sum of Rs. _____ for which payment will and truly to be made to the said Client (IPC /HLL), the bank binds itself, its successors and assigns by these presents.

WHEREAS.....(Name of Bidder) (hereinafter called “the Bidder”) has submitted its Bid dated _____ for “Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh”

AND WHEREAS the Bidder is required to furnish a bank guarantee for the sum of Rs. _____ (Rupees _____ Only) as Bid Security against the Bidder’s offer as aforesaid.

AND WHEREAS _____ (Name of Bank) have, at the request of the Bidder, agreed to give this guarantee as hereinafter contained.

1. We further agree as follows :

- 1.1 That the client (IPC /HLL), may without affecting this guarantee grant time or other indulgence to or negotiate further with the Bidder in regard to the conditions contained in the said Bid and thereby modify these conditions or add thereto any further conditions as may be mutually agreed upon between the client (IPC /HLL) and the Bidder.
- 1.2 That the guarantee herein before contained shall not be affected by any change in the constitution of our bank or in the constitution of the Bidder.
- 1.3 That any account settled between the client (IPC /HLL) and the Bidder shall be conclusive evidence against us of the amount due hereunder and shall not be questioned by us.
- 1.4 That this guarantee commences from the date hereof and shall remain in force till _____ (date to be filled up)
- 1.5 That the expression ‘the Bidder’ and ‘the Bank’ herein used shall, unless such an interpretation is repugnant to the subject or context, include their respective successors and assigns.

2. The conditions of this obligation are :

- a) if the Bidder withdraws his Bid during the period of Bid Validity, or
- b) if the Bidder does not accept the correction of his Bid Price as corrected by the evaluation committee
- c) if the Bidder having been notified of the acceptance of his Bid by the client (IPC /HLL) during the period of Bid Validity :
 - i. fails or refuses to furnish the required Performance Guarantee for the amount equal to 5% of the Contract price and/ or

- ii. fails or refuses to enter into a Contract within 30 days of issue of Letter of Award by the Client (IPC/HLL)

We undertake to pay to the client (IPC/HLL) up to the above amount upon receipt of his first written demand, without the client (IPC/HLL) having to substantiate his demand provided that in his demand the client (IPC/HLL) will note that the amount claimed by him is due to him owing to the occurrence of any one or more of the conditions (a), (b), (c) mentioned above, specifying the occurred condition or conditions.

	Signature of Authorized Official of the Bank
Signature of the witness	Name of Official Designation
Name of the Witness	Stamp/Seal of the Bank
Address of the Witness	

Form-CFORM OF PERFORMANCE GUARANTEE

This deed of guarantee made this day of _____ between Bank of _____ (hereinafter called the "Bank") of the one part, and the Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh (hereinafter called "IPC") of the other part.

Whereas Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh (IPC), has awarded the Contract "Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh" to _____ (Name of the Contractor)

AND WHEREAS the Contractor is bound by the said Contract to submit to IPC a Performance Guarantee for a total amount of Rs. _____ (Rupees _____ only) (Amount in figures and words).

1. Now we the undersigned _____ (Name of the Bank) being fully authorized to sign and to incur obligations for and on behalf of and in the name of _____ (Full name of Bank), hereby declare that the said Bank will guarantee IPC the full amount of Rs. _____ (Rupees _____ only) (Amount in figures and Words) as stated above.
2. After the Contractor has signed the afore mentioned Contract with IPC/HLL, the Bank is engaged to pay IPC/HLL, any amount up to and inclusive of the aforementioned full amount upon written order from IPC/HLL to indemnify IPC/HLL for any liability of damage resulting from any defects or shortcomings of the Contractor or the debts he may have incurred to any parties involved in the works under the Contract mentioned above, whether these defects or shortcomings or debts are actual or estimated or expected. The Bank will deliver the money required by IPC immediately on demand without delay without reference to the Contractor and without the necessity of a previous notice or of judicial or administrative procedures and without it being necessary to prove to the Bank the liability or damages resulting from any defects or shortcomings or debts of the Contractor. The Bank shall pay to IPC/HLL any money so demanded not withstanding any dispute/disputes raised by the Contractor in any suit or proceedings pending before any Court, Tribunal or Arbitrator/s relating thereto and the liability under this guarantee shall be absolute and unequivocal.
3. This guarantee is valid till _____ (date to be mentioned) (six months beyond the end of expected Defects Liability Period or the extended period, thereof)

At any time during the period in which this guarantee is still valid, if IPC/HLL agrees to grant a time extension to the Contractor or if the Contractor fails to complete the Works within the time of completion as stated in the Contract, or fails to discharge himself of the liability or damages or debts as stated under Para 2, above, it is understood that the Bank will extend this Guarantee under the same

conditions for the required time on demand by IPC/HLL and at the cost of the Contractor.

4. The Guarantee shall be interpreted in accordance with the laws of India.
5. The Bank represents that this Bank Guarantee has been established in such form and with such content that is fully enforceable in accordance with its terms as against the Guarantor Bank in the manner provided herein.
6. This Bank Guarantee shall not be affected in any manner by reason of merger, amalgamation, restructuring or any other change in the Constitution of the guarantor Bank or of the Contractor.
7. The neglect or forbearance of IPC/HLL in enforcement of payment of any moneys, the payment whereof is intended to be hereby secured or the giving of time by IPC/HLL for the payment hereof shall in no way relieve the bank of their liability under this deed.
8. The expressions "IPC/HLL", "the Bank" and "the Contractor" herein before used shall include their respective successors and assigns.

In witness whereof I/We of the bank have signed and sealed this guarantee on the -
----- day of ----- (Month) **2015** being herewith duly authorized.

For and on behalf of the.....Bank.

Signature of authorized bank official

Name:

Designation:

Stamp/Seal of the Bank:

Signed, sealed and delivered for and on behalf of the Bank by the above
named _____ in the presence of :

Witness 1

Signature

Name

Address

.....

Witness 2

Signature

Name

Address

Form D**(To be furnished on a Non Judicial Stamp Paper of appropriate value)****FORM OF CONTRACT AGREEMENT**

This agreement is made at _____ on the ---- day of ----- 2015 between Shri -----, The Secretary-cum-Scientific Director, Indian Pharmacopoeia Commission, Ghaziabad (UP) having its office at Ghaziabad (UP), (hereinafter called “Client” which expression shall, unless repugnant to the context or meaning thereof be deemed to mean and include its successors, legal representatives and assigns) of the **First Part.**

Second Part

M/s ----- a Company incorporated under the Companies Act 1956 having Head Office at -----, (hereinafter called the “Contractor” which expression unless repugnant to the context shall mean and include its successors-in-interest assigns etc.) of the **Second Part.**

Whereas IPC is desirous that certain works should be executed, for “**Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh**” hereinafter called the “The Project” and has accepted a Tender submitted by the contractor for the execution and completion of such works as well as guarantee of such works and the remedying of defects therein. NOW THIS AGREEMENT WITHNESSTH as follows:

1. In this agreement words and expression shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and construed as part of this agreement Viz.

Volume – I (NIT& ITB)

- Notice Inviting Tender
- Instruction to Bidders

Volume- II (GCC and SCC)

- General Conditions of Contract(GCC)
- Special Conditions of Contract (SCC)

Volume – III (TS)

- Technical Specifications(TS)

Volume – IV (BOQ)

- (Financial bid and Bill of Quantities)

All the correspondence till award of contract i.e. addendum, LOA etc.

Technical and Financial bids submitted by bidder.

3. In consideration of the payment to be made by IPC to the Contractor as hereinafter mentioned, the Contractor hereby covenants with IPC to execute and complete the Project “**Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh**” and remedy and defects therein in conformity in all respects with the provisions of the Contract.

IPC hereby covenants to pay the Contractor in consideration of the execution and completion of the Project and the remedying of defects therein, the total Contract Price of Rs. -----

----- only) being the sum stated in the Letter of Award (LOA) subject to such additions thereto or deductions there from as may be made under the provisions of the Contract at the times and in the manner prescribed by the Contract.

4. OBLIGATION OF THE CONTRACTOR

The Contractor shall ensure full compliance with tax laws of India with regard to this Contract and shall be solely responsible for the same. The contractor shall keep IPC / HLL fully indemnified against liability of tax, interest, penalty etc, of the Contractor in respect thereof, which may arise.

IN WITNESS OF WHEREOF the parties hereto have caused their respective common seals to be hereunto affixed / (or have hereunto set their respective hands and seals) the day and year first above written.

For and on behalf of the Contractor

Signature of the authorized official

Name of the Contractor
Stamp / Seal of the Contractor
official

For and on behalf of the
Secretary-cum-Scientific Director,
IPC, Ghaziabad (UP)

Signature of the authorized
official

Name of the authorized official
Stamp / Seal of authorized

SIGNED, SEALED AND DELIVERED

By the said

On behalf of the Contractor in

In the presence of:

Witness

Name

Address

By the Said

On behalf of the Secretary-cum-
Scientific Director, IPC, Ghaziabad
(UP)

In the Presence of

Witness

Name

Address

Form EFormat for Power of Attorney for authorized signatory**FORMAT FOR POWER OF ATTORNEY FOR SIGNING OF PROPOSAL**

Know all men by these presents, We.....(Name of the Tenderer and address of their registered office) do hereby constitute, appoint and authorize Mr / Ms.....(name and residential address of Power of Attorney holder) who is presently employed with us and holding the position of

As our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our Bid for the Project and submission of all documents and providing information / responses to IPC/HLL, representing us in all matters before IPC/HLL, and generally dealing with IPC/HLL in all matters in connection with our proposal for the said Project.

We hereby agree to ratify all acts, deeds and things lawfully done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

Signature:

Name and Designation:

FORM G**LITIGATION HISTORY**

**Name of Applicant or partner of a joint venture
(NOT PERMITTED)**

Applications including each of the partners of a joint venture should provide information on any history of litigation or arbitration resulting from contracts executed in the last five years or currently under execution. A separate sheet should be used for each partner of a joint venture.

Year	Award FOR or AGAINST Applicant	Name of Client, cause of litigation and matter in dispute	Disputed amount (current value in INR)	Actual Awarded Amount (in INR)

FORM H**UNDERTAKING**

We do hereby undertake to engage a specialized agency after approval of IPC/HLL Lifecare Limited for undertaking the execution of respective E&M components of **“Construction of State of the Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh”** whose minimum qualifications shall be as under:

- i. Specialized agency of appropriate class meeting the eligibility requirements as per CPWD norms eligible to bid for these respective components individually. For lifts, associated agency shall be from category “A” as per approved list by CPWD.
- ii. The specialized agencies shall have a valid license from competent authority in the respective field.
- iii. I/We shall be solely responsible for quality and successful execution/performance of the completed works by such agencies.
- iv. I shall enter into work specific agreement/ MoU with the agency/ agencies approved by IPC/HLL, supply a copy of such MoU/ Agreement to IPC/HLL and retain them till completion of works in the said field.

Authorized Signature of bidder with stamp

Form K

AFFIDAVIT

I, the undersigned, do hereby certify that the statements made in the required attachments are true and correct.

The undersigned also hereby certifies that our firm M/S have neither abandoned any contract awarded to us nor such work have been rescinded, during last five years prior to date of application.

The undersigned hereby authorize (s) and request (s) any bank , person, firm or corporation to furnish pertinent information deemed necessary and requested by the IPC/HLL to verify this statement or regarding my (our) competence and general reputation.

The under signed understands and agrees that further qualifying information may be requested, and agrees to furnish any such information at the request of the IPC/HLL.

Signed by the Authorized officer of the firm

FORM 'T-1'**FINANCIAL INFORMATION**

- 1. Financial Analysis**-Details to be furnished duly supported by figures in balance sheet/ profit & loss account for the last five years duly certified by the Chartered Accountant, as submitted by the applicant to the Income tax Department (Copies to be attached) and duly certified by the Chartered Accountant mentioning the membership number issued by ICAI along with full address.

i) Gross Annual Turnover on construction works for last five years ending 31.03.2014

ii) Profit / Loss for last five years ending 31.03.2014

Financial arrangements for carrying out the proposed work.

Solvency certificate from Bankers of the **bidder in the prescribed Form "T-1 B"**.

Signature of Chartered Accountant with Seal

Signature of Bidder (s).

FORM 'T-1 B'**FORM OF BANKERS' CERTIFICATE FROM A SCHEDULED BANK**

This is to certify that to the best of our knowledge and information that M/s./Shri having marginally noted address, a customer of our bank are/is respectable and can be treated as good for any engagement upto a limit of Rs. (Rupees.....). This certificate is issued without any guarantee or responsibility on the bank or any of the officers.

(Signature)
For the Bank

NOTE:-

- (1) Bankers certificates should be on letter head of the Bank, sealed in cover addressed to tendering authority.
- (2) In case of partnership firm, certificate should include names of all partners as recorded with the bank.

FORM - 'T - 2'**DETAILS OF WORKS OF SIMILAR NATURE COMPLETED**

**DURING THE LAST SEVEN YEARS ENDING LAST DAY OF THE MONTH PREVIOUS
TO THE ONE IN WHICH THE BIDS ARE INVITED**

Sl. No	Name of Work/ Project& location	Owner of sponsoring Organization	Cost of Work In Lakh)*	Date of Commencement As per contract	Stipulated Date of completion	Actual date of completion	Litigation/ Arbitration Pending/ in Progress with details**	Name & address/ Telephone No. of officer to whom reference may be made	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

* Indicate gross amount claimed and amount awarded by the Arbitrator.

** Copy of work orders of the above works should also be submitted

Signature of Bidder(s)

FORM 'T - 3'**PROJECT UNDER EXECUTION OR AWARDED**

Sl. No	Name of Work/ Project & location	Owner of sponsoring Organization	Cost of Work	Date of Commencement As per contract	Stipulated Date of completion	Up-to-date Percentage Progress of work	Slow Progress, if any, & reasons thereof	Name & address/ Telephone No. of officer to whom reference may be made	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Certified that above lists of works is complete and no work has been left out and that the information given is correct to my knowledge and belief.

Signature of Bidder(s)

FORM 'T - 4'

PERFORMANCE REPORT OF WORKS
from Owner/Sponsoring organization/ Department referred to
IN FORM "T-2" TO "T-3"

01.	Name of work / Project & Location	
02.	Agreement No.	
03.	Bided Cost	
04.	Executed Cost	
05.	Date of Start	
06.	Date of completion :	
	i) Stipulated date of completion	
	ii) Actual date of completion	
07.	Amount of compensation levied for delayed completion, if any	
08.	Amount of reduced rate items, if any	
09.	Performance Report :	
	a) Qualify of work	Very Good / Good / Fair / Poor
	b) Financial soundness	Very Good / Good / Fair / Poor
	c) Technical Proficiency	Very Good / Good / Fair / Poor
	d) Resourcefulness	Very Good / Good / Fair / Poor
	e) General behavior	Very Good / Good / Fair / Poor

Dated: _____

Signatures of
Authorized Signatory
Official Seal of owner/sponsoring organization/ Department

Form 'T – 5'**STRUCTURE & ORGANIZATION**

01.	Name & Address of the applicant	
02.	Telephone No. / Telex / Fax No.	
03.	Legal status of the applicant (attach copies of original document defining the legal status)	
	a) An Individual	
	b) A proprietary firm	
	c) A firm in partnership	
	d) A limited company or Corporation	
04.	Particulars of registration with various Government bodies (attach attested photocopy)	
	<u>Organization / Place of Registration :</u>	
	1.	
	2.	
	3.	
05.	Names and Titles of Directors & Officers with designation to be concerned with this work	
06.	Designation of individuals authorized to act for the organization.	
07.	Was the applicant ever required to suspend construction for a period of more than six months continuously after commencement? If so, give the name of the project and reasons of suspension of work.	
08.	Has the applicant or any constituent partner in case of partnership firm, ever abandoned the awarded work before its completion? If so, give name of the project and reasons for abandonment.	
09.	Has the applicant or any constituent partner in case of partnership firm, ever been debarred/ black-listed for Biding in any organization at any time? If so, give details.	
10.	Has the applicant or any constituent partner in case of partnership firm, ever been convicted by a Court of Law? If so, give details.	
11.	In which field of Civil Engineering construction the applicant has specialization and interest?	
12.	Any other information considered necessary but not included above.	

Signature of Bidder(s)

Form 'T – 6'

**DETAILS OF TECHNICAL & ADMINISTRATIVE
PERSONNEL PROPOSED TO BE EMPLOYED FOR THE WORK**

Sl. No	Designation	Total Number	Number Available For this Work	Name	Qualification	Professional experience and details of work carried out	How these would be involved in this work	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

Signature of Bidder(s)

FORM 'T - 7'**DETAILS OF CONSTRUCTION PLANT AND EQUIPMENT LIKELY TO BE USED IN
CARRYING OUT THE WORK**

Sl.No.	Name of Equipment	Nos.	Capacity of Type	Age	Condition	Ownership Status			Current Location	Remarks
						Presently owned	Leased	To be Purchased		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Earth Moving Equipment :										
1	Excavator (various sizes)									
Equipment for Hoisting & Lifting										
1	Tower									
2	Builder's Hoist									
Equipment of concrete work										
1.	Concrete batching plant									
2.	Concrete pump									
3.	Concrete transit mixer									
4.	Concrete mixer (diesel)									
5.	Concrete mixer (electrical)									
6.	Needle vibrator (electrical/ Petrol)									
7.	Table vibrator (electrical/ Petrol)									
Equipment for building work										
1.	Bar bending machine									
2.	Bar cutting machine									
3.	Welding generators									

4.	Vibration Compactor									
5.	Welding transformers									
6.	Cube testing machines									
7.	M.S. Pipes									
8.	Steel Shuttering									
Equipment for transportation :										
1	Tippers									
2	Trucks									
Pneumatic equipment :										
1	Air compressors (diesel)									
Dewatering equipment										
1	Pump (diesel)									
2	Pump (electric)									
Power equipment :										
1	Diesel generators									
Any other equipment/s										

Signature of Bidder(s)
)

Form 'T-8'						
CRITERIA FOR EVALUATION OF THE PERFORMANCE OF CONTRACTORS FOR PRE- ELIGIBILITY						
	ATTRIBUTES		EVALUATION			
(a)	Financial Strength (20 Marks)					
	(i) Average Annual Turnover (16 Marks)		(i) 60% marks for minimum eligibility criteria			
	(ii) Solvency Certificate (4 Marks)		(ii) 100% marks for twice the minimum eligibility criteria or more			
			In between (i) & (ii) – on pro rata basis			
(b)	Experience of similar class of works (20 marks)					
			(i) 60% marks for minimum eligibility criteria			
			(ii) 100% marks for twice the minimum eligibility criteria or more			
			In between (i) & (ii) – on pro rata basis			
(c)	Performance on works (Time over run) (20 Marks)					
	Parameter	Calculation for Point	Score			
			1.0	2.0	3.0	>3.50
		If TOR=	20	15	10	10
	(i) Without Levy of compensation		20	5	0	-5
	(ii) With Levy of compensation		20	10	0	0
	(iii) Levy of compensation not decided		20	10	0	0
	TOR = AT/ ST, where AT = Actual Time; ST = Stipulated Time					
	Note: - Marks for value in between the stages indicated above is to be determined by straight line variation method.					
(d)	Performance of Works (Quality) (15 Marks)		Performance		Marks	
			Very Good		15	
			Good		10	
			Fair		5	
			Poor		0	
(e)	Personnel & Establishment (10 Marks)					
	i	Graduate Engineer	3 marks for each upto max. 3 marks			
	ii	Diploma Holder Engineer	2 marks for each upto max. 4 marks			
	iii	Supervisory/ Foreman	1 mark for each upto max. 3 marks			
(f)	Plant & Equipment (15 Marks)					
	i	Hopper Mixer	1 mark for each upto Max. 2 marks			
	ii	Truck/Tippers/Transit mixer	1 mark for each upto Max. 2 marks			
	iii	Steel shuttering	2 marks for each 800 sqm upto, Maximum 4 marks			
	iv	Tower Crane	1 mark for each upto Max. 2 marks			
	v	Building Hoist	1 mark for each upto Max. 2 mark			
	vi	Excavator	1 mark for each upto Max. 2 mark			
	vii	Batch Mix Plant	1 mark for each upto Max. 2 mark			
	viii	Vibration Compactor	1 mark for each upto Max. 1 mark			
	viii	Concrete Pumps	1 mark for each upto Max.2 mark			
	Bidders qualifying the initial criteria as set out in para 1.4 above will be evaluated for following criteria by scoring method on the basis of details furnished by them.					
a	Financial strength (Form 'A' & 'B') –					Maximum 20 marks
b	Experience in similar nature of work during last five years (Form 'C')					Maximum 20 marks
c	Performance on works (Form 'E') – Time over run					Maximum 20 marks

d	Performance on works (Form 'E') – Quality	Maximum 15 marks
e	Personnel and Establishment (Form "F" & "G")	Maximum 10 marks
f	Plant & Equipment (form "H")	Maximum 15 marks
	Total -	100 marks
<p>Details of Technical & Administrative personnel employed with the firm should be given in the format T-6 and the bidder should indicate no. of technical / administrative personnel which will be deployed for the project. Further in format T-7, the bidder should specifically give the detail of only those plants and equipment which are to be exclusively deployed for the project</p> <p>To become eligible for shortlisting, the bidder must secure at least 50% marks in each attribute and minimum 60 % marks in aggregate. However, IPC/ HLL reserve the right to modify these criteria.</p>		

Indian Pharmacopoeia Commission
GHAZIABAD, U.P.
(An Autonomous Institution of Ministry of Health & Family Welfare)

Tender No. IPC/GZB/HLL/ID/2015

Request for Proposal (RFP)
for

**Construction of State of the Art Laboratory Building for Indian
Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh**

Volume – II

- General Conditions of Contract(GCC)
- Special Conditions of Contract(SCC)



B-14A, Sector – 62,
NOIDA (UP) -201307
Phone no: 0120-4071500,
Fax no: 0120-4071513

(May, 2015)

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Section -1
CONDITIONS OF CONTRACT

Definitions

1. The **Contract** means the documents forming the tender and acceptance thereof and the formal agreement executed between the competent authority as indicated in Schedule 'F' on behalf of the Indian Pharmacopoeia Commission(IPC) and the Contractor, together with the documents referred to therein including these conditions, the specifications, designs, drawings and instructions issued from time to time by the Engineer-in-charge and all these documents taken together, shall be deemed to form one contract and shall be complementary to one another.
2. In the contract the following expressions shall, unless the context otherwise requires, have the meanings, thereby respectively assigned to them:-
 - i) The **work(s)** shall, unless there be something either in the subject or context repugnant to such **construction**, be construed and taken to mean the works by or by virtue of the contract contracted to be executed whether temporary or permanent, and whether original, altered, substituted or additional.
 - ii) The **site** shall mean the land/ or place on, into or through which work is to be executed under the contract or any adjacent land, path or street through which work is to be executed under the contract or any adjacent land, path or street which may be located or used for the purpose of carrying out the contract.
 - iii) The **Accepting Authority** shall mean the authority mentioned in Schedule 'F'.
 - iv) The **Contractor** shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, or the successors of such firm or company and the permitted assignees of such individual, firm or company.
 - v) The **Department** means **Indian Pharmacopoeia Commission (An Autonomous Institution of Ministry of Health & Family Welfare) Raj Nagar, Ghaziabad, Uttar Pradesh** which invites tenders and shall include their legal representatives, nominee, employees and permitted agencies who invite tenders on behalf of IPC.
 - vi) The **Engineer-in-charge (EIC)** means the Engineer / Officer as mentioned in Schedule 'F' hereunder, authorized by the Department i.e. IPC/HLL, who shall supervise and be in charge of the work.
 - vii) The **IPC** means **Indian Pharmacopoeia Commission (An Autonomous Institution of Ministry of Health & Family Welfare) Raj Nagar, Ghaziabad, Uttar Pradesh**.
 - viii) The **Client** shall mean **Indian Pharmacopoeia Commission (An Autonomous Institution of Ministry of Health & Family Welfare) Raj Nagar, Ghaziabad, Uttar Pradesh** represented by a Designated Officer
 - ix) The **Consultant/ Project Consultant** shall mean consultant appointed by the Client for implementing of the Project i.e. HLL Lifecare limited, having its corporate office at HLL Bhavan, Poojappura, Thiruvannathapuram-695012, Kerala and its Regional Office at B-14A, Sec-62, NOIDA (U.P.)- 201307 (HLL).
 - x) The **Government or Government of India** shall mean Government of India shall include the Indian Pharmacopoeia Commission.
 - xi) The **Expected risk are** risks due to riots(other than those on account of the contractor's employees), war (whether declared or not) invasion, act of foreign enemies, hostilities, civil war, rebellion revolution, insurrection, military or usurped power, any act of Government, damage from aircraft, acts of God, such as earthquake, lighting and

unprecedented floods, and other causes over which the contractor has no control and accepted as such by the Accepting Authority or causes solely due to use or occupation by Government of the part of the works in respect of which a certificate of completion has been issued or a cause solely due to Government's faulty design of work.

- xii) **Market rate** shall be the rate as decided by Engineer-in-charge on the basis of the cost of materials and labour at the site where the work is to be executed plus the percentage mentioned in Schedule 'F' to cover, all overheads and profits.
- xiii) **Specifications** means the specification mentioned in Schedule 'F', and, included and / or referred to in the Tender document and any modification thereof or addition thereto as may from time to time be issued to the Contractor.
- xiv) **District Specifications** means the specifications followed by the State Government in the area where the work is to be executed.
- xv) **Schedule(s)** referred to in these conditions shall mean the relevant schedule(s) annexed to the tender papers or the standard Schedule of Rates of the Government mentioned in Schedule 'F' hereunder, with the amendments thereto issued up to the date of receipt of the tender.
- xvi) **Tendered Value** means the value of the entire work as stipulated in the letter of award.
- xvii) **Bill of Quantities or Schedule of items** means the schedule and quantities of items, materials and rates, summaries etc. priced and completed and as finally accepted.
- xviii) **Month** means calendar month without regard to the number of days worked or not worked in that month.
- xix) **Week** means seven calendar days without regard to the number of hours worked or not worked in any day in that week.
- xx) **Day** means a calendar day of 24 hours (beginning and ending at 00 hrs. and 24 hrs. Respectively) irrespective of number of hours worked or not worked in that day.
- xxi) **Act of Insolvency** shall mean any Act of Insolvency as defined by the Presidency Towns Insolvency Act or Provincial Insolvency Act or any Act amending such original.
- xxii) **Approved** means approved in writing, including subsequent written information of previous verbal approval and "approval" means approval in writing, including as aforesaid.
- xxiii) **As directed** means the direction given by the Engineer In-Charge/Client/ Consultant.
- xxiv) **Constructional Plant** means all appliances or things of whatsoever nature required in or about the execution or maintenance of the Works but does not include materials or other things intended to form or forming part of the Works.
- xxv) **Material** means the materials, apparatus, equipment, fittings, fixtures and all such other materials, which are incorporated in the work.
- xxvi) **Drawings** means the drawings prepared and issued by the Consultant and referred to in the tender and specifications and any modification of such drawings and such other drawings, calculations and technical information of a like nature as may, from time to time, be issued by the Consultant.
- xxvii) **I.S.** means latest revision of particular 'Indian Standards specification issued by Bureau of Indian Standards.
- xxviii) **Notice in writing or written notice** shall mean notice in written, typed or printed characters, sent (unless delivered personally or otherwise proved to have been received) by registered post to the site office/ last known private or business address or registered office of the addressee and shall be deemed to have been received when in the ordinary course of post it would have been delivered.

- xxix) **Permanent Works** means the permanent works to be executed (including Plant) in accordance with the Contract.
- xxx) **Temporary Works** means all temporary works of every kind required in or about the execution and completion or maintenance of the Works and the remedying of any defects therein.
- xxxi) **Urgent Works** means any urgent works which in the opinion of the Client and/or Consultant becomes necessary at the time of execution and/or during the progress of work to obviate any risk of accident or failure or to obviate any risk of damage to the structure of services or required to accelerate the progress of the work for which becomes necessary for safety and security or for any other reason the Client and or Consultant may find it necessary.
- xxxii) **Net Prices** If in arriving at the contract amount or contract sum, the Contractor shall have added or deducted from the total amount of the items in the Tender any sum, either as a percentage or otherwise, then the net price of any item in the tender shall be the sum arrived at by adding to or deducting from the actual figure appearing in the Tender as the price of that item and similar percentage or proportionate sum provided always that in determining the percentage or proportion of the sum so added or deducted by the Contractor, the total amount of any Prime cost items and provisional sums of money shall be deducted from the total amount of the tender. The expression "net rates" or "net prices" when used with reference to the contract or accounts shall be held to mean rates or prices so arrived at.

Scope and performance

- 3. Where the context so requires, words imparting the singular only also include the plural or vice versa. Any reference to masculine gender shall whenever required include feminine gender and vice versa.
- 4. Heading and Marginal notes to these General Conditions of Contract shall not be deemed to form part thereof or be taken into consideration in the interpretation or construction thereof or of the contract.
- 5. The contractor shall be furnished, free of cost one certified copy of the contract documents except standard specifications, Schedule of rates and such other printed and published documents, together with all drawings as may be forming part of the tender papers. None of these documents shall be used for any purpose other than that of this contract.

Languages & Law

- 6. The ruling language in which the Contract and related aspects shall be drawn up shall be English only. Law means- law as applicable to site of work.

Works to be carried out

- 7. The work to be carried out under the contract shall, except as otherwise provided in these conditions, include all labour, materials, tools, plants, equipment and transport which may be required in preparation of and for and in the full and entire execution and completion of the works. The description given in the Schedule of Quantities shall, unless otherwise stated, be held to include wastage of materials, cartage and carriage, carrying and return of empties, hoisting, setting, fitting and fixing in position and all other labour necessary in and for the full entire execution and completion of the work as aforesaid in accordance with good practice and recognized principles.

Sufficiency of tender

- 8. The contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his tender for the works and of the rates and price quoted in the Schedule of Quantities, which rates and price shall, except as otherwise provided,

cover all his obligations under the contract and all matters and things necessary for the proper completion and maintenance of the works.

Discrepancies and Adjustment of errors

9. The several documents forming the contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small scale drawings and figured dimensions in preference to scale and specific conditions in preference to general conditions.
- 9.1 In the case of discrepancy between the Schedule of Quantities, the Specifications and /or the Drawings, the following order of preference shall be observed.
- a) Description of Schedule of Quantities
 - b) Particular specification and Specific Condition, if any.
 - c) Drawings
 - d) CPWD Specifications
 - e) Indian Standard Specifications of B.I.S.
 - f) For items not covered by any of the above, the work shall be done, as per sound engineering practices and as directed by the Engineer-in-charge.
- 9.2 If there are varying or conflicting provisions made in any one document forming Part of the contract, Accepting Authority shall be deciding authority with regard to the intention of the document and his decision shall be final and binding on the Contractor.
- 9.3 Any error in description, quantity or rate in schedule of quantities or any omission there from shall not vitiate the contract or release the contractor from the execution of the whole or any part of the works comprised therein according to drawings and specifications or from any of his obligation under the contract.

Errors, Omissions and Discrepancies.

- 10.1 In case of errors, omissions and /or disagreement between written and scaled dimensions on the drawings or between the drawings and specifications, etc. the following order of precedence shall apply:
- i. Between scaled and written dimension (or description) on drawing, written dimension shall be adopted.
 - ii. Between the written or shown description or dimensions in the drawings and the corresponding one in the specification, the former shall be taken as correct.
 - iii. Between the written description of the item in the specifications and descriptions in the Bill of Quantities of the same item, the latter shall be adopted.
- 10.2 Between the duplicate/subsequent copies of the tender and original tender, the original tender shall be taken as correct.
- 10.3 All documents forming the Contract are to be taken as mutually explanatory of one another, but in case of ambiguity or discrepancies in conditions or specifications the same shall be explained and adjusted by Engineer-in-charge. In case the Contractor does not agree with the explanation given by the Engineer-in-charge, then the matter, on his written notice, will be referred to the Client and his decision shall be final and binding to the contractor.
- 10.4 In all cases of omissions and /or doubts or discrepancies in any of the items or specifications, a reference shall be made to the Engineer-in-Charge. Elucidation, elaboration or decision of the Engineer-in-charge shall be considered as authentic. The Contractor shall be held responsible for any error that may occur in the work through lack of such reference and precaution.

- 10.5 Any dispute arising due to typing mistakes/ omissions in the document shall be mutually discussed between Contractor and Engineer-in-charge and the decision of the Engineer-in-charge will be final and binding on the contractor in the matter.

Signing of Contract

11. The successful tenderer/contractor, on acceptance of his tender by the Accepting Authority, shall, within 30 days from the date of issue of LOA for the work, sign the contract consisting of documents as specified.
12. No payment for the work done will be made unless contract is signed by the contractor.

SECTION -2

CLAUSES OF CONTRACT

CLAUSE 1 Performance Guarantee

- (i) The contractor shall submit an irrevocable Performance Guarantee of 5% (Five per-cent) of the tendered value in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement, (not withstanding and / or without prejudice to any other provisions in the contract) within period specified in Schedule 'F' from the date of issue of letter of acceptance. This period can be further extended by the Engineer-in-Charge up to a maximum period as specified in schedule 'F' on written request of the contractor stating the reason for delays in procuring the Performance Guarantee, to the satisfaction of the Engineer-in-Charge. This guarantee shall be in the form of Cash (in case guarantee amount is less than Rs. 10,000/-) or Banker's Cheque of any scheduled bank/ Demand Draft of any scheduled bank/ Pay Order of any scheduled bank (in case guarantee amount is less than Rs. 1,00,000/-) or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the form annexed hereto.
- (ii) The Performance Guarantee shall be initially valid up to the stipulated date of completion plus 60 days beyond that. In case the time for completion of work gets enlarged, the contractor shall get the validity of Performance Guarantee extended to cover such enlarged time for completion of work. After recording of the completion certificate for the work by the competent authority, the performance guarantee shall be returned to the contractor, without any interest.
- (iii) The Engineer-in-Charge shall not make a claim under the performance guarantee except for amounts to which the Indian Pharmacopoeia Commission (IPC) is entitled under the contract (not withstanding and / or without prejudice to any other provisions in the contract agreement) in the event of:
 - a) Failure by the contractor to extend the validity of the Performance Guarantee as described herein above, in which event the Engineer-in-Charge may claim the full amount of the Performance Guarantee.
 - b) Failure by the contractor to pay Indian Pharmacopoeia Commission(IPC) any amount due, either as agreed by the contractor or determined under any of the Clauses / Conditions of the agreement, within 30 days of the service of notice to this effect by Engineer- in-Charge.
- (iv) In the event of the Contract being determined or rescinded under provision of any of the Clause / Condition of the agreement, the performance guarantee shall stand forfeited in full and shall be absolutely at the disposal of the Indian Pharmacopoeia Commission.

CLAUSE 1A Recovery of Security Deposit

The person / persons whose tender(s) may be accepted (hereinafter called the contractor) shall permit Government at the time of making any payment to him for work done under the contract to deduct a sum at the rate of 5% of the gross amount of each running bill till the sum along with the sum already deposited as earnest money, will amount to security deposit of 5% of the tendered value of the work. Earnest Money if deposited in the form of FDR/DD shall be adjusted first in the Security Deposit and further recovery of the Security Deposit shall commence only when the up to date amount of Security Deposit starts exceeding the Earnest Money. Such deductions will be made and held by Government by way of Security Deposit unless he / they has / have deposited the amount of Security at the rate mentioned above in case.

All compensations or the other sums of money payable by the contractor under the terms of this contract may be deducted from, or paid by the sale of a sufficient part of his security deposit or from the interest arising there from, or from any sums which may be due to or may become due to the contractor by Government on any account whatsoever and in the event of his Security Deposit being reduced by reason of any such deductions or sale as aforesaid the contractor shall within 10 days make good in cash or fixed deposit receipt tendered by the state Bank of India or by Scheduled Banks or Government Securities (if deposited for more than 12 months) endorsed in favour of the Engineer-in-Charge, any sum or sums which may have been deducted from, or raised by sale of his security deposit or any part thereof. The security deposit shall be collected from the running bills of the contractor at the rates mentioned above and the Earnest money deposited at the time of tenders will be treated as part of the Security Deposit.

The security deposit as deducted above can be released against bank guarantee issued by a scheduled bank, on its accumulations to a minimum of Rs.5 lakh subject to the condition that amount of such bank guarantee, except last one, shall not be less than Rs.5 lakh. Provided further that the validity of bank guarantee including the one given against the earnest money shall be in conformity with provisions contained in clause 17 which shall be extended from time to time depending upon extension of contract granted under provisions of Clause 2 and Clause 5.

CLAUSE 2 Compensation for Delay

If the contractor fails to maintain the required progress in terms of clause 5 or to complete the work and clear the site on or before the contract or extended date of completion, he shall, without prejudice to any other right or remedy available under the law to the HLL on account of such breach, pay as agreed compensation the amount calculated at the rates stipulated below as the authority specified in schedule 'F' (whose decision in writing shall be final and binding) may decide on the amount of the tendered value of the work for every completed day / month (as applicable) that the progress remains below that specified in Clause 5 or that the work remains incomplete.

This will also apply to items or group of items for which a separate period of completion has been specified.

- | | | |
|-----|--------------------------------|---|
| (i) | Compensation for delay of work | @1.5% per month of delay to be
Computed on per day basis |
|-----|--------------------------------|---|

Provided always that the total amount of compensation for delay beyond 6 months to be paid under this Condition shall not exceed 10% of the Tendered value of the item or group of items of work for which a separate period of completion is originally given.

The amount of compensation may be adjusted or set-off against any sum payable to the Contractor under this or any other contract with the HLL. In case, the contractor does not achieve a particular milestone mentioned in schedule 'F', or the re-scheduled milestone(s) in terms of Clause 5.4, the amount shown against that milestone shall be withheld, to be adjusted against the compensation levied at the final grant of Extension of Time. With-holding of this amount on failure to achieve a milestone, shall be automatic without any notice to the contractor. However, if the contractor catches up with the progress of work on the subsequent milestone(s), the withheld amount shall be released. In case the contractor fails to make up for the delay in subsequent milestone(s), amount mentioned against each milestone missed subsequently also shall be withheld. However, no interest, whatsoever, shall be payable on such withheld amount.

CLAUSE 2A Incentive for early completion

In case, the contractor completes the work ahead of updated stipulated date of completion considering the effect of extra work (to be calculated on pro-rata basis as cost of extra work X stipulated period/ tendered cost), a bonus @ 1% (one per cent) of the tendered value per month computed on per day basis, shall be payable to the contractor, subject to a maximum limit of 5%

(five per cent) of the tendered value. This shall be decided by the authority as indicated in Schedule 'F' whose decision shall be final and binding on the Contractor and conveyed to the contractor by the Engineer-in-charge. The amount of bonus/incentive, if payable, shall be paid along with final bill after completion of work. Provided always that provision of the Clause 2A shall be applicable only when so provided in 'Scheduled F'.

CLAUSE 3 When Contract can be Determined

Subject to other provisions contained in this clause, the Client may, without prejudice to his any other rights or remedy against the contractor in respect of any delay, inferior workmanship, any claims for damages and / or any other provisions of this contract or otherwise, and whether the date of completion has or has not elapsed, by notice in writing absolutely determine the contract in any of the following cases:

- (i) If the contractor having been given by the Engineer-in-Charge a notice in writing to rectify reconstruct or replace any defective work or that the work is being performed in an inefficient or otherwise improper or un-workmanlike manner shall omit to comply with the requirement of such notice for a period of seven days thereafter.
- (ii) If the contractor has, without reasonable cause, suspended the progress of the work or has failed to proceed with the work with due diligence so that in the opinion of the Engineer-in-Charge (which shall be final and binding) he will be unable to secure completion of the work by the date for completion and continues to do so after a notice in writing of seven days from the Engineer-in-Charge.
- (iii) If the contractor fails to complete the work within the stipulated date or items of work with individual date of completion, if any stipulated, on or before such date(s) of completion and does not complete them within the period specified in a notice given in writing in that behalf by the Engineer-in-Charge.
- (iv) If the Contractor persistently neglects to carry out his obligations under the contract and / or commits default in complying with any of the terms and conditions of the contract and does not remedy it or take effective steps to remedy it within 7 days after a notice in writing is given to him in that behalf by the Engineer-in-Charge.
- (v) If the contractor shall offer or give or agree to give to any person in HLL service or to any other person on his behalf any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any act in relation to the obtaining or execution of this or any other contract for HLL.
- (vi) If the contractor shall enter into a contract with HLL in connection with which commission has been paid or agreed to be paid by him or to his knowledge, unless the particulars of any such commission and the terms of payment thereof have been previously disclosed in writing to the Engineer-in-Charge.
- (vii) If the contractor shall obtain a contract with HLL as a result of wrong tendering or other non-bonafide methods of competitive tendering.
- (viii) If the contractor being an individual, or if a firm, any partner thereof shall at any time be adjudged insolvent or have a receiving order or order for administration of his estate made against him or shall take any proceedings for liquidation or composition (other than a voluntary liquidation for the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or purport so to do, or if any application be made under any Insolvency Act for the time being in force for the sequestration of his estate or if a trust deed be executed by him for benefit of his creditors.
- (ix) If the contractor being a company shall pass a resolution or the court shall make an order that the company shall be wound up or if a receiver or a manager on behalf of a creditor shall be appointed or if circumstances shall arise which entitle the court or the creditor to

appoint a receiver or a manager or which entitle the court to make a winding up order.

- (x) If the contractor shall suffer an execution being levied on his goods and allow it to be continued for a period of 21 days.
- (xi) If the contractor assigns, transfers, sublets (engagement of labour on a piece- work basis or of labour with materials not to be incorporated in the work, shall not be deemed to be subletting) or otherwise parts with or attempts to assign, transfer, sublet or otherwise parts with the entire works or any portion thereof without the prior written approval of the Engineer-in-Charge.

When the work contractor has made himself liable for action under any of the cases aforesaid, the Client on behalf of the HLL shall have powers:

- (a) To determine the contract as aforesaid (of which termination notice in writing to the contractor under the hand of the Engineer-in-Charge shall be conclusive evidence). Upon such determination, the Earnest Money Deposit, Security Deposit already recovered and Performance Guarantee under the contract shall be liable to be forfeited and shall be absolutely at the disposal of the HLL.
- (b) After giving notice to the contractor to measure up the work of the contractor and to take such whole, or the balance or part thereof, as shall be un-executed out of his hands and to give it to another contractor to complete the work. The contractor, whose contract is determined as above, shall not be allowed to participate in the tendering process for the balance work.

In the event of above courses being adopted by the Client, the contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any materials or entered into any engagement or made any advances on account or with a view to the execution of the work or the performance of the contract. And in case action is taken under any of the provision aforesaid, the contractor shall not be entitled to recover or be paid any sum for any work thereof or actually performed under this contract unless and until the Engineer-in-Charge has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified.

CLAUSE 3A

In case, the work cannot be started due to reasons not within the control of the contractor within 1/8th of the stipulated time for completion of work, either party may close the contract. In such eventuality, the Earnest Money Deposit and the Performance Guarantee of the contractor shall be refunded, but no payment on account of interest, loss of profit or damages etc. shall be payable at all.

CLAUSE 4 Contractor liable to pay Compensation even if action not taken under Clause 3

In any case in which any of the powers conferred upon the Client by Clause-3 thereof, shall have become exercisable and the same are not exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the contractor and the liability of the contractor for compensation shall remain unaffected. In the event of the Client putting in force all or any of the power vested in him under the preceding clause he may, if he so desires after giving a notice in writing to the contractor, take possession of (or at the sole discretion of the Engineer-in-Charge which shall be final and binding on the contractor) use as on hire (the amount of the hire money being also in the final determination of the Engineer-in-Charge) all or any tools, plant, materials and stores, in or upon the works, or the site thereof belonging to the contractor, or procured by the contractor and intended to be used for the execution of the work / or any part thereof, paying or allowing for the same in account at the contract rates, or in the case of these not being applicable, at current market rates to be certified by the Engineer-in-Charge, whose

certificate thereof shall be final, and binding on the contractor, clerk of the works, foreman or other authorized agent to remove such tools, plant, materials, or stores from the premises (within a time to be specified in such notice) 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 his risk in all respects 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.

CLAUSE 5 Time and Extension for Delay

The time allowed for execution of the Works as specified in the Schedule 'F' or the extended time in accordance with these conditions shall be the essence of the Contract. The execution of the works shall commence from such time period as mentioned in schedule 'F' or from the date of handing over of the site whichever is later. If the Contractor commits default in commencing the execution of the work as aforesaid, Department shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the earnest money & performance guarantee absolutely.

- 5.1** As soon as possible after the Contract is concluded, the Contractor shall submit a Time and Progress Chart for each mile stone and get it approved by the Engineer-in-charge. The Chart shall be prepared in direct relation to the time stated in the Contract documents for completion of items of the works. It shall indicate the forecast of the dates of commencement and completion of various trades of sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the Contract documents, and further to ensure good progress during the execution of the work, the contractor shall in all cases in which the time allowed for any work, exceeds one month (save for special jobs for which a separate programme has been agreed upon) complete the work as per mile stones given in Schedule 'F'.

The project management shall be done using M. S. Project software

PROGRAMME CHART

- (I) The Contractor shall prepare an integrated programme chart in MS Project for the execution of work showing clearly all activities from the start of work to completion, with details of manpower, equipment and machinery required for the fulfilment of the programme within the stipulated period or earlier and submit the same for approval to the Engineer-in-Charge within ten days of award of the Contract.
- (II) The Programme chart should include the following:
 - a) Descriptive note explaining the sequence of the various activities.
 - b) Network (PERT / CPM / BAR CHART).
 - c) Programme for procurement of materials by the contractor. Programme of procurement of machinery / equipments having adequate capacity, commensurate with the quantum of work to be done within the stipulated period, by the contractor. In addition to above to achieve the progress of Work as per programme, the contractor must bring at site adequate shuttering material required for cement concrete and R.C.C. works etc. for three floors within one month from the date of start of work till the completion of RCC work as per requirement of work. The contractor shall submit shuttering schedule adequate to complete structure work within laid down physical milestone(s).
- (iii) If at any time, it appears to the Engineer-in-charge that the actual progress of work does not conform to the approved programme referred above or after rescheduling of milestones, the contractor shall produce a revised programme within 7 (seven) days, showing the modifications to the approved programme to ensure timely completion of the

work. The modified schedule of programme shall be approved by the Engineer in Charge.

- (iv) The submission for approval by the Engineer-in-Charge of such programme or such particulars shall not relieve the contractor of any of the duties or responsibilities under the contract. This is without prejudice to the right of Engineer-in-Charge to take action against the contractor as per terms and conditions of the agreement.
- (v) The contractor shall submit the progress report using MS Project software with base line programme referred above for the work done during previous month to the Engineer-In-charge on or before 5th day of each month.

5.2 If the work(s) be delayed by: -

- (i) Force majeure, or
- (ii) Abnormally bad weather, or
- (iii) Serious loss or damage by fire, or
- (iv) Civil commotion, local commotion of workmen, strike or lockout, affecting any of the traders employed on the work, or
- (v) Delay on the part of other contractors or tradesmen engaged by Department in executing work not forming part of the Contract, or
- (vi) Non-availability of stores, which are the responsibility of Department to supply, or
- (vii) Non-availability or break down of tools and Plant to be supplied or supplied by Department or
- (viii) Any other cause which, in the absolute discretion of the Engineer-in- Charge is beyond the Contractor's control.

then upon the happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the Engineer-in-Charge but shall nevertheless use constantly his best endeavours to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the Engineer-in-Charge to proceed with the works.

- 5.3** Request for rescheduling of Milestones and extension of time, to be eligible for consideration, shall be made by the Contractor in writing within fourteen days of the happening of the event causing delay on the prescribed form. The contractor may also, if practicable, indicate in such a request the period for which extension is desired.

- 5.4** In any such case the authority as indicated in Schedule F may give a fair and reasonable extension of time and reschedule the milestones for completion of work. Such extension shall be communicated to the Contractor by the Engineer- in-Charge in writing within 3 months of the date of receipt of such request. Non application by the contractor for extension of time shall not be a bar for giving a fair and reasonable extension by the authority as indicated in Schedule F and this shall be binding on the contractor.

CLAUSE 6 Measurements of Work Done

Engineer-in-Charge shall, except as otherwise provided, ascertain and determine by measurement, the value in accordance with the contract of work done.

All measurement of all items having value shall be entered in Measurement Book and / or level field book so that a complete record is obtained of all works performed under the contract.

All measurements and levels shall be taken jointly by Engineer-in-Charge or his authorized representative and by the contractor or his authorized representative from time to time during the progress of the work and such measurements shall be signed and dated by the Engineer-in-Charge and the contractor or their representatives in token of their acceptance. If the contractor objects to any of the measurements recorded, a note shall be made to that effect with reason and

signed by both the parties.

If for any reason the contractor or his authorized representative is not available and the work of recording measurements is suspended by the Engineer-in-Charge or his representative, the Engineer-in-Charge and the Department shall not entertain any claim from contractor for any loss or damages on this account. If the contractor or his authorized representative does not remain present at the time of such measurements after the contractor or his authorized representative has been given a notice in writing three (3) days in advance or fails to countersign or to record objection within a week from the date of the measurement, then such measurements recorded in his absence by the Engineer-in-Charge or his representative shall be deemed to be accepted by the Contractor.

The contractor shall, without extra charge, provide all assistance with every appliance, labour and other things necessary for measurements and recording levels.

Except where any general or detailed description of the work expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the specifications notwithstanding any provision in the relevant Standard Method of measurement or any general or local custom. In the case of items which are not covered by specifications, measurements shall be taken in accordance with the relevant standard method of measurement issued by the Bureau of Indian Standards and if for any item no such standard is available, then a mutually agreed method shall be followed.

The contractor shall give, not less than seven days' notice to the Engineer-in-Charge or his authorized representative in-charge of the work, before covering up or otherwise placing beyond the reach of measurement any work in order that the same may be measured and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of measurement and shall not cover up and placed beyond reach of measurement any work without consent in writing of the Engineer-in-Charge or his authorized representative in-charge of the work who shall within the aforesaid period of seven days inspect the work, and if any work shall be covered up or placed beyond the reach of measurements without such notice having been given or the Engineer-in-Charge's or his authorized representative's consent being obtained in writing, the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

Engineer-in-Charge or his authorized representative may cause either themselves or through another officer of the department to check the measurements recorded jointly or otherwise as aforesaid and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

It is also a term of this contract that recording of measurements of any item of work in the measurement book and / or its payment in the interim, on account or final bill shall not be considered as conclusive evidence as to the sufficiency of any work or material to which it relates nor shall it relieve the contractor from liabilities from any over measurement or defects noticed till completion of the defects liability period.

CLAUSE 6A Computerized Measurement Book

Engineer-in-Charge shall, except as otherwise provided, ascertain and determine by measurement the value of work done in accordance with the contract.

All measurements of all items having financial value shall be entered by the contractor and compiled in the shape of the Computerized Measurement Book having pages A-4 size as per the format of the CPWD so that a complete record is obtained of all the items of works performed under the contract.

All such measurements and levels recorded by the contractor or his authorized representative from time to time, during the progress of the work, shall be got checked by the

contractor from the Engineer-in-Charge or his authorized representative as per interval or program fixed in consultation with Engineer-in-Charge or his authorized representative. After the necessary corrections made by the Engineer-in-Charge or his authorized representative, the measurement sheets shall be returned to the contractor for incorporating the corrections and for resubmission to the Engineer-in-Charge or his authorized representative for the dated signatures by the Engineer-in-Charge and the contractor or their representatives in token of their acceptance.

Whenever bill is due for payment the contractor would initially submit draft computerized measurement sheets and these measurements would be got checked / test checked from the Engineer-in-Charge and / or his authorized representative. The contractor will, thereafter incorporate such changes as may be done during these checks / test checks in his draft computerized measurements, and submit to the department a computerized measurement book, duly bound, and with its pages machine numbered. The Engineer-in-Charge and / or his authorized representative would thereafter check this MB, and record the necessary certificates for their checks / tests checks.

The final, fair computerized measurement book given by the contractor, duly bound, with its pages machine numbered, should be 100% correct, and no cutting or over-writing in the measurements would thereafter be allowed. If at all any error is noticed, the contractor shall have to submit a fresh computerized MB with its pages duly machine numbered and bound, after getting the earlier MB cancelled by the department. Thereafter, the MB shall be taken in the Project Cell established at site, and allotted a number as per the Register of Computerized MBs. This should be done before the corresponding bill is submitted to the Project Cell for payment. The contractor shall submit two spare copies of such computerized MB's for the purpose of reference and record by the various officers of the Engineer-in-charge or his authorized representative or the Department.

The contractor shall also submit to the Engineer-in-charge or his authorized representative separately his computerized Abstract of Cost and the bill based on these measurements, duly bound, and its pages machine numbered along with two spare copies of the "bill. Thereafter, this bill will be processed by the Project Cell and allotted a number as per the computerized record in the same way as done for the measurement book meant for measurements.

The contractor shall, without extra charge, provide all assistance with every appliance, labour computer, printer and its consumable and other things necessary for checking of measurement / levels as per required by the Engineer-in-Charge or his representative.

Except where any general or detailed description of the work expressly shows to the contrary, measurement shall be taken in accordance with the procedure set forth in the specifications notwithstanding any provision in the relevant Standard Method of measurement or any general or local custom. In the case of items which are not covered by specifications, measurements shall be taken in accordance with the relevant standard method of measurement issued by the Bureau of Indian Standards and if for any item no such standard is available then a mutually agreed method shall be followed.

The contractor shall give not less than seven days' notice to the Engineer-in-Charge or his authorized representative in charge of the work before covering up or otherwise placing beyond the reach of checking and / or test checking and / or test checking the measurement of any work in order that the same may be checked and / or test checked and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of checking and / or test checking measurement and shall not cover up and place beyond reach of measurement any work without consent in writing of the Engineer-in-Charge or his authorized representative in-charge of the work who shall within the aforesaid period of seven days inspect the work, and if any work shall be covered up or placed beyond the reach of checking and/or test checking measurements without such notice having been given or the Engineer-in-Charge's or his authorized representative's consent being obtained in writing the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such work

or the materials with which the same was executed.

The Engineer-in-Charge or his authorized representative may cause either themselves or through another officer of the department to check the measurements recorded by contractor and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

It is also a term of this contract that checking and / or test checking the measurements of any item of work in the measurement book and / or its payment in the interim, on account of final bill shall not be considered as conclusive evidence as to the sufficiency of any work or material to which it relates nor shall it relieve the contractor from liabilities from any over measurement or defects noticed till completion of the defects liability period.

CLAUSE 7 Payment on Intermediate Certificate to be Regarded as Advances

No payment shall be made for work, estimated to cost Rs. Twenty Thousand or less till after the whole of the work shall have been completed and certificate of completion given. For works estimated to cost over Rs. Twenty thousand, the interim or running account bills shall be submitted by the contractor for the work executed on the basis of such recorded measurements on the format as approved by the Engineer-in-Charge in triplicate on or before the date of every month fixed for the same by the Engineer-in-Charge. The contractor shall not be entitled to be paid any such interim payment if the gross work done together with net payment / adjustment of advances for material collected, if any, since the last such payment is less than the amount specified in Schedule 'F', in which case the interim bill shall be prepared on the appointed date of the month after the requisite progress is achieved. Engineer-in-Charge shall arrange to have the bill verified by taking or causing to be taken, where necessary, the requisite measurements of the work. In the event of the failure of the contractor to submit the bills, Engineer-in-Charge shall prepare or cause to be prepared such bills in which event no claims whatsoever due to delays on payment including that of interest shall be payable to the contractor. Payment on account of amount admissible shall be made by the Engineer-in-Charge certifying the sum to which the contractor is considered entitled by way of interim payment at such rates as decided by the Engineer-in-Charge. The amount admissible shall be paid within thirty days after the day of certification of the bill by the Engineer-in-Charge or his authorised representative together with the account of the material issued by the department, or dismantled materials, if any along with all required supporting documents.

All such interim payments shall be regarded as payment by way of advances against final payment only and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be rejected, removed, taken away and reconstructed or re-erected. Any certificate given by the Engineer-in-Charge relating to the work done or materials delivered forming part of such payment, may be modified or corrected by any subsequent such certificate(s) or by the final certificate and shall not by itself be conclusive evidence that any work or materials to which it relates is / are in accordance with the contract and specifications. Any such interim payment, or any part thereof shall not in any respect conclude, determine or affect in any way powers of the Engineer-in-Charge under the contract or any of such payments be treated as final settlement and adjustment of accounts or in any way vary or affect the contract.

Pending consideration of extension of date of completion, interim payments shall continue to be made as herein provided without prejudice to the right of the department to take action under the terms of this contract for delay in the completion of work, if the extension of date of completion is not granted by the competent authority.

The Engineer-in-Charge in his sole discretion on the basis of a certificate from his authorized representative in-charge of the work at site to the effect that the work has been completed upto the level in question make interim advance payments without detailed measurements for work done (other than foundations, items to be covered under finishing items) upto lintel level (including sunshade etc.) and slab level, for each floor working out at 75% of the assessed value. The advance payment so allowed shall be adjusted in the subsequent interim bill by taking

detailed measurements thereof.

Payment in Composite Contracts

In case of composite tenders, running payment for the major component shall be made by EE of major discipline to the main contractor. Running payment for minor component shall be made by the Engineer-In-Charge of the discipline of minor component directly to the main contractor.

In case main contractor fails to make the payment to the contractor associated by him within 15 days of receipt of each running account payment, then on the written complaint of contractor associated for such minor component, Engineer in Charge of minor component shall serve the show cause to the main contractor and if reply of main contractor either not received or found unsatisfactory, he may make the payment directly to the contractor associated for minor component as per the terms and conditions of the agreement drawn between main contractor and associate contractor fixed by him. Such payment made to the associate contractor shall be recovered by Engineer-In-Charge of major or minor component from the next RA / final bill due to main contractor as the case may be.

In case the Engineer-In-Charge for minor component is not defined and there is Engineer-In-Charge for the composite work, this clause shall be operated by the Engineer-In-Charge of the composite work.

CLAUSE 8 Completion Certificate and Completion Plans

Within ten days of the completion of the work, the contractor shall give notice of such completion to the Engineer-in-Charge and within thirty days of the receipt of such notice the Engineer-in-Charge shall inspect the work and if there is no defect in the work, shall furnish the contractor with a final certificate of completion, otherwise a provisional certificate of physical completion indicating defects (a) to be rectified by the contractor and / or (b) for which payment will be made at reduced rates, shall be issued. But no final certificate of completion shall be issued, nor shall the work be considered to be complete until the contractor shall have removed from the premises on which the work shall be executed all scaffolding, surplus materials, rubbish and all huts and sanitary arrangements required for his / their work people on the site in connection with the execution of the works as shall have been erected or constructed by the contractor(s) and cleaned off the dirt from all wood work, doors, windows, walls, floor or other parts of the building, in, upon, or about which the work is to be executed or of which he may have had possession for the purpose of the execution; thereof, and not until the work shall have been measured by the Engineer-in-Charge. If the contractor shall fail to comply with the requirements of this Clause as to removal of scaffolding, surplus materials and rubbish and all huts and sanitary arrangements as aforesaid and cleaning off dirt on or before the date fixed for the completion of work, the Engineer-in-Charge may at the expense of the contractor remove such scaffolding, surplus materials and rubbish etc. and dispose of the same as he thinks fit and clean off such dirt as aforesaid, and the contractor shall have no claim in respect of scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

CLAUSE 8A Contractor to keep Site Clean

When the annual repairs and maintenance of works are carried out, the splashes and droppings from white washing, colour washing, painting etc., on walls, floor, windows, etc shall be removed and the surface cleaned simultaneously with the completion of these items of work in the individual rooms, quarters or premises etc. where the work is done without waiting for the actual completion of all the other items of work in the contract. In case the contractor fails to comply with the requirements of this clause, the Engineer-in-Charge shall have the right to get this work done at the cost of the contractor either departmentally or through any other agency. Before taking such action the Engineer-in-Charge shall give ten days' notice in writing to the contractor.

CLAUSE 8B Completion Plans to be Submitted by the Contractor

The contractor shall submit completion plan required as per General CPWD Specifications for Electrical works (Part – I internal)2005 and (Part – II External) 1994 within thirty days of the completion of the work.

In case, the contractor fails to submit the completion plans as aforesaid, he shall be liable to pay a sum equivalent to 2.5% of the value of the work subject to a ceiling of Rs.5,00,000/- (Rs. Five lakhs only) as may be fixed by the Engineer-in-charge and in this respect the decision of the Engineer-in-charge shall be final and binding on the contractor.

The contractor shall submit completion plan for water, sewerage and drainage line plan within thirty days of the completion of the work.

In case the contractor fails to submit the completion plan as aforesaid, the department will get it done through other agency at his cost and actual expenses incurred plus Rs 15,000/- for the same shall be recovered from the contractor.

CLAUSE 9 Payment of Final Bill

The final bill shall be submitted by the contractor in the same manner as specified in interim bills within three months of physical completion of the work or within one month of the date of the final certificate of completion furnished by the Engineer-in-Charge whichever is earlier. No further claims shall be made by the contractor after submission of the final bill and these shall be deemed to have been waived and extinguished. Payment of those items of the bill in respect of which there is no dispute and of items in dispute, for quantities and rates as approved by Engineer-in-Charge, will, as far as possible be made within the period of six months reckoned from the date of receipt of the bill by the Engineer-in-Charge or his authorized Engineer, complete with account of materials issued by the Department and dismantled materials along with all supporting documents.

CLAUSE 9A Payment of Contractor's Bills to Bank

Payments due to the contractor may, if so desired by him, be made to his bank, registered financial, co-operative or thrift societies or recognized financial institutions instead of direct to him provided that the contractor furnishes to the Engineer-in-Charge (1) an authorization in the form of a legally valid document such as a power of attorney conferring authority on the bank; registered financial, co-operative or thrift societies or recognized financial institutions to receive payments and (2) his own acceptance of the correctness of the amount made out as being due to him by Government or his signature on the bill or other claim preferred against Government before settlement by the Engineer-in-Charge of the account or claim by payment to the bank, registered financial, co-operative or thrift societies or recognized financial institutions. While the receipt given by such banks; registered financial, co-operative or thrift societies or recognized financial institutions shall constitute a full and sufficient discharge for the payment, the contractor shall whenever possible present his bills duly receipted and discharged through his bank, registered financial, co-operative or thrift societies or recognized financial institutions.

Nothing herein contained shall operate to create in favour of the bank; registered financial, co-operative or thrift societies or recognized financial institutions any rights or equities vis-à-vis the Indian Pharmacopoeia Commission(IPC).

CLAUSE 10 Materials supplied by the HLL / IPC

Materials which HLL/ IPC will supply are shown in Schedule 'B' which also stipulates quantum, place of issue and rate(s) to be charged in respect thereof. The contractor shall be bound to procure them from the Engineer-in-Charge.

As soon as the work is awarded, the contractor shall finalize the programme for the completion of work as per clause 5 of this contract and shall give his estimates of materials required on the basis of drawings/or schedule of quantities of the work. The Contractor shall give in writing his

requirement to the Engineer-in-Charge which shall be issued to him keeping in view the progress of work as assessed by the Engineer-in-Charge, in accordance with the agreed phased programme of work indicating monthly requirements of various materials. The contractor shall place his indent in writing for issue of such materials at least 7 days in advance of his requirement.

Such materials shall be supplied for the purpose of the contract only and the value of the materials so supplied at the rates specified in the aforesaid schedule shall be set off or deducted, as and when materials are consumed in items of work (including normal wastage) for which payment is being made to the contractor, from any sum then due or which may therefore become due to the contractor under the contract or otherwise or from the security deposit. At the time of submission of bills, the contractor shall certify that balance of materials supplied is available at site in original good condition.

The contractor shall submit along with every running bill (on account or interim bill) material wise reconciliation statements supported by complete calculations reconciling total issue, total consumption and certified balance (diameter/section-wise in the case of steel) and resulting variations and reasons therefore. Engineer-in-Charge shall (whose decision shall be final and binding on the contractor) be within his rights to follow the procedure of recovery in clause 42 at any stage of the work if reconciliation is not found to be satisfactory.

The contractor shall bear the cost of getting the material issued, loading, transporting to site, unloading, storing under cover as required, cutting assembling and joining the several parts together as necessary. Notwithstanding anything to the contrary contained in any other clause of the contract and (or the CPWD Code) all stores/materials so supplied to the contractor or procured with the assistance of the Government shall remain the absolute property of Government and the contractor shall be the trustee of the stores/materials, and the said stores/ materials shall not be removed / disposed off from the site of the work on any account and shall be at all times open to inspection by the Engineer-in-Charge or his authorized agent. Any such stores/materials remaining unused shall be returned to the Engineer-in-Charge in as good a condition in which they were originally supplied at a place directed by him, at a place of issue or any other place specified by him as he shall require, but in case it is decided not to take back the stores/ materials the contractor shall have no claim for compensation on any account of such stores/ materials so supplied to him as aforesaid and not used by him or for any wastage in or damage to in such stores/materials.

On being required to return the stores/materials, the contractor shall hand over the stores/ materials on being paid or credited such price as the Engineer-in-Charge shall determine, having due regard to the condition of the stores/materials. The price allowed for credit to the contractor, however, shall be at the prevailing market rate not exceeding the amount charged to him, excluding the storage charge, if any. The decision of the Engineer-in-Charge shall be final and conclusive. In the event of breach of the aforesaid condition, the contractor shall in addition to throwing himself open to account for contravention of the terms of the licenses or permit and/or for criminal breach of trust, be liable to Government for all advantages or profits resulting or which in the usual course would have resulted to him by reason of such breach. Provided that the contractor shall in no case be entitled to any compensation or damages on account of any delay in supply or non-supply thereof all or any such materials and stores provided further that the contractor shall be bound to execute the entire work if the materials are supplied by the Government within the original scheduled time for completion of the work plus 50% thereof or schedule time plus 6 months whichever is more if the time of completion of work exceeds 12 months, but if a part of the materials only has been supplied within the aforesaid period, then the contractor shall be bound to do so much of the work as may be possible with the materials and stores supplied in the aforesaid period. For the completion of the rest of the work, the contractor shall be entitled to such extension of time as may be determined by the Engineer-in-Charge whose decision in this regard shall be final and binding on the contractor.

The contractor shall see that only the required quantities of materials are got issued. Any such material remaining unused and in perfectly good/ original condition at the time of completion or determination of the contract shall be returned to the Engineer-in-Charge at the stores from

which it was issued or at a place directed by him by a notice in writing. The contractor shall not be entitled for loading, transporting, unloading and stacking of such unused material except for the extra lead, if any involved, beyond the original place of issue.

CLAUSE 10A Materials to be provided by the Contractor

The contractor shall, at his own expense, provide all materials, required for the works, other than those which are stipulated to be supplied by the Government.

The contractor shall, at his own expense and without delay, supply to the Engineer-in-Charge or his authorized representative samples of materials to be used on the work and shall get these approved in advance. All such materials to be provided by the Contractor shall be in conformity with the specifications laid down or referred to in the contract. The contractor shall, if requested by the Engineer-in-Charge furnish proof, to the satisfaction of the Engineer-in-Charge that the materials so comply. The Engineer-in-Charge or his authorized representative shall within thirty days of supply of samples or within such further period as he may require intimate to the Contractor in writing whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the Engineer-in-Charge or his authorized representative for his approval, fresh samples complying with the specifications laid down in the contract. When materials are required to be tested in accordance with specifications, approval of the Engineer-in-Charge shall be issued after the test results are received.

The Contractor shall at his risk and cost submit the samples of materials to be tested or analyzed and shall not make use of or incorporate in the work any materials represented by the samples until the required tests or analysis have been made and materials finally accepted by the Engineer-in-Charge. The Contractor shall not be eligible for any claim or compensation either arising out of any delay in the work or due to any corrective measures required to be taken on account of and as a result of testing of materials.

The contractor shall, at his risk and cost, make all arrangements and shall provide all facilities as the Engineer-in-Charge or his authorized representative may require for collecting, and preparing the required number of samples for such tests at such time and to such place or places as may be directed by the Engineer-in-Charge or his authorized representative and bear all charges and cost of testing unless specifically provided for otherwise elsewhere in the contract or specifications. The Engineer-in-Charge or his authorized representative shall at all times have access to the works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery are being obtained for the works and the contractor shall afford every facility and every assistance in obtaining the right to such access.

The Engineer-in-Charge shall have full powers to require the removal from the premises of all materials which in his opinion are not in accordance with the specifications and in case of default, the Engineer-in-Charge shall be at liberty to employ at the expense of the contractor, other persons to remove the same without being answerable or accountable for any loss or damage that may happen or arise to such materials. The Engineer-in-Charge shall also have full powers to require other proper materials to be substituted thereof and in case of default, the Engineer-in-Charge may cause the same to be supplied and all costs which may attend such removal and substitution shall be borne by the Contractor.

Wherever different pattern/ design/ quality of materials with same specifications/ make as specified in the contract is available in the market, Engineer-in-Charge will be sole authority to decide pattern/ design/ quality of the material which shall be final and binding on the contractor.

The contractor shall at his own expense, provide a material testing lab at the site for conducting routine field tests. The lab shall be equipped at least with the testing equipment as specified in schedule F. In addition, equipment for carrying out various tests (except chemical analysis) on basic materials i.e. cement, fine aggregate, coarse aggregate & bricks shall be kept in the site lab. Contractor shall employ sufficient manpower to ensure that all tests are carried out in accordance

with the periodicity specified in relevant IS Code/ Specifications.

CLAUSE 10B

Secured Advance on Non-perishable Materials

- (i) The contractor, on signing an indenture in the form to be specified by the Engineer-in-Charge, shall be entitled to be paid during the progress of the execution of the work up to 90% of the assessed value of any materials or an amount not exceeding 90% of the material element cost in the tendered rate of the finished item of work, whichever is lower which are in the opinion of the Engineer-in-Charge non-perishable, non-fragile and non-combustible and are in accordance with the contract and which have been brought on the site in connection therewith and are adequately stored and/or protected against damage by weather or other causes but which have not at the time of advance been incorporated in the works. When materials on account of which an advance has been made under this sub-clause are incorporated in the work, the amount of such advance shall be recovered / deducted from the next payment made under any of the clause or clauses of this contract.

Such secured advance shall also be payable on other items of perishable nature, fragile and combustible with the approval of the Engineer-in-Charge provided the contractor provides a comprehensive insurance cover for the full cost of such materials. The decision of the Engineer-in-Charge shall be final and binding on the contractor in this matter. No secured advance, shall however, be paid on high-risk materials such as ordinary glass, sand, petrol, diesel etc.

- (ii) **Mobilization Advance**

Mobilization advance not exceeding 10% of the tendered value may be given, if requested by the contractor in writing within one month of the order to commence the work. Such advance shall be in two or more instalments to be determined by the Engineer-in-Charge at his sole discretion. The first instalment of such advance shall be released by the Engineer-in-Charge to the contractor on a request made by the contractor to the Engineer-in-Charge in this behalf. The second and subsequent instalments shall be released by the Engineer-in-Charge only after the Contractor furnishes a proof of the satisfactory utilization of the earlier instalments to the entire satisfaction of the Engineer-in-Charge.

Before any instalment of advance is released, the Contractor shall execute a Bank Guarantee Bond from Scheduled Bank for the amount equal to 110% of the amount of advance and valid for the Contract Period. This (Bank Guarantee from Scheduled Bank for the amount equal to 110% of the balance amount advance) shall be kept renewed from time to time to cover the balance amount and likely period of complete recovery, together with interest.

Provided always the provision of Clause 10 B (ii) shall be applicable only when so provided in 'Schedule F'.

- (iii) **Plant Machinery & Shuttering Material Advance**

An advance for plant, machinery & shuttering material required for the work and brought to site by the contractor may be given if requested by the contractor in writing within one month of bringing such plant and machinery to site. Such advance shall be given on such plant and machinery, which in the opinion of the Engineer-in-Charge will add to the expeditious execution of work and improve the quality of work. The amount of advance shall be restricted to 5% per-cent of the tender value. In the case of new plant and equipment to be purchased for the work, the advance shall be restricted to 90% of the price of such new plant and equipment paid by the contractor for which the contractor shall produce evidence satisfactory to the Engineer-in-Charge. In the case of second hand and used plants and equipment, the amount of such advance shall be limited to 50% of the depreciated value of plant and equipment as may be decided by the Engineer-in-Charge.

The contractor shall, if so required by the Engineer-in-Charge, submit the statement of value of such old plant and equipment duly approved by a Registered Valuer recognized by the Central board of Direct Taxes under the Income-Tax Act, 1961. No such advance shall be paid on any plant and equipment of perishable nature and on any plant and equipment of a value less than Rs.50,000/- Seventy five per cent of such amount of advance shall be paid after the plant & equipment is brought to site and balance twenty five per-cent on successfully commissioning the same.

Leasing of equipment shall be considered at par with purchase of equipment and shall be covered by tripartite agreement with the following:

1. Leasing company which gives certificate of agreeing to lease equipment to the contractor.
2. Engineer-in-Charge, and
3. The contractor.

This advance shall further be subject to the condition that such plant and equipment (a) are considered by the Engineer-in-Charge to be necessary for the works; (b) and are in working order and are maintained in working order; (c) hypothecated to the Government as specified by the Engineer-in-Charge before the payment of advance is released. The contractor shall not be permitted to remove from the site such hypothecated plant and equipment without the prior written permission of the Engineer-in-Charge. The contractor shall be responsible for maintaining such plant and equipment in good working order during the entire period of hypothecation failing which such advance shall be entirely recovered in lump sum. For this purpose, steel scaffolding and form work shall be treated as plant and equipment.

The contractor shall insure the Plant and Machinery for which mobilization advance is sought and given, for a sum sufficient to provide for their replacement at site. Any amounts not recovered from the insurer will be borne by the contractor.

Provided always the provision of Clause 10 B (iii) shall be applicable only when so provided in 'Schedule F'.

(iv) Interest & Recovery

The mobilization advance and plant and machinery advance in (ii) & (iii) above bear simple interest at the rate of 10 per cent per annum and shall be calculated from the date of payment to the date of recovery, both days inclusive, on the outstanding amount of advance. Recovery of such sums advanced shall be made by the deduction from the contractors bills commencing after first ten per cent of the gross value of the work is executed and paid, on pro-rata percentage basis to the gross value of the work billed beyond 10% in such a way that the entire advance is recovered by the time eighty per cent of the gross value of the contract is executed and paid, together with interest due on the entire outstanding amount up to the date of recovery of the instalment. However, the net up to date interest on the mobilization advance and plant and machinery advance in (ii) & (iii) above would be deducted from all payments released to the Contractors beginning the first interim certificate.

- (v) If the circumstances are considered reasonable by the Engineer-in-Charge, the period mentioned in (ii) and (iii) for request by the contractor in writing for grant of mobilization advance and plant and equipment advance may be extended in the discretion of the Engineer-in-Charge.

CLAUSE 10C Payment on Account of Increase in Prices/Wages due to Statutory Order(s)

If after submission of the tender, the price of any material incorporated in the works (excluding the materials covered under Clause 10CA and not being a material supplied from the Engineer-in-Charge's stores in accordance with Clause 10 thereof) and/or wages of labour increases as a

direct result of the coming into force of any fresh law, or statutory rule or order (but not due to any changes in sales tax/VAT, Central/ State Excise / Custom Duty) beyond the prices/wages prevailing at the time of the last stipulated date of receipt of tenders including extensions, if any, for the work during contract period including the justified period extended under the provisions of Clause 5 of the Contract without any action under Clause 2, then the amount of contract shall accordingly be varied and provided further that any such increase shall be limited to the price/wages prevailing at the time of stipulated date of completion or as prevailing for the period under consideration, whichever is less.

If after submission of the tender, the price of any material incorporated in the works (excluding the materials covered under Clause 10CA and not being a material supplied from the Engineer-in-Charge's stores in accordance with Clause 10 thereof) and/or wages of labour as prevailing at the time of last stipulated date of receipt of tender including extensions, if any, is decreased as a direct result of the coming into force of any fresh law or statutory rules or order (but not due to any changes in sales tax/VAT, Central/ State Excise / Custom Duty), Government shall in respect of materials incorporated in the works (excluding the materials covered under Clause 10CA and not being materials supplied from the Engineer-in-Charge's stores in accordance with Clause-10 hereof) and/or labour engaged on the execution of the work after the date of coming into force of such law statutory rule or order be entitled to deduct from the dues of the contractor, such amount as shall be equivalent to the difference between the prices of the materials and/or wages as prevailed at the time of the last stipulated date for receipt of tenders including extensions if any for the work and the prices of materials and/or wages of labour on the coming into force of such law, statutory rule or order. This will be applicable for the Contract period including the justified period extended under the provisions of Clause 5 of the Contract without any action under Clause 2.

Engineer-in-charge may call books of account and other relevant documents from the contractor to satisfy himself about reasonability of increase in prices of materials and wages.

The Contractor shall, within a reasonable time of his becoming aware of any alteration in the price of any such materials and/or wages of labour, give notice thereof to the Engineer-in-Charge stating that the same is given pursuant to this condition together with all information relating thereto which he may be in position to supply.

For this purpose, the labour component of the work executed during the period under consideration shall be the percentage as specified in Schedule F, of the value of work done during that period and the increase/decrease in labour shall be considered on the minimum daily wages in rupees of any unskilled adult male mazdoor, fixed under any law, statutory rule or order.

CLAUSES 10 CA Payment due to variation in prices of materials after receipt of tender

If after submission of the tender, the price of materials specified in Schedule F increases/decreases beyond the price(s) prevailing at the time of the last stipulated date for receipt of tenders (including extensions, if any) for the work, then the amount of the contract shall accordingly be varied and provided further that any such variations shall be effected for stipulated period of Contract including the justified period extended under the provisions of clause 5 of the contract without any action under Clause 2.

However for work done/during the justified period extended as above, it will be limited to indices prevailing at the time of stipulated date of completion considering the effect of extra work Ito be calculated on pro-rata basis as cost of extra work X Stipulated period/ tendered Cost).

The increase/decrease in prices of cement, steel reinforcement and structural steel shall be determined by the Price Indices issued by the Director General, CPWD. For other items provided in the Schedule 'F', these shall be determined by the All India Wholesale Price Indices of Materials as published by economic Advisor to government of India, Ministry of commerce and Industry and base price for cement, steel reinforcement and structural steel as issued under the authority of Director General CPWD applicable for Delhi including Noida, Gurgaon, Faridabad &

Ghaziabad and for other places as issued under the authority of the Zonal Chief Engineer, CPWD and base price of other materials issued by concerned Zonal Chief Engineer as indicated in Schedule 'F' as valid on the last stipulated date of receipt of tender, including extension if any and for the period under consideration. In case, price index of a particular material is not issued by Ministry of Commerce and Industry, then the price index of nearest similar material as indicated in Schedule 'F' shall be followed.

The amount of the contract shall accordingly be varied for all such materials and will be worked out as per the formula given below for individual material:-

Adjustment for component of individual material

Where,

$$V = \frac{P \times Q \times CI - CI0}{CI0}$$

V = Variation in material cost i.e. increase or decrease in the amount in rupees to be paid or recovered.

P = Base Price of material as mentioned in Schedule 'F'.

Q = Quantity of material brought at site for bonafide use in the works since previous bill.

CI0 = Price Index for cement, steel reinforcement bars and structural steel as issued by the DG, CPWD as valid on the last stipulated date of receipt of tenders including extensions, if any. For other items, if any, provided in Schedule 'F', All India wholesale Price Index for the material as published by the economic Advisor to government of India, Ministry of Industry and Commerce as valid on the last stipulated date of receipt of tenders including extensions, if any.

CI = Price Index for cement, steel reinforcement bars and structural steel as issued by the DG, CPWD for the period under consideration. For other items, if any, provided in Schedule 'F' All India Wholesale Price Index for the material for period under consideration as published by Economic advisor to Government of India, Ministry of Industry and Commerce.

Note:

- (i) In respect of the justified period extended under the provisions of clause 5 of the contract without any action under clause 2, the index prevailing at the time of stipulated date of completion or the prevailing index of the period under consideration, whichever is less, shall be considered.

Provided always that provisions of preceding clause 10 C shall not be applicable in respect of Materials covered in this clause.

- (ii) If during the progress of work or at the time of completion of work, it is noticed that any material brought to site is in excess of requirement, then amount of escalation if paid earlier on such excess quantity of material shall be recovered on the basis of cost indices as applied at the time of payment of escalation or as prevailing at the time of effecting recovery, whichever is higher.
- (iii) Cement mentioned wherever in this clause includes Cement component used in RMC brought at site from outside approved RMC plants. If any.
- (iv) The date wise record of ready mix concrete shall be kept in a register and the cement consumption for the same shall be calculated accordingly.
- (v) If built-up steel items are brought at site from workshop, then the variation shall be paid for the structural steel, if so provided in schedule F, up to the period when the built up item/ finished product is brought at site.

CLAUSE 10 CC (As per Schedule-F)**Payment due to Increase/Decrease in Prices/Wages (excluding materials covered under clause 10CA) after Receipt of Tender for Works**

If the prices of materials (not being materials supplied or services rendered at fixed prices by the department in accordance with clause 10 & 34 thereof) and/or wages of labour required for execution of the work increase the contractor shall be compensated for such increase as per provisions detailed below and the amount of the contract shall accordingly be varied, subject to the condition that such compensation for escalation in prices and wages shall be available only for the work done during the stipulated period of the contract including the justified period extended under the provisions of clause 5 of the contract without any action under clause 2. However, for the work done during the justified period extended as above, the compensation as detailed below will be limited to prices/wages prevailing at the time of stipulated date of completion or as prevailing for the period under consideration, whichever is less. No such compensation shall be payable for a work for which the stipulated period of completion is equal to or less than the time as specified in Schedule F. Such compensation for escalation in the prices of materials and labour, when due, shall be worked out based on the following provisions:-

- (i) The base date for working out such escalation shall be the last stipulated date of receipt of tenders including extension, if any.
- (ii) The cost of work on which escalation will be payable shall be reckoned as below:
 - (a) Gross value of work done upto this quarter: (A)
 - (b) Gross Value of work done upto the last quarter: (B)
 - (c) Gross value of work done since previous quarter (A-B): (C)
 - (d) Full assessed value of Secured Advance (excluding materials covered under clause 10CA) fresh paid in this quarter: (D)
 - (e) Full assessed value of Secured Advance (excluding materials covered under clause 10CA) recovered in this quarter: (E)
 - (f) Full assessed value of Secured Advance for which escalation is payable in this quarter (D-E): (F)
 - (g) Advance payment made during this quarter: (G)
 - (h) Advance payment recovered during this quarter: (H)
 - (i) Advance payment for which escalation is payable in this quarter (G-H): (I)
 - (j) Extra Items/deviated quantities of items paid as per Clause 12 based on prevailing market rates during this quarter: (J)

$$\text{Then, } M = C + F + I - J$$

$$N = 0.85 M$$

- (k) Less cost of material supplied by the department as per Clause 10 and recovered during the quarter: (K)
- (l) Less cost of services rendered at fixed charges as per Clause 34 and recovered during the quarter: (L)

Cost of work for which escalation is applicable: $W = M - (K + L)$

- (iii) Components of materials (except cement, reinforcement bars, structural steel or others materials covered under clause 10CA), labour, P.O.L., etc. shall be pre- determined for every work and incorporated in the conditions of contract attached to the tender papers included in Schedule 'F'. The decision of the Engineer-in- Charge in working out such percentage shall be binding on the contractors.
- (iv) The compensation for escalation for other materials (excluding cement, reinforcement bars,

structural steel or others materials covered under clause 10CA) P.O.L. shall be worked as per the formula given below:-

Adjustment for civil component (except cement, reinforcement bars, structural steel or others materials covered under clause 10CA)/electrical component of construction '**Materials**'

$$V_m = W \times \frac{X_m}{100} \times \frac{MI - MIO}{MIO}$$

VM = Variation in material cost i.e. increase or decrease in the amount in rupees to be paid or recovered.

W = Cost of work done worked out as indicated in sub-para (ii) of Clause 10CC.

XM = Component of 'materials' (except cement, reinforcement bars, structural steel or others materials covered under clause 10CA) expressed as per-cent of the total value of work.

MI = All India Wholesale Price Index for civil component/electrical component* of construction material as worked out on the basis of All India Wholesale Price Index for Individual commodities/Group Items for the period under consideration as published by Economic Advisor to Govt. Of India, Ministry of Industry & Commerce and applying weight ages to the Individual Commodities/ Group Items. (In respect of the justifies period extended under the provisions of clause 5 of the contract without any action under clause 2, the index prevailing at the time of stipulated date of completion or the prevailing index of the period under consideration, whichever is less, shall be considered.)

MIO = All India Wholesale Price Index for civil component/electrical component* of construction material as worked out on the basis of all India Wholesale Price Index for Individual Commodities/group Items valid on the last stipulated date of receipt of tender including extension, if any, as published by the Economic Advisor to Govt. of India, Ministry of Industry & Commerce and applying weight ages to the Individual Commodities/Group Items.

*Note: relevant component only will be applicable.

(d) Adjustment for component of '**POL**'

$$V_F = W \times \frac{Z}{100} \times \frac{FI - FIO}{FIO}$$

VF = Variation in cost of Fuel, Oil & Lubricant i.e. increase or decrease in the amount in rupees to be paid or recovered.

W = Cost of work done worked out as indicated in sub-para (ii) of Clause 10CC.

Z = Component of Fuel, Oil & Lubricant expressed as per-cent of the total value of work.

FI = All India Wholesale Price Index for Fuel, Oil & Lubricant for the period under consideration as published by Economic Advisor to Govt. of India, Ministry of Industry & commerce, New Delhi. (In respect of the justified period extended under the provisions of clause 5 of the contract without any action under clause 2, the index prevailing at the time of stipulated date of completion or the prevailing index of the period under consideration, whichever is less, shall be considered.)

FIO = All India Wholesale Price Index for Fuel, Oil & Lubricant valid on the last stipulated date of receipt of tender including extension, if any.

(v) The following principles shall be followed while working out the indices mentioned in para (iv)

above.

- (a) The compensation for escalation shall be worked out at quarterly intervals and shall be with respect the cost of work done as per bills paid during the three calendar months of the said quarter. The first such payment shall be made at the end of three months after the month (excluding) in which the tender was accepted and thereafter at three months interval. At the time of completion of the work, the last period for payment might become less than 3 months, depending on the actual date of completion.
- (b) The index (MI/FI etc.) relevant to any quarter/period for which such compensation is paid shall be the arithmetical average of the indices relevant to the three calendar months. If the period up to date of completion after the quarter covered by the last such instalment of payment, is less than three months, the index MI and FI shall be the average of the indices for the months falling within that period.
- (vi) The compensation for escalation for **labour** shall be worked out as per the formula given below:-

$$VL = W \times \frac{Y}{100} \times \frac{LI - LIO}{LIO}$$

VL = Variation in labour cost i.e. amount of increase or decrease in rupees to be paid or recovered.

W = Value of work done, worked out as indicated in sub-para (ii) above.

Y = Component of labour expressed as a percentage of the total value of the work.

LI = Minimum wage in rupees of an unskilled adult male mazdoor, fixed under any law, statutory rule or order as applicable on the last date of the quarter previous to the one under consideration. (In respect of the justified period extended under the provisions of clause 5 of the contract without any action under clause 2, the minimum wage prevailing on the last date of quarter previous to the quarter pertaining to stipulated date of completion or the minimum wage prevailing on the last date of the quarter previous to the one under consideration, whichever is less, shall be considered.)

Lio = Minimum daily wage in rupees of an unskilled adult male mazdoor, fixed under any law, statutory rule or order as on the last stipulated date of receipt of tender including extension, if any.

- (vii) The following principles will be followed while working out the compensation as per sub-Para (vi) above.
- (a) The minimum wage of an unskilled male mazdoor mentioned in sub-para (vi) above shall be the higher of the wage notified by Government of India, Ministry of Labour and that notified by the local administration both relevant to the place of work and the period of reckoning.
- (b) The escalation for labour also shall be paid at the same quarterly intervals when escalation due to increase in cost of materials and/or P.O.L. is paid under this clause. If such revision of minimum wages takes place during any such quarterly intervals, the escalation compensation shall be payable at revised rates only for work done in subsequent quarters;
- (c) Irrespective of variations in minimum wages of any category of labour, for the purpose of this clause, the variation in the rate for an unskilled adult male mazdoor alone shall form the basis for working out the escalation compensation payable on the labour component.

- (viii) In the event the price of materials and/or wages of labour required for execution of the work decrease/s, there shall be a downward adjustment of the cost of work so that such price of materials and/or wages of labour shall be deductible from the cost of work under this contract and in this regard the formula herein before stated under this Clause 10CC shall mutatis mutandis apply, provided that:
- (a) No such adjustment for the decrease in the price of materials and/or wages of labour aforementioned would be made in case of contracts in which the stipulated period of completion of the work is equal to or less than the time as specified in Schedule 'F'.
 - (b) The Engineer-in-Charge shall otherwise be entitled to lay down the procedure by which the provision of this sub-clause shall be implemented from time to time and the decision of the Engineer-in-Charge in this behalf shall be final and binding on the contractor.
- (ix) Provided always that :-
- (a) Where provisions of clause 10CC are applicable, provisions of Clause 10C will not be applicable but provisions of clause 10CA will be applicable.
 - (b) Where provisions of clause 10CC are not applicable, provisions of clause 10C and 10CA will become applicable.

CLAUSE 10 D Dismantled Material Govt. Properties

The Contractor shall treat all materials obtained during dismantling of a structure, excavation of the site for a work, etc. as Government's property and such materials shall be disposed off to the best advantage of Government according to the instructions in writing issued by the Engineer-in-Charge.

CLAUSE 11 Work to be Executed in Accordance with specifications, Drawings, Orders etc.

The Contractor shall execute the whole and every part of the work in the most substantial and workmanlike manner both as regards materials and otherwise in every respect in strict accordance with the specifications. The contractor shall also conform exactly, fully and faithfully to the design, drawings and instructions in writing in respect of the work signed by the Engineer-in-Charge and/or his authorized representative and the contractor shall be furnished free of charge one copy of the contract documents together with specifications, designs, drawings and instructions as are not included in the standard specifications of Central Public works Department specified in Schedule 'F' or in any Bureau of Indian Standard or any other, published standard or code or, Schedule of Rates or any other printed publication referred to elsewhere in the contract.

The contractor shall comply with the provisions of the contract and with the care and diligence execute and maintain the works and provide all labour and materials, tools and plants including for measurements and supervision of all works, structural plans and other things of temporary or permanent nature required for such execution and maintenance in so far as the necessity for providing these, is specified or is reasonably inferred from the contract. The Contractor shall take full responsibility for adequacy, suitability and safety of all the works and methods of construction.

CLAUSE 12 Deviations/Variations Extent and Pricing

The Engineer-in-Charge shall have power (i) to make alteration in, omissions from, additions to, or substitutions for the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work, and (ii) to omit a part of the works in case of non-availability of a portion of the site or for any other reasons and the contractor shall be bound to carry out the works in accordance with any instructions given to him in writing signed by the Engineer-in-Charge and such alterations, omissions, additions or substitutions shall form part of the contract as if originally provided therein and any altered, additional or substituted work which

the contractor may be directed to do in the manner specified above as part of the works, shall be carried out by the contractor on the same conditions in all respects including price on which he agreed to do the main work excepts as hereafter provided.

12.1 The time for completion of the works shall, in the event of any deviations resulting in additional cost over the tendered value sum being ordered be extended, if requested by the contractor, as follows:

- (i) In the proportion which the additional cost of the altered, additional or substituted work, bears to the original tendered value plus
- (ii) 25% of the time calculated in (i) above or such further additional time as may be considered reasonable by the Engineer-in-Charge.

12.2 **Deviation, Extra Items and Pricing**

In the case of extra item (s) (items that are completely new, and are in addition to the items contained in the Contract), the contractor may within fifteen days of receipt of order or occurrence of the item(s) claim rates, supported by proper analysis, for the work and the Engineer-in-Charge shall within one month of the receipt of the claims supported by analysis, after giving consideration to the analysis of the rates submitted by the contractor, determine the rates on the basis of the market rates and the contractor shall be paid in accordance with the rates so determined.

In the case of substituted items (items that are taken up with partial substitution or in lieu of items of work in the contract), the rate for the agreement item (to be substituted) and substituted item shall also be determined in the manner as mentioned in the following para.

Deviation, Substituted Items, Pricing

- (a) If the market rate for the substituted item so determined is more than the market rate of the agreement item (to be substituted), the rate payable to the contractor for the substituted item shall be the rate for the agreement item (to be substituted) so increased to the extent of the difference between the market rates of substituted item and the agreement item (to be substituted).
- (b) If the market rate for the substituted item so determined is less than the market rate of the agreement item (to be substituted), the rate payable to the contractor for the substituted item shall be rate for the agreement item (to be substituted) so decreased to the extent of the difference between the market rate of substituted item and the agreement item (to be substituted)

Deviation, Deviated Quantities, Pricing

In the case of contract items, substituted items, contract cum substituted items, which exceed the limits laid down in schedule F, the contractor may within fifteen days of receipt of order or occurrence of the excess, claim revision of the rates, supported by the proper analysis for the work in excess of the above mentioned limits, provided that if the rates so claimed are in excess of the rates specified in the schedule of quantities, the Engineer –in –Charge shall within one month of receipt of the claim supported by the analysis, after giving consideration to the analysis of the rate submitted by the contractor, determine the rates on the basis of the market rates and the contractor shall be paid in accordance with the rates so determined.

12.3 The provisions of the preceding paragraph shall also apply to the decrease in the rates of items for the work in excess of the limits laid down in schedule F, and the Engineer–in–Charge shall after giving notice to the contractor within one month of occurrence of the excess and after taking in top consideration any reply received from him within fifteen days of the receipt of the notice, revise the rates of the work in question within one month of the expiry of the said period of fifteen days having regard to the market rates.

12.4 The contractor shall send to the Engineer – in – Charge once every three months, an up to date account giving complete details of all claims for additional payments to which the

contractor may consider himself entitled and of all additional work ordered by the Engineer – in – Charge which he has executed during the preceding quarter failing which the contractor shall be deemed to have waived his right. However, the Engineer-in-charge may authorize consideration of such claims on merits.

12.5 For the purpose of the operation of schedule F, the following work shall be treated as works relating to foundation:

- (i) For buildings: All works upto 1.2 metres above ground level or upto floor 1 level, whichever is lower.
- (ii) For abutments, piers, and well staining: All works upto 1.2 m above bed level
- (iii) For retaining walls, wing walls, compound walls, overhead reservoirs/tanks and other elevated structures: All works upto 1.2 metres above the ground level.
- (iv) For reservoirs/tanks (other than overhead reservoirs/tanks): All works upto 1.2 metres above the ground level
- (v) For basement : All works upto 1.2 m above ground level or upto floor 1 level, whichever is lower.
- (vi) For Roads all items of excavation and filling including treatment of sub- base.

12.6 Any operation incidental to or necessarily has to be in contemplation of bidder while filling tender, or necessary to proper execution of the item included in the schedule of quantities or in the schedule of rates mentioned above, whether or not, specifically indicated in the description of the item and the relevant specifications, shall be deemed to be included in the rates quoted by the bidder or the rate given in the said schedule of rates, as the case may be. Nothing extra shall be admissible for such operations.

CLAUSE 13 Foreclosure of contract due to Abandonment or Reduction in scope of Work

If at any time after acceptance of the tender, Engineer-in-charge shall decide to abandon or reduce the scope of works for any reason whatsoever and hence not require the whole or any part of the works to be carried out, the Engineer – in – Charge shall give notice in writing to that effect to the contractor and the contractor shall act accordingly in the matter. The contractor shall have no claim to any payment of compensation or otherwise whatsoever, on account of any profit or advantage which he might have derived from the execution of the works in full but which he did not derive in consequence of the foreclosure of the whole or part of the works.

The contractor shall be paid at contract rates, full amount for work executed at site and, in addition, a reasonable amount as certified by the Engineer – in – Charge for the items hereunder mentioned which could not be utilised on the work to the full extent in the view of foreclosure;

- (i) Any expenditure incurred on preliminary site work, e.g. temporary access roads, temporary labour huts, staff quarters and site office; storage accommodation and water storage tanks.
- (ii) Department/Government shall have the option to take over contractor's materials or any part of thereof either brought to site or of which the contractor is legally bound to accept delivery from suppliers (for incorporation in or incidental to the work) provided, however Department/ Government shall be bound take over the materials or such portions thereof as the contractor does not desire to retain. For materials taken over to be taken over by Department/ Government, cost of such materials as detailed by Engineer –in – Charge shall be paid. The cost shall, however, take in to account purchase price, cost of transportation and deterioration or damage which may have been caused to materials whilst in the custody of the contractor.
- (iii) If any materials supplied by the Department/Government are rendered surplus, the same except normal wastage shall be returned by the contractor to the Department/ Government at rates not exceeding those at which these were originally issued, less allowance for any deterioration or damage which may have been caused whilst the materials were in the

custody of the contractor. In addition, cost of transporting such materials from site to Government stores, if so required by Department/Government, shall be paid.

- (iv) Reasonable compensation of transfer of T&P from site to contractor's permanent stores or to his other works, whichever is less. If T&P are not transported to either of the said places, no cost of transportation shall be payable.
- (v) Reasonable compensation for repatriation of contractor's site staff and imported labour to the extent necessary.

The contractor shall, if required by the Engineer – in – Charge, furnish to him, books of account, wage books, time sheet and other relevant documents and evidence as may be necessary to enable him to certify the reasonable amount payable under this condition.

The reasonable amount of items on (i), (iv) and (v) above shall not be in excess of 2% of the cost of the work remaining incomplete on the date of closure, i.e. total stipulated cost of the work as per accepted tender less the cost of work actually executed under the contract and less the cost of contractor's materials at site taken over by the Department/Government as per item (ii) above. Provided always that against any payments due to the contractor on this account or otherwise, the Engineer – in – Charge shall be entitled to recover or be credited with any outstanding balances due from the contractor for advance paid in respect of any tool, plants and materials and any other sums which at the date of termination were recoverable by the Government from the contractor under the terms of the contract

CLAUSE 14 – Carrying out part work at risk & cost of Contractor

If contractor:

- i) At any time makes default during currency of work or does not execute any part of the work with due diligence and continues to do so even after a notice in writing of 7 days in this respect from the Engineer-in-charge; or
- ii) Commits default in complying with any of the terms and conditions of the Contract and does not remedy it or takes effective steps to remedy it within 7 days even after a notice in writing is given in that behalf by the Engineer-in-Charge; or
- iii) Fails to complete the work(s) or items of work with individual dates of completion, on or before the date(s) so determined, and does not complete them within the period specified in the notice given in writing in that behalf by the Engineer-in-charge.

The Engineer-in-Charge without invoking action under clause 3 may, without prejudice to any other right or remedy against the contractor which have either accrued or accrue thereafter to Client, by a notice in writing to take the part work/part incomplete work of any item(s) out of his hands and shall have powers to:

- (a) Take possession of the site and any materials, constructional plant, implements, stores, etc., thereon; and/or
- (b) Carry out the part work/part incomplete work of any item(s) by any means at the risk and cost of the Contractor.

The Engineer-in-Charge shall determine the amount, if any, is recoverable from the Contractor for completion of the part work/part incomplete work of any item(s) taken out of his hands and execute at the risk and cost of the Contractor, the liability of contractor on account of loss or damage suffered by the Client because of action under this clause shall not exceed 10% of the tendered value of the work.

In determining the amount, credit shall be given to the contractor with the value of work done in all respect in the same manner and at the same rate as if it had been carried out by the original contractor under the terms of his contract, the value of Contractor's materials taken over and incorporated in the work and use of plant and machinery belonging to the contractor. The certificate of the Engineer-in-Charge as to the value of work done shall be final and conclusive against the

contractor provided always that action under this clause shall only be taken after giving notice in writing to the contractor. Provided also that if the expenses incurred by the department are less than the amount payable to the contractor at his agreement rates, the difference shall not be payable to the contractor.

Any excess expenditure incurred or to be incurred by the Client in completing the part work/part incomplete work of any item(s) or the excess loss of damages suffered or may be suffered by Government as aforesaid after allowing such credit shall without prejudice to any other right or remedy available to the Client in law or per as agreement be recovered from any money due to the contractor or any account, and if such money is insufficient, the contractor shall be called upon in writing and shall be liable to pay the same within 30 days.

If the contractor fails to pay the required sum within the aforesaid period of 30 days, the Engineer-in-Charge shall have the right to sell any or all of the contractor's unused materials, constructional plant, implements, temporary building at site etc. and adjust the proceed of sale thereof towards the dues recoverable from the contractor under the contract and if thereafter there remains any balance outstanding, it shall be recovered in accordance with the provisions of the contract.

In the event of above course being adopted by the Engineer-in-Charge, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advance on any account or with a view to the execution of the work or the performance of the contract.

CLAUSE 15 Suspension of Work

- (i) The contractor shall, on receipt of the order in writing of the Engineer – in – Charge, (whose decision shall be final and binding on the contractor) suspend the progress of the works or any part thereof for such time and in such manner as the Engineer – in – Charge may consider necessary so as not to cause any damage or injury to the work already done or endanger the safety thereof for any of the following reasons:
 - (a) On account of any default on the part of the contractor or;
 - (b) For proper execution of the works or part thereof for reasons other than the default of the contractor; or
 - (c) For safety of the works or part thereof.

The contractor shall, during such suspension, properly protect and secure the works to the extent necessary and carry out the instructions given in that behalf by the Engineer – in – Charge.

- (ii) If the suspension is ordered for reasons (b) and (c) in sub-para (i) above:
 - (a) The contractor shall be entitled to an extension of time equal to the period of every such suspension PLUS 25%, for completion of the item or group of items of work for which a separate period of completion is specified in the contract and of which the suspended work forms a part, and;
 - (b) If the total period of all such suspension in respect of an item or group of items or work for which a separate period of completion is specified in the contract exceeds thirty days, the contractor shall, in addition, be entitled to such compensation as the Engineer –in – Charge may consider reasonable in respect of salaries and /or wages paid by the contractor to his employees and labour at site, remaining idle during the period of suspension, adding thereto 2% to cover indirect expenses of the contractor provided the contractor submit the claim supported by details to the Engineer – in – Charge within fifteen days of the expiry of the period of 30 days.
- (iii) If the works or part thereof is suspended on the orders of the Engineer – in – Charge for more than three months at a time, except when suspension is ordered for reason (a) in sub-para (i) above, the contractor may after receipt of such order serve a written notice on the Engineer –

in – Charge requiring permission within fifteen days from receipt by the Engineer – in – Charge of the said notice, to proceed with the work or part thereof in regard to which progress has been suspended and if such permission is not granted within that time, the contractor, if he intends to treat the suspension, where it affects only a part of the works as an omission of such part by Government or where it affects whole of the works as an abandonment of the works by Government, shall within ten days of expiry of such period of 15 days give notice in writing of his intention to the Engineer –in – Charge. In the event of the contractor treating the suspension as an abandonment of the contract by the Government, he shall have no claim to payment of any compensation on account of any profit or advantage which he might have derived from the execution of the work in full but which he could not derive in consequence of the abandonment. He shall, however, be entitled to such compensation, as the Engineer – in – Charge may consider reasonable, in respect of salaries and /or wages paid by him to his employees and labour at site, remaining idle in consequence adding to the total thereof 2% to cover indirect expenses of the contractor provided the contractor submits his claim supported by details to the Engineer – in – Charge within 30 days of the expiry of the period of 3 months.

Provided, further that the contractor shall not be entitled to claim any compensation from Government for the loss suffered by him on account of delay by Government in the supply of materials in schedule 'B' where such delay is covered by difficulties relating to the supply of wagons, force majeure including non- allotment of such materials by controlling authorities, acts of God, acts of enemies of the state/country or any reasonable cause beyond the control of the Government.

CLAUSE 16

Action in case Work not done as per Specifications

All works under or in course of execution or executed in pursuance of the contract, shall at all times be open and accessible to the inspection and supervision of the Engineer – in – Charge, his authorized subordinates in charge of the work and all the superior officers, officer of the Quality Assurance Unit of the Department or any organization engaged by the Department for Quality Assurance and of the Chief Technical Examiner's Office, and the contractor shall, at all times, during the usual working hours and at all other times at which reasonable notice of the visit of such officers has been given to the contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that 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.

If it shall appear to the Engineer – in – Charge or his authorized subordinates in charge of the work or to the Officer in charge of Quality Assurance or his subordinate officers or the officers of the organization engaged by the Department for Quality Assurance or to the Chief Technical Examiner or his subordinate officers, that any work has been executed with unsound, imperfect, or unskilful workmanship, or with materials or articles provided by him for the execution of the work which are unsound or of a quality inferior to that contracted or otherwise not in accordance with the contract, the contractor shall, on demand in writing which shall be made within twelve months (six months in the case of work costing Rs.10 Lac and below except road work) of the completion of the work from the Engineer –in – Charge specifying the work, materials or articles complained of notwithstanding that the same may have been passed, certified and paid for forthwith rectify, or remove and reconstruct the work so specified in whole or in part, as the case may require or as the case may be, remove the materials or articles so specified and provide other proper and suitable materials or articles at his own charge and cost. In the event of the failing to do so within a period specified by the Engineer – in – Charge in his demand aforesaid, then the contractor shall be liable to pay compensation at the same rate as under clause 2 of the contract (for non- completion of the work in time) for this default.

In such case the Engineer – in – Charge may not accept the item of work at the rates applicable under the contract but may accept such items at reduced rates as the authority specified in schedule 'F' may consider reasonable during the preparation of on account bills or final bill if the item

is so acceptable without detriment to the safety and utility of the item and the structure or he may reject the work outright without any payment and /or get it and other connected and incidental items rectified, or removed and re – executed at the risk and the cost of the contractor. Decision of the Engineer – in – Charge to be conveyed in writing in respect of the same will be final and binding on the contractor.

CLAUSE 17 Contractor Liable for Damages, defects during Defect Liability Period

If the contractor or his working people or servants shall break, deface, injure or destroy any part of building in which they may be working, or any building, road, road kerb, fence, enclosure, water pipe, cables, drains, electric or telephone post or wires, trees, grass or grassland, or cultivated ground contiguous to the premises on which the work or any part is being executed, or if any damage shall happen to the work while in progress, from any cause whatever or if any defect, shrinkage or other faults appear in the work within twelve months (six months in the case of work costing Rs. Ten lacs and below except road work) after a certificate final or otherwise of its completion shall have been given by the Engineer – in – Charge as aforesaid arising out of defect or improper materials or workmanship the contractor shall upon receipt of a notice in writing on that behalf make the same good at his own expense or in default the Engineer – in – Charge cause the same to be made good by other workmen and deduct the expense from any sums that may be due or at any time thereafter may become due to the contractor, or from his security deposit or the proceeds of sale thereof or of a sufficient portion thereof. The Security Deposit of the contractor shall not be refunded before the expiry of twelve months (six months in the case of work costing Rs. Ten lacs and below except road work) after the issue of the certificate final or otherwise, of completion of work, or till the final bill has been prepared and passed whichever is later. Provided that in the case of road work, if the opinion of the Engineer – in – Charge, half of the security deposit is sufficient, to meet all liabilities of the contractor under this contract, half of the security deposit will be refundable after six months and the remaining half after twelve month of the issue of the said certificate of completion or till the final bill has been prepared and passed whichever is later.

In case of Maintenance and Operation works of E&M services, the security deposit deducted from contractors shall be refunded within one month from the date of final payment or within one month from the date of completion of the maintenance contract whichever is earlier.

CLAUSE 18 Contractors to Supply Tools & Plants etc.

The contractor shall provide at his own cost all materials (except such special materials, if any, as may in accordance with the contract be supplied from the Engineer – in – Charge’s stores), machinery, tools & plants as specified in schedule “F”. In addition to this, appliances, implements, other plants, ladders, cordage, tackle, scaffolding and temporary works required for the proper execution of the work, whether original, altered or substituted and whether included in the specifications or other documents forming part of the contract or referred to in these conditions or not, or which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer – in – Charge as to any matter as to which under these conditions he is entitled to be satisfied, or which he is entitled to require together with carriage therefore to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials, necessary for the purpose of setting out works, and counting, weighing and assisting the measurement for examination at any time and from time to time of the work or materials. Failing his so doing, the same may be provided by the Engineer-in-Charge at the expense of the contractor and the expenses may be deducted, from any money due to the contractor under this contract or otherwise and /or from his security deposit or the proceeds of sale thereof, or a sufficient portions thereof.

CLAUSE 18A Recovery of Compensation paid to workmen

In every case in which by virtue of the provision sub-section (1) of Section 12, of the Workmen’s

Compensation Act, 1923, Government is obliged to pay compensation to a workman employed by the contractor, in execution of the works, Government will recover from the contractor, the amount of the compensation so paid; and, without prejudice to the rights of the Government under sub-section (2) of Section 12, of the said Act, Government shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by Government to the contractor whether under this contract or otherwise. Government shall not be bound to contest any claim made against it under sub-section (1) of Section 12, of the said Act, except on the written request of the contractor and upon his giving to Government full security for all costs for which Government might become liable in consequence of contesting such claim.

CLAUSE 18B Ensuring Payment and Amenities to Workers if Contractor fails

In every case in which by virtue of the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and of the Contract Labour (Regulation and Abolition) Central Rules, 1971, Government is obliged to pay any amounts of wages to a workman employed by the contractor in execution of the work, or to incur any expenditure in providing welfare and health amenities required to be provided under the above said Act or under the Rules framed by Government from time to time for the protection of the health and sanitary arrangements for workers employed by Contractors to be followed by the Contractor for this Project, Department/Government will recover from the contractor, the amount of wages so paid or the amount of expenditure so incurred; and without prejudice to the rights of the Government under sub-section (2) of Section 20, and sub-section (4) of Section 21, of the Contract Labour (Regulation and Abolition) Act, 1970, Government shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by Department/Government to the contractor whether under this contract or otherwise. Department/Government shall not be bound to contest any claim made against it under sub-section (1) of Section 20, sub-section (4) of Section 21, of the said Act, except on the written request of the contractor and upon his giving to the Department/Government full security for all costs for which the Department /Government might become liable in contesting such claim.

CLAUSE 19 Labour Laws to be complied by the Contractor

The contractor shall obtain a valid license under the Contract Labour (R & A) Act, 1970, and the Contract Labour (Regulation & Abolition) Central Rules, 1971, before the commencement of the work, and continue to have a valid license until the completion of the work. The contractor shall also abide by the provisions of the Child Labour (Prohibition and Regulation) Act, 1986.

The contractor shall also comply with the provisions of the Building and Other Construction Workers (Regulation of Employment & Condition of Service) Act, 1996 and the Building and Other Construction Workers Welfare Cess Act, 1996.

Any failure to fulfil these requirements shall attract the penal provisions of this contract arising out of the resultant non-execution of the work.

CLAUSE 19A

No labour below the age of fourteen years shall be employed on the work.

CLAUSE 19B Payment of wages:

Payment of wages:

- (i) The Contractor shall pay to labour employed by him either directly or through sub-contractors, wages not less than fair wages as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970 and the contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

- (ii) The contractor shall, notwithstanding the provisions of any contract to the contrary, cause to be paid fair wage to labour indirectly engaged on the work, including any labour engaged by his sub-contractors in connection with the said work, as if the labour had been immediately employed by him.
- (iii) In respect of labour directly or indirectly employed in the works for performance of the contractor's part of this contract, the contractor shall comply with or cause to be complied with the Central Public Works Department contractor's Labour Regulations made by Government from time to time in regard to payment of wages, wage period, deduction from wages recovery of wages not paid and deductions unauthorisedly made, maintenance of wage books or wage slips, publication of scale of wages and other terms of employment, inspection and submission of periodical returns and all other matters of the like nature or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.
- (iv) (a) The Engineer-in-Charge concerned shall have the right to deduct from the moneys 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-fulfilment of the conditions of the contract for the benefit of the workers, non-payment of wages or of deductions made from his or their wages which are not justified by their terms of the contract or non-observance of the Regulations.
 (b) Under the provision of Minimum Wages (Central) Rules, 1950, the contractor is bound to allow to the labours directly or indirectly employed in the works one day rest for 6 days continuous work and pay wages at the same rate as for duty. In the event of default, the Engineer-in-Charge shall have the right to deduct the sum or sums not paid on account of wages for weekly holidays to any labours and pay the same to the persons entitled thereto from any money due to the contractor by the Engineer-in-Charge Concerned.
 In the case of Union Territory of Delhi, however, as the all-inclusive minimum daily wages fixed under Notification of the Delhi Administration No. F. 12 (162) MWO/ DAB/43884-91, dated 31.12.1979 as amended from time to time are inclusive of wages for the weekly day of rest, the question of extra payment for weekly holiday would not arise.
- (v) The contractor shall comply with the provisions of the Payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees Liability Act, 1938, Workmen's Compensation Act, 1923, Industrial Disputes Act, 1947, maternity Benefits Act, 1961, and the Contractors Labour (Regulation and Abolition) Act 1970, or the modifications thereof or any other laws relating thereto and the rules made thereunder from time to time.
- (vi) The contractor shall indemnify and keep indemnified Government against payments to be made under and for the observance of the laws aforesaid and the C.P.W.D Contractor's Labour Regulations without prejudice to his right to claim indemnity from his sub-contractors.
- (vii) The laws aforesaid shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this contract.
- (viii) Whatever is the minimum wage for the time being, or if the wage payable is higher than such wage, such wage shall be paid by the contractor to the workman directly without the intervention of Jamadar and that Jamadar shall not be entitled to be deduct or recover any amount from the minimum wage payable to the workmen as and by way of commission or otherwise.
- (ix) The contractor shall ensure that no amount by way of commission or otherwise is deducted or recovered by the Jamadar from the wage of workmen

CLAUSE**19C**

In respect of all labour directly or indirectly employed in the work for the performance of the contractors part of this contract, the contractor shall at his own expense arrange for the safety

provisions as per Safety Code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the contractor fails to make arrangement and provide necessary facilities as aforesaid, he shall be liable to pay a penalty of Rs. 200/- for each default and in addition, the Engineer-in- Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in that behalf from the contractor.

CLAUSE 19D

The contractor shall submit by 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 respectively:-

- (1) The number of labours employed by him on the work,
- (2) Their working hours,
- (3) The wages paid to them,
- (4) 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
- (5) The number of female workers who have been allowed maternity benefit according to Clause 19F and amount paid to them.

Failing which the contractor shall liable to pay Government, a sum not exceeding Rs.200/- for each default or materially incorrect statement. The decision of the Engineer-in-charge shall be final in deducting from any bill due to the contractor, the amount levied as fine and be binding on the contractor.

CLAUSE 19E

In respect of all labour directly or indirectly employed in the works for the performance of the contractor part of this contract, the contractor shall comply with or cause to be complied with all the rules framed by Government from time to time for the protection of the health and sanitary arrangements for workers employed by the HLL/ Client and its contractors.

CLAUSE 19F

Leave and pay during leave shall be regulated as follows:-

1. Leave
 - (i) In the case of delivery – maternity leave not exceeding 8 weeks, 4 weeks up to and including the day of delivery and 4 weeks following that day,
 - (ii) In the case of miscarriage – up to 3 weeks from the date of miscarriage.
2. Pay:
 - (i) In the case of delivery – leave pay during maternity leave will be at the rate of the women's average daily earnings, calculated on total wages earned on the days when fulltime work was done during a period of three months immediately preceding the date on which she gives notice that she expects to be confined or at the rate of Rupee one only a day whichever is greater.
 - (ii) In the case of miscarriage – leave pay at the rate of average daily earning calculated on the total wages earned on the day when full time work was done during a period of three months immediately preceding the date of such miscarriage.
3. Conditions for grant of Maternity Leave:

No maternity leave benefit shall be admissible to a woman unless she has been employed for a

total period of not less than six months immediately preceding the date on which she proceeds on leave.

4. The contractor shall maintain a register of Maternity (Benefit) in the Prescribed form as shown in appendix –I and II, and the same shall be kept at the place of work.

CLAUSE 19G

In the event of the contractor(s) committing a default or breach of any of the provisions of the CPWD Contractor's Labour Regulations and Model Rules for the protection of health and sanitary arrangements for the workers as amended from time to time or furnishing any information or submitting or filling any statement under the provisions of the above Regulations and Rules which is materially incorrect, he/they shall without prejudice to any other liability, pay to the Government a sum not exceeding Rs.5000/- for every default breach or furnishing, making, submitting filling such materially incorrect statements and in the event of the contractor(s) defaulting continuously in this respect, the penalty may be enhanced to Rs.5000/-per day for each day of default subject to a maximum of 5 per cent of the estimated cost of the work put to tender. The decision of the Engineer-in-Charge shall be final and binding on the parties.

Should it appear to the Engineer-in-Charge that the contractor(s) is/are not properly observing and complying with the provisions of the C.P.W.D Contractor's Labour Regulations and Model Rules and the provisions of the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (R&A)Central Rules 1971, for the protection of health and sanitary arrangements for work people employed by the contractor(s) (hereinafter referred as "the said Rules") the Engineer-in-Charge shall have power to give notice in writing to the contractor(s) requiring that the said Rules be complied with and the amenities prescribed therein be provided to the work-people within a reasonable time to be specified in the notice. If the contractor(s) shall fail within the period specified in the notice to comply with and/ observe the said Rules and to provide the amenities to the work-people as aforesaid, the Engineer-in-Charge shall have the power to provide the amenities hereinbefore mentioned at the cost of the contractor(s). The contractor(s) shall erect, make and maintain at his/their own expense and to approved standards all necessary huts and sanitary arrangements required for his/their work people on the site in connection with the execution of the works, and if the same shall not have been erected or constructed, according to approved standards, the Engineer-in-Charge shall have power to give notice in writing to the contractor(s) requiring that the said huts and sanitary arrangements be remodelled and/or reconstructed according to approved standards, and if the contractor(s) shall fail to remodel or reconstruct such huts and sanitary arrangements according to approved standards within the period specified in the notice, the Engineer-in-Charge shall have the power to remodel or reconstruct such huts and sanitary arrangements according to approved standards at the cost of the contractor(s).

CLAUSE 19H

The contractor(s) shall at his/their own cost provide his/their labour with a sufficient number of huts (hereinafter referred to as the camp) of the following specifications on a suitable plot of land to be approved by the Engineer-in-Charge.

- (i) (a) The minimum height of each hut at the eaves level shall be 2.1m (7ft.)and the floor area to be provided will be at the rate of 2.7 sqm (30 sqft) for each member of the worker's family staying with the labourer.
- (b) The Contractor(s) shall in addition construct suitable cooking places having a minimum area of 1.80m x 1.50m (6'x5') adjacent to the hut for each family.
- (c) The contractor(s) shall also construct temporary latrines and urinals for the use of the labourers each on the scale of not less than four per each one hundred of the total strength, separate latrines and urinals being provided for women.
- (d) The contractor(s) shall construct sufficient number of bathing and washing places, one

- unit for every 25 persons residing in the camp. These bathing and washing places shall be suitably screened.
- (ii) (a) All the huts shall have walls of sun-dried or burnt- bricks laid in mud mortar or other suitable local materials as may be approved by the Engineer- in-Charge. In case of sun-dried bricks, the walls should be plastered with mud gobri on both sides. The floor may be kutcha but plastered with mud gobri and shall be at least 15 cm (6") above the surrounding ground. The roofs shall be laid with thatch or any other materials as may be approved by the Engineer-in-Charge and the contractor shall ensure that throughout the period of their occupation, the roofs remain water-tight.
 - (b) The contractor(s) shall provide each hut with proper ventilation.
 - (c) All doors, windows and ventilators shall be provided with suitable leaves for security purposes.
 - (d) There shall be kept an open space of at least 7.2m (8 yards) between the rows of hut which may be reduced to 6m (20 ft.) according to the availability of site with the approval of the Engineer-in-Charge. Back to back construction will be allowed.
 - (iii) **Water Supply** – The contractor(s) shall provide adequate supply of water for the use of labourers. The provision shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river, tanks which may be of metal or masonry, shall be provided. The contractor(s) shall also at his/their own cost make arrangements for laying pipelines for water supply to his/ their labour camp from the existing mains wherever available, and shall pay all fees and charges therefore.
 - (iv) The site selected for the camp shall be high ground, removed from jungle.
 - (v) **Disposal of Excreta** – The contractor(s) shall make necessary arrangements for the disposal of excreta from the latrines by trenching or incineration which shall be according to the requirements laid down by the Local Health Authorities. If trenching or incineration is not allowed, the contractor(s) shall make arrangements for the removal of the excreta through the Municipal Committee/authority and inform it about the number of labourers employed so that arrangements may be made by such Committee /authority for the removal of the excreta. All charges on this account shall be borne by the contractor and paid direct by him to the Municipality/authority. The contractor shall provide one sweeper for every eight seats in case of dry system.
 - (vi) **Drainage** – The contractor(s) shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy.
 - (vii) The contractor(s) shall make necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers.
 - (viii) **Sanitation** – The contractor(s) shall make arrangements for conservancy and sanitation in the labour camps according to the rules of the Local Public Health and Medical Authorities.

CLAUSE 19I

The Engineer-in-Charge may require the contractor to dismiss or remove from the site of the work any person or persons in the contractor(s) employ upon the work who may be incompetent or misconduct himself and the contractor shall forthwith comply with such requirements.

CLAUSE 19J

It shall be the responsibility of the contractor to see that the building under construction is not

occupied by anybody unauthorisedly during construction, and is handed over to the Engineer-in-Charge with vacant possession of complete building. If such building though completed is occupied illegally, then the Engineer-in-Charge shall have the option to refuse to accept the said building / buildings in that position. Any delay in acceptance on this account will be treated as the delay in completion and for such delay, a levy upto 5% of tendered value of work may be imposed by the Engineer-in-charge whose decision shall be final both with regard to the justification and quantum and be binding on the contractor.

However, Engineer-in-Charge, through a notice, may require the contractor to remove the illegal occupation any time on or before construction and delivery.

CLAUSE 19K Employment of skilled /semi skilled workers

The contractor shall, at all stages of work, deploy skilled/semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute/ Industrial Training Institute / National Institute of Construction Management and Research (NICMAR) /National Academy of Construction, CIDC or any similar reputed and recognized Institute managed /certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled /semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesman along with requisite certificate from recognized Institute to Engineer in charge for approval. Notwithstanding such approval if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs.100 per such tradesmen per day. Decision of Engineer in Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

Provided always, that the provisions of this clause shall not be applicable for works with estimated cost put to tender being less than Rs.5 crores.

CLAUSE 20 Minimum Wages Act to be complied with

The contractor shall comply with all the provisions of the Minimum Wages Act, 1948, and Contract Labour (Regulation and Abolition) Act, 1970, amended from time to time and rules framed there under and other labour laws affecting contract labour that may be brought into force from time to time.

CLAUSE 21 Work not to be sublet. Action in case of insolvency

The contract shall not be assigned or sublet without the written approval of the Engineer-in-Charge. And if the contractor shall assign or sublet his contract, or attempt to do so, or become insolvent or commence any insolvency proceedings or make any composition with his creditors or attempt to do so, or if any bribe, gratuity, gift, loan, perquisite, reward or advantage pecuniary or otherwise, shall either directly or indirectly, be given promised or offered by the contractor, or any of his servants or agent to any public officer or person in the employ of Government in any way relating to his office or employment, or if any such officer or person shall become in any way directly or indirectly interested in the contract, the Engineer-in-Charge on behalf of the Indian Pharmacopoeia Commission(IPC) shall have power to adopt the course specified in Clause 3 hereof in the interest of Government and in the event of such course being adopted, the consequences specified in the said Clause 3 shall ensue.

CLAUSE 22

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

CLAUSE 23 Changes in firm's Constitution to be intimated

Where the contractor is a partnership firm, the previous approval in writing of the Engineer-in-Charge shall be obtained 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 the contractor enters into any partnership agreement where-under the partnership firm would have the right to carry out the works hereby undertaken by the contractor. If previous approval as aforesaid is not obtained, the contract shall be deemed to have been assigned in contravention of Clause 21 hereof and the same action may be taken, and the same consequences shall ensue as provided in the said Clause 21.

CLAUSE 24

All works to be executed under the contract shall be executed under the direction and subject to the approval in all respects of the Engineer-in-Charge who shall be entitled to direct at what point or points and in what manner they are to be commenced, and from time to time carried on.

CLAUSE 25 Settlement of Disputes & Arbitration

Except where otherwise provided in the contract, all questions and disputes relating to the meaning of the specifications, design, drawings and instructions here-in before mentioned and as to the quality of workmanship or materials used on the work or as to any other question, claim, right, matter or thing whatsoever in any way arising out of or relating to the contract, designs, drawings, specifications, estimates, instructions, orders or these conditions or otherwise concerning the works or the execution or failure to execute the same whether arising during the progress of the work or after the cancellation, termination, completion, or abandonment thereof shall be dealt with as mentioned hereinafter:

- (i) If the contractor considers any work demanded of him to be outside the requirements of the contract, or disputes any drawings, record or decision given in writing by the Engineer-in-Charge on any matter in connection with or arising out of the contract or carrying out of the work, to be unacceptable, he shall promptly within 15 days request the authority as indicated in Schedule 'F' (Reviewing Authority) in writing for written instruction or decision. Thereupon, the Reviewing Authority shall give his written instructions or decision within a period of one month from the receipt of the contractor's letter.

If the Reviewing Authority fails to give his instructions or decision in writing within the aforesaid period or if the contractor is dissatisfied with the instructions or decision of the Reviewing Authority, the contractor may, within 15 days of the receipt of Reviewing Authorities' decision, appeal to the authority as indicated in Schedule 'F' (Appealing Authority) who shall afford an opportunity to the contractor to be heard, if the latter so desires, and to offer evidence in support of his appeal. The Appealing Authority shall give his decision within 30 days of receipt of contractor's appeal. If the contractor is dissatisfied with this decision, the contractor shall within a period of 30 days from receipt of the decision, give notice to the Secretary-cum-Scientific Director, Indian Pharmacopoeia Commission (IPC) Ghaziabad (U.P.) for appointment of arbitrator failing which the said decision shall be final binding and conclusive and not referable to adjudication by the arbitrator.

It is a term of contract that each party Invoking arbitration must exhaust the aforesaid mechanism of settlement of claims/disputes prior to invoking arbitration.

- (ii) Except where the decision has become final, binding and conclusive in terms of sub-para (i)

above, disputes or difference shall be referred for adjudication through arbitration by a sole arbitrator appointed by the Secretary-cum-Scientific Director, Indian Pharmacopoeia Commission (IPC) Ghaziabad (U.P.). If the arbitrator so appointed is unable or unwilling to act or resigns his appointment or vacates his office due to any reason whatsoever, another sole arbitrator shall be appointed in the manner aforesaid. Such person shall be entitled to proceed with the reference from the stage at which it was left by his predecessor.

It is a term of this contract that the party invoking arbitration shall give a list of disputes with amounts claimed in respect of each such dispute along with the notice for appointment of arbitrator and giving reference to the rejection by the Appealing Authority of the appeal.

It is also a term of this contract that no person, other than a person appointed by MoHFW or the Client, as aforesaid, should act as arbitrator.

It is also a term of this contract that if the contractor does not make any demand for appointment of arbitrator in respect of any claims in writing as aforesaid within 120 days of receiving the intimation from the Engineer-in-Charge that the final bill is ready for payment, the claim of the contractor shall be deemed to have been waived and absolutely barred and the Department/ Government shall be discharged and released of all liabilities under the contract in respect of these claims.

The arbitration shall be conducted in accordance with the provisions of the Arbitration and Conciliation Act, 1996 (26 of 1996) or any statutory modifications or re-enactment thereof and the rules made thereunder and for the time being in force shall apply to the arbitration proceeding under this clause.

It is also a term of this contract that the arbitrator shall adjudicate on only such disputes as are referred to him by the appointing authority and give separate award against each dispute and claim referred to him and in all cases where the total amount of the claims by any party exceeds Rs, 1,00,000/-, the arbitrator shall give reasons for the award.

It is also a term of the contract that if any fees are payable to the arbitrator, these shall be paid equally by both the parties.

It is also a term of the contract that the arbitrator shall be deemed to have entered on the reference on the date he issues notice to both the parties calling them to submit their statement of claims and counter statement of claims. The venue of the arbitration shall be such place as may be fixed by the arbitrator in his sole discretion. The fees, if any, of the arbitrator shall, if required to be paid before the award is made and published, be paid half and half by each of the parties. The cost of the reference and of the award (including the fees, if any, of the arbitrator) shall be in the discretion of the arbitrator who may direct to any by whom and in what manner, such costs or any part thereof shall be paid and fix or settle the amount of costs to be so paid.

CLAUSE 26 Contractor to indemnify Govt. against Patent Rights

The contractor shall fully indemnify and keep indemnified the Indian Pharmacopoeia Commission(IPC) against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any article or part thereof included in the contract. In the event of any claims made under or action brought against Department/Government in respect of any such matters as aforesaid, the contractor shall be immediately notified thereof and the contractor shall be at liberty, at his own expense, to settle any dispute or to conduct any litigation that may arise there from, provided that the contractor shall not be liable to indemnify the Indian Pharmacopoeia Commission(IPC) if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Engineer-in-Charge in this behalf.

CLAUSE 27 Lump sum Provisions in Tender

When the estimate on which a tender is made includes lump sum in respect of parts of the work, the

contractor shall be entitled to payment in respect of the items of work involved or the part of the work in question at the same rates as are payable under this contract for such items, or if the part of the work in question is not, in the opinion of the Engineer-in-Charge payable of measurement, the Engineer-in-Charge may at his discretion pay the lump-sum amount entered in the estimate, and the certificate in writing of the Engineer-in-Charge shall be final and conclusive against the contractor with regard to any sum or sums payable to him under the provisions of the clause.

CLAUSE 28 Action where no specifications are specified

In the case of any class of work for which there is no such specifications as referred to in Clause 11, such work shall be carried out in accordance with the Bureau of Indian Standards Specifications. In case there are no such specifications in bureau of Indian Standards, the work shall be carried out as per manufacturers' specifications, if not available then as per District Specifications. In case there are no such specifications as required above, the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-Charge.

CLAUSE 29 With-holding and lien in respect of sums due from contractor

- (i) Whenever any claim or claims for payment of a sum of money arises out of or under the contract or against the contractor, the Engineer-in-Charge or the Government shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from the security, if any deposited by the contractor and for the purpose aforesaid, the Engineer-in-Charge or the Government shall be entitled to withhold the security deposit, if any, furnished as the case may be and also have a lien over the same pending finalization or adjudication of any such claim. In the event of the security being insufficient to cover the claimed amount or amounts or if no security has been taken from the contractor, the Engineer-in-Charge or the Government shall be entitled to withhold and have a lien to retain to the extent of such claimed amount or amounts referred to above, from any sum or sums found payable or which may at any time thereafter become payable to the contractor under the same contract or any other contract with the Engineer-in-Charge of the Government or any contracting person through the Engineer-in-Charge pending finalization of adjudication of any such claim.

It is an agreed term of the contract that the sum of money or moneys so withheld or retained under the lien referred to above by the Engineer-in-Charge or Government will be kept withheld or retained as such by the Engineer-in-Charge or Government till the claim arising out of or under the contract is determined by the arbitrator (if the contract is governed by the arbitration clause) by the competent court, as the case may be and that the contractor will have no claim for interest or damages whatsoever on any account in respect of such withholding or retention under the lien referred to above and duly notified as such to the contractor. For the purpose of this clause, where the contractor is a partnership firm or a limited company, the Engineer-in-Charge or the Government shall be entitled to withhold and also have a lien to retain towards such claimed amount or amounts in whole or in part from any sum found payable to any partner/limited company as the case may be, whether in his individual capacity or otherwise.

- (ii) Government shall have the right to cause an audit and technical examination of the works and the final bills of the contractor including all supporting vouchers, abstract, etc., to be made after payment of the final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the contractor under the contract or any work claimed to have been done by him under the contract and found not to have been executed, the contractor shall be liable to refund the amount of over-payment and it shall be lawful for Government to recover the same from him in the manner prescribed in sub-clause (i) of this clause or in any other manner legally permissible; and if it is found that the contractor was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid by Government to the contractor, without any interest thereon whatsoever.

Provided that the Government shall not be entitled to recover any sum overpaid, nor the contractor shall be entitled to payment of any sum paid short where such payment has been agreed upon between the Engineer-in-Charge on the one hand and the contractor on the other under any term of the contract permitting payment for work after assessment by the Engineer-in-Charge.

CLAUSE 29A Lien in respect of claims in other Contracts

Any sum of money due and payable to the contractor (including the security deposit returnable to him) under the contract may be withheld or retained by way of lien by the Engineer-in-Charge or the Government or any other contracting person or persons through Engineer-in-Charge against any claim of the Engineer-in-Charge or Government or such other person or persons in respect of payment of a sum of money arising out of or under, any other contract made by the contractor with the Engineer-in-Charge or the Government or with such other person or persons.

It is an agreed term of the contract that the sum of money so withheld or retained under this clause by the Engineer-in-Charge or the Government will be kept withheld or retained as such by the Engineer-in-Charge or the Government or till his claim arising out of the same contract or any other contract is either mutually settled or determined by the arbitration clause or by the competent court, as the case may be and that the contractor shall have no claim for interest or damages whatsoever on this account or on any other ground in respect of any sum of money withheld or retained under this clause and duly notified as such to the contractor.

CLAUSE 30 Employment of coal mining or controlled area labour not permissible

The contractor shall not employ coal mining or controlled area labour falling under any category whatsoever on or in connection with the work or recruit labour from area within a radius of 32 km (20 miles) of the controlled area. Subject as above the contractor shall employ imported labour only i.e., deposit imported labour or labour imported by contractors from area, from which import is permitted.

Where ceiling price for imported labour has been fixed by State or Regional Labour Committees not more than that ceiling price shall be paid to the labour by the contractor.

The contractor shall immediately remove any labourer who may be pointed out by the Engineer-in-Charge as being a coal mining or controlled area labourer,. Failure to do so shall render the contractor liable to pay to Government a sum calculated at the rate of Rs. 10/- per day per labourer. The certificate of the Engineer-in-Charge about the number of coal mining or controlled area labourer and the number of days for which they worked shall be final and binding upon all parties to this contract.

It is declared and agreed between the parties that the aforesaid stipulation in this clause is one in which the public are interested within the meaning of the exception in Section 74 of Indian contract Act, 1872.

Explanation: - Controlled Area means the following areas:

Districts of Dhanbad, Hazaribagh, Jamtara – a Sub-Division under Santhal Pargana Commissioner, Districts of Bankura, Birbhum, Burdwan, District of Bilaspur.

Any other area which may be declared a Controlled Area by or with the approval of the Central Government.

CLAUSE 31 Unfiltered water supply

The contractor(s) shall make his/their own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following conditions.

- (i) That the water used by the contractor(s) shall be fit for construction purposes to the satisfaction of the Engineer-in-Charge.

- (ii) The Engineer-in-Charge shall make alternative arrangements for supply of water at the risk and cost of contractor(s) if the arrangements made by the contractor(s) for procurement of water are in the opinion of the Engineer-in-Charge, unsatisfactory.

CLAUSE 31A Departmental water supply, if available

Water if available may be supplied to the contractor by the Department subject to the following conditions:-

- (i) The water charges @ 1% shall be recovered on gross amount of the work done.
- (ii) The contractor(s) shall make his/their own arrangement of water connection and laying of pipelines from existing main of source of supply.
- (iii) The Department do not guarantee to maintain uninterrupted supply of water and it will be incumbent on the contractor(s) to make alternative arrangements for water at his/their own cost in the event of any temporary break down in the Government water main so that the progress of his/their work is not held up for want of water. No claim of damage or refund of water charges will be entertained on account of such break down.

CLAUSE 32 Alternate water arrangements

- (i) Where there is no piped water supply arrangement and the water is taken by the contractor from the wells or hand pump constructed by the government, no charge shall be recovered from the contractor on that account. The contractor shall, however, draw water at such hours of the day that it does not interfere with the normal use for which the hand pumps and wells are intended. He will also be responsible for all damage and abnormal repairs arising out of his use, the cost of which shall be recoverable from him. The Engineer-in-Charge shall be the final authority to determine the cost recoverable from the contractor on this account and his decision shall be binding on the contractor.
- (ii) The contractor shall be allowed to construct temporary wells in Government land for taking water for construction purposes only after he has got permission of the Engineer-in-Charge in writing. No charges shall be recovered from the contractor on this account, but the contractor shall be required to provide necessary safety arrangements to avoid any accidents or damage to adjacent buildings, roads and service lines. He shall be responsible for any accidents or damage caused due to construction and subsequent maintenance of the wells and shall restore that ground to its original condition after the wells are dismantled on completion of the work.

CLAUSE 33 Return of Surplus materials

Notwithstanding anything contained to the contrary in this contract, where any materials for the execution of the contract are procured with the assistance of Government either by issue from government stocks or purchase made under orders or permits or licences issued by Government, the contractor shall hold the said materials economically and solely for the purpose of the contract and not dispose of them without the written permission of the Government and return, if required by the Engineer-in-Charge, all surplus or unserviceable materials that may be left with him after the completion of the contract or at its termination for any reason whatsoever on being paid or credited such price as 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 element of storage charges. The decision of the Engineer-in-Charge shall be final and conclusive. In the event of breach of the aforesaid condition, the contractor shall in addition to throwing himself open to action for contravention of the terms of the licence or permit and/or for criminal breach of trust, be liable to Government for all moneys, advantages or profits resulting or which in the usual course would have resulted to him by reason of such breach.

CLAUSE 34 Hire of Plant & Machinery

- (i) The contractor shall arrange at his own expense all tools, plant, machinery and equipment (hereinafter referred to as T & P) required for execution of the work except for the Plant & Machinery listed in Schedule 'C' and stipulated for issue to the contractor. If the contractor requires any item of T&P on hire from the T & P available with the Government over and above the T&P stipulated for issue, the Government will, if such item is available, hire it to the contractor at rates to be agreed upon between him and the Engineer-in-Charge. In such a case, all the conditions hereunder for issue of T&P shall also be applicable to such T&P as is agreed to be issued.
- (ii) Plant and Machinery when supplied on hire charges shown in Schedule 'C' shall be made over and taken back at the departmental equipment yard/shed shown in Schedule 'C' and the contractor shall bear the cost of carriage from the place of issue to the site of work and back. The contractor shall be responsible to return the plant and machinery with condition in which it was handed over to him, and he shall be responsible for all damage caused to the said plant and machinery at the site of work or elsewhere in operation and otherwise during transit including damage to or loss of plant and for all losses due to his failure to return the same soon after the completion of the work for which it was issued. The Divisional Engineer shall be the sole judge to determine the liability of the contractor and its extent in this regard and his decision shall be final and binding on the contractor.
- (iii) The plant and machinery as stipulated above will be issued as and when available and if required by the contractor. The contractor shall arrange his programme of work according to the availability of the plant and machinery and no claim, whatsoever, will be entertained from him for any delay in supply by the Department.
- (iv) The hire charges shall be recovered at the prescribed rates from and inclusive of the date the plant and machinery made over upto and inclusive of the date of the return in good order even though the same may not have been working for any cause except major breakdown due to no fault of the contractor or faulty use requiring more than three working days continuously (excluding intervening holidays and Sundays) for bringing the plant in order. The contractor shall immediately intimate in writing to the Engineer-in-Charge when any plant or machinery gets out of order requiring major repairs as aforesaid. The Engineer-in-Charge shall record the date and time of receipt of such intimation in the log sheet of the plant or machinery. Based on this if the breakdown before lunch period or major breakdown will be computed considering half a day's breakdown on the day of complaint. If the breakdown occurs in the post lunch period of major breakdown will be computed starting from the next working day. In case of any dispute under this clause, the decision of the Engineer-in-charge shall be final and binding on the contractor.
- (v) The hire charges shown above are for each day of 8 hours (inclusive of the one hour lunch break) or part thereof.
- (vi) Hire charges will include service of operating staff as required and also supply of lubricating oil and stores for cleaning purposes. Power fuel of approved type, firewood, kerosene oil etc. for running the plant and machinery and also the full time chowkidar for guarding the plant and machinery against any loss or damage shall be arranged by the contractor who shall be fully responsible for the safeguard and security of plant and machinery. The contractor shall on or before the supply of plant and machinery sign an agreement indemnifying the Department against any loss or damage caused to the plant and machinery either during transit or at site of work.
- (vii) Ordinarily, no plant and machinery shall work for more than 8 hours a day inclusive of one hour lunch break. In case of an urgent work however, the Engineer-in-Charge may, at his discretion, allow the plant and machinery to be worked for more than normal period of 8 hours a day. In that case, the hourly hire charges for overtime to be borne by the contractor shall be 50% more than the normal proportionate hourly charges (1/8th of the daily charges)

subject to a minimum of half day's normal charges on any particular day. For working out hire charges for over time, a period of half an hour and above will be charged as one hour and a period of less than half an hour will be ignored.

- (viii) The contractor shall release the plant and machinery every seventh day for periodical servicing and/or wash out which may take about three to four hours or more. Hire charges for full day shall be recovered from the contractor for the day of servicing/wash out irrespective of the period employed in servicing.
- (ix) The plant and machinery once issued to the contractor shall not be returned by him on account of lack of arrangements of labour and materials, etc. on his part, the same will be returned only when they are required for major repairs or when in the opinion of the Engineer-in-Charge, the work or a portion of work for which the same was issued is completed.
- (x) Log Book for recording the hours of daily work for each of the plant and machinery supplied to the contractor will be maintained by the Department and will be countersigned by the contractor or his authorized agent daily. In case the contractor contests the correctness of the entries and/or fails to sign the Log Book, the decision of the Engineer-in-Charge shall be final and binding on him. Hire charges will be calculated according to the entries in the Log book and will be binding on the contractor. Recovery on account of hire charges for road rollers shall be made for the minimum number of days worked out on the assumption that a roller can consolidate per day and maximum quantity of materials or area surfacing as noted against each in the annexed statement (see attached annexure).
- (xi) In the case of concrete mixers, the contractors shall arrange to get the hopper cleaned and the drum washed at the close of the work each day or each occasion.
 - (a) In case rollers for consolidation are employed by the contractor himself, log book for such rollers shall be maintained in the same manner as is done in case of departmental rollers, maximum quantity of any items to be consolidated for each roller-day shall also be same as in annexure to Clause 34(x). For less use of rollers, recovery for the less roller days shall be made at the stipulated issue rate.
- (xii) The contractor shall be responsible to return the plant and machinery in the condition in which it was handed over to him and he shall be responsible for all damage caused to the said plant and machinery at the site of work or elsewhere in operation or otherwise or during transit including damage to or loss of parts, and for all losses due to his failure to return the same soon after the completion of the work for which it was issued. The Divisional Engineer shall be the sole judge to determine the liability of the contractor and its extent in this regard and his decision shall be final and binding on the contractor.
- (xiii) The contractor will be exempted from levy of any hire charges for the number of days he is called upon in writing by the Engineer-in-Charge to suspend execution of the work, provided Government plant and machinery in question have, in fact, remained idle with the contractor because of the suspension.
- (xiv) In the event of the contractor not requiring any item of plant and machinery issued by Government though not stipulated for issue in Schedule 'C' any time after taking delivery at the place of issue, he may return it after two days written notice or at any time without notice if he agrees to pay hire charges for two additional days without, in any way, affecting the right of the Engineer-in-Charge to use the said plant and machinery during the said period of two days as he likes including hiring out to a third party.

CLAUSE 35

Condition relating to use of asphaltic materials

- (i) The contractor undertakes to make arrangement for the supervision of the work by the firm supplying the tar or bitumen used.
- (ii) The contractor shall collect the total quantity of tar or bitumen required for the work as per

standard formula, before the process of painting is started and shall hypothecate it to the Engineer-in-Charge. If any bitumen or tar remains unused on completion of the work on account of lesser use of materials in actual execution for reasons other than authorized changes of specifications and abandonment of portion of work, a corresponding deduction equivalent to the cost of unused materials as determined by the Engineer-in-Charge shall be made and the material return to the contractors. Although the materials are hypothecated to Government, the contractor undertakes the responsibility for their proper watch, safe custody and protection against all risks. The materials shall not be removed from site of work without the consent of the Engineer-in- Charge in writing.

- (iii) The contractor shall be responsible for rectifying defects noticed within a year from the date of completion of the work and the portion of the security deposit relating to asphaltic work shall be refunded after the expiry of this period.

CLAUSE 36 Employment of Technical Staff and Employees

Contractors Superintendence, Supervision, Technical Staff & Employees

- (i) The contractor shall provide all necessary superintendence during execution of the work and all along thereafter as may be necessary for proper fulfilling of the obligations under the contract.

The contractor shall immediately after receiving letter of acceptance of the tender and before commencement of the work, intimate in writing to the Engineer-in- Charge, the name(s), qualifications, experience, age, address(s) and other particulars along with certificates, of the principal technical representative to be in charge of the work and other technical representative(s) who will be supervising the work. Minimum requirement of such technical representative(s) and their qualifications and experience shall not be lower than specified in Schedule 'F'. The Engineer-in-Charge shall within 3 days of receipt of such communication intimate in writing his approval or otherwise of such a representative(s) to the contractor. Any such approval may at any time be withdrawn and in case of such withdrawal, the contractor shall appoint another such representative(s) according to the provisions of this clause. Decision of the tender accepting authority shall be final and binding on the contractor in this respect. Such a principal technical representative and other technical representative(s) shall be appointed by the contractor soon after receipt of the approval from Engineer-in-Charge and shall be available at site before start of work.

All the provisions applicable to the principal technical representative under the Clause will also be applicable to other technical representative(s). The principal technical representative and other technical representative(s) shall be present at the site of work for supervision at all times when any construction activity is in progress and also present himself/themselves, as required, to the Engineer-in- Charge and/or his designated representative to take instructions. Instructions given to the principal technical representative or other technical representative(s) shall be deemed to have the same force as if these have been given to the contractor. The principal technical representative and other technical representative(s) shall be actually available at site fully during all stages of execution of work, during recording/checking/test checking of measurements of works and whenever so required by the Engineer-in-Charge and shall also note down instructions conveyed by the Engineer-in-Charge or his designated representative(s) in the site order book and shall affix his/their signature in token of noting down the instructions and in token of acceptance of measurements/ checked measurements/test checked measurements. The representative(s) shall not look after any other work. Substitutes, duly approved by Engineer-in-Charge of the work in similar manner as aforesaid shall be provided in event of absence of any of the representative(s) by more than two days.

If the Engineer-in-Charge, whose decision in this respect is final and binding on the contractor, is convinced that no such technical representative(s) is/are effectively appointed or is /are effectively attending or fulfilling the provision of this clause, a recovery

(non-refundable) shall be effected from the contractor as specified in Schedule 'F' and the decision of the Engineer-in-Charge as recorded in the site order book and measurement recorded checked/test checked in Measurement Books shall be final and binding on the contractor. Further if the contractor fails to appoint suitable technical Principal technical representative and/or other technical representative(s) and if such appointed persons are not effectively present or are absent by more than two days without duly approved substitute or do not discharge their responsibilities satisfactorily, the Engineer-in-Charge shall have full powers to suspend the execution of the work until such date as suitable other technical representative(s) is/are appointed and the contractor shall be held responsible for the delay so caused to the work. The contractor shall submit a certificate of employment of technical representative(s) along with every on account bill/final bill and shall produce evidence if at any time so required by the Engineer-in-Charge.

- (ii) The contractor shall provide and employ on the site only such technical assistants as are skilled and experienced in their respective fields and such foremen and supervisory staff as are competent to give proper supervision to the work.

The contractor shall provide and employ skilled, semiskilled and unskilled labour as is necessary for proper and timely execution of the work.

The Engineer-in-Charge shall be at liberty to object to and require the contractor to remove from the works any person who in his opinion misconducts himself, or is incompetent or negligent in the performance of his duties or whose employment is otherwise considered by the Engineer-in-Charge to be undesirable. Such person shall not be employed again at works site without the written permission of the Engineer-in-Charge and the persons so removed shall be replaced as soon as possible by competent substitutes.

CLAUSE 37 Levy/Taxes payable by Contractor

- (i) Sales Tax/VAT (including service tax), Building and other Construction Workers Welfare Cess or any other tax or cess in respect of this contract shall be payable by the contractor and Government shall not entertain any claim whatsoever in this respect.
- (ii) The contractor shall deposit royalty and obtain necessary permit for supply of the red bajri, stone, kankar, etc. from local authorities.
- (iii) If pursuant to or under any law, notification or order any royalty, cess or the like becomes payable by the Government of India and does not any time become payable by the contractor to the State Government/Local authorities in respect of any material used by the contractor in the works then in such a case, it shall be lawful to the Government of India and it will have the right and be entitled to recover the amount paid in the circumstances as aforesaid from dues of the contractor.

CLAUSE 38 Conditions for reimbursement of levy/taxes if levied after receipt of tenders

- (i) All tendered rates shall be inclusive of all taxes and levies (including service tax) payable under respective statutes. However, if any further tax or levy or cess is imposed by Statute, after the last stipulated date for the receipt of tender including extensions if any and the contractor thereupon necessarily and properly pays such taxes/levies, the contractor shall be reimbursed the amount so paid, provided such payments, if any, is not, in the opinion of the Engineer-in-charge (whose decision shall be final and binding on the contractor) attributable to delay in execution of work within the control of the contractor.
- (ii) The contractor shall keep necessary books of accounts and other documents for the purpose of this condition as may be necessary and shall allow inspection of the same by a duly authorized representative of the Government and/or the Engineer-in-Charge and further shall furnish such other information/document as the Engineer-in-Charge may require from time to time.
- (iii) The contractor shall, within a period of 30 days of the imposition of any such further tax or

levy or cess, give a written notice thereof to the Engineer-in-Charge that the same is given pursuant to this condition, together with all necessary information relating thereto.

CLAUSE 39 Termination of Contract on death of contractor

Without prejudice to any of the rights or remedies under this contract, if the contractor dies, the authority indicated in Schedule 'F', on behalf of the Indian Pharmacopoeia Commission (IPC) shall have the option of terminating the contract without compensation to the contractor.

CLAUSE 40 If relative working in MoHFW then the contractor not allowed to tender

The contractor shall not be permitted to tender for works in MoHFW (responsible for award and execution of contracts) in which his near relative is posted as Accountant or as an officer in any capacity between the grades of the Secretary and Group B Gazetted officer (both inclusive). He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any Gazetted Officer in the Ministry of Health and Family Welfare. Any breach of this condition by the contractor would render him liable to be debarred from tendering in the Department in future.

NOTE: By the term "near relatives" is meant wife, husband, parents and grandparents, children and grandchildren, brothers and sisters, uncles, aunts and cousins and their corresponding in-laws.

CLAUSE 41 No Gazetted Engineer to work as Contractor within one year of retirement

No Engineer of Gazetted rank or other Gazetted officer employed in Engineering or administrative duties in an engineering department of the Government of India shall work as a contractor or employee of a contractor for a period of one year after his retirement from government service without the previous permission of Government of India in writing. This contract 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 had not obtained the permission of Government of India as aforesaid, before submission of the tender or engagement in the contractor's service, as the case may be.

CLAUSE 42 Return of material & recovery for excess material issued.

- (i) After completion of the work and also at any intermediate stage in the event of no reconciliation of materials issued, consumed and in balance – (see Clause 10), theoretical quantity of materials issued by the Government for use in the work shall be calculated on the basis and method given hereunder:-
 - (a) Quantity of cement & bitumen shall be calculated on the basis of quantity of cement & bitumen required for different items of work as shown in the Schedule of Rates mentioned in Schedule 'F'. In case any item is executed for which standard constants for the consumption of cement or bitumen are not available in the above mentioned schedule/statement or cannot be derived from the same shall be calculated on the basis of standard formula to be laid down by the Engineer-in-Charge.
 - (b) Theoretical quantity of steel reinforcement or structural steel sections shall be taken as the quantity required as per design or as authorized by Engineer-in-Charge, including authorized lappages, chairs etc. plus 3% wastage due to cutting into pieces, such theoretical quantity being determined and compared with the actual issues each diameter wise, section wise and category wise separately.
 - (c) Theoretical quantity of G.I. & C.I. or other pipes, conduits, wires and cables, pig lead and G.I./M.S. sheets shall be taken as quantity actually required and measured plus 5% for wastage due to cutting into pieces (except in the case of G.I./M.S. sheets it shall be 10%), such determination & comparison being made diameter wise & category wise.

- (d) For any other material as per actual requirements.
- (ii) Over the theoretical quantities of materials so computed a variation shall be allowed as specified in Schedule 'F'. The difference in the net quantities of material actually issued to the contractor and the theoretical quantities including such authorized variation, if not returned by the contractor or if not fully reconciled to the satisfaction of the Engineer-in-Charge within fifteen days of the issue of written notice by the Engineer-in-Charge to this effect shall be recovered at the rates specified in Schedule 'F', without prejudice to the provision of the relevant conditions regarding return of materials governing the contract. Decision of Engineer-in-Charge in regard to theoretical quantities of materials, which should have been actually used as per the Annexure of the standard schedule of rates and recovery at rates specified in Schedule 'F', shall be final & binding on the contractor.
- For non-scheduled items, the decision of the Superintending Engineer regarding theoretical quantities of materials which should have been actually used shall be final and binding on the contractor.
- (iii) The said action under this clause is without prejudice to the right of the Government to take action against the contractor under any other conditions of contract for not doing the work according to the prescribed specifications.

CLAUSE 43 Compensation during warlike situations

The work (whether fully constructed or not) and all materials, machines, tools and plants, scaffolding, temporary buildings and other things connected therewith shall be at the risk of the contractor until the work has been delivered to the Engineer-in-Charge and a certificate from him to that effect obtained. In the event of the work or any materials properly brought to the site for incorporation in the work being damaged or destroyed in consequence of hostilities or warlike operation, the contractor shall when ordered (in writing) by the Engineer-in-Charge to remove any debris from the site, collect and properly stack or remove in store all serviceable materials salvaged from the damaged work and shall be paid at the contract rates in accordance with the provision of this agreement for the work of clearing the site of debris, stacking or removal of serviceable material and for reconstruction of all works ordered by the Engineer-in-Charge, such payments being in addition to compensation up to the value of the work originally executed before being damaged or destroyed and not paid for. In case of works damaged or destroyed but not already measured and paid for, the compensation shall be assessed by the Engineer-in-charge or his authorized representative. The contractor shall be paid for the damages/destruction suffered and for restoring the material at the rate based on analysis of rates tendered for in accordance with the provision of the contract. The certificate of the Engineer-in-Charge regarding the quality and quantity of materials and the purpose for which they were collected shall be final and binding on all parties to this contract.

Provided always that no compensation shall be payable for any loss in consequence of hostilities or warlike operations (a) unless the contractor had taken all such precautions against air raid as are deemed necessary by the A.R.P. Officers or the Engineer-in-Charge (b) for any material etc. not on the site of the work or for any tools, plant, machinery, scaffolding, temporary building and other things not intended for the work.

In the event of the contractor having to carry out reconstruction as aforesaid, he shall be allowed such extension of time for its completion as is considered reasonable by the Divisional Officer.

CLAUSE 44 Apprentices Act provisions to be complied with

The contractor shall comply with the provisions of the Apprentices Act, 1961 and the rules and orders issued there under from time to time. If he fails to do so, his failure will be a breach of the contract and the Client may, in 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 said Act.

CLAUSE 45 Release of Security deposit after labour clearance

Security Deposit of the work shall not be refunded till the contractor produces a clearance certificate from the Labour Officer. As soon as the work is virtually complete the contractor shall apply for the clearance certificate to the Labour Officer under intimation to the Engineer-in-Charge. The Engineer-in-Charge, on receipt of the said communication, shall write to the Labour Officer to intimate if any complaint is pending against the contractor in respect of the work. If no complaint is pending, on record till after 3 months after completion of the work and/or no communication is received from the Labour Officer to this effect till six months after the date of completion, it will be deemed to have received the clearance certificate and the Security Deposit will be released if otherwise due.

CLAUSE 46 Insurance

46.1 Without limiting the Contractor's obligations and responsibilities stated elsewhere in the Contract, the Contractor shall at his own cost arrange, secure and maintain insurance in the joint names of the HLL/ Client and the contractor with an insurance company selected by the contractor and acceptable to the HLL/ Client/Consultant, in such a manner that the HLL/ Client and the contractor are covered for all time during the period of contract i.e. the time period allowed for completion of work, extended period and the defect liability period. The insurance shall be effected in accordance with terms approved by the HLL/ Client and the contractor shall submit the insurance policies to the Engineer-In-Charge within one week of signing of the agreement along with the receipt of premium. The contractor shall timely pay and submit the receipts of payment of premiums for extensions of policies, if any. The insurance shall cover the following: -

a) Contractor's All Risks Insurance

The contractor shall insure the work for a sum equivalent to the Contract value together with materials and Plant for incorporation therein, to the full replacement cost and it being understood that such insurance shall provide for compensation to be payable to rectify the loss or damage incurred, and, an additional sum of 15 (%) per-cent of such replacement cost to cover any additional costs of and incidental to the rectification of loss or damage including professional fees and the cost of demolishing and removing any part of the Works and of removing debris of whatsoever nature, and it being understood that such insurance shall provide for compensation to be payable to rectify the loss or damage incurred or such additional sums as specified and the interests of the HLL/ Client against ALL RISKS claims, proceedings, loss or damages, costs, charges and expenses from whatsoever cause arising out of or in consequence of the execution and maintenance of the work for which the contractor is responsible under the contract.

b) Workman Compensation & Employers Liability Insurance.

This insurance shall be effected for all the contractor's employees engaged in the performance of the contract. The HLL/ Client shall not be liable in respect of any damages or compensation payable at law in respect of or in consequence of any accident or injury to any workman or any other person in the employment of the contractor and the contractor shall indemnify and keep indemnified the HLL/Client against all such damages and compensation and against all claims, demands, proceedings, costs, charges and expenses, whatsoever in respect or in relation thereof.

c) Third Party Insurance.

The contractor shall be responsible for making good to the satisfaction of the Engineer-in-Charge any loss or any damage to all structures and properties belonging to the HLL/ Client or being executed or procured or being procured by the HLL/ Client or of the other agencies within the premises of all work of the HLL/ Client if such loss or damage is due to fault and or the negligence or willful acts or omissions of the contractor, his employees, agents, representatives.

The contractor shall take sufficient care in moving his plants, equipment and materials from one place to another so that they do not cause any damage to any person or to the property of the HLL/ Client or any third party including overhead and underground cables and in the event of any damage resulting to the property of the HLL/ Client or to 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 HLL/ Client or ascertained or demanded by the third party, shall be borne by the contractor.

Before commencing the execution of the work, the contractor, shall insure and indemnify and keep the HLL/ Client harmless of all claims, against the contractor's liability for any materials or physical damage, loss or injury which may occur to any property, including that of the HLL/ Client or to any person including any employee of HLL/ Client, or arising out of the execution of the work or in the carrying out of the contract, otherwise than due to the matters referred to in the provision to (a) above. Such insurance shall be effected for an amount sufficient to cover such risks. The terms shall include a provision whereby, in the event of any claim in respect of which the contractor, would be entitled to receive indemnify under the policy being brought or made against the HLL/ Client, the insurer willfully indemnify HLL/ Client against such claims and any costs, charges and expenses in respect thereof.

- d) The contractor shall also at times indemnify the HLL/ Client against all claims, damages or compensation under the provisions of Payment or Wages Act, 1936, Minimum Wages Act, 1948, Employer's Liability Act, 1938, the Workman's Compensation Act, 1947, Industrial Disputes Act, 1947 and Maternity Benefit Act, 1961, or any modification thereof or any other law relating thereof and rules made there under from time to time.
- e) The Contractor shall also at his own cost carry and maintain any and all other insurance(s) which he may be required for the Contractor's Equipment and other things brought onto the Site by the Contractor, for a sum sufficient to provide for their replacement at the Site
- f) The Contractor shall also at his own cost carry and maintain any and all other insurance(s) which he may be required to take out under any law or regulation from time to time. He shall also carry and maintain any other insurance, which may be required by the Engineer-in-Charge.
- g) **Cross liabilities:** -The insurance policy shall include a cross liability clause such that the insurance shall apply to the contractor and to the client/HLL as separate insured.

46.2.1 The Contractor shall prove to the Engineer-in-charge from time to time he has taken out all the insurance policies referred to above and has paid the necessary premiums for keeping the policies alive till expiry of the Defects Liability Period.

46.2.2 Evidence and Terms of Insurance

The Contractor shall provide evidence to the Consultant as soon as practicable after the respective insurance have been taken out but in any case prior to the start of work at the Site that insurance required under the Contract have been effected and shall, within 84 days of the Commencement Date, provide the insurance policies to the Client/HLL. When providing such evidence and such policies to the Client/HLL, the Contractor shall notify to the Engineer in Charge also. Such insurance policies shall be consistent with the general terms agreed prior to the issue of the Letter of Acceptance. The Contractor shall effect all insurance for which he is responsible with insurers and in terms approved by the Consultant.

46.2.3 Adequacy and cancellation of Insurance

- a) The Contractor shall notify the insurers of changes in the nature, extent or programme for the execution of the Works and ensure the continuity and adequacy of the insurance at all

times in accordance with the terms of the Contract and shall, when required, produce to the Consultant the insurance policies in force and the receipts for payment of the current premiums.

- b) The aforesaid insurance policies shall provide that they shall not be cancelled till the Engineer-in-charge has agreed for cancellation.

46.3 Remedy on the contractor's failure to insure

If the contractor shall fail to effect and keep in force the insurance referred to above or any other insurance which he/they may be required to effect under the terms of the contract then and in any such case Engineer-in-charge may without being bound to, effect and keep in force any such insurance and pay such premium or premiums, as may be necessary for that purpose and from time to time deduct the amount so paid by the Engineer-in-charge from any moneys due or which may become due to the contractor or recover the same as a debt due from the contractor.

46.4 Compliance with Policy Conditions

In the event that the Contractor fails to comply with conditions imposed by the insurance policies effected pursuant to the Contract, the Contractor indemnify the Client/HLL against all losses and claims arising from such failure.

SECTION-3**SAFETY CODE**

1. Suitable scaffolds 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 materials as well suitable footholds and hand-hold shall be provided on the ladder and the ladder shall be given an inclination not steeper than $\frac{1}{4}$ to 1 ($1\frac{1}{4}$ horizontal and 1 vertical).
2. Scaffolding of staging more than 3.6 m (12 ft.) above the ground or floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached or bolted, braced and otherwise secured at least 90 cm (3 ft.) 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 opening 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.
3. Working Platforms, gangways and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6 m (12 ft.) above ground level or floor level, they should be closely boarded, should have adequate width and should be suitably fastened as described in (2) above.
4. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of person or materials by providing suitable fencing or railing whose minimum height shall be 90 cm (3 ft.).
5. 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 m (30 ft) in length while the width between side rails in rung ladder shall in no case be less than 29 cm. ($11\frac{1}{2}$ ") for ladder up to and including 3 metre (10 ft.) in length. For longer ladders this width should be increased at least $\frac{1}{4}$ " for each additional 30 cm. (1 foot) of length. Uniform step spacing of not more than 30 cm shall be kept. 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 as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect the public from accident and shall be bound to bear the expenses of defence of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit, action or proceedings to any such person or which may, with the consent of the contractor, be paid to compensate any claim by any such person.
6. Excavation and trenching- All trenches 1.2 m (4 ft.) or more in depth, shall at all times be supplied with at least one ladder for each 30 metre (100 ft) in length or fraction thereof. Ladder shall extend from bottom of the trench to at least 90 cm. (3 ft) above the surface of the ground. The sides of the trenches, which are 1.5 m (5 ft) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides collapsing. The excavated material shall not be placed within 1.5 m (5 ft) of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.
7. Demolition. - Before any demolition work is commenced and also during the progress of the work,
 - i) All roads and open areas adjacent to the work site shall either be closed or suitably protected.
 - ii) No electric cable or apparatus which is liable to be a source of danger or a cable or apparatus used by the operator shall remain electrically charged.
 - iii) 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.
8. All necessary personal safety equipment as considered adequate by the Engineer- in-Charge should be kept available for the use of the person employed on the site and maintained in a condition suitable for immediate use, and the contractor should take adequate steps to ensure proper use of equipment by those concerned. The following safety equipment shall invariably be provided.
 - i) Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles.

- ii) Those engaged in whitewashing and mixing or stacking of cement bags or any material, which is injurious to the eyes, shall be provided with protective goggles.
- iii) Those engaged in welding works shall be provided with welder's protective eye shields.
- iv) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
- v) When workers are employed in sewers and manholes, which are in active use, the contractors shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manholes and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public. In addition, the contractor shall ensure that the following safety measures are adhered to:-
 - a) Entry for workers into the line shall not be allowed except under supervision of the Engineer in Charge or any other higher officer.
 - b) At least 5 to 6 manholes upstream and downstream should be kept open for at least 2 to 3 hours before any man is allowed to enter into the manhole for working inside.
 - c) Before entry presence of toxic gases should be tested by inserting wet lead acetate paper, which changes colour in the presence of such gases and gives indication of their presence.
 - d) Presence of oxygen should be verified by lowering a detector lamp into the manhole. In case, no oxygen is found inside the sewer line, worker should be send only with oxygen kit.
 - e) Safety belt with rope should be provided to the workers. While working inside the manhole such rope should be handled by two men standing outside to enable him to be pulled out during emergency.
 - f) The area should be barricaded or cordoned off by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public whenever for the cleaning works are undertaken during night or day.
 - g) No smoking or open flames shall be allowed near the blocked manhole being cleaned.
 - h) The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of slippery nature of the malba.
 - i) Workers should not be allowed to work inside the manhole continuously. He should be given rest intermittently. The Engineer-in-Charge may decide the time upto which worker may be allowed to work continuously inside the manhole.
 - j) Gas masks with Oxygen cylinder should be kept at site for use in emergency.
 - k) Air blowers should be used for flow of fresh air through the manholes.

Whenever called for, portable air blowers are recommended for ventilating the manholes. The motors for these, shall be vapour proof and of totally enclosed type. Non-sparking gas engines also could be used but they should be placed at least 2 metres away from the opening and on the leeward side, protected from wind so that they will not be the source of friction on any inflammable gas that might be present.

- l) The workers engaged for cleaning the manholes/sewers should be properly trained before allowing working in the manhole.
- m) The worker shall be provided with Gumboots or non-sparking shoes bump helmets and gloves non-sparking tools and safety lights and gas masks and portable air-blowers (when necessary). They must be supplied with barrier cream for anointing the limits before working inside the sewer lines.
- n) Workmen descending a manhole shall try each ladder stop or rung carefully before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole well.
- o) If a man has received a physical injury, he should be brought out of the sewer immediately and adequate medical aid should be provided to him.
- p) The extent to which these precautions are to be taken depend on individual situation but the decision of the Engineer-in-Charge regarding the steps to be taken in this regard in an individual case will be final.

- vi) The contractor shall not employ men and women below the age of 18 years on the work of painting with products containing lead in any form. Whenever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken: -
 - a) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.
 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 is dry rubbed and scrapped.
 - b) Overalls shall be supplied by the contractors to the workmen and adequate facilities shall be provided to enable the working painters to wash during and on the cessation of work.
- 9. As per additional clause (viii)(i) of Government Safety Code (iv), the Contractor shall not employ women and men below the age of 18 years on the work of painting with product containing lead in any form. Whenever men above the age of 18 are employed on the work of lead painting, the following principles must be observed for such use:
 - i) White lead, sulphate of lead or product containing these pigments, shall not be used in painting operation except in the form of pastes or paint ready for use.
 - ii) Measures shall be taken, wherever required in order to prevent danger arising from the application of paint in the form of spray.
 - iii) Measures shall be taken, wherever practicable to prevent danger arising out of from dust caused by dry rubbing down and scrapping.
 - iv) Adequate facilities shall be provided to enable working painters to wash during and on cessation of work
 - v) Overall shall be worn by working painters during the whole of working period.
 - vi) Suitable arrangement shall be made to prevent clothing put off during working hours being spoiled by painting materials.
 - vii) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by medical man appointed by the competent authority of Department.
 - viii) Department may require, when necessary, medical examination of workers.
 - ix) Instructions with regard to special hygienic precautions, to be taken in the painting trade, shall be distributed to working painters.
- 10. When the work is done near any place where there is risk of drowning, all necessary equipment should be provided & 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 obtained during the course of the work.
- 11. Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following standards or conditions: -
 - (i)
 - (a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defects and shall be kept repaired and 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.
 - (ii) 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 operator.
 - (iii) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley blocks used in hoisting or as means of suspension the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of hoisting machine having a variable safe working load each safe working load and the condition under which it is applicable shall be clearly indicated. No part of any machine or any gear, referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

- (iv) In case of departmental machines, the safe working load shall be notified by the Electrical Engineer-in-Charge. As regard contractor's machines the contractors shall notify the safe working load of the machines to the Engineer-in-Charge whenever he brings any machinery to the site of work and get it verified by the Electrical Engineer concerned.
12. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce to the minimum the risk of any part 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 worker should not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.
 13. All scaffolds ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, 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.
 14. These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place at work spot. The person responsible for compliance of the safety code shall be named therein by the contractor.
 15. 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 Labour Officer or the Engineer-in-Charge or their representatives.
 16. Notwithstanding the above clauses from (1) to (15) there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force in the Republic of India.

SECTION -4**RULES FOR THE PROTECTION OF HEALTH AND SANITARY ARRANGEMENTS FOR WORKERS
EMPLOYED BY CONTRACTORS****1. APPLICATION**

These rules shall apply to all buildings and construction works in charge of the MoHFW in which twenty or more workers are ordinarily employed or are proposed to be employed in any day during the period during which the contract work is in progress.

2. DEFINITION

Work place means a place where twenty or more workers are ordinarily employed in connection with construction work, on any day during the period, during which the contract work is in progress.

3. FIRST-AID FACILITIES

- i) At every work place there shall be provided and maintained, so as to be easily accessible during working hours, first aid boxes at the rate of not less than one box for 150-contract labour or part thereof ordinarily employed.
- ii) The first-aid box shall be distinctly marked with a red cross on white back ground and shall contain the following equipment: -
 - a) For work places in which the number of contract labour employed does not exceed 50- Each first-aid box shall contain the following equipment: -
 1. 6 small sterilised dressings.
 2. 3 medium size sterilised dressings.
 3. 3 large size sterilised dressings.
 4. 3 large sterilised burn dressings.
 5. 1 (30 ml.) bottle containing a two per-cent alcoholic solution of iodine
 6. 1 (30ml) bottle containing salvolatile having the dose and mode of administration indicated on the label.
 7. 1 snakebite lancet.
 8. 1 (30gms.) bottle of potassium permanganate crystals.
 9. 1 pair scissors.
 10. 1 copy of the first-aid leaflet issued by the Director General, Factory Advice Service and Labour Institute, Government of India or his Client.
 11. 1 Bottle containing 100 tablets (each of 5 gms.) of aspirin.
 12. Ointment for burns.
 13. A bottle of suitable surgical antiseptic solution
 - b) For workplaces in which the number of contract labour exceeds 50- Each first-aid-box shall contain the following equipment.
 1. 12 small sterilized dressing.
 2. 6 medium size sterilised dressings.
 3. 6 large size sterilised dressings.
 4. 6 large size sterilised burn dressings.
 5. 6 (15-gms.) packets sterilised cotton wool.
 6. 1 (60 ml.) bottle containing two per-cent alcoholic solution iodine.
 7. 1 (60-ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label.
 8. 1 roll of adhesive plaster.
 9. 1 snake bite lancet.
 10. 1 (30gms.)Bottle of potassium permanganate crystals.
 11. 1 pair of scissors.

12. 1 copy of the first-aid leaflet issued by the Director General Factory Advice Service and Labour Institute/ Government of India or Client of India.
 13. A bottle containing 100 tablets (each of 5 gms.) of aspirin.
 14. Ointment for burns.
 15. A bottle of suitable surgical antiseptic solution.
- iii) Adequate arrangements shall be made for immediate procurement of the equipment when necessary.
 - iv) Nothing except the prescribed contents shall be kept in the First-aid box.
 - v) The first-aid box shall be kept in charge of a responsible person who shall always be readily available during the working hours at the work place.
 - vi) A person in charge of the first-aid box shall be a person trained in First-Aid treatment, at the work places where the number of contract labour employed is 150 or more.
 - vii) In work places where the number of contract labour employed is 500 or more and hospital facilities are not available within easy distance from the works, First-aid posts shall be established and run by a trained compounder. The compounder shall be on duty and shall be available at all hours when the workers are at work.
 - viii) Where work places are situated in places, which are not towns or cities, a suitable motor transport shall be kept readily available to carry injured person or person suddenly taken ill to the nearest hospital.

4. DRINKING WATER

- i) In every work place, there shall be provided and maintained, at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.
- ii) Where drinking water is obtained from an intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored.
- iii) Every water supply or storage shall be at a distance of not less than 50 feet from any latrine drain or other source of pollution. Where water has to be drawn from an existing well, which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it or for drinking. All such wells shall be entirely closed in and be provided with a trap door, which shall be dust and waterproof.
- iv) A reliable pump shall be fitted to each covered well, the trap door shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

5. WASHING FACILITIES

- i) In every work place adequate and suitable facilities for washing shall be provided and maintained for the use of contract labour employed therein.
- ii) Separate and adequate cleaning facilities shall be provided for the use of male and female workers.
- iii) Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition.

6. LATRINES AND URINALS

- i) Latrines shall be provided in every work place on the following scale namely:-
 - a) Where female are employed there shall be at least one latrine for every 25 females.
 - b) Where males are employed, there shall be at least one latrine for every 25 males.

Provided that where the number of males or females exceeds 100, it shall be sufficient if there is one latrine for 25 males or females as the case may be up to the first 100, and one for every 50 thereafter.
- ii) Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.
- iii) Construction of latrines: The inside walls shall be constructed of masonry or some suitable heat-resisting non-absorbent materials and shall be cement washed inside and outside at least once a year. Latrines shall not be of a standard lower than bore-hole system.

- iv) a) Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal, a notice in the language understood by the majority of the workers "For Men only" or "For Women only" as the case may be.
b) The notice shall also bear the figure of a man or a woman, as the case may be.
- v) There shall be at least one urinal for up to 50 number of male workers and one for upto 50 number of female workers employed at a time, provided that where the number of male or female workers, as the case may be, exceeds 500, it shall be sufficient if there is one urinal for every 50 males or females, up to the first 500 and one for every 100 or part thereafter.
- vi) a) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.
b) Latrines and urinals other than those connected with a flushes wage system shall comply with the requirements of the Public Health Authorities.
- vii) Water shall be provided by means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.
- viii) Disposal of excreta: - Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator. Alternately excreta may be disposed off by putting a layer of night soil at the bottom of a pucca tank prepared for the purpose and covering it with a 15 cm. layer of waste or refuse and then covering it with a layer of earth for a fortnight (When it will turn to manure).
- ix) The contractor shall at his own expense, carry out all instructions issued to him by the Engineer-in-Charge to effect proper disposal of night soil and other conservancy work in respect of the contractor's workmen or employees on the site. The contractor shall be responsible for payment of any charges, which may be levied by Municipal or Cantonment Authority for execution of such on his behalf.

7. PROVISION OF SHELTER DURING REST

At every place there shall be provided, free of cost, four suitable sheds, two for meals and the other two for rest separately for the use of men and women labour. The height of each shelter shall not be less than 3 metres (10 ft.) from the floor level to the lowest part of the roof. These shall be kept clean and the space provided shall be on the basis of 0.6 sq. m. (6 sq. ft.) per head.

Provided that the Engineer-in-Charge may permit, subject to his satisfaction, a portion of the building under construction or other alternative accommodation to be used for the purpose.

8. CRECHES

- i) At every work place, at which 20 or more women worker are ordinarily employed, there shall be provided two rooms of reasonable dimensions for the use of their children under the age of six years. One room shall be used as a playroom for the children and the other as their bedroom. The rooms shall be constructed with specifications as per clause 19 H (ii) a, b & c.
- ii) The rooms shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean.
- iii) The contractor shall supply adequate number of toys and games in the playroom and sufficient number of cots and beddings in the bedroom.
- iv) The contractor shall provide one ayah to look after the children in the crèche when the number of women workers does not exceed 50 and two when the number of women workers exceeds 50.
- v) The use of the room sear marked as crèches shall be restricted to children, their attendants and mothers of the children.

9. CANTEENS

- i) In every work place where the work regarding the employment of contract labour is likely to continue for six months and where in contract labour numbering one hundred or more are ordinarily employed, an adequate canteen shall be provided by the contractor for the use of such contract labour.
- ii) The contractor shall maintain the canteen in an efficient manner.

- iii) The canteen shall consist of atleast a dining hall, kitchen, storeroom, pantry and washing places, separately for workers and utensils.
- iv) The canteen shall be sufficiently lighted at all times when any person has access to it.
- v) The floor shall be made of smooth and impervious materials and inside walls shall be lime-washed or colour washed atleast once in each year. Provided that the inside walls of the kitchen shall be lime-washed every 4 months.
- vi) The premises of the canteen shall be maintained in a clean and sanitary condition.
- vii) Wastewater shall be carried away in suitable covered drains and shall not be allowed to accumulate so as to cause a nuisance.
- viii) Suitable arrangements shall be made for the collection and disposal of garbage.
- ix) The dining hall shall accommodate at a time 30 percent of the contract labour working at a time.
- x) The floor area of the dining hall, excluding the area occupied by the service counter and any furniture, except tables and chairs, shall not be less than one square metre (10 sq.ft.) per diner to be accommodated as prescribed in sub-Rule 9.
 - a) A portion of the dining hall and service counter shall be partitioned off and reserved for women workers in proportion to their number.
 - b) Washing places for women shall be separate and screened to secure privacy.
- xii) Sufficient tables, stools, chair or benches shall be available for the number of diners to be accommodated as prescribed in sub-Rule 9
- xiii)
 - a)
 - 1. There shall be provided and maintained, sufficient utensils, crockery, furniture and any other equipment's, necessary for the efficient running of the canteen.
 - 2. The furniture utensils and other equipment shall be maintained in a clean and hygienic condition.
 - b)
 - 1. Suitable clean clothes for the employees serving in the canteen shall be provided and maintained.
 - 2. A service counter, if provided, shall have top of smooth and impervious material.
 - 3. Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipment's.
- xiv) The foodstuffs and other items to be served in the canteen shall be in conformity with the normal habits of the contract labour.
- xv) The charges for foodstuffs, beverages and any other items served in the canteen shall be based on 'No profit, No loss' and shall be conspicuously displayed in the canteen.
- xvi) In arriving at the price of food stuffs, and other articles served in the canteen, the following items shall not be taken into consideration as expenditure namely: -
 - a) The rent of land and building.
 - b) The depreciation and maintenance charge for the building and equipment's provided for the canteen.
 - c) The cost of purchase, repairs and replacement of equipment's including furniture, crockery, cutlery and utensils.
 - d) The water charges and other charges incurred for lighting and ventilation.
 - e) The interest and amounts spent on the provision and maintenance of equipment's provided for the canteen.
- xvii) The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors.

10. ANTI-MALARIAL PRECAUTIONS

The contractor shall at his own expense, conform to all anti-malarial instructions given to him by the Engineer-in-Charge including the filling-up of any borrow pits which may have been dug by him.

- 11.** The above rules shall be incorporated in the contracts and in notices inviting tenders and shall form an integral part of the contracts.

12. AMENDMENTS

Department may, from time to time, add to or amend these rules and issue directions it may consider necessary for the purpose of removing any difficulty, which may arise in the administration thereof.

SECTION-5**CONTRACTOR'S LABOUR REGULATIONS TO BE FOLLOWED IN THIS PROJECT****1. SHORT TITLE**

These may be called Contractors Labour Regulations and shall be followed by the Contractor for this Project.

2. DEFINITIONS

- i) **Workman** means, any person employed by Department or its contractor directly or indirectly, through a subcontractor, with or without the knowledge of the Department, to do any skilled, semiskilled or unskilled, manual, supervisory, technical or clerical work, for hire or reward, whether the terms of employment are expressed or implied, but does not include any person: -
 - a) Who is employed mainly in a managerial or administrative capacity; or,
 - b) Who, being employed in a supervisory capacity draws wages exceeding five hundred rupees per mensem or exercises either by the nature of the duties attached to the office or by reason of powers vested in him, functions mainly of managerial nature; or,
 - c) Who is an out worker, that is to say, person to whom any article or materials are given out by or on behalf of the principal employers to be made up cleaned, washed, altered, ornamental finished, repaired adopted or otherwise processed for sale for the purpose of the trade or business of the principal employers and the process is to be carried out either in the home of the out worker or in some other premises, not being premises under the control and management of the principal employer.

No person below the of 14 years shall be employed to act as a workman

- ii) **Fair Wages** means wages whether for time or piecework fixed and notified under the provision of the Minimum Wages Act from time to time.
- iii) **Contractors** shall include every person who undertakes to produce a given result other than a mere supply of goods or articles of manufacture through contract labour or who supplies contract labour for any work and includes a subcontractor.
- iv) **Wages** shall have the same meaning as defined in the Payment of Wages Act.

3.

- i) Normally working hours of an adult employee should not exceed 9 hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 hours on any day.
- ii) When an adult worker is made to work for more than 9 hours on any day or for more than 48 hours in any week he shall be paid over time for the extra hours put in by him at double the ordinary rate of wages.
- iii) a) Every worker shall be given a weekly holiday normally on a Sunday, in accordance with the provisions of Minimum Wages (Central) Rules 1960, as amended from time to time, irrespective of whether such worker is governed by the Minimum Wages Act or not.
 - b) Where the minimum wages prescribed by the Government, under the Minimum Wages Act, are not inclusive of the wages for the weekly day of rest, the worker shall be entitled to rest day wages, at the rate applicable to the next preceding day, provided he has worked under the same contractor for a continuous period of not less than 6 days.
 - c) Where a contractor is permitted by the Engineer-in-Charge to allow a worker to work on a normal weekly holiday, he shall grant a substituted holiday to him for the whole day, on one of the five days, immediately before or after the normal weekly holiday, and pay wages to such worker for the work performed on the normal weekly holiday at the overtime rate.

4. DISPLAY OF NOTICE REGARDING WAGES ETC.

The contractor shall, before he commences his work on contract, display and correctly maintain and continue to display and correctly maintain, in a clear and legible condition in conspicuous places on the work, notices in English and in local Indian languages spoken by the majority of the workers, giving the minimum rates of the wages fixed under Minimum Wages Act, the actual wages being paid, the hours of work for which such wage are earned, wages periods, dates of payments of wages and other relevant information as per Appendix 'III'.

5. PAYMENT OF WAGES.

- i) The contractor shall fix wage periods in respect of which wages shall be payable.
- ii) No wage period shall exceed one month.
- iii) The wages of every person employed as contract labour in an establishment or by a contractor, where less than one thousand such persons are employed, shall be paid before the expiry of seventh day and in other cases before the expiry of tenth day after the last day of the wage period in respect of which the wages are payable.
- iv) Where the employment of any worker is terminated by or on behalf of the contractor the wages earned by him shall be paid before the expiry of the second working day from the date on which his employment is terminated.
- v) All payment of wages shall be made on a working day at the work premises and during the working time and on a date notified in advance and in case the work is completed before the expiry of the wage period, final payment shall be made within 48 hours of the last working day.
- vi) Wages due to every worker shall be paid to him direct or to other person authorised by him in this behalf.
- vii) All wages shall be paid in current coin or currency or in both.
- viii) Wages shall be paid without any deductions of any kind except those specified by the Central Government by general or special order in this behalf or permissible under the Payment of Wages Act 1956.
- ix) A notice showing the wages period and the place and time of disbursement of wages shall be displayed at the place of work and a copy sent by the contractor to the Engineer-in-Charge under acknowledgement.
- x) It shall be the duty of the contractor to ensure the disbursement of wages in presence of authorised representative of the Engineer-in-Charge who will be required to be present at the place and time of the disbursement of wages by the contractor to workmen.
- xi) The contractor shall obtain from the junior engineer or any other authorised representative of the Engineer-in-Charge, as the case may be, a certificate under his signature at the end of the entries in the "Register of Wages" or the "Wage-cum-Muster Roll", as the case may be, in the following form: -

"Certified that the amount shown in the column No.....has been paid to the workman concerned in my presence on.....at....."

6. FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES

- (i) The wages of a worker shall be paid to him without any deduction of any kind except the following: -
 - (a) Fines
 - (b) Deductions for absence from duty i.e. from the place or the places where by the terms of his employment he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.
 - (c) Deductions for damage to or loss of goods expressly entrusted to the employed person for custody, or for loss of money or any other deductions which he is required to account, where such damage or loss is directly attributable to his neglect or default.
 - (d) Deduction for recovery of advances or for adjustment of overpayment of wages, advances granted shall be entered in a register.
 - (e) Any other deduction, which the Central Government may from time to time, allows.

- (ii) No fines should be imposed on any worker save in respect of such acts and omissions on his part as have been approved of by the Chief Labour Commissioner.

Note:- An approved list of Acts and Omission for which fines can be imposed is enclosed at Appendix-1.

- (iii) No fine shall be imposed on a worker and no deduction for damage or loss shall be made from his wages until the worker has been given an opportunity of showing cause against such fines or deductions.
- (iv) The total amount of fine, which may be imposed, in any one-wage period, on a worker, shall not exceed an amount equal to three paise in a rupee of the total wages, payable to him in respect of that wage period.
- (v) No fine imposed on any worker shall be recovered from him by instalment, or after the expiry of sixty days from the date on which it was imposed.
- (vi) Every fine shall be deemed to have been imposed on the day of the act or omission in respect of which it was imposed.

7. LABOUR RECORDS

- (i) The contractor shall maintain a **Register of Persons employed** on work on contract in Form XIII of the CL (R&A) Central Rules 1971 (Appendix IV)
- (ii) The contractor shall maintain a **Muster Roll** register in respect of all workmen employed by him on the work under Contract in Form XVI of the CL (R&A) Rules 1971 (Appendix V)
- (iii) The contractor shall maintain a **Wage Register** in respect of all workmen employed by him on the work under contract in Form XVII of the CL (R&A) Rules 1971 (Appendix VI)
- (iv) **Register of accident** – The contractor shall maintain a register of accidents in such form as may be convenient at the work place but the same shall include the following particulars:
 - a) Full Particulars of the labourers who met with accident.
 - b) Rate of wages.
 - c) Sex
 - d) Age
 - e) Nature of accident and cause of accident
 - f) Time and date of accident
 - g) Date and time when admitted in hospital
 - h) Date of discharge from the hospital
 - i) Period of treatment and result of treatment
 - j) Percentage of loss of earning capacity and disability as assessed by Medical Officer.
 - k) Claim required to be paid under Workmen's Compensation Act.
 - l) Date of payment of compensation
 - m) Amount paid with details of the person to whom the same was paid
 - n) Authority by whom the compensation was assessed
 - o) Remarks.
- v) The contractor shall maintain a **Register of Fines** in the Form XII of the CL (R&A) Rules 1971 (Appendix XI). The contractor shall display in a good condition and in a conspicuous place of work the approved list of acts and omission for which fines can be imposed (Appendix X)
- vi) The contractor shall maintain a Register of deductions for damage or loss in Form XX of the CL (R&A) Rules 1971 (Appendix XII).
- vii) The contractor shall maintain a **Register of Advances** in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIII).
- viii) The contractor shall maintain a **Register of Overtime** in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIV).

8. ATTENDANCE CARD-CUM WAGE SLIP

- i) The contractor shall issue an **Attendance card cum wage slip** to each workman employed by him in the specimen form at (Appendix-VII).
- ii) The card shall be valid for each wage period.
- iii) The contractor shall mark the attendance of each workman on the card twice each day, once at

the commencement of the day and again after the rest interval, before he actually starts work.

- iv) The card shall remain in possession of the worker during the wage period under reference.
- v) The contractor shall complete the wage slip portion on the reverse of the card at least a day prior to the disbursement of wages in respect of the wage period under reference.
- vi) The contractor shall obtain the signature or thumb impression of the worker on the wage slip at the time of disbursement of wages and retain the card with him.

9. EMPLOYMENT CARD

The contractor shall issue an **Employment Card** in the Form XIV of CL (R&A) Central Rules 1971 to each worker within three days of the employment of the worker (Appendix-VIII).

10. SERVICE CERTIFICATE

On termination of employment for any reason whatsoever the contractor shall issue to the workman whose services have been terminated, a Service Certificate in the Form XV of the CL (R&A) Central Rules 1971 (Appendix-IX).

11. PRESERVATION OF LABOUR RECORDS

All records required to be maintained under Regulations Nos. 6 & 7 shall be preserved in original for a period of three years from the date of last entries made in them and shall be made available for inspection by the Engineer-in-Charge or Labour Officer or any other officers authorised by the Ministry of Health and Family Welfare in this behalf.

12. POWER OF LABOUR OFFICER TO MAKE INVESTIGATIONS OR ENQUIRY

The labour officer or any person authorised by the Central Government on their behalf shall have power to make enquiries with a view to ascertaining and enforcing due and proper observance of Fair Wage Clauses and provisions of these Regulations. He shall investigate into any complaint regarding the default made by the contractor or subcontractor in regard to such provision.

13. REPORT OF LABOUR OFFICER

The Labour Officer or other persons authorised as aforesaid shall submit a report of result of his investigation or enquiry to the Engineer in charge concerned indicating the extent, if any, to which the default has been committed with a note that necessary deductions from the contractor's bill be made and the wages and other dues be paid to the labourers concerned. In case an appeal is made by the contractor under Clause 13 of these regulations, actual payment to labourers will be made by the Engineer in charge after the competent authority has given his decision on such appeal.

- i) Engineer in charge shall arrange payments to the labour concerned within 45 days from the receipt of the report from or the superintending engineer as the case may be the Labour Officer

14. APPEAL AGAINST THE DECISION OF LABOUR OFFICER

Any person aggrieved by the decision and recommendations of the Labour Officer or other person so authorised may appeal against such decision to the Superintending Engineer concerned within 30 days from the date of decision, forwarding simultaneously a copy of his appeal to the Executive Engineer concerned but subject to such appeal, the decision of the officer shall be final and binding upon the contractor.

15. PROHIBITION REGARDING REPRESENTATION THROUGH LAWYER

- i) A workman shall be entitled to be represented in any investigation or enquiry under these regulations by:-
 - a) An officer of a registered trade union of which he is a member.
 - b) An officer of a federation of trade unions to which the trade union referred to in Clause (a) is affiliated.
 - c) Where the employer is not a member of any registered trade union, by an officer of a registered trade union, connected with the industry in which the worker is employed or by any other workman employed in the industry in which the worker is employed.
- ii) An employer shall be entitled to be represented in any investigation or enquiry under these regulations by:-

- a) An officer of an association of employers of which he is a member.
 - b) An officer of a federation of associations of employers to which association referred to in Clause (a) is affiliated.
 - c) Where the employer is not a member of any association of employers, by an officer of association of employer connected with the industry, in which the employer is engaged or by any other employer, engaged in the industry in which the employer is engaged.
- iii) No party shall be entitled to be represented by a legal practitioner in any investigation inquiry under these regulations.

16. INSPECTION OF BOOKS AND SLIPS

The contractor shall allow inspection of all the prescribed labour records to any of his workers or to his agent at a convenient time and place after due notice is received or to the Labour Officer or any other person, authorised by the Central Government on his behalf.

17. SUBMISSION OF RETURNS

The contractor shall submit periodical returns as may be specified from time to time.

18. AMENDMENTS

The Central Government may from time to time add to or amend the regulations and on any question as to the application/interpretation or effect of those regulations the decision of the EIC concerned shall be final.

Appendix 'I'**REGISTER OF MATERNITY BENEFITS (Clause 19F)**

Name and address of the contractor _____

Name and Location of the work _____

Name of the Employee	Father's/ husband's name	Nature of Employment	Period of actual confinement	Date on which notice of confinement given
1	2	3	4	5

Date on which maternity leave commenced and ended				
Date of Delivery/ Miscarriage	In case of delivery		In case of miscarriage	
	Commenced	Ended	Commenced	Ended
6	7	8	9	10

Leave pay paid to the employee				Remarks
In case of delivery		In case of miscarriage		
Rate of leave pay	Amount paid	Rate of leave pay	Amount paid	
11	12	13	14	15

Appendix 'II'**SPECIMEN FORM OF THE REGISTER, REGARDING MATERNITY BENEFIT ADMISSIBLE TO THE CONTRACTOR'S LABOUR IN****Ministry of Health and Family Welfare.**

Name and address of the contractor _____

Name and location of the work _____

1. Name of the woman and her husband's name.
2. Designation
3. Date of appointment.
4. Date with months and years in which she is employed.
5. Date of discharge / dismissal, if any.
6. Date of production of certificates in respect of pregnancy.
7. Date on which the woman informs about the expected delivery.
8. Date of delivery / miscarriage / death.
9. Date of production of certificates in respect of delivery / miscarriage.
10. Date with the amount of maternity/ death benefit paid in advance of expected delivery.
11. Date with amount of subsequent payment of maternity benefit.
12. Name of the person nominated by the woman to receive the payment of the maternity benefit after her death.
13. If the woman dies, the date of death, the name of the person to whom maternity benefit amount was paid, the month thereof and the date of payment.
14. Signature of the contractor authenticating entries in the register.
15. Remarks column for the use of inspecting officer.

Appendix 'III'**LABOUR BOARD**

Name of work: _____

Name of Contractor: _____

Address of Contractor: _____

Name and address of Government divn. _____

Name of CLIENT Labour Officer: _____

Address of CLIENT Labour Officer: _____

Name of Labour Enforcement Officer: _____

Address of Labour Enforcement Officer: _____

Sl.No	Category	Minimum wage Fixed	Actual wage paid	Number Present	Remarks

Weekly holiday _____

Wage period _____

Date of payment of Wages _____

Working hours _____

Rest interval _____

Appendix 'IV'

Form-XIII (See Rule 75)

Register of Workmen Employed by Contractor

Name and address of contractor _____

Name and address of establishment under which contract is carried on _____

Nature and location of Work _____

Name and address of Principal Employer _____

Sl. No.	Name and surname of Workman	Age and Sex	Father's/husband Name	Nature of employment / designation.	Permanent home address of the workman(Village and Tehsil, Taluka and District)	Local Address	Date of commencement of employment	Signature or thumb impression of the workman	Date of Termination of employment.	Reasons For terminations.	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Appendix 'V'

Form-XVI (See Rule 78(2)(a))

Muster Roll

Name and address of the contractor _____

Name and address of establishment under which contract is carried on _____

Nature and location of work _____

Name and address of Principal Employer _____

For the month of fortnight _____

Sl. No.	Name of workman	Sex	Father's/Husband's Name	Dates					Remarks
1	2	3	4	5					6
				1	2	3	4	5	

Appendix 'VI'**Form –XVII (See Rule 78(2)(a))****Register of Wages**

Name and address of the contractor_____

Name and address of establishment under which contract is carried on_____

Nature and location of work_____

Name and address of Principal Employer_____

Wages period_____ Monthly/fortnightly

Sl.No.	Name of workman	Serial No.in the register of workman	Designation of Nature of work done	No. of days worked	Units of work done	Daily rate of wages/piece rate	Basic Wages
1	2	3	4	5	6	7	8

Dearness allowances	Overtime	Other cash payments (Indicate nature)	Total	Deductions (indicate nature)	Net amount paid	Signature or thumb impression	Initial of his representative
9	10	11	12	13	14	15	16

Wage Card No. _____

Wage Card**Appendix 'VII' (Observe)**

Name and address of the contractor Date of issue _____

Name and location of work Designation _____

Name of Workman _____

Month/fortnight-----

Rate of Wages _____

DATE																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Morning																															
Evening																															
Initial																															

Rate _____ Amount _____

Received from _____ the sum of Rs. _____ on account of my wages.

Signature _____

The wage card is valid for one month from the date of issue

Appendix 'VII' (Reverse)

Form-XIX(See rule 78(2)(b))

Wages Slip

Name and address of the contractor_____

Name and Father's/Husband's name of workman_____

Nature and location of work_____

For the Week/Fortnight/Month ending_____

1. No. of days worked _____

2. No. of units worked in case of piece rate workers_____

3. Rate of daily wages/piece rate_____

4. Amount of overtime wages_____

5. Gross wages payable_____

6. Deduction, if any_____

7. Net amount of wages paid_____

Initials of the Contractors or his representative

Appendix 'VIII'

Form-XIV (See rule 76)

Employment Card

Name and address of the contractor_____

Name and address of establishment under which contract is carried on_____

Nature of work and location of work_____

Name and address of Principal Employer_____

1. Name of Workman_____

2. SI No. in the register of workman employed_____

3. Nature of employment/designation_____

4. Wage rate (with particulars of unit in case of piece work)_____

5. Wages period_____

6. Tenure of employment_____

7. Remarks_____

Signature of contractor

Appendix 'IX'

Form-XV (See Rule 77)

Service Certificate

Name and address of the contractor_____

Nature and location of work_____

Name and Address of workman_____

Age or date of birth_____

Identification marks_____

Father's/Husband's name_____

Name and address of establishment in under which contract is carried on_____

Name and address of Principal Employer_____

Sl.No.	Total period for which employed		Nature of work done	Rate of Wages (with particulars of unit in case of piece work)	Remarks
	From	To			
1	2	3	4	5	6

Signature

Appendix 'X'**LIST OF ACTS AND OMISSIONS FOR WHICH FINES CAN BE IMPOSED**

In accordance with rule 7 (v) of the CPWD Contractor's Labour Regulations to be displayed prominently at the site of work both in English and local Language.

1. Wilful insubordination or disobedience, whether along or in combination with other.
2. Theft fraud or dishonestly in connection with the contractors beside a business or property of Department.
3. Taking or giving bribes or any illegal gratifications.
4. Habitual late attendance.
5. Drunkenness fighting, riotous or disorderly or indifferent behaviour.
6. Habitual negligence.
7. Smoking near or around the area where combustible or other materials are locked.
8. Habitual indiscipline.
9. Causing damage to work in the progress or to property of the Department or of the contractor.
10. Sleeping on duty.
11. Malingering or slowing down work.
12. Giving of false information regarding name, age, father's name etc.
13. Habitual loss of wage cards supplied by the employers.
14. Unauthorized use of employer's property of manufacturing or making of unauthorized particles at the work place.
15. Bad workmanship in construction and maintenance by skilled workers which is not approved by the Department and for which the contractors are compelled to undertake rectification.
16. Making false complaints and/or misleading statements.
17. Engaging on trade within the premises of the establishments.
18. Any unauthorized divulgence of business affairs of the employees.
19. Collection or canvassing for the collection of any money within the premises of an establishment unless authorized by the employer.
20. Holding meeting inside the premises without previous sanction of the employers.
21. Threatening or intimidating any workman or employer during the working hours within the premises.

Appendix 'XI'

Form-XII (See Rule 78(2)(d))

Register of Fines

Name and address of the contractor_____

Name and address of establishment in under which contract is carried on_____

Nature and location of work_____

Name and address of Principal Employer_____

Sl.No.	Name of workman	Father's/Husband's name	Designation/nature of employment	Act/Omission For which fine imposed	Date of Offence
1	2	3	4	5	6

Whether workman Showed cause against fine	Name of person in whose presence employees explanation was heard	Wage period and wages payable	Amount of fine imposed	Date on which fine realized	Remarks.
7	8	9	10	11	12

Appendix 'XII'

Form-XX(See Rule 78(2)(d))

Register of Deduction for Damage or Loss

Name and address of the contractor_____

Name and address of establishment in under which contract is carried on_____

Nature and location of work_____

Name and address of Principal Employer_____

Sl.No.	Name of workman	Father's/Husband's name	Designation/nature of employment	Particulars of damage or loss	Date of damage or loss
1	2	3	4	5	6

Whether workman showed cause against fine	Name of person whose presence employees explanation was heard	Amount of deduction imposed	No. of instalments	Date of recovery		Remarks
				First instalment	Last instalment	
7	8	9	10	11	12	13

Appendix 'XIII'**Register of Advances**

Name and address of the contractor_____

Name and address of establishment in under which contract is carried on_____

Nature and location of work_____

Name and address of Principal Employer_____

Sl. No.	Name of workman	Father's/Husband's name	Designation nature of employment	Wage period and wages payable	Date and Amount of Advance given	Purpose(s) for which Advance made	Number of Instalments by which advance to be repaid	Date and amount of each instalments repaid	Date on which last Instalments was repaid	Remarks
1	2	3	4	5	6	7	8	9	10	11

Appendix 'XIV'

Form-XXIII (See Rule 78(2)(e))

Register of Overtime

Name and address of the contractor _____

Name and address of establishment in under which contract is carried on _____

Nature and location of work _____

Name and address of Principal Employer _____

Sl.No.	Name of workman	Father's/husband's name	Sex	Designation /nature of employment	Date on which Overtime worked	Total overtime worked or production in case of piece rated	Normal rate of wages	Overtime rate of wages	Overtime earnings	Rate on which overtime wages paid	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Section -6**Formats****GUARANTEE TO BE EXECUTED BY THE CONTRACTOR FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF WATER SUPPLY AND SANITARY INSTALLATIONS**

The agreement made this..... Day of Two thousand and between S/O..... (Hereinafter called the GUARANTOR of the one part) and the (herein after called the Client of the other part). WHEREAS THIS agreement is supplementary to the contract. (Herein after called the Contract) dated.....and made between the GUARANTOR OF THE ONE PART AND the Client of the other part, whereby the contractor inter alia, undertook to render the work in the said contract recited structurally stable workmanship and use of sound materials.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said work will remain structurally stable and guarantee against faulty workmanship, finishing, manufacturing defects of materials and leakages etc.

NOW THE GUARANTOR hereby guarantee that work executed by him will remain structurally stable, after the expiry of maintenance period prescribed in the contract for the minimum life of ten years, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

The decision of the Engineer- in- charge with regard to nature and cause of defects shall be final.

During the period of guarantee the guarantor shall make good all defects to the satisfaction of the Engineer- in- charge calling upon him to rectify the defects, failing which the work shall be got done by the Client by some other contractor at the guarantor's cost and risk. The decision of the Engineer –in- charge as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to make good all the defects, commits breach there-under then the guarantor will indemnify the Principal and his successor against all loss, damage cost expense or otherwise which may be incurred by him by reason of any default on the part of THE GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and/or cost incurred by the Client the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator. And by for and on behalf of the Client on the day, month and year first above written. Signed sealed and delivery by OBLIGATOR in the presence of:

1

.

2

.

SIGNED FOR AND ON BEHALF OF ----- BY..... in the present of:

1

.

2

.

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR FOR
WATERPROOFING TREATMENT FOR BASEMENT/TERRACE/TOILETS.**

The agreement made this _____ day of two thousand and _____ between _____ S/o _____ (hereinafter called the GUARANTOR of the one part) and the ----- (hereinafter called the Client of the other part).

WHEREAS this agreement is supplementary to a contract. (Herein after called the Contract) dated _____ and made between the GUARANTOR OF THE ONE PART AND the Client of the other part, whereby the contractor inter alia, undertook to render the structures in the said contract of the work in the said contract recited completely water and leak proof.

THE GUARANTOR hereby guarantee that the water proofing treatment given by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be ten years to be reckoned from the date after the expiry of maintenance period prescribed in the contract. Provided that the guarantor will not be responsible for leakage caused by earthquake or structural defects.

The decision of the Engineer in charge with regard to cause of leakage shall be final. During the period of guarantee the guarantor shall make good all defects and in case of any defects being found render the structure water proof to the satisfaction of the Engineer in charge at his cost and shall commence the work for such rectification within seven days from the date of issue of notice from the Engineer in charge calling upon him to rectify the defects, failing which the work shall be got done by the Client through some other contractor at the guarantor's cost and risk. The decision of the Engineer in charge as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the water proofing, or commits breach there-under then the guarantor will indemnify the Principal and his successor against all loss, damage, cost of expenses or otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement.

As to the amount of loss and/or cost incurred by the Client on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator _____ and by _____ by for and on behalf of ----- on the day, month and year first above written.

Signed sealed and delivered by OBLIGATOR in presence of:

1. _____ 2. _____

SIGNED FOR AND ON BEHALFOF ----- BY _____

In presence of:

1. _____ 2. _____

SECTION 7**PROFORMA OF SCHEDULES****(Operative Schedules)**

SCHEDULE 'A'		
	Schedule of quantities (BOQ)	Attached as Volume –IV, Bill of Quantities.
SCHEDULE 'B'		
	Schedule of materials to be issued to the contractor	NIL – No material to be issued to the Contractor
SCHEDULE 'C'		
	Tools and plants to be hired to the contractor	NIL - No tools and plants to be hired to the Contractor
SCHEDULE 'D'		
	Extra schedule for specific requirements/ document for the work, if any.	NIL
SCHEDULE 'E'		
	Reference to General Conditions of Contract	
	Name of work :	Construction of State of Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh
	Estimated cost of work:	As per NIT
	Earnest money:	As per NIT
	Performance Guarantee:	5% of Accepted Tendered Value
	Security Deposit:	5% of Accepted Tendered Value
SCHEDULE 'F'		
	GENERAL RULES & DIRECTIONS	
	Officer inviting bid	Pr. Chief Engineer (ID-N&E), HLL, Noida on behalf of the Secretary-cum-Scientific Director, IPC, Ghaziabad (UP)
	DEFINITIONS	
1	Authority executing the agreement on behalf of HLL	Authority duly authorised by the Secretary-cum-Scientific Director, IPC, Ghaziabad (UP)
2(iii)	Accepting Authority	The Secretary-cum-Scientific Director, IPC, Ghaziabad (UP)
2(v)	Department	IPC, Ghaziabad (UP)
2(vi)	Engineer-in-Charge	Authorized representative of HLL
2(xiii)	Percentage on cost of materials and labour to cover all Overheads and profits.	15%
2(xvi)	Standard Schedule of Rates	Latest CPWD Schedule of Rates, with up to date correction slips
	CLAUSES OF CONTRACT	
Clause 1	(i) Time allowed for submission of Performance Guarantee from the date of issue of letter of acceptance	30 days
	(ii) Maximum allowable extension beyond the period provided in (i) above	15 days

Clause 2		Authority for fixing compensation under Clause 2.	Director, HLL Lifecare Ltd.	
		Whether Clause 2A shall be applicable	NO	
		Authority for deciding incentive under Clause 2A.	Not Applicable	
Clause 5		Time Allowed for execution of Works	15 Months	
		Number of days from the date of issue of letter of acceptance for reckoning date of Start	30 Days	
		Authority to decide shifting of date of start in case of delay in handing over of site.	Vice President (ID), HLL Lifecare Ltd.	
		Mile stone(s) will be as per table given below:-		
Mile Stone No	Description of Milestone (Physical)		Time allowed in days (from date of start)	Amount to be withheld in case of non - achievement of milestone.
1	Completion of RCC Foundation work		90 days	Rs.25 lakhs
2	Completion of structure		210 days	Rs.35 lakhs
3	Completion of finishing works (excluding services and painting)		300 Days	Rs.45 lakhs
4	Completion of internal and external services including utilities		390 Days	Rs.55 lakhs
5	Completion of testing & commissioning of building works, services and utilities		420 days	Rs. 65 lakhs
6	Final finishing including painting and Handing over		Total time allowed in days for completion of work as per terms of Contract	Rs. 70 lakhs *Total withheld amount not to exceed 10% of the tendered cost.
Note:				
(i) If the Milestone(s) are not completed as per Time Schedule specified above, then the amount as given in the table above will be withheld against the respective Milestone(s) from the payment due to the Contractor. However if the subsequent milestone (inclusive of the earlier milestones) are achieved within the Time Allowed/ Specified herein, then the amount withheld for non- completion of previous milestone(s) shall release in the payments thereafter.				
(ii) The total amount with held under the above milestones shall be adjusted against any levy of compensation decided by the competent authority under Clause 2 above.				
Clause 5.4		Authority for deciding Extension of Time and rescheduling of Milestones	Vice President (ID), HLL, Noida	
Clause 6, 6A		Clause applicable – (6 or 6A)	6A	
Clause 7		Gross work to be done together with net payment /adjustment of advances for material collected, if any, since the last such payment for being eligible to interim payment.	Rs. 50 Lacs Only	
Clause 10A		List of testing equipment to be provided by the contractor at site laboratory.	As per Annexure-I and II	
Clause 10B		Whether Clause 10 B (ii) shall be applicable	Yes	
		Whether Clause 10 B (iii) shall be applicable	NO	

Clause 10C		Component of labour expressed as per-cent of value of work		25 %		
Clause 10CA		Material covered under this clause		Cement, Reinforcement Steel		
		Base price of all the materials covered under Clause 10CA		Cement- Rs.5540/- Tonne,		
				Reinforcement Steel- Rs.48,721/- Tonne		
		Note: Clause 10CA is applicable only for Cement and Steel reinforcement bars and not for any other materials.				
Clause 10CC		Whether Clause 10 CC shall be applicable		NO		
Clause 11		Specifications to be followed for execution of work		Latest CPWD Specifications for Civil, Electrical and all other works with up to date correction slips for all sub heads of work as applicable, and, Technical Specifications included in the tender documents, wherever applicable		
Clause 12						
12.2 & 12.3		Deviation Limit beyond which clauses 12.2 & 12.3 shall apply for building work.		30 % of Items		
12.5		Deviation Limit beyond which clauses 12.5 shall apply for foundation work.		100 % of Items		
Clause 16		Competent Authority for deciding reduced rates		Vice President (ID), HLL, Noida		
Clause 18		List of mandatory machinery, tools & plants to be deployed at site.	1. Material lift 2. Electrical and petrol operated vibrators 3. D.G. set			
Clause 25		Reviewing Authority		Pr. Chief Engineer (ID), HLL, Noida		
		Appealing Authority		Vice President (ID), HLL, Noida		
Clause 36 (i)		Minimum Requirement of Technical Representative(s) and monthly recovery Rate				
S. No.	Designation (Principal Technical/ Technical representative)	Discipline	Minimum Qualification of Technical Representative	Minimum Experience	Minimum Nos.	Rate at which recovery shall be made from the contractor in the event of not fulfilling provision of clause 36 (i)
						Rate per month
1.	Project Manager	Civil	Degree	20	1	Rs 60,000/-
2.	Deputy Project Manager	Civil/ Electrical/ Mechanical	Degree/Diploma	12/15	2	Rs.40,000/-
3.	Project/ Site Engineer	Civil/ Electrical/ Mechanical	Degree/Diploma	5/10	3	Rs.25,000/-
4.	Quality Engineer	Civil	Degree	8	1	Rs.25,000/-
5.	Surveyor	Civil	Diploma	8	1	Rs 15,000/-

6.	Project Planning / Billing Engineer	Civil/Elect	Degree/Diploma	6/9	2	Rs 20,000/-
Note: The staffs at S. No. 1, 3(Civil), 5, 6 (Civil) above are required to be in position at site within 15 days of commencement of work. The balance along with other staff for specialised works to be in position at site as per requirements at project site or within 15 days of directions of Engineer-in-Charge whichever is earlier.						
Assistant Engineer retired from Government services that are holding Diploma will be treated at par with Graduate Engineers. Diploma holder with minimum 10 years relevant experience with a reputed construction co. can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree Engineers.						
Clause 39		Authority having option of terminating the Contract in event of death of Contractor		The Secretary-cum-Scientific Director, IPC, Ghaziabad (UP)		
Clause 42		I. (a) Schedule/statement for determining theoretical quantity of cement & bitumen		On the basis of Delhi schedule of Rates 2014, printed by C.P.W.D.		
		II. Variations permissible on theoretical quantities				
		(a) Cement				
		(i) For works with estimated cost put to tender not more than Rs. 5 lakh.		3% plus/minus		
		(ii)For work with estimated cost put to tender more than Rs. 5 lakh.		2% plus/minus.		
		(b) Bitumen all works		2.5% on plus only & nil on minus side.		
		(c) Steel reinforcement and structural steel sections for each diameter, section and category		2% plus/minus.		
		(d) All other materials		Nil		
RECOVERY RATES FOR QUANTITIES BEYOND PERMISSIBLE VARIATION						
		Rates in figure and words at which recovery shall be made from the contractor				
S. No.	Description of item	Excess beyond permissible variation		Less use beyond permissible variation		
1	Cement	Nil		1.10* (base price + CI)		
2	Steel reinforcement	Nil		1.10* (base price + CI)		

<u>Annexure – I</u>	
A-List of Equipment for Field Testing Laboratory (Minimum)	
S. No	
1	Balances
(i)	7 kg. to 10 kg. capacity, semi-self-indicating type – accuracy 10 gm.
(ii)	500 gm. Capacity, semi-self-indicating type – accuracy 1 gm.
(iii)	Pan balance- 5 kg. Capacity – accuracy 10 gms.
2	Ovens-electrically operated thermostatically controlled upto 1100C – sensitivity 10 C.
3	Sieves: as per IS 460-1962.
(i)	I.S. sieves – 450mm internal dia, of sizes 100mm, 80mm, 63mm, 50mm, 40mm, 25mm, 20mm, 12.5mm, 10mm, 6.3mm, 4.75mm, complete with lid and pan
(ii)	I.S. sieves – 200mm internal dia (brass frame) consisting of 2.36mm, 1.18mm, 600 microns, 425 microns, 300 microns, 212 microns, 150 microns, 90 microns, 75 microns, with lid and pan.
4	Sieve shaker capable of 200 mm and 300 mm dia sieves, manually operated with timing switch assembly.
5	Equipment for slump test – Slump cone, steel plate, tamping rod, steel scale, scoop.
6	6. Dial gauges, 25 mm travel – 0.01 mm/ division least count – 2 nos.
7	7. 100 tonnes compression testing machine, electrical-cum manually operated.
8	8. Graduated measuring cylinders 200 ml capacity – 3 Nos.
9	9. Enamel trays (for efflorescence test for bricks).
(i)	300 mm x 250 mm x 40 mm – 2 nos.
(ii)	Circular plates of 250 mm dia – 2 nos.
10	Cube Mould – as per requirement
	Note: The above list is indicative and is bare minimum. However Contractors are advised to provide Laboratory Testing Equipment in required number so that Quality of work does not suffer due to shortage of Equipment.

Annexure – II	
B-Field Testing Instruments (Minimum)	
S.No.	
1	Steel tapes – 3m
2	Vernier calipers
3	Micrometer screw gauge-25 mm
4	A good quality plumb bob
5	Spirit level, minimum 30 cms long with 3 bubbles for horizontal vertical
6	Wire gauge (circular type) disc
7	Foot rule
8	Long nylon thread
9	Rebound hammer for testing concrete
10	Dynamic penetrometer
11	Magnifying glass
12	Screw driver 30 cms long
13	Ball pin hammer, 100 gms
14	Plastic bags for taking samples
15	Moisture meter for timber
16	Earth resistance tests (for Electrical Divisions)
17	Megger (for Electrical Divisions)
Note: The above list is indicative and is bare minimum. However Contractors are advised to provide Field Testing Equipment in required number so that Quality of work does not suffer due to shortage of Equipment.	

Indian Pharmacopoeia Commission
GHAZIABAD, U.P.
(An Autonomous Institution of Ministry of Health & Family Welfare)

Tender No. IPC/GZB/HLL/ID/2015

Request for Proposal (RFP)
for
**Construction of State of Art Laboratory Building for Indian
Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh**

VOLUME – II

Special Conditions of Contract
(SCC)



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(May, 2015)

SPECIAL CONDITIONS OF CONTRACT (S C C)

1. Scope of Contract

The scope of work comprises of construction of multi-storeyed buildings including water supply, sanitary & plumbing comprehensive Fire Fighting / Protection System, Internal & External Electrification, HVAC Works, Lifts, CCTV and Security System, Solar Panel, PA System, EPABX/ Communication System, LAN system, Site development works such as Internal road + Path & site levelling, sewer and storm water drainage works etc.

The scope of work also includes preparation of all detailed shop drawings, obtaining approvals at different stages from local authorities, electrical inspector, lifts inspector, water & sewer line connection, pollution, permission/approval for tree cuttings, permission for bore well, completion certificates, occupancy certificate and all other required statutory approvals /clearances from relevant Statutory authorities. It also includes maintenance of these works during defect liability period.

The work is to be executed for Certifications as per GRIHA (Green Rating for Integrated Habitat Assessment) National Green Building Rating System. At least 3 (Three) Star rating under the GRIHA Green Building Rating System is to be ensured.

2. Drawings

(a) Tender Drawings

The tender drawings are for Tender Purpose only and are intended as a guide to the Bidder / Contractor and give general layout of buildings and general information of the structures and general positions of utilities, services and equipments only. Contractor's quoted rate for any item should not be based on any measurement, quantity, and specification from these drawings. Any claim raised by the contractor in this regard shall not be valid in this contract and shall not be accepted by the Client.

(b) Issue and custody of drawings & specifications

The contractor on the signing of contract shall be furnished free of cost three copies of all drawings and all further drawings issued during the progress of the works. The contractor shall keep one copy of all drawings at the works site and the Client/Engineer-in-charge/Consultant shall have, at all reasonable times, access to the same.

The drawings shall be provided to the Contractor as per the schedule (prepared at the starting of the works and necessarily updated or revised time to time) mutually agreed by the Engineer-in-charge and the Contractor. Last major drawings may be provided as per the schedule prior to the stipulated date of completion and the Contractor, if found necessary shall increase his resources and effort so as to complete the works within stipulated time

From time to time during the course of contract revised drawings may be issued to the Contractor and the Contractor shall ensure that all superseded drawings are removed from site and stored in a lockable cabinet as directed by the Engineer-in-charge and replaced by revised drawings.

The Contractor shall maintain complete up to date Register of drawings at site. All drawings shall be properly numbered and indexed for ready reference. Superseded drawings should be properly identified.

The contractor shall ensure that only the valid up to date drawings are used for setting out, construction and preparation of as built drawings etc.

(c) Bar Bending Schedule

Contractor shall prepare bar bending schedules and shall get them approved from the Engineer-in-charge or his authorized representative.

(d) Working drawings/ Shop drawings/ Design:

The drawings supplied by the Engineer-in-charge have been listed in the tender documents. These drawings are indicative for the purpose of detailing and requirement of the contracts. The contractor shall take into consideration space allocated for equipments before ordering them to ensure that the equipment would fit in the space provided with necessary clearances required as per the relevant standard / manufacture's recommendations. In case of any difficulty it should be brought to the notice of the Engineer - in- Charge.

Structural and architectural drawings will be provided by the Engineer-in-charge / Consultant. However, to ensure the uninterrupted progress of work and timely completion, the contractor will do further detailing as per site requirement at his own.

Detailing for shop drawings of all services will have to be done by the contractor based on the schematics and other details provided by the Engineer-in-charge /Consultant or local authorities. The work will be executed by the contractor based on the approved drawings from the concerned authority and accordingly contractor will be responsible for obtaining all required final NOC / clearance from concerned authorities. These drawings and details shall also contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipments and also details of all related items of work by other discipline.

The contractor shall submit to the Engineer-in-charge for approval details of all proposed equipments, accessories, equipment characteristics and capacity details of all equipment, accessories and devices etc. as per the specifications and obtain approval of the Engineer-in-charge.

In case there is delay in any drawings and design viz shop drawings, or specialised works drawings etc. to be supplied by the contractor, Engineer - in- Charge may ask the Contractor to make necessary changes as required. In case of failure on the part of the contractor to carryout the directions of the Engineer - in- Charge action may be taken to get the needful done at the risk and cost of the Contractor. All drawings shall be signed by Contractor or their authorised representative with name, seal and date before submission to Engineer-in-charge.

3. Disruption of Progress

- (a). The Contractor shall give 4 weeks written notice to the Engineer-in-charge whenever planning or progress of the Works is likely to be delayed or disrupted due to non-issue of any drawing or order by the Engineer-in-charge. The notice shall give details of the drawing or order required explaining why and by when it is required and if any delay or disruption is likely to be suffered on that account.
- (b). If by reason of any failure or inability of the Engineer-in-charge /Consultant to issue drawings/ order/ clarifications within 4 weeks of such notice the Contractor and the contractor suffers delay, then the Engineer-in-charge, shall record the facts for any extension of time under respective clause of the agreement. Notwithstanding anything stated above, the Contractor shall not be eligible for any financial compensation arising out of the above.
- (c). No compensation whatsoever shall be payable to the contractor for any damage by rains,

lightening, wind, storm, floods, tornadoes, earthquakes, or any other natural calamities during execution of work and no claim on this account will be entertained such damages.

4. Further Drawings and Instructions

The Contractor shall carry out and complete the said work in every respect in accordance with this Contract and with the directions of and to the satisfaction of the Engineer-in-charge/Consultant. The Engineer-in-charge /Consultant may in his absolute discretion and from time to time further issue drawings and/or written instructions, details, directions and explanations, which are hereafter collectively referred to as "Engineer-in-charge /Consultant 's Instructions" in regard to:

- a. The variation or modification of the design, quality or quantity of items of works or the addition or omissions or substitution of any item.
- b. Any discrepancy in the drawings or between the bill of quantities and/or drawings and/or specification.
- c. The removal from the site of any material brought thereon by the contractor and the substitution of any other material thereof.
- d. The removal and/or re-execution of any works executed by the contractor.
- e. The removal of any persons employed by the contractor on the site.
- f. The opening up for inspection of any work covered up.
- g. The amending and making good of any defects noticed during or after execution of the work.

The contractor shall forthwith comply with and duly execute any work in compliance to above instructions provided always that verbal instructions, directions and explanations given to the contractor or his representative by the Engineer - in- Charge / Consultant, shall, if involving a variation, be confirmed in writing by the Contractor within seven days, and if not dissented in writing within a further seven days by the Engineer - in- Charge / Consultant, these shall be deemed to be Engineer - in- Charge / Consultant's instructions within the scope of the contract

5. Contractor's General Responsibilities

(a). Execution of works:

The Contractor shall, subject to the provisions of the Contract, and with due care and diligence, execute and complete the Works & remedy any defects therein in accordance with the Contract. The Contractor shall provide all labour, including the supervision thereof, materials, Constructional Plant and Machineries and all other things, whether of a temporary or permanent nature, required in and for such execution, completion, maintenance and remedying of any defects, so far as the necessity for providing the same is specified in or is reasonably to be inferred from the Contract.

If the contractor finds any discrepancy in the drawings or between the drawings, bill of quantities and specifications, he shall immediately and in writing refer the same to the Engineer - in- Charge /Consultant for clarifications who shall decide the matter.

The successful contractor is bound to carry out any items of work necessary for the completion of the job even though such items are not included in the bill of quantities and rates instructions in respect of such additional items and their quantities will be decided as per the provision of the contract and issued in writing by the Engineer-in-charge / Consultant .

The Contractor must bear in mind that all the work shall be carried out strictly in accordance with the specifications as given in these documents and also in compliance of the requirements of the local public authorities and to the requirements/ satisfaction/ direction of the Consultant / Engineer-in-charge and no deviation of any account will be permitted.

The contractor shall have to use materials from the makes / manufacturers specified in the list of materials of approved brand and/or manufacture contained in the contract documents and as approved by the Engineer - in- Charge / Consultant. Wherever different pattern/ Design/ Quality of materials with same specification/ make as specified in the contract, is available in the market, Consultant/ Engineer-in-Charge will approve the pattern/ Design/ Quality of the material/ item which shall be final and binding on the contractor. The contractor shall supply samples of all the materials / fittings / fixtures proposed to be used in the work and obtain approval of the Engineer - in- Charge / Consultant. These samples shall be retained at site till completion of the work. If subsequently it is found that approved material upon testing does not meet the requirement as specified in the contract the contractor shall get approval of alternate material.

(b). Adequacy, stability and safety:

The Contractor shall be fully responsible for the adequacy, stability and safety of all site operations and methods of construction, the contractor shall ensure that all safety norms are followed as per contractual and other statutory requirements.

(c). Temporary works and arrangements:

The Contractor shall furnish to the Engineer-in-charge /Consultant full particulars i.e. site location and area required including drawings, etc. of all temporary works necessary for the execution of the works and shall give adequate time to the Engineer - in- Charge for his approval. The Contractor shall be solely responsible for the stability and structural safety of all temporary works including obtaining statutory approvals and payment of statutory fees, if any. Should it be necessary to shift the temporary works to some other place during the execution of the works, the Contractor shall do so, at his own cost.

(d). Initial and Final Clearance of site for temporary works:

The Contractor shall be responsible for the clearance of the site of all scrub, debris, rubbish, etc. to be removed off site to a location to be provided by the contractor and approved by the Engineer- in-charge. However, no tress shall be removed without the prior permission of the Engineer-in-charge. The structures, services and works required to be demolished and removed shall also be removed off site to a location as mentioned above. The Contractor shall obtain necessary permissions and approvals from the local authorities for such disposals. The demolition shall include digging, excavating and removal of substructures, foundations and buried works. The cost of all this shall be borne by the Contractor.

The above is applicable for all site offices, labour camps, and godowns etc., which are not required after the works is completed.

(e). Storage, Cleaning and Dewatering

The Contractor shall at all the times during construction keep the Site clean and free from all debris and unwanted materials on a daily basis as per instructions of the Engineer-in-charge.

Storage of materials shall be in an organized manner and in proper compartments as directed by the Engineer - in- Charge. Storage on suspended floors shall not be permitted unless specifically approved in writing by the Engineer-in-charge /Consultant for specific materials in specific locations and in approved manner. The Engineer-in-charge / Consultant shall be furnished with load details, if requested, before seeking approval for storage.

Regular cleaning operations shall be undertaken to remove all dust, debris, waste materials etc. A cleaning schedule shall be maintained.

Contractor shall make his own arrangement for storage of those materials, which can be accommodated at site. Contractor shall be fully responsible for safe custody of the same. Materials shall be considered as "Delivered at Site" only after the physical presence of materials at site are verified by the Engineer-in-charge /Consultant. Storage of materials / equipment else where shall not be considered as "Delivered at Site."

Contractor shall be responsible to keep entire site free from water due to water coming from any source at any level and shall protect all materials and works from being damaged by the water from any source. Contractor shall make proper arrangements for drainage prior to use of water for curing, testing, cleaning etc.

Any expenditure incurred by the Contractor in fulfilment of his obligations under this sub-clause shall be deemed to have been included in the financial bid and subsequent contract.

6. Watching & Lighting

The Contractor shall throughout the execution and completion of the Works and the remedying of the site and the Works and the remedying of any defects therein have full regard for the safety of all persons entitled to be on the site and keep the site and the Works in an orderly state to avoid any accident or danger and provide safety measures, lights, guards, fencing and barricades where ever necessary or required by the Engineer-in-charge /Consultant, or by any duly constituted authority, for the execution and for the protection of the Work, and/or for the safety and convenience of the public or others and take all reasonable steps to protect the environment on and off the site and to avoid damage or nuisance to person or property of the public or others resulting from pollution, noise and other causes etc. at his own cost.

7. Care of Works

From the commencement to the certified completion of the whole of works, the contractor shall be responsible for the care, safety and maintenance of the works executed under the contract thereof and of all temporary works. In case of any damage/ loss or injury shall happen to the works or to any part thereof or to any temporary works from any cause whatsoever save and except the expected risks as defined in sub-clauses of Clause 12, the contractor shall at his own cost repair and make good the same, so that on completion the works shall be in good order and condition in conformity to every respect with the requirements of the contract. The contractor shall also be liable for any damage to the works occasioned by him including his subcontractors in the course of any operations carried out by him for the purpose of completing any outstanding work and complying with his obligations under clause 33 hereof. In case of failure on the part of the contractor the damage/ loss/ injury shall be made good by the client at the risk and cost of the contractor.

8. Force Majeure:

Any failure or delay in the performance by either party hereto of its obligations under his Contract shall not constitute a breach thereof or give rise to any claims for damages if, and to the extent that it is caused by occurrences beyond the control of the party affected, namely, acts of God, floods, explosions, wars, riots, storms, earthquakes, insurrection, epidemic or other natural disasters. The party so affected shall continue to take all actions reasonably within its power to comply as far as possible with its obligations under this Contract. The affected party shall promptly notify the other party after the occurrence of the relevant

event and shall use every reasonable effort to minimize the effects of such event and act in all good faith with due care and diligence.

9. Contractor's Superintendence

- (a). The contractor shall be solely responsible for the means, methods, techniques sequence and procedure of construction. The Contractor shall be responsible to see the completed work complies accurately with the Contract requirements. The Contractor shall provide all necessary superintendence during the execution of the Works as per contractual provisions.

(b). Contractor's Senior Representative for Execution & Coordination of Works

The Contractor shall ensure his presence at site all times during working hours throughout the course of the Contract or depute a Competent representative who shall be empowered to receive instructions from the Engineer - in- Charge in respect of all matters likely to arise in connection with the execution & coordination of the works at the site Contractor's Representative shall have the power to take joint measurement and sign the measurement books / bills. Any direction, explanations, instructions or notices given by the Consultant/ Engineer-in-charge to such representative shall be held to be given to the Contractor. In case of absence of said Representative other alternative representative should also be mentioned having same powers.

The contractor should submit curriculum vitae (CV) of the following key personnel proposed to be deployed at site for supervision and execution of work.

- Director/Project Coordinator
- Project Managers
- Construction Engineers
- Project Engineers
- Billing Engineers
- Quality Control Engineers
- Planning Engineers

The contractor under normal circumstances would not be allowed to replace the key personnel during the execution of the contract. However, for any reasons, due to unavoidable circumstances if it becomes necessary in the interest of the project to replace any one / all the above key personnel the contractor must submit the CV of the new personnel (having qualification and experience as per requirement of the contract) to Engineer-in-Charge/ Consultant for their approval.

A list of all technical and key personal staffs must be submitted to the Engineer-in-Charge / Consultant with their area of work / responsibility with verified signature and the link persons to receive the instruction at site (in case the main person was not found at site) during the inspection by representative of Client and/or Consultant and/or Engineer-in-charge. Any staff of contractor found incapable/unsuitable to execute the assigned work shall be replaced by the Contractor if desired by the Engineer-in-Charge /Consultant.

(c). Contractor's Employees

The Contractor shall employ competent Engineering staff / technical assistants/ technicians who are qualified, skilled and experienced in their respective trades, to ensure proper supervision, quality & output of the work they are required to supervise. No child labour

shall be employed on the work. All the skilled semi-skilled and unskilled labour shall work under the sole guidance of the contractor/his representative.

(d). Removal of Contractor's Employees

The Contractor shall on the direction of the Consultant/Engineer-in-Charge immediately remove from the work any person employed thereon by him who may, in the opinion of the Consultant/ Engineer-in-Charge has misconduct himself and such person shall not be again employed on the works without the permission of the Engineer-in-charge/ Consultant.

(e). Unauthorized Persons

No unauthorized persons shall be allowed on the site. The contractor shall provide complete security arrangement for the campus during construction to avoid trespassing. The Contractor shall ensure all such persons are kept out and shall take steps to prevent trespassing. However the contractor will make sure to provide free access at any time for Engineer-in-charge/Client/Consultant to the site and other working places.

10. Compliance with Statutes, Regulations, Etc.

The contractor shall conform to the provisions of all statutes, ordinance, laws, acts of the legislature relating to the works, and to the regulations and by-laws of any local or other duly constituted authority and of any water, electric supply and other companies and/or authorities with whose systems the structure is proposed to be connected. The Contractor shall keep the Client / Engineer-in-charge/ Consultant indemnified against all fines or penalties or liability of every kind for breach of any such statutory ordinance, law act of the legislation, regulations, and byelaws as aforesaid.

The contractor shall before making any variations from the drawings or specifications that may be necessitated by such regulations, give to the Engineer- in-charge/Consultant written notice, specifying the variation proposed to be made and the reasons for making it and apply for instructions thereon. The contractor will not execute any work without written permission from the Engineer-in-charge/ Consultant

The contractor shall bring to the attention of the Engineer-in-charge/Consultant any specific requirement of the local authorities or any notice required for execution by virtue of such acts, regulations or bye-laws of such authority, or public office. All fees that may be chargeable in respect of these works shall be reimbursed by the client/consultant on production of authorised receipts.

11. Setting out

The contractor shall be responsible for the true and proper setting-out of the Works in relation to original points, lines and levels or reference issued by Engineer-in-charge/Consultant in drawing or in writing and for the correctness, subject as above mentioned, of the position, levels, dimensions and alignment of all parts of works and for the provision of all necessary instruments, appliances and labour in connection therewith. If, at any time during the progress of the works, and during defects liability period, any error shall appear or arise in the position, levels, dimensions or alignment of any part of the Works, the Contractor, on being required to do by the Engineer-in-charge/ Consultant and / or Client or his authorised representative shall at his own cost, rectify such error to the satisfaction of the Engineer-in-charge. The checking of any setting out or of any line or level by the Consultant shall not in any way relieve the Contractor of his responsibility for the correctness thereof. The Contractor shall carefully protect and preserve the benchmarks; sight-rails, pegs and other things used in setting-out the Works. Any rectification works required should be done by the Contractor at his own cost.

12. Quality of Materials, Workmanship and Test

- (a). All the materials used in the work shall be subjected to the mandatory tests as prescribed in the specifications detailed in Schedule F of the General Condition of Contract and other specifications referred to in the contract and workmanship shall be the best of the respective kinds described in the Contract and in accordance with the Engineer-in-charge / Consultant's instructions and shall be subjected from time to time to such tests as the Engineer-in-charge / Consultant may direct at the place of manufacture or fabrication or on the Site or at an approved testing laboratory. The source of supply and / or manufacturing within/ out side India may be inspected by the Engineer-in-charge/ Consultant/ any representative as nominated by the client. The expenditure on this account is deemed to be included in the rate quoted.

The contractor shall upon the instruction of the Engineer-in-charge /Consultant 's representative furnish him with documentation to prove that the materials & goods comply with the requirements of contract and for requirement stated above. The Engineer-in-charge /Consultant may issue instruction in regard to removal of material from site or any work, if these are not in accordance with the contract. The contractor shall provide such assistance, instruments, machinery, labour and materials as are required for examining, measuring, sampling, testing of material or part of work.

The Engineer-in-charge/ Consultant may carry out Third Party Quality Assurance /Audit by an independent agency/ individual/firm/institute at any time. The agency will be permitted and offered all support related to site inspection by the Contractor. Observations / discrepancies noticed by third party quality assurance/audit shall be attended by the contractor at his own cost.

(b). Samples

- i) All samples of materials and /or items of works in adequate numbers, sizes, shades & pattern as per specifications shall be supplied free of charge by the contractor without any extra charge. All other expenditure required to be incurred like conveyance for taking the samples for testing at the laboratory, packing, etc, shall be borne by the contractor. If the test results do not confirm to the specifications and standards laid down, the materials shall be rejected, the contractor shall remove such materials from site. The laboratory for testing of samples shall be decided by the Engineer – in charge, whose decision shall be final and binding.
- ii) Contractor shall submit Samples to the Engineer-in-charge/Consultant for approval. If certain items proposed to be used are of such nature that samples cannot be presented or prepared at the site, detailed literature / test certificate of the same shall be provided instead to the satisfaction of the Engineer-in-charge /Consultant. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalogue numbers and the use for which intended and otherwise as the Engineer-in-charge /Consultant may require to review the submittals for the limited purposes required by paragraph (d) below. The numbers of each sample to be submitted will be as specified in the Specifications, or as shall be specified by the Engineer-in-charge/Consultant.
- iii) Submittal Procedures
 - (a). Before submitting each Sample, Contractor shall have determined and verified all materials with respect to intended use, fabrication, shipping, handling, storage, assembling and installation pertaining to the performance of the Work and All information relative to Contractor's sole responsibilities in respect of means,

methods, techniques, sequences and procedures of construction and safety precautions and programmes incident thereto.

- (b). Each submittal will bear a specific written indication that Contactor has satisfied Contractor's obligation under the Contract Documents with respect to Contractor's review and approval of that submittal.
- (c). At the time of each submission, contractor shall give the Engineer-in-charge/ Consultant specific written notice of such variations, if any; that the sample submitted may have from the requirements of the contract document. Such notice shall be separate from the submittal and in addition shall cause a specific notation to be made on each sample submitted for review and approval of each such variation

iv) Review and Approval:

- a. Sample shall be reviewed and approved only to determine if the items covered by the submittals will, after installation or incorporation in the work, conform to the information given in the contract documents and be compatible with the design concept of the completed project functioning as a whole as indicated by the contract documents, drawings.
- b. Review and approval will not extend to means, methods, techniques, sequences or procedures of construction. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. Contractor shall make corrections required by Engineer-in-charge/Consultant and shall submit as required new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for and by the Engineer-in-charge/ Consultant on previous submittals.
- c. Above referred review and approval Samples shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Document unless Contractor has in writing called the Engineer-in-charge/Consultant's attention to each such variation at the time of submission as specified above and received written approval of each such variation by specific written notation thereof incorporated in or accompanying the Sample approval; nor will any approval by Engineer-in-charge / Consultant relieve Contractor from responsibility for complying with the requirements of contract.
- d. Only when the samples are approved in writing by the Consultant, the contractor shall proceed with the procurement and installation of the particular material / equipment. The approved samples shall be signed by the Consultant for identification and shall be kept on record at site office until the completion and acceptance of the work and shall be available at the site for inspection / comparison at any time. The contractor shall keep with him a duplicate of such samples to enable him to process the matter.
- e. For items of works where the samples are to be made at the site, the same procedure shall be followed. All such samples shall be prepared at a place where it can be left undisturbed until the completion of the project.
- f. The Engineer-in-charge shall communicate his comments / approval to the Contractor to the samples at his earliest convenience. Any delay that might

occur in approving of the samples for reasons of its not meeting with the specifications or other discrepancies, inadequacy in furnishing samples of best qualities from various manufacturers and such other aspects causing delay on the approval of the materials / equipment's etc., shall be to the account of the contractor. In this respect the decision of the Engineer-in-charge shall be the final.

- v) On delivery of the supplies of materials / equipments for permanent works at the site, the contractor shall specifically arrange to get the supply inspected by the Engineer-in-charge /Consultant and compared with the approved sample and his specific obtained before using the same in the work.

(a). Cost of Tests

The cost of making any test shall be borne by the Contractor as intended by or provided for the Contract or as found necessary by the Engineer-in-charge/Consultant for ascertaining whether the quality of materials intended to be used by the Contractor in the Works is acceptable, whether any finished or partially finished work is appropriate for the purposes which it was intended to fulfil.

(b). Testing facilities

The Contractor shall, at his own cost, provide testing facilities as per CPWD specifications and IS Codes at site as stipulated in the General conditions of the contract (GCC) or as directed by the Engineer-in-charge/Consultant including staff required for testing. The test shall be carried out jointly in the presence of Engineer-in-charge/ Consultant or his representative and the contractor or his representative.

The contractor shall also provide suitable weighing and measuring arrangement and testing instruments and machines for testing of materials and cubes at site as per details given in GCC.

The contractor shall carryout all the mandatory tests and shall maintain records of testing & checks of material, in formats, checklists etc. to be given by Engineer-in-charge /Consultant. All such records shall be maintained jointly by the contractor and Engineer-in-charge/ Consultant these shall remain under the custody of the Engineer-in-charge / Consultant.

The laboratory shall be connected to the main potable water, electricity and other Services.

Some of the mandatory tests for each item of work and /or materials shall be carried out in approved outside laboratory as directed by the Engineer-in-charge/Consultant. The Contractor shall bear the entire cost of testing charges for samples of items of work and /or materials and also the other expenditure towards making samples, packaging, and transport etc.

The materials brought at site of work shall not be used in the work before getting satisfactory test result as per relevant mandatory tests, detailed in the relevant CPWD specifications.

13. Absence of Specifications

If the nomenclature of any item do not contain particulars of materials and works which are necessary for its proper execution, all such materials shall be supplied and item shall be

executed by the Contractor without extra charge over the quoted rates and If the Contractor requires any information, he shall request in writing well in advance to commencement of the particular work to the Engineer-in-charge /Consultant who will clarify the issue within a reasonable time.

14. Obtaining Information's related to Execution of work

No claim by the Contractor for additional payment will be entertained which in consequent upon failure on his part to obtain correct information as to any matter affecting the execution of the works, nor will any misunderstandings or the obtaining of incorrect information or the failure to obtain information relieve him from any risks or from the entire responsibility for the fulfilment of the contract.

15. Access for Inspection

Persons nominated by Engineer-in-charge /Consultant shall at all reasonable times have free access to work and/ or to the workshops, factories or other places where materials are lying or from which they are being obtained and the Contractor shall extend necessary service to Engineer-in-charge / Consultant and their representatives every facility necessary for checking measurements, inspection and examination and test of the materials and workmanship.

16. Examination of Work before covering up

(a) No part of the works shall be covered up or put out of view without the written approval of the Engineer-in-charge/Consultant and the contractor shall give due notice to the Engineer-in-charge/ Consultant whenever any such work or foundation is or ready or about to be ready for examination and the Engineer-in-charge/Consultant shall, examine and measure any work before it is covered up or put out of view and to examine foundations before further work is placed thereon.

(b) Uncovering and making openings

The contractor shall uncover any part or parts of the works or make openings in or through the same as the Engineer-in-charge /Consultant may direct from time to time and shall reinstate and make good such part or parts to the satisfaction of the Engineer-in-charge /Consultant at his own cost.

17. Assignment

The contractor shall not, without the prior consent of the Engineer-in-charge / Consultant assign the Contract or any part thereof, or any benefit or interest therein or there under, otherwise than by:

- A change in favour of the Contractor's bankers of any money due or to become due under the Contract, or
- Assignment to the Contractor's insurers (in case where the insurers have discharged the Contractor's loss or liability) of the Contractor's right to obtain relief against any other party liable.

The Contractor shall not sub-contract the whole of the Works. Also, the Contractor shall not subcontract any part of the works without the prior consent of the Engineer-in-charge/ Consultant, except where otherwise provided under the Contract. Any such consent shall not relieve the Contractor from any liability or obligation under the Contract and he shall be fully responsible for the for the quality of the work executed and acts omission and commission, defaults and neglects of any Subcontractor, his agents, servants or workmen as if these were the acts, defaults or neglects of the Contractor, his agents, servants or workmen. Such Permission

may be granted only for the specialized work etc and the decision of Engineer-in-charge/ Consultant shall be final.

18. Claims

The contractor shall submit to the Engineer-in-charge monthly statement giving full details of claims for any additional payments for extra or additional / substituted work ordered by the Engineer-in-charge /Consultant which he has executed during the preceding month, to which the contractor may consider himself entitled supported with analysis of rates being claimed.

19. Secured Advance

- I. Secured advance on materials, which are admissible as per Clause 10 (B) (i) of the General Conditions of Contract and brought to site for use in the work, shall be paid only after:
 - a. Receipt of satisfactory test result from the laboratory.
 - b. Engineer in charge has personally verified that the material brought at site of work for use in the work conforms to the sample approved by him.
- II. Secured advance shall be allowed by the EIC for a period of 3 Months only. Advance shall be recovered according to consumption of material in the work. Contractor shall have to sign an Indenture Bond before release of the advance.
- III. The materials shall virtually stand Hypothecated to Client/HLL but contractor shall be fully responsible for watch & ward/ security of materials for which Secured Advance has been paid by client/HLL.
- IV. Any infringement and / or breach of the above specifications and conditions etc, shall render the contractor liable to action under various clause of the contract and such action as stipulated in the conditions therein.

20. (a) Inspection & Testing during manufacture

The Client / Engineer-in-charge / Consultant shall be entitled to inspect, examine and test during manufacture the materials and workmanship and check the progress of manufacture of all fabrication materials to be supplied under the contract on the contractor's premises during working hours, and if part of the said materials is being manufactured on other premises, the contractor shall obtain for the Client / Engineer-in-charge / Consultant permission to inspect the same at such premises. This inspection, examination or testing shall not relieve the contractor from any obligation under the contract.

(b) Dates for Inspection & Testing

The dates of Inspection & Testing shall be mutually agreed by the Engineer-in-charge / Consultant and the contractor.

(c) Facilities for Testing at Manufacturer's Works

Where the contract provides for tests on the premises of the contractor or of any sub-contractor the contractor shall provide such assistance, labour, materials, electricity, fuel, stores, apparatus and instruments as may be required and as may be reasonably demanded to carry out such tests.

(d) Certificate of Testing

As and when fabrication materials shall pass the tests referred in this clause, the Engineer-in-charge /Consultant shall furnish to the contractor a certificate in writing to that effect.

(e) Rejection

If as a result of such inspection, examination or test of the works (other than a Test on Completion the Engineer-in-charge /Consultant shall decide that such material is defective or not in accordance with the contract he shall notify the contractor accordingly stating in writing his observations and reasons thereof. The contractor shall with due diligence make good the defect and ensures that the material complies with the Contract. Thereafter, if required by the Engineer-in-charge/Consultant, the tests shall be repeated under the same terms and conditions till satisfactory results are made available.

(f) Delivery of Materials and Equipment

The contractor shall be responsible for all materials and equipment brought at site for the purposes of the contract. Unless the Engineer-in-charge/Consultant directs, no material shall be brought to the site which is not required for execution of the work.

(g) Inspection & Testing and Re-inspection

All deficiencies revealed by testing and inspection shall be rectified by the contractor at his own expense and to the satisfaction and approval of the Engineer-in-charge/Consultant. Rectified components shall be subject to re-testing till desired results are obtained.

(h) Inspection Reports

The contractor shall provide the Engineer - in- Charge /Consultant with five copies of reports of all inspection and tests.

21. Virtual Completion Certificate

When the whole of the Work is substantially and virtually complete and has satisfactorily passed required tests that may be prescribed under the Contract:-

- (a). The contractor shall give a written notice to this effect alongwith an under taking to rectify any defects that may be found during inspection. The Engineer - in- Charge / consultant shall jointly inspect the work with the contractor within 30 days of receipt of such notice.
- (b). The Engineer-in-charge / Consultant shall inspect the works are completed to see if they are in such a condition so as to be put to its proper or other intended final use and / or occupied without any short comings and no major or minor items of works are remaining which in the opinion of the Engineer-in-charge/ Consultant will cause undue difficulties in satisfactory use/ occupation of the works.

22. Provisional Acceptance and Certificate of final completion

(a) Provisional Acceptance

The work shall be deemed to have been provisionally accepted after fulfilment of all the following by the Contractor.

- i) Submitting As-Built Drawings, Catalogues, Brochures, and Data Sheets, manuals in the form as directed by Engineer in Charge
- ii) Obtaining Certificate of Virtual Completion from the Engineer-in- Incharge /Consultant.
- iii) Obtaining all required approvals from the statutory authorities as required for occupation and use of the works and handing over such certificates to the Engineer-in-charge /Consultant.

(b) Certificate of Final Completion

The contract shall not be considered as completed until a Certificate of Final Completion has been issued by the Engineer-in-charge/ Consultant stating that the Works have been

completed to his satisfaction and remedying / rectifying of defects have been satisfactorily completed.

The composite work shall be treated as complete when all the components of the work are complete. The Certificate for Final Completion of the Composite work shall be recorded by the Engineer-in-charge / Consultant after obtaining / recording of completion certificate of all the components.

The Engineer-in-charge/ Consultant shall give the Certificate for Final Completion as per the following, whichever is later:

- Twenty-eight days after the expiration of the Defects Liability Period

OR

- If different Defect Liability Periods shall become applicable to different sections or parts of the Works, the expiration of the last such period

OR

- As soon thereafter as any works ordered during such period have been completed to the satisfaction of the Client.

Provided always that the issue of the Certificate of Final Completion shall be a condition precedent to payment or return to the Contractor the security deposit and / or Performance security in accordance with the conditions set out in the contract.

23. The contractor shall give performance test of the entire work as per standards specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the tests.
24. The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased handing over of completed portion of the work is required by the Engineer – in – charge, the provisions mentioned for completion of entire work will apply to each phase.

25. Defect after completion

(a). General

Any defect, shrinkage, settlement or other faults that may appear within the “Defects Liability Period” which in the opinion of the Client / Engineer-in- charge/ Consultant are due to materials or workmanship not in accordance with the contract, shall be rectified as per the directions in writing of the Client / Engineer-in- charge/ Consultant to the Authorized representative of the contractor within such reasonable time as shall be specified therein by the contractor, at his own cost. In case of default, the Client / Engineer-in-charge /Consultant/ may employ any person’s to amend and make good such defects, shrinkage, settlements or other faults and all expenses consequent thereon or incidental thereto shall be borne by the contractor. Such damages, losses and expenses shall be recoverable from the bills due or may be deducted from any money due to or that may become due to the contractor. If no amount is available to the credit of contractor, the Client / Engineer-in-charge/Consultant/ may recover the amount from the dues of the contractor with any other government/department.

(b). Execution of work of repair etc.

Any defects, shrinkage, settlement or other faults which may appear or be noticed within the defect liability period, and arising in the opinion of the Engineer-in-charge/Consultant from materials or workmanship not having in accordance with the contract, shall upon the

direction in writing of the Engineer-in-charge's / Consultant's representative and within such reasonable time as shall be specified therein and without any delay, be amended and made good or replaced by the contractor at his own cost.

(c). Cost of Execution of Work of Repair, Etc.

All such works shall be carried out by the Contractor at his own expense if the necessity thereof shall, in the opinion of the Engineer-in-charge/Consultant, be due to the use of materials or workmanship not in accordance with the Contract, or due to neglect or failure on the part of the Contractor to comply with any obligation, expressed or implied, on the Contractor's part under the Contract.

(d). Contractor's personnel to be at site

During the defects liability period the contractor shall depute at least one of his authorized representative at site along with required tradesmen to attend the defects to the satisfaction of Client/ Engineer-in-charge/ Consultant.

26. Works by Other Agencies

The Client/ Engineer-in-charge/Consultant reserves the right to use premises and any portion of the site for the execution of any work not included in this contract which it may desire to have carried out by other persons simultaneously, and the contractor shall allow the reasonable facilities for the execution of such work, but shall not be required to provide any plant or material for the execution of such work except by special arrangement with the other agency. Such work shall be carried out in a manner so as not to impede the progress of the works included in the contract, the contractor shall not be responsible for any damage or delay which may happen to or occasioned by such work.

The contractor shall co-operate with other agencies working in the same project, and coordinate his plans and time schedules so that there will be no interference. The Contractor shall forward to the Engineer-in-charge /Consultant all correspondences and drawings exchanged. Failure to check plans for conditions will render the Contractor responsible for bearing the cost of any subsequent changes found necessary or damages done.

The Client/ Engineer-in-charge /Consultant shall not entertain any claim on account of the Contractor affording necessary facilities to execute the work simultaneously with other agencies executing the works for the same project.

27. Dues not paid by the Contractor

The contractor shall pay all dues or fees to Statutory authorities and Electric and Water supply authorities & Lift licensing authority etc. within due period and indemnify the Client and the Engineer-in-charge /Consultant from any claims or compensations or penalties or damages arising out of non-payment of any such dues or fees. However, in case some dues or fees are not paid by contractor / and or claims for compensations or penalties etc. are raised by the Statutory authorities, the Client may deposit the required amount or any or all of the above and recover or deduct the same from any money payable to the contractor by the Client or any other means available to the Client such as bank guarantee.

28. Urgent Repairs

If, by reason of any accident, or failure, or other event occurring to or in connection with the works, or any part thereof, either during the execution of the works, or during period of Defects Liability any remedial or other work or repair, shall, in the opinion of the Engineer-in-charge/ Consultant/Client be urgently necessary for the safety of the Works and the Contractor is unable or unwilling to do such work or repair despite notice, the Engineer-in-charge/

Consultant/ may employ and pay other persons to carry out such work or repair as the case may be and may consider necessary. If the work or repair so done by the other agency is the work which, in the opinion of the Engineer-in-charge/Consultant the Contractor was liable to do at his own expense under the Contract, all expenses incurred by Other agency in so doing shall be recoverable from the Contractor by the Engineer-in-charge/Consultant, or may shall be deducted by the Engineer-in- charge/ Consultant from any monies due or which may become due to Contractor.

29. Boreholes & Exploratory Excavation

If, at any time during the execution of the Works, the Engineer-in-charge /Consultant shall require the Contractor to make boreholes or to carry out exploratory excavation, such requirement shall be ordered in writing and shall be deemed to be an additional ordered under the provisions unless a provisional sum in respect of such anticipated work shall have been included in the schedule of items.

30. Fossils, Etc.

All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the site of the works shall be the property of the Government.

31. Plant Temporary Works & Materials

(a.) Plant, etc. Exclusive use for the Works

All Constructional Plant, Temporary Works and materials provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Works and the Contractor shall not remove the same or any part thereof except for the purpose of moving it from one part of the Site to another, without the consent, in writing of the Engineer-in-charge /Consultant, which shall not be unreasonably withheld.

(b.) Removal of Plant etc.

Upon completion of the Works, the Contractor shall remove from the Site all the said Constructional Plant and Temporary Works remaining thereon and any unused materials provided by the Contractor, within 10 days of obtaining the completion certificate/ Virtual completion of the work.

32. Operations and Maintenance Manual

The Contractor shall provide and submit to the Engineer-in-charge /Consultant with two copies of the Operation and Maintenance Instruction Manuals as may be applicable for the works in a durable plastic case. The arrangement of these manuals shall be as follows:

SECTION A:	Index
SECTION B:	Full set of Indexed Photographs showing all salient features of the Project.
SECTION C:	Description and details of materials, items and fittings and fixtures used for the project along with Catalogues & Addresses of the Suppliers.
SECTION D:	Planned maintenance instruction and dates for order replacements.
SECTION E:	List of recommended Spare parts of consumables.
SECTION F:	List of "As-Built" Drawings (related to Working/ Shop drawings)

Until the Record Drawings, prints, transparencies and manuals referred to above have

been received and approved by the Engineer-in-charge /Consultant , Contract shall not be considered as complete and payment of monies will be withheld until such drawings, etc. have been submitted to and approved by the Engineer-in-charge /Consultant . The cost of providing such records including proper submission thereof is deemed to be included in the Contract Sum quoted by the Contractor.

33. Reports by Contractor

- (a.) The Contractor shall submit CPM – Pert Chart and activity wise bar charts, indicating the duration of various subheads of the work, for the complete work within 30 days of award of work for approval by the Engineer - in- Charge /Consultant. On the basis of approved bar charts contractor shall submit Progress Charts by the 4th day of every month.
 - (b.) The Contractor shall submit Monthly Progress Report in triplicate in format approved by Engineer-in-charge /Consultant. Failure to submit reports may result in holding up or delay in Payment of bills.
 - (c.) **Monthly Progress Photographs:-** The Contractor shall arrange at his own cost to maintain a progress record of the works by taking postcard size colour photographs (preferably digitized photographs) 6 Nos. or more per month per block as directed by the Engineer-in-charge / Consultant during the constructions stages and after completion and shall supply three sets at no extra cost. The Contractor will be required to submit monthly reports on the progress of his work as per the format approved by the Engineer-in-charge /Consultant.
 - (d.) The Contractor shall prepare Weekly Reports of planned and actual progress of work and subsequent week's scheduled work. These will also include material procurement status. These reports shall be submitted to the Engineer-in-charge /Consultant & shall be reviewed in Weekly Co-ordination Meetings.
 - (e.) The Contractor shall file daily category-wise labour report to the Engineer-in- charge / Consultant. The report shall indicate scheduled requirement against actual strength.
 - (f.) The contractor shall maintain daily weather record. Daily maximum and minimum temperature and corresponding, humidity shall be recorded and charted. Rainy days shall be recorded when the rain lasting more than one hour hampers the work. Any other inclemency in weather shall be recorded. The records shall be regularly shown to the Engineer-in-charge /Consultant and his signature obtained.
- 34.** Every care has been made to include all the aspects/ terms and condition in these documents. However, during execution, if any issue arises, which has not been included in these documents then standard norms / rules & regulations/ terms & conditions as prevalent in CPWD shall be followed which shall be binding on both the parties.

35. Technical Examination

The Client/ Engineer-In-Charge/ Consultant shall have the right to cause Audit and Technical Examination of the works and the final bills of the contractor including all supporting vouchers, abstracts, etc. to be made as per payments of the final bill and if as a result of such Audit and Technical Examination the sum is found to have been overpaid in respect of any work done by the contractor under the contract and found not to have been executed, the contractor shall be liable to refund the amount of over payment and it shall be lawful for the Client/ Engineer-in-charge/ Consultant to recover the same from the security deposit or Performance Security of the contractor or from any dues payable to the contractor. If it is found that the contractor was paid less than what was due to him under the contractor in respect of any work executed by him under it, the amount of such under payment shall be duly paid. The work comes under the

purview of CVC and as such all orders and instructions are applicable to this work.

In the case of any audit examination and recovery consequent on the same the contractor shall be given an opportunity to explain his case and the decision of the Client shall be final. Payment on this account will be recovered from the contractor.

In the case of Technical Audit, consequent upon which there is a recovery from the contractor, recovery shall be made with orders of the Client whose decision shall be final. All action under this clause shall be initiated and intimated to the contractor within the period of twelve months from the date of completion.

36. Miscellaneous

(a.) Safety Regulations

Contractor shall be fully responsible for the safety of his Employees / Visitors / Contract Labour / Sub-Contractors Labour. The Contractor shall provide first-aid box readily available at site. The Contractor shall provide all safety measures as per labour safety rules applicable

(b.) Labour Laws

The Contractor shall strictly adhere to all labour laws prevailing in the region. The contractor shall make timely payment of wages of his labour and the wages paid to the labour shall be equal to or more than the minimum wage prevailing at the time of payment. The Contractor shall comply with all applicable labour legislation, maintain labour records including payment made to the workers and obtain licence for engaging workers for the work as required under the labour laws.

(c.) By-Laws of Statutory Authorities

The Contractor and his labour shall not violate municipal /sanitation /health or any other byelaws.

(d.) Tax Deduction at Source

All Taxes and surcharge as applicable on date shall be deducted from the amount due to the Contractor towards the value of the work done. TDS certificate thereof shall be issued to the Contractor.

(e.) General Lighting and Securities

The Contractor shall, throughout the execution, completion and remedying of the defects, provide and maintain at his own cost all lights, guards, fencing, warning signs and watch post, when and where necessary or directed by the Engineer-in-charge / Consultant or by any duly constituted authority for the protect for the safety and convenience of the workers / public / or others.

(f.) Delay in starting the work

No compensation shall be allowed for any delay caused in the starting of the work on account of acquisition of land, encroachment or in the case of clearance of works, on account of any delay in according sanction to estimates in issue of drawings, decisions etc. However, the extension of time shall be granted as per relevant conditions of Contract.

(g.) Site instruction book

For the purpose of quick communication between Engineer-in- charge / Consultant and

the Contractor or his representative, site instruction book shall be maintained at site as described below:

Any communication, relating the works may be conveyed through instructions in the site instruction book. Such a communication from Engineer-in-charge / Consultant to the Contractor shall be deemed to have been adequately served in terms of the contract once the entries are made and signed by the authorised representative of the contractor. For this purpose the contractor should authorise one of his employees on the site instruction book itself. Site instruction book shall have machine numbered pages and shall be carefully maintained and remain under custody of Engineer-in-charge / Consultant/Client the contractor can also avail of the site instructions book for urgent communication with Engineer-in-charge/ Consultant. Any instruction which Engineer-in-charge / Consultant may like to issue to the Contractor may be recorded by the Engineer-in-charge / Consultant in site instruction book.

(h.) Signage

The Contractor shall provide at his own cost, a sign board at directed location having overall size 2 meters by 4 meters indicating name of the project, and a three-D view of the project, as approved by Engineer-In-Charge/Consultant. The signboard will be illuminated during night.

- (i.) **Cutting of Trees** Permission for cutting of trees if required will be obtained by Client from the concerned authority
- (j.) The contractor shall have adequate generators of required capacity as per site requirement as stand by arrangement.
- (k.) The temporary connection for electric line and water line from local authorities shall be taken by the contractor who will bear the expenditures
- (l.) No idling charges or compensation shall be paid for idling of the contractor's labour, staff or P&M etc. on any ground or due to any reason whatsoever.
- (m.) The Contractor shall mobilize and employ sufficient resources for completion of all the works within the stipulated time period as per agreement and as indicated in the approved Bar Chart/ Network. No additional payment will be made to the contractor for any multiple shift work or other incentive methods contemplated by him in his work schedule even though the time schedule is approved by Engineer-in-charge /Consultant.

37. Co-ordination Meetings

The Contractor shall be required to attend co-ordination meetings with the Engineer-in-charge / Consultant / Client and the other Contractors during the period of Contract as intimated by the Engineer-in-charge / Consultant / Client. All costs incidental to such interaction shall be to the Contractor's account and no claim will be entertained by the Engineer-in-charge / Consultant / Client on this account.

38. Site Management:

(a) Contractor's Working Area

Suitable working space will be provided by the Engineer-in-charge/Consultant /Client to the Contractor as per site conditions and availability. The Contractor may have to carry out some cutting / filling work for making this area workable. The cost of all such Works shall be deemed to have been included in the contract price quoted for the Works and no payment shall be made on this account.

Before commencement of the work, the contractor shall obtain approval of the Engineer-in-charge the location of cement godown, steel stacking and fabrication yard, site office and shall from time to time take instructions from the Engineer – in- charge regarding collection and stacking of materials at the site.

No excavated earth or building material shall be stacked on areas where other buildings, roads, services or compound wall or any other structure are to be constructed.

(b) Contractor's Temporary Structures

The Contractor may, at his own expense and subject to the approval of the Engineer-in-charge / Consultant /Client and statutory authorities, construct temporary structures for its site office, stores; Workshop etc. in the working area allocated to him as above and remove the same on completion of Works. The Contractor shall furnish such details of his Temporary Works as may be called for by the Engineer-in-charge/Consultant /Client and the Contractor shall satisfy the Engineer-in-charge/Consultant as to their structural safety. Temporary structures, found unsafe or inefficient shall be removed and replaced in a satisfactory manner.

(c) Contractor's Labour Camp

The Contractor shall make arrangements at his own expense for labour camp / accommodation for labour and staff to be employed for execution of the work and their conveyance to Site. No workers/ staff shall be allowed to stay within the Site except with the specific approval of the Engineer-in-charge/Consultant /Client. Proper ID Cards shall be got approved /authorized by the contractor from the Engineer-in-charge/ Consultant / Client to authorise the Contractor's staff and workers to enter the Site.

(d) Procurement of Various Materials

The Engineer-in-charge/Consultant / Client will not supply any materials required for execution of the Works under this Contract. The Contractor must, therefore, make his own arrangements for timely procurement of various materials including steel and cement. Prior approval of each and every material including steel cement, aggregate, bricks etc or any other fittings & fixtures shall be taken by the contractor from the Engineer-in-charge / Consultant. Samples for all the materials to be used in the work shall be got approved from Engineer-in-charge /Consultant before their bulk procurement. Samples approved shall be kept in the sample room till the completion of the work. However in case of delay in procurement of various materials by the contractor resulting into likely delay in completion of work, the Engineer-in-charge /Consultant /Client may procure the required materials directly and the cost of the same will be recovered from the contractor.

(e) Water Supply & Power Supply

The Contractor shall make his own arrangement for water supply at Site for drinking as well as construction purposes & Power Supply at his own cost. Non-availability of power supply and /or water from whatever source shall not entail any additional claims or extension of Contract period in this account.

(f) Site office

The contractor at his own cost shall provide a reasonably furnished site office of area 150 Sqm (approx.) having, a sample room, A.C meeting room, staff rooms along with toilets & pantry with file storage facility, computers (2 Nos.),Broad band (2 Nos.) and printers (2 Nos.) with their consumables, a telephone for the Engineer-in-charge and his site staff. Electricity & drinking water will be provided by the contractor free of cost.

(g) Temporary Fencing

The Contractor shall at his own expense, erect and maintain in good condition temporary fence all around the working area as per directions of the Engineer-in-charge / Consultant

(h) The contractor shall make, till completion of the project arrangements for/of:

- i. Proper pumping for removing water from the basement or elsewhere at site.
- ii. Proper security, safety, transportation, manpower, lighting arrangement for execution of works at night.
- iii. Tower crane, batching plant and others machinery, tools and tackles required for timely execution of work.
- iv. Proper barricading around site so that surrounding area is made free from disturbances. The specifications of barricading shall be got approved by Engineer-in-charge / Consultant. External face of barricading to display name of Client, Consultant & Engineer-in-charge. No sign board of contractor is allowed unless permitted by the Engineer-in-charge in writing.
- v. Diversion of underground services with the approval of Engineer-in-charge.

(i) Restriction in work areas.

- (a). The contractor must see the site of the work, its approaches carefully before tendering, No claim of any sort shall be entertained on account of any site conditions. If any approach from main road is required or existing approach is to be improved and maintained, for cartage and materials by the contractor, the same shall be done by the contractor his own cost.
- (b). Some restrictions may be imposed by the Hospital authorities or its security staff etc. On the working and/or movement of labour, materials etc. The contractor shall follow all such restrictions / instructions and nothing shall be payable on this account.
- (c). In case the contractor is not permitted to erect the huts for labour at the site of work, the contractor will have to make his own arrangement to provide such accommodation elsewhere and nothing extra shall be paid for this.
- (d). The contractor shall obtain approval of the Hospital authorities to erect the hutments for labour etc. at the site of work; denial of approval shall not affect the construction activities.
- (e). The contractor shall take all precautions to avoid accidents by exhibiting necessary caution boards such as day and night boards, speed limit boards, red lights and providing barriers. He shall be responsible for all damages and accidents caused due to negligence on his part. No hindrance shall be caused to traffic during the execution of the work.

39. Payment of water charges in connection with water used for construction purpose and for drinking purpose by the contractor's labour.

Both the water charges (if any) incidents to water used by the Contractor for construction purpose and for the drinking purpose for his labours residing in the site of work shall be borne by the Contractor / agency under the following cases:

- i. In case of temporary water connections from municipal mains: - Water charges (including the water used for construction purpose and drinking purpose of the contractor's labours) have to be borne by the contractor / agency.
- ii. Water used from other source: - Prior permission for using the water for construction purpose and drinking purpose of the contractor's labours has to be obtained from

Municipal Corporation / local body by the contractor / agency. Water charges if any and other charges for use of water from other sources for construction purposes/for drinking purposes of the contractor's labours have to be borne by the contractor / agency.

- iii. Any infringement and / or breach of the above shall render the contractor liable to action under various clauses of the contract and such actions stipulated in the conditions therein.

40. Statutory Requirements/ Approvals

The Contractor shall be responsible for obtaining approval from local electrical inspector, Lifts authority & water & Sewer line connection, tree cuttings, permission for bore well and for temporary structures etc. from local Authorities. All the statutory expenditure incurred towards payment to the local bodies for getting local Electric inspector, sewer line and water supply connection for Client/ Engineer-in-charge /Consultant will be reimbursed on the production of proof of payment. Contractor will be extended all assistance in this connection by the Engineer-in-charge /Consultant/ client.

The Contractor shall obtain all necessary approvals from Municipal and other local bodies including Municipal bodies, Water supply agencies concerned, Electric Supply and inspectorate. Agencies concerned, Police and Security Agencies, Chief Controller of Explosives, Fire Department, Civil Aviation Department, concerned in accordance to prevailing rules, Building Bye-Laws etc., as the case may be with related to Construction/ Completion. All expenditure on this account will be borne by the contractor. However the fees paid by the contractor to these statutory authorities only for obtaining the required statutory approvals shall be reimbursed by the Client on submission of valid payment receipts from these statutory authorities.

The approvals shall include the **following in addition to any other approval which may be required for the project.**

- Construction Permit if required
- NOC from Chief Fire Officer
- NOC from Lift Inspector where lifts are provided
- Occupancy certificate

The Engineer-in-charge/Consultant /Client may, at the written request of the Contractor, assist him in obtaining the approvals from relevant authorities. However any such request by the Contractor shall not bind the Engineer-in-charge/Consultant /Client in any manner.

41. Compliance of Statutory Obligations for obtaining completion Certificates:

The Contractor shall comply all the statutory obligations and obtain all required clearances to implement the project without any financial repercussions to Engineer-in-charge /Consultant /client and ensure all follow up actions with the local authorities in this respect for smooth completion of the project. All statutory charges to get any NOC, clearances from local authorities shall be reimbursed by the Engineer-in-charge /Consultant / client after submission of the bills/documentary evidences by the contractor. The contractor shall assist the client/Engineer-in-charge /Consultant to obtain all NOC, completion & Occupancy certificates from respective local bodies and other statutory authorities as under:

- i) Pollution control Board,

- ii) Environment clearances,
- iii) NOC from fire department,
- iv) Lift licence,
- v) Chief Electrical Inspector CEA,
- vi) Local Municipal authority/South Delhi Municipal Corporation etc.
- vii) Airport Authority,
- viii) Forest Department for Tree cutting etc.,
- ix) Explosive department,
- x) Delhi Jal Board / Local Municipal authority for water and sewer connection,
- xi) And any other statutory requirement for execution of work and to occupy the buildings and run the services in all respects.

Contractor shall organise all inspections of concerned authorities & obtain the NOC's within the time for completion.

The contractor is required to submit the relevant drawings like completion Drawings and any other statutory documentary requirements of local bodies in copies as per requirement to obtain the above etc. at their own cost.

ADDITIONAL CONDITIONS OF CONTRACT AND SPECIFICATIONS

(A) RELATING TO CIVIL, ELECTRICAL, PLUMBING & FIRE FIGHTING WORKS, HVAC WORKS, LIFTS AND GRIHA RATING SYSTEM

1.0 General

1.1 The following Additional Conditions and specification shall be read in conjunction with General Conditions of Contract and Specific Conditions of Contract. If there are any provisions in these Additional Conditions of Contract & specifications which are at variance with the provisions in the above mentioned documents, the provisions in these Additional Conditions of Contract & specifications shall take precedence.

1.2 Rates: -

1.2.1 The quoted rates shall be for complete items of work i.e. inclusive of material, labour, plant and machinery, tools and tackles, batching plant etc. including water & electricity, overheads charges, all taxes, statutory charges / levies applicable from time to time and others as specified etc, incidental works and all other charges for items contingent to the work, such as, packing, forwarding, insurance, freight and delivery at Site, watch and ward of all materials & successful installation, testing & commissioning at site etc.

1.2.2 The rate of all items of work, shall, unless clearly specified otherwise include cost of all labour, materials and all other inputs required in the execution of the item, including octroi, sales tax and any other taxes.

1.2.3 Unless otherwise specified in the schedule of quantities, the rate tendered by the contractor shall be all inclusive and shall apply to all heights, lifts, leads and depth of the building and nothing extra shall be payable to him on any account.

1.2.4 The rates for items of work wherein cement is used are inclusive of cost for curing

1.2.5 Royalty at the prevalent rates whenever payable shall have to be borne by the contractor on the boulders, metal, shingle, sand and bajri etc. Or any other materials collected by him for the work direct to the revenue authority of the District / state Government concerned and nothing extra shall be payable on this account

2.0 The work shall be carried out in conformity with the relevant drawings and the requirement of architectural, electrical, structural, and other specialised service drawings approved by Engineer-in-charge/Consultant.

The Contractor shall make provision of hangers, sleeves, structural openings and other requirements during construction to avoid holding up progress of the construction schedule. The Contractor should ensure that the structure is designed for additional loads or cut outs. Subsequent Cutting holes in the RCC structural members /slab shall not be allowed.

The contract items comprises of furnishing of all materials, equipment, labour & transportation etc. necessary to render the installation / item fully operational as per the intent of specification and drawings, including any necessary adjustment or corrections. Further the installation / item shall be in conformity with local laws and manufacturer instructions applicable.

3.0 Contract Drawings

3.1 The drawings issued with the Bid are diagrammatic only and indicate the extent and

general arrangement of the installation. Drawings shall not be scaled.

- 3.2 The Contractor shall follow the Bid drawings for preparation of his detailed sanitary, plumbing & fire fighting & Shop drawings and for subsequent installation work and also cross check the drawings of other services to avoid subsequent complications in inter services. Any discrepancies observed should be immediately brought into the notice of Engineer-in-charge/Consultant and clarifications obtained. No changes from approved plans shall be made without prior approval of the Engineer-in-charge.

4 Shop Drawings

- 4.1 The Contractor shall furnish for approval of the Engineer-in-charge/Consultant three sets of detailed sanitary, plumbing, fire fighting (external & internal), Pump room & Shop drawings of all equipment and materials required to complete the work as per specifications well in advance. These drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics, and capacity of all items of equipment, as also the details of all related items of work of other trades. All shop drawings to be made in accordance with latest fire safety norms and building codes.
- 4.2 All drawings necessary for assembly, erection, maintenance, repair and operation of the equipment shall be furnished and different parts shall be suitably numbered for identification and ordering of spare parts.
- 4.3 For any amendments proposed by Engineer-in-charge / Consultant in the above drawings, the Contractor shall supply fresh sets of drawings with the amendments duly incorporated, along with the drawings on which corrections were indicated.
- 4.4 No material or equipment may be brought at Site until the Contractor has the approved Shop drawings for that particular material or equipment.
- 4.5 After approval of the drawings by the Engineer-in-charge / Consultant, the Contractor shall further furnish six sets of Shop drawings for the exclusive use of and retention by the Engineer-in-charge/Consultant /Client.
- 4.6 Approval of drawings by the Engineer-in-charge/Consultant shall not relieve the Contractor of any obligation to meet all the requirements of the Contract or of the correctness of his drawings. The Engineer's approval of specific item shall not mean the approval of the assembly of which it is a component. The Contractor shall be responsible for and is to bear the cost for all alternations of the works due to discrepancies or omission in the drawings or other particulars supplied by him, whether such drawings have been approved by the Engineer-in-charge/ Consultant or not.
- 4.7 Where the work of the Contractor has to be installed in close proximity to, or will interfere with the work of other trades, the Contractor shall assist in working out the space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections to a suitable scale not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, and it is cause for any interference with the work of other trades, he shall make all the necessary changes without extra cost.
- 4.8 All shop drawings and detail drawings will be made as per requirements of local authorities and tender drawings incorporating all latest regulations and requirements. No separate drawings will be, issued for making shop drawings.

5 Samples and Catalogues

5.1 Prior to ordering any equipment/ material/ system, the Contractor shall submit to the Engineer-in-charge/ Consultant the catalogues, along with samples from approved list of manufacturers. No material shall be procured without written approval of the Engineer-in-charge / Consultant.

5.2 Approval of Materials

All materials used on the Works shall be new and of the best quality and make available, conforming to the relevant specifications of the contract. Prior approval shall be obtained in writing from the Engineer-in-charge/Consultant for all materials proposed and when necessary, approved samples duly identified and labelled shall be deposited with the Engineer-in-charge/ Consultant and shall be kept in the sample room at Site. List of approved make indicates make / manufacturer generally acceptability. Final choice of make / manufacturer of material & models shall be with the Engineer-in-charge /Consultant.

6 Material and Equipment

6.1 All material and equipment shall conform to the relevant Indian Standards and bear IS marking where ever applicable.

6.2 Where interfacing is involved, both equipments shall be mutually compatible in all respects.

6.3 Where an item of equipment, other than as specified or detailed on the drawings, is approved by Engineer-in-charge/ Consultant, requires any re-design of the structure, partitions, foundation, piping, writing or any other part of the mechanical, electrical or architectural layout, all such re-design, and all new drawings and detailing required therefore, shall be prepared by the Contractor at his own expense and approval obtained by the Engineer.

6.4 All similar equipment, materials, removable parts of similar equipment etc. shall be inter-changeable with one another.

6.5 Approved makes for materials and vendor list

The contractor shall procure materials from vendors as mentioned in the vendor lists enclosed. In case a material is not available from any of the vendors in the enclosed vendor lists, the contractor may intimate and submit details of source from where, the contractor wishes to procure the material, along with complete details and the particular material shall be got approved from the Engineer - in- Charge before procurement.

7 Procurement of Cement and Steel

The **procurement** of Cement and Reinforcement Steel, and, their issue and consumption shall be governed as per conditions laid down hereunder.

7.1 Cement

7.1.1 The contractor shall procure 43 grade Ordinary Portland cement conforming to IS 8112 / Portlant Pozzolana Cement conforming to IS 1489 (Part I) as required in the work, from manufacturers as per list of approved makes.

7.1.2 In case the cement is not available from manufacturers as per list of approved makes, the tenderers may submit a list of names of cement manufacturers from which they propose to use in the work. Such manufacturers of cement should be

having a production capacity not less than one million tonnes or more per annum, such as ACC, UltraTech, J.P.Rewa, Vikram, Shri Cement, AMBUJA, Japee Cement, Century Cement & J.K. or from any other reputed manufacturer having a production capacity not less than one million tonnes as approved by the Engineer-in-charge.

- 7.1.3 The tender accepting authority reserves right to accept or reject name(s) of cement manufacturer(s) which the tenderer proposes to use in the work. No change in the tendered rates will be accepted if the tender accepting authority does not accept the list of cement manufacturers, given by the tenderer, fully or partially.
- 7.1.4 The supply of cement shall be taken in 50 kg. bags bearing manufacturer's name and ISI marking. Samples of cement arranged by the contractor shall be taken by the Engineer-in-charge and got tested in accordance with provisions of relevant BIS codes. In case the test results indicate that the cement arranged by the contractor does not conform to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the contractor at his own cost within a week's time of written order from the Engineer-in-charge to do so.
- 7.1.5 The Cement shall be brought at site in bulk supply of approximately 50 tonnes or as decided by the Engineer-in-Charge
- 7.1.6 The cement godown of the capacity to store about 2000 bags of cement or as decided by the Engineer-in-Charge shall be constructed by the contractor at site of work for which no extra payment shall be made. Double lock provision shall be made to the door of the cement godown. The keys of one lock shall remain with the Engineer-in-Charge or his authorized representative and the key of other lock shall remain with the contractor. The contractor shall facilitate the inspection of the cement godown by the Engineer-in-Charge at any time.
- 7.1.7 The contractor shall supply free of charge the cement required for testing including its transportation to testing laboratories. The cost of tests shall be borne by the contractor.

7.2 Steel

- 7.2.1 The contractor shall procure TMT bars of Fe415/Fe415D/Fe500/Fe550/Fe550D grade (the grade as per BOQ) from manufacturers as per list of approved makes.
- 7.2.2 The grade of the steel such as **Fe 415/Fe 415D/Fe 500/Fe500 D/Fe 550 / Fe 550 D** or other grade (the grade as per BOQ) to be procured is to be specified as per BIS 1786-2008. The TMT bars procured from Primary producers shall conform to manufacturer's specifications.
- 7.2.3 The contractor shall have to obtain and furnish test certificates to the Engineer-in-charge in respect of all supplies of steel brought by him to the site of work.
- 7.2.4 Samples shall also be taken and got tested by the Engineer-in-Charge as per the provisions in this regard in relevant BIS codes such as IS 1786: 2008. In case the test results indicate that the steel arranged by the contractor does not conform to the specifications as defined above, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his cost within a week time or written orders from the Engineer-in-Charge to do so.
- 7.2.5 The steel reinforcement bars shall be brought to the site in bulk supply of 10 tonnes or more, or as decided by the Engineer-in-charge.

7.2.6 The steel reinforcement bars shall be stored by the contractor at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.

7.2.7 For checking nominal mass, tensile strength, bend test, re-bend test etc. specimens of sufficient length shall be cut from each size of the bar at random, and at frequency not less than that specified below:

<i>Size of bar</i>	<i>For consignment below 100 tonnes</i>	<i>For consignment above 100 tonnes</i>
Under 10 mm dia bars	One sample for each 25 tonnes or part thereof	One sample for each 40 tonnes or part thereof
10 mm to 16 mm dia bars	One sample for each 35 tonnes or part thereof	One sample for each 45 tonnes or part thereof
Over 16 mm dia bars	One sample for each 45 tonnes or part thereof	One sample for each 50 tonnes or part thereof

7.2.8 The contractor shall supply free of charge the steel required for testing including its transportation to testing laboratories. The cost of tests shall be borne by the contractor.

7.2.9 The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible variations recovery at the rate so prescribed shall be made. In case of excess consumption no adjustment need to be made.

7.2.10 The steel brought to site and the steel remaining unused shall not be removed from site without the written permission of the Engineer-in-charge.

7.2.11 Coefficient of weight i.e. the weight per unit length of the steel procured by the contractor shall be ascertained at site before using it and certified by the Engineer-In-Charge. In case weight per unit length is beyond the rolling margin as laid down in the BIS: 1786, the steel will be rejected and shall be removed from the site of work within; a weeks' time from written order from the Engineer-in-Charge to do so. In case weight per unit length is more than the standard coefficient of weight for the diameter, but is within the rolling margin, then the payment shall be made as per the standard weight per unit length, and, where the weight per unit length is lesser than the standard coefficient of weight for the diameter, but is within the rolling margin, the payment shall be restricted with respect to the actual weight per unit length of the diameter.

7.3 The actual issue and consumption of steel and Cement on the work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by conditions laid therein.

7.4 Steel and Cement brought to site and remaining unused shall not be removed from site without the written permission of the Engineer-In-Charge.

7.5 No payment shall be made to the contractor for any damage caused during the execution of work because of cause(s) not covered under Clause 43 of the Contract. The damage to

work will be made good by the contractor at his own cost, and no claim on this account shall be entertained.

7.6 The Contractor shall maintain safe custody of materials brought to the site. The Contractor shall also employ necessary watch and ward establishment for the work and other purposes as required at his own cost.

7.7 For Cement and Steel and other materials, as prescribed, the quantities brought at site shall be entered in the respective material at site accounts and shall be treated as issued for maintenance of daily consumption.

8 Conformity with Statutory Acts, Rules and Standards

8.1 The installation shall be in conformity with the Bye-laws Regulations and Standards of the local authorities applicable to the installations. But if the specifications and drawings call for a higher standard of materials and/or workmanship than those required by any of the above regulations and those required by any of the above regulations and standards, then the specifications and drawings shall take precedence over the said Regulations and Standards.

8.2 However, if the drawings or specifications required something, which violates the Byelaws and Regulations, then the Bye-laws and Regulations shall govern the requirement of such installation/drawings.

8.3 Indian Standards: The System / Components shall conform to relevant Indian standards wherever they exist and to the National Building Code Amended up to date.

8.4 Nothing in these Specifications shall be construed to relieve the contractor of his responsibility for the design, Manufacture and installation of equipment with all its accessories in accordance with applicable statutory regulations and safety codes in force.

9 Manufacturer's Instructions

Where manufacturers have furnished specific instructions relating to the materials and equipment used, covering points not specifically mentioned in these documents, manufacture's instructions shall be followed with the approval of Engineer-in-charge.

10 Training and Operating Instructions

10.1 If required by the Engineer-in-charge / Consultant, the Contractor shall at his cost, train members of the maintenance staff either at his or the subcontractor's workshop or at such other place or places as may be considered suitable by the Engineer-in-charge / Consultant.

10.2 Upon completion of all work and all tests, the Contractor shall furnish the necessary skilled labour and helpers for operating the entire installation for a period of fifteen (15) working days. During this period, the Contractor shall instruct and train the Engineer-in-charge /Consultant/ client representative in operation, adjustments and maintenance of the equipment installed.

10.3 The Contractor shall submit to the Engineer-in-charge /Consultant draft comprehensive operating instructions and maintenance schedule for all systems and equipment included in this Contract. This shall be supplemented, not substituted, by manufacturer's operating and maintenance manuals. Upon approval of the draft, the Contractor shall submit to the Engineer-in-charge/Consultant four (4) complete bound sets of operating and maintenance schedules along with manufacturers printed literature.

11 Inspection and Testing

- 11.1 The Engineer-in-charge / Consultant reserve the right to request inspection and testing at manufacturer's Works at all reasonable times during manufacture of items for this Contract.
- 11.2 The Engineer-in-charge / Consultant or his authorised representative shall have full power to inspect the materials and workmanship at the Contractor's Works or at any place from which the materials or equipment is obtained. Approval by the Engineer-in-charge /Consultant of any material or equipment shall in no way relieve the Contractor of his responsibility for meeting the requirements of the specifications. All incident expenditure like travelling, boarding and lodging etc shall be born by the contractor.
- 11.3 Routine and typical tests for the various items of equipment shall be performed at the Contractor's Workshop in the presence of Engineer-in-charge/Consultant or his authorised representative, results recorded and test certificates issued.
- 11.4 After installation has been virtually completed, the Contractor shall carry out under the direction and in the presence of the representative of the Engineer-in-charge such tests and inspections as have been specified, or as considered necessary to determine whether or not the requirements of the item, drawings and specifications have been fulfilled. In case the work does not meet the full intent of the drawings and specifications and further tests after making require changes and as considered necessary shall be done again, the Contractor shall carry them out and bear the expenses thereof. If test fail to demonstrate the satisfactory nature of the installation or any part thereof, then no claims for the extra cost of modifications, replacement or retesting will be considered. The decision of the Engineer shall be regarded as final as to what constitutes a satisfactory test.
- 11.5 The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere
- 11.6 The Contractor shall provide all necessary instruments such as Theodolite, Dumpy level, steel tapes, weighing machine, plumb bobs, spirit levels, hammers, micro-meters, thermometers, hydraulic cube testing machine, smoke test machine and labour for conducting tests. All such equipments shall be tested for calibration by an approved laboratory. The Contractor shall make adequate records of the test procedures, readings and results to be maintained by the Engineer-in-charge/Consultant who shall issue test certificates signed by the person authorised by him.

12 Test Certificates

The contractor shall submit test certificates for all the materials / systems issued by government recognized inspection / office / manufacturer certifying the Equipment / Materials / installation and its function are in agreement with the requirements of relevant specification and accepted standards.

13 Guarantee of Performance

It is clearly understood that the specifications, drawings, schedule of quantities are for bidder's guidance only. The bidder shall carry out necessary calculation and provide alternative equipment required to achieve the specified level of fire fighting required for human safety. Complete sets of Architectural Drawings shall be available at site in the Engineer-in-charge / Consultant office and reference may be made to these drawings as required for calculations or for other details. The contractor shall also guarantee that performance of various equipments, individually, shall not be less than, the specified ratings.

14 Quiet Operation and Vibration

All equipments shall operate under all conditions of designed load without any sound or vibration, which is considered objectionable by the Engineer-in-charge. Such conditions shall be corrected by the Contractor at his own expense. Decision of the Engineer-in-charge / Consultant shall be final in this regard.

15 Accessibility

The Contractor shall locate all equipment, which require servicing, operation or regular maintenance in a fully accessible positions. The exact location and size of access panels, required for each valve or other devices requiring attendance, shall be finalised and communicated to Engineer - in- Charge well in time, to facilitate working by other agencies, failing this, the Contractor shall make all the necessary repairs and changes at his own expense.

16 Handing over & Taking over process

For handing over & taking over process, in addition to clauses specified elsewhere, following services / works have to be complied with by the main contractor:

- a. Submission of Guarantees in stamp paper, of appropriate value, (format approved by Engineer-in-charge/ Consultant) for all water proofing treatment executed in the works for a period of ten years. If any defects noticed within 10 years from completion of defect liability period the main contractor shall be sole responsible for the defects and same shall be rectified by the main contractor as per information from client within a period of 10 days from the notice.
- b. Rectification of all defects shall be carried out by the main contractor before Handing over/ Taking over process.
- c. As built drawings : - **4** (four) sets for Architectural, Structural, Plumbing, Electrical, HVAC system, Specialised services and other required drawings as approved by Engineer-in-charge / Consultant shall be submitted by the main contractor before handing over & taking over process.
- d. All services/equipments to be run and check before handing over & taking over process as per requirements of Engineer-in-charge/Consultant.
- e. Contractor has to arrange water, electricity, fuel , consumables and manpower at their own cost for the purpose of testing of services and equipments. No amount shall be payable on this account.
- f. Main contractor shall submit catalogues, brochures, operation manual, manufacturer test certificate, Guaranty/ Warranty papers, licence etc for all equipments /materials before handing over & taking over process.

(B) RELATING TO CIVIL WORKS

- (i) All concrete work will be strictly done by automatic computerized batching plant of suitable capacity installed at site or RMC as per approval of Engineer-in-Charge / HLL. No concrete work will be permitted without automatic batching plant unless specifically approved in writing by Engineer-in-Charge / HLL. Transportation of the mix concrete shall be through transit mixers and concrete pumped through suitable concrete pumps and pipes arrangement and vibrated by vibration machines, materials lifts shall also be provided at site as and where required.
- (ii) All operation required for continuing concreting work at the construction joints for

better bond are deemed to be included in the rates of the relevant items and nothing extra shall be payable on this account.

- (iii) **Mix Design of Concrete:-** The contractor shall carry out the mix design for the relevant item of concrete from a reputed institution / laboratories as approved by Engineer-in-charge / Consultant at his own expenses within 15 days from notification of award. Samples of materials (i.e. Cement, Coarse & fine aggregates) shall be jointly sealed jointly by Engineer-in-charge /Consultant and contractor before sending the same for Mix design. The design mix may be with or without admixtures as per specifications /requirements at site.

(iv) **Ready Mixed Concrete**

- a. The rate for the item of Ready Mixed Concrete shall be inclusive of all the ingredients including admixtures if required, labour, machine T&P etc (except shuttering which will be measured & paid for separately) required for design mix concrete of required strength and workability.
- b. The rate quoted by the agency shall be net & nothing extra shall be payable in account of change in quantities of concrete ingredients like cement and aggregates and admixtures etc. in the approved mix design.

- (v) Reinforcement Steel conforming to BIS specifications (latest edition) shall be procured directly from main manufacturers or their authorised dealers as per the approved list provided in the agreement. The manufacturer has to give a certificate that the material supplied is not a re-rolled product. Relevant vouchers & test certificates will be produced by the contractor. Re-rolled sections will not be allowed. Reinforcement steel, structural steel shall be stored and stacked in such manner so as to facilitate easy identification, removal etc. The contractor shall take proper care to prevent direct contact between the steel and the ground/ water for which he shall provide necessary arrangement at his own cost including ensuring proper drainage of area to prevent water logging as per directions of the Engineer-in- charge/Consultant. Steel shall also be protected, by applying a coat of neat cement slurry over the bars for which no extra payment shall be made. Test certificates for each consignment of steel shall be furnished and further tests shall be got carried out from the authorized laboratory as per the directions of Engineer-in-charge /Consultant, before incorporating the materials in the work.

(vi) **Receipt and storage of materials:**

- a. **Cement bags** shall be stored in Godowns to be constructed by contractor at his own cost as per sketch of CPWD specifications with weather proof roofs and walls. Godown shall be provided with a single door with two locks. The keys of one lock shall remain with the authorized representatives and that of the other lock with the authorized agent of the contractor at the site of work so that the cement is removed from the godown according to the daily requirement with the knowledge of both the parties. Samples of fresh cement shall be got tested from lab. Only tested cement shall be allowed in the work, contractor shall bring cement keeping this in view to maintain progress of the work. No request for extension of time on this account shall be entertained.
- b. The contractor shall be fully responsible for the safe custody of the materials brought at site even if the materials are under double lock system.

- c. The contractor shall construct suitable godowns – yards at the location of the site of work duly approved by the Engineer – in – charge or his authorized representative for storing all other materials so as to be safe against damage by sun, rain, dampness, theft etc. at his own cost and employ necessary watch and ward establishment at his cost.
 - d. The contractor shall maintain and render proper account of all material brought by him to the site, consumed by him on the work and balance if any. In respect of steel reinforcement bars, theoretical consumption will be calculated diameter wise.
 - e. All material obtained from Government stores or otherwise shall be got checked by the Engineer in charge of the work on the receipt of the same before its use in the work.
- (vii) Marine plywood only or steel plates of minimum thickness as approved by Engineer-in-charge / Consultant shall be used for formwork. All shuttering material to be used at site will be new / just like new as approved by Engineer-in-charge/Consultant The shuttering plates shall be cleaned and oiled after every repetition and shall be used only after obtaining approval of Engineer's representative at site. The number of repetitions allowed for plywood and steel shuttering shall be at the discretion of Engineer-in- charge / Consultant depending upon the condition of shuttering surface after each use and the decision of Engineer-in-charge/ Consultant in this regard shall be final and binding on the contractor. No claim whatsoever on this account shall be admissible.
- (viii) Anti-termite treatment & waterproofing treatment:-
- a. The treatment against water-proofing of basement, roofs, water retaining areas and termite infestation shall be of type and specifications as given in the schedule of quantities and remain fully effective for a period of not less than 10 (Ten) years to be reckoned from the date of expiring of the Defect Liability period, prescribed in the contract. At any time during the said guarantee period if the Client Engineer-in-charge / Consultant or his representative finds any defects in the said treatment or any evidence of re-infestation, dampness, leakage in any part of buildings or structure and notifies the contractor of the same, the contractor shall be liable to rectify the defect or give re-treatment and shall commence the work or such rectification or re-treatment within seven days from the date of issue of such letter to him. If the contractor fails to commence such work within the stipulated period, the Client Engineer-in-charge /Consultant or his representative may get the same done by another agency at the Contractor's cost and risk and the decision of the Client/ Engineer-in-charge / Consultant for the cost payable by the contractor shall be final and binding upon him. Re-treatment if required shall be attended to and carried out by the Contractor within seven days of the notice from the client or his representative.
 - b. Water proofing and anti-termite treatment shall be got done through approved specialized agencies only with prior approval of the Engineer-in-charge / Consultant or his representative. During the execution of work, if any damage shall occur to the treatment already done, either due to rain or any other circumstances, the same shall be rectified and made good to the entire satisfaction of the client or his representative by the contractor at his costs and risks.

- c. The contractor shall submit a guarantee bond for the water proofing and anti-termite work executed under the contract in a format specified in the GCC. Further a security deposit amounting to 10% of the cost of these items as executed shall be retained for a period of 10 years with effect from actual date of actual completion of the work. 50% of the security deposit shall be released on successful completion of 5 years period and the balance shall be released on completion of 10 years.
- (ix) Records of Consumption of Cement & Steel –
- a. For the purpose of keeping a record of cement and steel received at site and consumed in works, the contractor shall maintain a properly bound register in the form approved by the Engineer-in-charge / Consultant, showing columns like quantity received and used in work and balance in hand etc. The contractor's representative shall sign this register daily.
 - b. The register of cement & steel shall be kept at site in the safe custody of Engineer-in-charge / Consultant during progress of the work. This provision will not, however, absolve the contractor from the quality of the final product.

C) RELATING TO ELECTRICAL WORKS & INSTALLATIONS

1.0 General

- i. The electrical installation shall be in total conformity with the control wiring drawings prepared by the Contractor and approved by the Engineer-in-charge & shall be connected and tested in the presence of an authorised representative of the Contractor and of the Engineer - in- Charge.
- ii. The responsibility for the sufficiency, adequacy and conformity to the Contract requirements of the electrical installation work lies solely with the Contractor.

2.0 Regulations and Standards

The installations shall conform in all respects to Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and as per latest CPWD General Specification for Electrical Works as mentioned in Schedule "F" of General Conditions of Contract. It shall also be in conformity with the current Indian Electricity Rules and regulations in so far as these are applicable to the installations. Wherever these Additional Specific Conditions call for a higher standard of material and/or workmanship than those required by any of the above regulations, then this Additional Specific Conditions shall take precedence over the said Regulation and Standards. External works & fire detection & alarm system works to be done as per CPWD specification & relevant BIS codes.

3.0 Completeness of Bid

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the Bid rates and prices, whether such items are specifically mentioned in the Bid documents or not.

4.0 Works to be done by the Contractor :-

Unless and otherwise mentioned in the Bid documents, the following works shall be done by the Contractor, and their cost shall be deemed to be included in the contract price:

- i. Foundations for equipment and components where required, including foundation bolts
- ii. Cutting and making good all damages caused during installation and restoring the same to their original finish
- iii. Sealing of all floor openings provided for pipes and cables, from fire safety point of view, after laying of the same
- iv. Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/ distribution gear items, cubicle switch board etc. damages during erection, shall however be rectified by the contractor.
- v. Testing and commissioning of complete installation

5.0 Completion Certificate by the licensed supervisor

On completion of the installation, a certificate shall be furnished to the Engineer-in-charge, by the Contractor, countersigned by the licensed supervisor under whose direct supervision the installation was carried out. This Certificate shall be in the prescribed form as required by the local authority. On the basis of this certificate, the Contractor shall arrange for inspection of installation by the concerned local authorities.

6.0 Completion Drawings

On completion of the work, the Contractor shall at his own cost submit to the Engineer-in-charge / Consultant 4 (four) sets of layout drawings drawn at the approved scale indicating the installation. These drawings shall clearly indicate the complete plant layouts, and piping layouts, location wiring, exact location of all the concealed piping, valves, controls, wiring and other services. The Contractor shall also submit 4 (four) sets of consolidated control diagrams, technical literature on all automatic controls and complete technical literature on all equipment and materials. The Contractor shall mount a set of all consolidated control diagrams and all piping diagrams in a frame with glass, and display in the plant room

7.0 Interrelationship of Services

The Contractor shall keep a check at all stages and supervise at the point of connection the associated civil, HVAC, electrical and plumbing works like underground and overhead tanks, power supply and installation of makeup water connection, drain connection in the fire fighting tanks and vicinity of plant room etc. In case of any discrepancy the same should be brought into the knowledge of Engineer-in-charge / Consultant in writing, all rectifications etc, required in future as a result of failure on the part of the contractor to do so, shall be carried out by the Contractor at his own expenses.

8.0 Check List

The Contractor shall provide to the Engineer-in-charge / Consultant 4 (four) copies of a comprehensive maintenance checklist and shall place a copy of it in the Plant Room. The checklist shall be a list of each piece of equipment in this Contract, and shall provide a space for record of maintenance provided and status of various equipment during the maintenance period. This list shall be updated every month at the time of inspection. The Contractor shall certify on this check list that he has examined each piece of equipment and that; it is operating as intended in the contract.

9.0 Repairs

All equipment that requires repairing shall be immediately serviced and repaired during the maintenance period. All spares/parts and labours shall be furnished by the contractor free of

cost.

10.0 Control System

During the maintenance period, the Contractor shall monthly check all controls in various areas to ensure that these are functioning satisfactorily. This shall apply to all pressure switches and pressure gauges, contacts, relays, controller switches, high and low pressure cut-outs etc.

11.0 Reference Points

Contractor shall provide permanent bench marks, flag tops and other reference points in consultation with Engineer-in-charge/Consultant for the proper execution of work and these shall be preserved till the completion of the work.

12.0 Licenses and Permits

- i. **Contractor** or the approved specialised agency engaged by them shall hold a valid plumbing, electrical, HVAC, Lifts, license issued by the Competent Authority under whose jurisdiction the work falls.
- ii. The contractor has to take all the approvals of local bodies for all the addition/deletion over the approved building plans which are to be given by the Engineer-in-charge/Consultant. The documents/drawings to be prepared and submitted in the manner desired by them after the same is approved by Engineer-in-charge /**Consultant**. Contractor has to take approvals of entire/Part works if required before start of works. Contractor will be responsible for any work at site carried out without approval of municipal or local bodies.
- iii. Contractor shall keep constant liaison with the competent Municipal or other authority and obtain approvals for all drainage and water supply works carried out by him.
- iv. Contractor shall obtain from the competent Municipal Authority completion certificates with respect to his work as required for occupation of the building.
- v. Any fees in connection with obtaining the approvals on behalf of the Client from the statutory bodies/Corporations/Government departments, etc. shall be paid by the Contractor and the same shall be reimbursed on production of original vouchers. Necessary endorsement / application if required shall be arranged from the Engineer-in-charge/Consultant/Client.
- vi. Before undertaking of works for HVAC, Lifts, Electrical, Anti Termite Treatment, Water proofing, Fire Fighting, Fire alarm system, PA system, EPABX System, Horticulture Works etc., the contractor must take approval of specialised agencies proposed to be engaged by him from Engineer-in-charge/Consultant.

13.0 Cutting of structural members

No structural member shall be chased or cut without the written permission of the Engineer-in- Charge/Consultant.

14.0 Operation and Running of entire system

The contractor shall ensure smooth operation & running of entire sanitary, HVAC , Lifts, plumbing and fire fighting system including pumps and RO plant, solar water heating system etc. for a minimum period of one month after satisfactory completion of work as desired by Engineer. Cost of such operation & running of entire system including required material e.g. fuel, consumables, tools & tackles, requisite manpower etc. shall be borne by the contractor

& deemed to be included in the contract price , nothing shall be paid on this account.

15.0 Regulations and Standards

The installations shall conform in all respects to Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and as per latest CPWD General Specification for Electrical Works as mentioned in Schedule “F” of General Conditions of Contract. It shall also be in conformity with the current Indian Electricity Rules and regulations in so far as these are applicable to the installations. Wherever these Additional Specific Conditions call for a higher standard of material and/or workmanship than those required by any of the above regulations, then this Additional Specific Conditions shall take precedence over the said Regulation and Standards. External works & fire detection & alarm system works to be done as per CPWD specification & relevant BIS codes.

16.0 Tools for Handling and Erection

All tools and tackles required for handling of equipments and materials at Site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the Contractor.

17.0 Drawings

The drawings indicate the extent and general arrangements of the fixtures, controlling switches, wiring system etc. and are essentially diagrammatic explanation. The drawings indicate the points of termination of conduit runs and broadly suggest the routes to be followed. The Contractor shall submit six sets of working electrical drawings based on tender drawing including reflected ceiling plan coordinating other essential building services for the Engineer-in-charge / Consultant's approval. Contractor has to make necessary changes if any as per comments given by Engineer-in-charge /Consultant before execution. The work shall be executed as indicated in the approved drawings, however any minor changes found essential to co-ordinate the installation of this work with the other trades shall be made in consultation with the Engineer-in-charge/Consultant.

The drawings are for guidance of the contractor and exact locations, distance and levels shall be governed by the building. The Contractor shall examine all architectural, structural, plumbing and sanitary & electrical drawings before starting the work any discrepancies noticed shall be reported to the Engineer-in-charge / Consultant for clarification. In case of failure to do so Contractor shall not be entitled to any cost for omissions or defects in electrical drawings due to any conflict with other services work.

18.0 Conduit/ Trunking Layout

Prior to the laying of the conduits and trunking, the Contractor shall examine/ study drawings and report to Engineer-in-charge/Consultant .If he desires to make any changes from Engineer-in-charge /Consultant proposed conduit layout plan and shall get the same approved from Engineer-in-charge /Consultant .

19.0 Shop Drawings

The Contractor shall prepare and submit to the Engineer-in-charge/Consultant for his approval detail shop drawings for Main & Sub Panels / Distribution Boards, Distribution Boards, special pull boxes, light & fan switch boards, telephone distribution boards, FDA system and lightning protection system and other equipment to be procured/ fabrication by the Contractor before 15 days of placing of the orders with manufacturers/suppliers.

20.0 Manufacturer's Instruction

Manufacturer instructions for approved products shall be followed in consultation with Engineer-in-charge/Consultant.

21.0 Materials & Equipment

All materials and equipment shall be ISI marked and shall be of the make and design approved by the Engineer-in-charge/Consultant . Unless otherwise called for, only the best Grade of materials and equipment shall be used. The Contractor shall be responsible for the safe custody of all materials and equipment till these are taken over by client and shall insure them against theft, damage by fire, earth quake etc. A list of items of materials and equipment, together with a sample of each shall be submitted to the Engineer-in-charge/Consultant for his approval and shall be kept in the sample box.

22.0 Scale

All drawings shall be prepared to the scale as required for proper explanation and shall indicate the size and location of all equipments and accessories therein. The Contractor shall follow all dimensions of approved architectural drawings for the work or part concerned and check proposed drawings for any interference with the building structure or other equipment or services.

23.0 Brochures and Data

The Contractor shall submit four copies of all brochures / manufacturer's description data, operation manuals with internal complete circuit diagrams and other similar literature while obtaining the approval of product Engineer-in-charge/Consultant.

24.0 Approval of Shop Drawings

The approval of shop drawings, schedule, brochures etc. by Engineer-in-charge / Consultant shall be an approval of general details and arrangements only and shall not relieve the Contractor from responsibility for any deviation from drawings or specifications unless he has in writing informed by Engineer-in-charge/Consultant of such deviations at the time of submission of the drawings nor shall it relieve the Contractor from any responsibility for errors or omissions of any kind in the shop drawings.

25.0 Samples & Catalogues

Contractor shall submit the samples & catalogue of the material, which are proposed to be used at Site as per the approved makes for obtaining approval of the by Engineer-in-charge/Consultant.

26.0 Approval of Materials

All materials used on the Works shall be new and of the best quality available, conforming to the relevant specifications. Prior approval shall be obtained in writing from the by Engineer-in-charge/Consultant for all materials proposed and when approved, sample shall be duly identified and labelled, it shall be deposited with the by Engineer-in-charge/Consultant and shall be kept in the sample's room at Site.

27.0 Inspection, Testing and Inspection Certificate

1. The Engineer-in-charge /Consultant and their authorised representative shall have at all reasonable times access to the Contractor's premises or Works and shall be at liberty to inspect and examine the materials and workmanship during its manufacture or erection even when they are being manufactured or assembled at other premises.
2. The Contractor shall arrange all the materials and labour required for inspection of

equipment or for any testing to be carried out at his/ manufacturer's works or at Site. Notice for such inspection/ presence for testing shall be given to the Engineer-in-charge / Consultant by the Contractor at least fifteen (15) days in advance together with the routine test certificates of the equipments/ materials given by the manufacturer.

3. Notwithstanding approval of tests or equipment by the by Engineer-in-charge/ Consultant, the Contractor shall be required to perform site tests and prove the correctness of ratings and performance of equipment / machinery and materials supplied and installed by the Contractor as per the Contract specifications and conditions. The Engineer-in-charge / Consultant shall also have the power to order the material or work to be tested by an independent agency at the Contractor's expense in order to prove soundness & adequacy.

28.0 Schedule & Manner of Operation

Time being the essence of this Contract, Contractor shall arrange for all required labour & material in sufficient quantities and at appropriate time, execute as per schedule for execution of work to meet the contract period requirement and so manage the operations that the work shall be completed in time as provided in the contract.

29.0 Performance Guarantee Certificates for Equipment

All equipment shall be guaranteed against unsatisfactory performance and/or break down for a minimum period of 12 (Twelve) months from the date of handing over of complete work to the by Client/ Engineer-in-charge/Consultant. The equipment or component or any other part of installation so found defective within the guarantee period shall be replaced / repaired by the Contractor free of cost to the satisfaction of the Client / Engineer-in-charge/Consultant. The above guarantee and/ or warrantee provided by the manufacturer will be submitted along with all the test certificates from manufacturer to Engineer-in-charge/Consultant.

30.0 Conformity with Statutory Acts, Rules and Standards

1. All installations shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities applicable them. But if the specifications and drawings call for a higher standard of material and/or workmanship than those required by any of the above Regulations and Standards, then the specifications and drawings provided in the contract shall take precedence over the said regulations and standards.
2. However, if the drawings or specifications required something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.
3. Indian Electricity Act and Rules: All electrical works in connection with installations of the system shall be carried out in accordance with the provision of the Indian Electricity Act, 1910 and the Indian Electricity Rules 1956, both amended up to date.
4. CPWD Specification: as at Schedule "F" of GCC.
5. Indian Standards: The system / components shall conform to relevant BIS wherever they exist and to the National Building Code-2005 with latest amendments / addendums.
6. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility for the design, manufacture and installation of the equipment with all its accessories in accordance with applicable Statutory Regulations and safety codes in force.

31.0 Completion Drawings (As Built Drawings)

1. On completion of the work and before issue of certificate of virtual completion, the Contractor shall submit to the Client/Engineer-in-charge/Consultant, completion plan drawn to a scale in the manner decided by him including the under mentioned details alongwith one set of computer CD containing the data.
 - a. Run and size of conduits, inspection boxes, junction boxes and pulls boxes
 - b. Number of circuits in each conduit
 - c. Location and rating of sockets and switches controlling the light and power outlets
 - d. Location and details of main & sub distribution boards, distribution boards indicating the circuit number controlled by them
 - e. Type of fitting viz. fluorescent, pendants, brackets, bulkhead etc., including their rating & type of lamp, fans and exhaust fans
 - f. A complete wiring diagram as installed and schematic drawings showing all connections for the complete electrical system
 - g. Location of telephone outlets, junction boxes and sizes of various conduits and number & sizes of wire drawn
 - h. Layout of telephone cables
 - i. Location of all earthing stations, route and size of all earthing conductors, manholes etc.
 - j. Layout and particulars of cables & sub mains.
 - k. Schematic drawing for telephone system
 - l. Layout of conduits for computer outlet points
 - m. Layout and details of lightning protection system.
 - n. Insulation tests and earth test results
 - o. PA System drawings
 - p. Disc Antenna drawings
 - q. Equipment drawings
 - r. Cable route layout of HT, LT & other cables
 - t. External lighting drawing with road layout

32.0 Checking of BOQ Quantities

All quantities indicated in BOQ are tentative which may vary as per site conditions. Contractor has to verify quantities before procuring the materials. No payment shall be payable for quantity brought to site but not used.

33.0 Terms of Payment

- A. For items covered by CPWD Specifications (Part-IV -Sub Station -2007 & Part-VII -DG Sets-2006) as given below:
 - i. 85% after initial inspection and delivery at site in good condition on pro-rata basis.
 - ii. 10% after completion of installation in all respects.
 - iii. Balance 5% will be paid after testing, commissioning and handing over to the client/HLL for beneficial use.
- B. For other items not covered in the above CPWD Specifications, payment shall be made as per GCC.

34.0 Training of Personnel

The Contractor shall arrange for training of the Client's personnel prior to provisional take over of the project for the following:

- a. Telephone Exchange
- b. All other Equipment like pumps, panels etc.
- c. Adjustment of setting for controls and protective devices
- d. Preventive maintenance

- e. Operation of all electrical panels including their interconnectivity and interlocking scheme
- f. Hot Water Boiler
- g. Any other specialized system as executed under this contract

35.0 Completion Certificate

1. On completion of the installation, a certificate shall be submitted to the Engineer-in-charge /Consultant by the Contractor which shall be countersigned by the agency under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority. On the basis of this certificate, the Contractor shall arrange for inspection of installation by the concerned local authorities.
2. The Contractor shall be responsible at his own cost for getting the installation duly approved by the authorities concerned.

36.0 Check List

The Contractor shall provide to the Client/ Engineer-in-charge/ Consultant, 4(four) copies of a comprehensive maintenance checklist and shall paste a copy of it in the Substations & Plant Room. The checklist shall be a list of each piece of equipment in this Contract, and shall provide a space for each of the next fifty-two weeks to record the maintenance results and status of various equipment each month i.e. at the time of inspection. The Contractor shall certify on this check list that he has examined each piece of equipment and that, in his opinion, it is operating as intended by the manufacturer, and that all necessary tests have been performed.

37.0 Repairs

All equipment that requires repairing shall be immediately serviced and repaired during the defect liability period. All parts and labours shall be furnished free of cost to the client.

38.0 Safe Custody and Storage

Safe custody of all machinery and equipment dismantled, shifted & supplied by the Contractor shall be his own responsibility till the final taking over by the Client/Engineer-in-charge/ Consultant. The Contractor should, therefore, employ sufficient staff for watch and ward at his own expenses. Client/Engineer-in-charge/Consultant may, however, allow the Contractor to use the building space for temporary storage of such equipment, if such space is available.

39.0 Testing and Commissioning

The Contractor shall pay for and arrange without any cost to the Engineer-in-charge / Consultant, all necessary balancing and testing equipment, instruments, materials, accessories, power, water, fuel and the requisite labour for testing. Any defects in materials and/ or in workmanship detected in the course of testing shall be rectified by the Contractor entirely at his own cost, to the satisfaction of the Engineer-in-charge/Consultant. The installation shall be retested after rectification of defects and shall be commissioned only after approval by the Engineer-in-charge /Consultant. All tests shall be carried out in the

presence of the Engineer-in-charge /Consultant or his representative.

40.0 Operation and Running of entire system

The contractor shall pay for and arrange for operation & running of entire electrical system and other equipment for a minimum period of one month after satisfactory completion of work as desired by Engineer-in-charge/ Consultant. Cost of operation & running of entire system including required material e.g. Fuel, water, electricity consumables, tools & tackles, requisite manpower etc. shall be deemed to be included in the contract price and nothing extra shall be paid.

41.0 Layout of all services, operating and maintenance instructions. DO's and Don'ts's etc for all the plant rooms, pump room, control panels etc must be equipped with coloured layout of services for the each floor. Operation and maintenance manual of the respective services, Do's and don'ts's for all the plants, machinery & services to be installed with every individual units.

(D) SPECIFIC CONDITIONS OF CONTRACT RELATING TO HVAC SYSTEM**1. Scope of Contract**

The scope and general character of works to be carried out under this section comprises of Supply, Installation, Testing and Commissioning of Heating, Ventilation and Air-conditioning installations as illustrated in drawings, specifications, technical data and Bill of Quantities.

2. Stores and Materials

The contractor shall provide everything necessary for the proper execution of the work according to the intent and meaning of the drawings, Bill of quantities and specifications taken together whether the same may or may not be particularly shown or described therein provided that the same can be reasonably inferred there from. In case of any discrepancy in the drawings or between the drawings, Bill of quantities and specification, decision of the Engineer-in-charge/Consultant will be final and binding.

3. Supply of Equipment

Equipment shall be strictly as per the list of approved makes/ manufacturers given in the Bid documents. However, final choice of make shall lie with the Engineer-in-charge / Consultant.

- i. The Contractor shall submit manufacturer's test certificates of equipment supplied.
- ii. The Contractor shall submit the original "Excise Paid Certificates", and exit Gate passes form manufacturer's factory/works clearly bearing the batch numbers and date of despatch.

4. Shop / Working Drawings etc.

- 4.1. The Contractor shall prepare and submit to the Engineer-in-charge/Consultant for approval, 2 sets of detailed shop drawings of equipment, equipment characteristics and capacity details of all equipment, accessories and devices etc. as per specifications well in advance or as required by the Engineer-in-charge/Consultant. The structure works should not be affected due to delay on this account. The shop drawings shall be submitted within 15 days of issue of instructions by Engineer - in- Charge. No claims for extension of time shall be entertained because of any delay in the work due to failure on part of the contractor to produce shop drawings in time.
- 4.2. These drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics, and capacity of all items of equipment, as also details of all related items of work by other disciplines.
- 4.3. If the Engineer-in-charge/Consultant makes any amendment in the above drawings, the Contractor shall supply two fresh sets of drawings with the amendments duly incorporated, along with the drawings on which corrections were made. After final approval has been obtained from the Engineer - in- Charge, the Contractor shall submit a further six sets of shop drawings for the exclusive use of and retention by the Engineer-in-charge/ Consultant.
- 4.4. Approval of shop drawings shall not be considered as a guarantee of measurement or of building condition. It will in no way relieve the contractor from his responsibility of furnishing materials or performing work as required by the contract.

5. Completion Drawings:-

Following "AS BUILT" drawings shall be submitted by the Contractor on completion of the work:

- a. Plant installation drawings giving complete details of the entire equipment including AHU's and their foundations.
- b. Ducting drawings showing all sizes, damper locations and sizes of all air outlets and intakes, for all floors
- c. Electrical drawings showing cable sizes, equipment capacities, control components and control wiring.
- d. Schematic control drawings giving detailed sequence of operation and notes to explain the operation of the control circuit.
- e. Piping drawings showing all pipe sizes, valves and fittings
- f. Any other drawings to be supplied as per instructions of the Engineer-in-charge / Consultant.

6. Operation and Service Manuals

6.1. The Contractor shall submit 3 (three) sets of operation and service manuals in respect of the air-conditioning plant including salient details of plant including internal circuit diagrams. Following minimum details shall be furnished:

- i. Detailed equipment data as approved by the Engineer-in-charge/Consultant
- ii. Manufacturer's maintenance and operating instruction
- iii. Approved test readings

6.2. The Contractor shall also submit 4 (four) sets of technical literature on all automatic controls and complete technical literature on all equipment and materials. The Contractor shall frame under glass, in the Air conditioning plant room all consolidated control diagrams and all piping diagrams.

6.3. Coloured Layouts of all electrical lines in A-1 size properly laminated to be fixed at various locations at the time of handing over of building.

7. Inspection at Work / Contractor's Premises

7.1. The Client/Engineer-in-charge/Consultant or their representatives shall at all reasonable time have free access to the Contractor's premises/works. The Contractor shall give every facility to them and necessary help for inspection and examinations and test of the materials and workmanship.

7.2. These representatives shall have full powers to inspect drawings of any portion of the work or examine the materials and workmanship of the plant at the Contractor's works or at any other place from where the material or equipment is to be obtained. Acceptance of any material or equipment shall in no way, relieve the Contractor of his responsibility for meeting the requirement of the specifications.

7.3. For Imported screw type water chilling machine manufacturer's factory test certificate would be acceptable in lieu of inspection at manufacturer works.

8. Subcontracting

The Contractor may subcontract part of the works with the written approval of the Engineer-in-charge /Consultant. A single sub-contractor as approved by the Engineer - in- Charge / Consultant shall be appointed for carrying out the entire work of supplying, installation, testing and commissioning of all the equipment covered under this package. However, the overall responsibility for compliance of the Contract lies with the Contractor.

9. Material Submittals

The Contractor shall submit materials for all equipment and machinery for the written approval of the Engineer-in-charge/Consultant before placing orders. The material submittals shall comprise of at least the following:

- i. Manufacturer's technical catalogues and brochures giving technical data about performance and other parameters
- ii. Manufacturers drawings / sketches showing construction, dimensional and installation details
- iii. Rating charts and performance curves clarifying rating of equipment proposed.

10. Samples and Prototypes

The Contractor shall submit samples of items such as grilles/ diffusers, valves, controls and/ or any other parts or equipment as required by the Engineer-in-charge/Consultant for prior approval in writing before placing the order. The Contractor shall also construct prototype or samples of work as laid down in the Contract or as instructed by the Engineer-in-charge /Consultant. Such samples and prototypes after approval shall be retained by the Engineer-in-charge/Consultant and shall serve as the standards to be achieved in final construction.

11. Testing and Commissioning

11.1. Tests on equipment as called for in the specifications shall be carried out by the Contractor in accordance with the specifications, the relevant Indian Standard Specifications (BIS) and International Standards.

11.2. The initial tests shall include but not be limited to the following:

- i. To operate and check the proper functioning of all electrically operated components viz., compressor motor, pumps, blowers, air handling units, rotating machine, fans, boilers, etc.
- ii. To operate and check the proper functioning of all electrical panels, switch gears, safety and other controls
- iii. To adjust and balance air, water, steam and gas quantities to provide the designed flow rates by adjusting valves, dampers, diverters etc.
- iv. To check the systems against leaks in different circuits, alignment of motor, 'V' Belt adjustments etc.
- v. To check the vibration and noise levels of the equipment
- vi. Setting of all control and all such other tests which are essential for smooth functioning of the plant.

11.3. The Contractor shall pay for and arrange without any cost, all necessary balancing and testing equipment, instruments, materials, accessories, power, water, fuel and the requisite labour for testing. Any defects in materials and/or in workmanship detected in the course of testing shall be rectified by the Contractor entirely at his own cost, to the satisfaction of the Engineer-in-charge/Consultant. The installation shall be tested again after removal of defects if any and shall be commissioned only after approval by the Engineer-in-charge/Consultant. All tests shall be carried out in the presence of the Engineer-in-charge/Consultant or his representative.

12. Provisional Taking Over

12.1. After completion of the HVAC system, the same shall be put to a continuous running test for a period of 72 (Seventy Two) hours. All adjustments should be made prior to this test so that proper conditions / working are achieved during this testing. The Contractor shall pay for and arrange at his own cost for materials, accessories, power, water, fuel and the requisite labour for this testing the test readings shall be noted in the Testing format approved by the Engineer-in-charge /Consultant.

The plant will be provisionally taken over after successful completion of the above test and the defects liability period shall commence after provisional taking over of the system.

13. Final Performance and Capacity Test

In addition to the above testing, final performance and capacity tests shall be carried out on the equipment as per the "Testing Schedules" during the defects liability period as follows:

- i. Peak summer / monsoon test during the period from 15th May to 31st July on the dates decided by Engineer - in- Charge /HLL. The installations should be able to maintain the specified inside temperature/conditions within the tolerance limits prescribed in the Contract the duration of the test shall be 72 hours.
- ii. Peak winter test during the period from 1st December to 15th February on the dates decided by Engineer - in- Charge / HLL. The installations should be able to maintain the specified inside temperature within the tolerance limits permitted in the Contract. The duration of the test shall be 72 hours.

13.1. All the arrangements required making the entire system operational /running, for the performance test as above, including cost of manpower, and fuel (Gas etc) etc will be borne by the Contractor.

14. General

14.1. After provisional taking over of the plant, user / owner shall provide staff for operation. Staff will work under the supervision of the Contractor for proper operation of the plant. This responsibility of the Contractor shall continue till completion of test liabilities with respect to the plant or the maintenance period (twelve months), whichever is later.

14.2. The user shall have the right to operate all equipments, if it is in the operating condition if such equipments, have been accepted as complete and satisfactory. Repairs and alterations if required shall be carried out as and when directed by the Client /Engineer-in-charge/Consultant. In special circumstances Client/Engineer-in-charge /Consultant may request Air conditioning of some areas even before the completion of whole of HVAC work. The Contractor shall co-operate fully under such circumstances.

15. Guarantee and Defects Liability Period

The guarantee of HVAC works shall be valid for a period of 12 (Twelve) months from the date of completion of the project as accepted by Client / Engineer-in-charge/ Consultant. In case the contractor is not able to carry out the seasonal tests (summer/ monsoon & winter) within the stipulated period as mentioned above, the same can be carried out even after defects liability period. The Defect Liability period for HVAC shall be deemed to be extended till satisfactory completion of seasonal tests.

16. Performance Guarantee from Sub contractor

The Contractor shall submit a performance guarantee certificate from the agency which executed the HVAC work, counter signed by the Contractor that the system shall maintain the

desired parameters within + /- 5 % of the specified parameters who shall also guarantee that the capacity of various components as well as the whole system covered under the scope of work, technical schedules and Bill of Quantities etc., shall not be less than the specified capacities. The guarantee of the specific equipment supplied alone with regard to the performance of the system shall not be acceptable and overall responsibility of the Contractor for performance of HVAC work & its compliance with the Contract terms and conditions remains unchanged.

17. Measurement of Works

All works shall be measured in accordance with the mode of measurement given in the specific sections of the specifications. In case the method of measurement for any item is not clarified in the specifications, the same shall be measured in accordance with the relevant IS standards and CPWD norms.

18. Maintenance

The Contractor shall provide free maintenance for a period of **twelve months** after testing and commissioning of the installation of HVAC works or from the date of completion accepted by Client / Engineer-in-charge / Consultant whichever is later. The Contractor shall carry out all routine and special maintenance of the plant and attend to any defects that may arise in operation of the plant.

19. Painting

All equipment and ancillary items such as pipes, supports etc., will be painted in approved manner, using standard paints as approved by Client/Engineer-in-charge /Consultant

20. Safe Custody and Storage

The contractor shall be responsible for safe custody of all machinery and equipment supplied and installed by the till the final taking over by the Client/Engineer-in-charge /Consultant.

21. Terms of Payment

The following norms shall be followed for the payment of HVAC equipment & installation:

- A. 75% of BOQ rate shall be paid on receipt of equipment at Site and after inspection and passing on pro-rata basis
- B. 10% of BOQ rate shall be paid on satisfactory erection and installation of equipment on pro-rata basis
- C. 10% after successful completion of running tests and provisional taking over.
- D. 5% after final performance and satisfactory seasonal test to be conducted in summer or monsoon and removal of all defects pointed out during previous tests.

22. Training of Personnel

The Contractor shall arrange to train the Client / HLL's personnel on the following aspects prior to provisional takeover of the plant:

- a. Operation of plant
- b. Gas charging and pumping down of the system
- c. Adjustments of settings for controls and protective devices
- d. Preventive maintenance
- e. Disassembling and assembling of compressor including identification and replacement.

23. Operation and Running of entire system

The contractor shall pay for and arrange for operation & running of entire HVAC system for a minimum period of one month after satisfactory completion of work as desired by Engineer-in-charge / Consultant. Cost of operation & running of entire system including required material e.g. fuel, consumables, tools & tackles, requisite manpower etc. shall be deemed to be included in the contract price and nothing extra shall be paid on this account. Only water and electricity shall be provided by the client/HLL.

(E) Special Conditions of Contract for “GRIHA Rating System”

1. This Project is to be executed for Certifications as per GRIHA (Green Rating for Integrated Habitat Assessment) National Green Building Rating System. At least 3 (Three) Star rating under the GRIHA Green Building Rating System is to be ensured. Accordingly, the contractor is required to adhere to the various environment friendly and GRIHA compliance aspects of construction as well as documentation with respect to use of Materials, Manpower, Machinery and other relevant mandatory requirements. Nothing extra shall be payable over and above the quoted rates as per the financial bid to comply with such requirements.
2. To achieve the above, the contractor shall specifically, adhere to the following during construction :
 - 2.1. Soil excavation, soil erosion and sedimentation control etc.:- Proper site management strategies shall be followed on the site to ensure proper material staging, soil spill prevention, soil erosion and sedimentation control. The following strategies are listed below:
 - a. Temporary sedimentation basins shall be made on the lowest possible elevation on site during construction to manage all the storm water generated during rains at the site. Photographs of the sedimentation tank shall be submitted to the Engineer-in-charge.
 - b. Spill prevention and control: Spill prevention and control plans to ensure so as to stop the source of the spill and dispose the contaminated material and hazardous wastes. Hazardous wastes include pesticides, paints, cleaners, and petroleum products.
 - c. Proper construction material staging shall be executed on the site.
 - d. Trenches shall be laid along the periphery of the site to carry the storm water from the various locations on the site to the sedimentation basins.
 - e. During the earth excavation, top soil of 0.20m shall be stacked separately on or near by the site at a maximum height of 0.40m.
 - f. Vegetation / mulching of the areas shall be done where the excavated top soil is stacked.
 - g. The soil excavation, particularly during rainy season, shall be done in such a way to minimize site disturbance such as soil pollution due to spillage of construction material and mixing with rainwater.
 - h. The existing vegetation shall be protected by preventing disturbance or damage to specified areas during construction. This will minimize the amount of bare soil exposed to erosive forces. All existing vegetation shall be barricaded on site and marked on a site survey plan.
 - i. Stacked top soil shall be mulched and protected by barricading as stated above and re-laid over pre-designated landscape areas post construction.
 - 2.2. Proper site management strategies shall be followed on the site to ensure labour safety and sanitation. The some of these are listed below:
 - a. Display warning and safety signs all across the site. Also ensure that safety nets and harnesses are provided for construction workers working on higher floors. The walking boards and formwork shall also be stable. Workers shall be provided with safety equipment like safety helmets, jackets, boots and gloves.
 - b. Provide fire extinguishers and barrels of water with bucket tans on the site and sufficient light for workers to work safely at night.
 - c. Provide accommodation and amenities for all staff and labours, employed for the purpose of, or in connection with the contract including fencing, water (both for

drinking and other uses), electricity, furniture and other such requirements. Such accommodation and amenities shall be provided by the contractor at a location specifically demarcated by the employer, in case such space is made available by the employer. In case the contractor makes his own arrangement, all such facilities shall be provided in such accommodation. On completion of the contract, such accommodation shall be removed and the site shall be cleared.

- d. The contractor shall employ an officer on the site concerned solely with the safety and protection of all staff and labour against accidents. The officer shall be qualified and shall have authority to issue instructions and take protective measures to prevent accidents. Or the contractor may setup a working arrangement with a local practitioner to handle injury in an emergency situation.
- e. The contractor shall establish a fully equipped first aid centre on site to deal with accidental injuries and workers health. The first aid box shall be marked with a red cross on a white background.
- f. The contractor shall not allow an individual to work on site while his ability or alertness is impaired by fatigue, illness or some other cause which might expose him to injury.

2.3. Proper site management strategies shall be adopted on the site to prevent air pollution viz:

- a. Preparation of site :
 - i. Clear vegetation only from the areas where work will start right away
 - ii. Vegetate/mulch areas where vehicles don't ply
 - iii. Apply gravel to the area where mulching/paving is impractical
 - iv. Identify roads on site that would be used for vehicular traffic. Add surface gravel to reduce source of dust emission
 - v. Limit vehicular speed on site to 10 km/hour
- b. Water shall be sprayed to prevent dust pollution on the following:
 - i. Any dusty materials before transferring, loading and unloading
 - ii. Areas where demolition work is being carried out
 - iii. Areas where excavation or earth-moving activities are to be carried out
 - iv. Arrangements for wheel washing should be made near the entry/exit gates to prevent air pollution
- c. The following activities shall be carried out:
 - i. Providing hoardings/barricading of not less than 3m high along the site boundary, next to a road or other public areas
 - ii. Providing dust screens, sheeting or netting along the perimeter of a building
 - iii. Covering full stockpile of dusty material with impervious sheeting
 - iv. Covering dusty load on vehicles by impervious sheeting before they enter or leave the site
 - v. Transferring, handling/storing dry loose materials like bulk cement, dry pulverized fly ash inside a totally enclosed system

2.4. Concrete Curing: - Use of gunny bags, ponding for curing purposes. Adding admixtures to concrete which cause a reduction in the water required for curing. Also construct curing tanks on the site for efficient usage of water.

2.5. Efficient use of available water

2.6. Plan utilities efficiently and optimize on-site circulation efficiency

2.7. Provide adequate level of sanitation and safety facilities for construction workers

2.8. Reduce air and noise pollution due to storage / use of materials and machinery

- 2.9. Preservation and protection of landscape during construction.
- 2.10. Proper conservation of soil and maintenance of adequate fertility of soil to support vegetative growth.
- 2.11. Reduction in waste of construction materials
- 2.12. Proper storage and disposal of wastes. Dedicated place within the site to be earmarked for storing and sorting construction wastes.
- 2.13. Implement recycling programme as far as possible to recycle construction waste materials during construction
- 2.14. Suitable arrangement for preventing dust and debris entering duct work and working areas
- 2.15. Create physical barriers between work and non-work areas.
- 2.16. Protection of materials and equipment against moisture dust etc.
- 2.17. Keeping work area clean and dry as possible
- 2.18. To take safety measures to avoid damage to existing plants and trees
- 2.19. Materials:-
 - 2.19.1. Use of materials which conform to the GRIHA Rating System criteria.
 - 2.19.2. Use of low emitting materials, adhesives and sealants to -
 - a. reduce / avoid use of materials, which are irritating and naturally cause health problems to the construction workmen and occupants.
 - b. achieve specified Volatile Organic Compounds (VOC) limits as per the requirements given in the **Table-1** & **Table - 2** below :

TABLE – 1

LIST OF ADHESIVES AND SEALANTS :			
SN	Types of Applications	Maximum VOC Limit (g/1)	Suggested vendors
1	Laminate Adhesive	30	Dow Corning/ Cani Merchandizing/ Esson Chemical/ Acqua Mix/ Finolex
2	Wood Flooring Adhesive	100	
3	Ceramic Tile Adhesive	65	
4	Rubber Flooring Adhesive	60	
5	Sub Floor Adhesive	50	
6	Structural Glazing Adhesive	100	
7	Architectural Sealant (<i>Non Porus</i>)	250	
8	Indoor Carpet Adhesive	50	

TABLE - 2

LOW EMITTING MATERIALS PAINTS : Interior paints (<i>walls, ceiling, wood polish etc</i>) should conform to the following criteria		
SN	Types of Applications	VOC Limit (g/L)
1	Flats	50
2	Non-flat	150
3	Anti rust paints	250
4	Varnish	350
5	Lacquer	550
6	Floor Coatings	100
7	Waterproofing sealers	250

3. The contractor shall maintain proper record of all the materials/ equipment procured with respect to their source & specifications with details of their manufacturing and recycled content etc. and submit along with all supporting documents to the Engineer-In-charge.

4. **Construction Waste Management Plan :**

As already detailed, the broad intent is to avoid materials going to landfills, during construction. It is required to develop a plan to recycle all possible waste generated during construction. Typical items would include land clearing debris, concrete, steel, ductwork, clean dimensional wood, paperboard and plastic used in packing, etc.

The plan should include where these materials will be sent to and the mode of transportation also. Donation of construction waste to other buildings for use is also deemed as having addressed the intent of this credit. The contractor should have a system to document the disposal of construction waste.

5. **Indoor Air Quality (IAQ) Management plan.**

The contractor shall be required to take the specific measures during construction with respect to following main areas of concern:

- a. HVAC System Protection :

- When performing construction activities that produce dust, such as drywall sanding, concrete cutting, masonry work, wood sawing or adding insulation, seal off the supply diffusers and return air system openings completely for the duration of the task.
- Shut down and seal off the supply diffusers and return air ducts during any demolition operations
- Till the HVAC system is put into use, seal-off the supply diffusers and return air system openings to prevent the accumulation of dust and debris in the duct system during construction.
- Do not use the mechanical rooms to store construction or waste materials. Keep rooms clean and neat.
- Provide periodic duct inspections during construction; if the ducts become contaminated due to inadequate protection, clean the ducts as per requirements and directions of Engineer-In-Charge

- b. Contaminant Source Control:

- Use low VOC products as indicated by the specifications to reduce potential problems
- Restrict traffic volume and avoid idling of motor vehicles as their emissions could be drawn into the building
- Utilize electric or natural gas alternatives for gasoline and diesel run equipment where possible and practical. Use low-sulphur diesel in lieu of regular diesel
- Cycle equipment off when not being used or needed
- Exhaust pollution sources to the outside with portable fan systems
- Prevent exhaust from re-circulating back into the building
- Keep containers of wet products closed as much as possible. Cover or seal containers of waste materials that can release odour or dust.
- Protect stored on-site or installed absorptive building materials, for instance, Cement, Gypsum / POP etc. from weather and moisture; wrap with plastic and seal tight to prevent moisture absorption.

- c. Pathway Interruption:

- Provide dust curtains or temporary enclosures to prevent dust from migrating to other areas including existing, Hospital Complex, where applicable.

- Locate pollutant sources as far away as possible from supply ducts and areas occupied by workers when feasible. Supply and exhaust systems may have to be shut down or isolated during such activity.
- During construction, isolate areas of work to prevent contamination of clean or occupied areas. Pressure differentials may be utilized to prevent contaminated air from entering clean areas.
- Depending on weather, ventilation using 100% outside air will be used to exhaust contaminated air directly to the outside during use of VOC emitting materials.

d. Housekeeping:

- Provide regular cleaning concentrating on HVAC equipment and building space to remove contaminants from the building prior to occupancy.
- All coils, air filters, fans & ducts shall remain clean during installation and, if required, will be cleaned prior to performing the testing, adjusting and balancing of the systems.
- Suppress and minimize dust with wetting agents or sweeping compounds. Utilize efficient and effective dust collecting methods such as a damp cloth, wet mop, or vacuum with particulate filters, or wet scrubber.
- Remove accumulations of water inside the building. Protect porous materials such as insulation and ceiling tile from exposure to moisture.
- Thoroughly clean all interior surfaces prior to replacing filters and running HVAC system for system balancing, commissioning and building flush-out.

e. Scheduling and Construction Activity Sequence:

Schedule high pollution activities that utilize high VOC level products (including paints, sealers, insulation, adhesives, caulking and cleaners) to take place prior to installing highly absorbent materials (such as ceiling tiles, gypsum wall board, fabric furnishings, carpet and insulation, for example).

6. Green Building (GRIHA) provisions for electrical materials

The contractor shall be required to take the specific measures during construction with respect to following:

1. All items to be quoted as per the Green Building provisions and shall adhere to GRIHA Green Building rating system and relevant ASHRAE standards and other Green building standards. This is irrespective of whether the same have been mentioned in the technical specifications or the Bill of Quantities.
2. The vendor to conform during negotiation meetings and before quoting that the MAKE of MATERIAL specified in the tender conforms to Green Building norms and requirements and in case of any queries would clarify during the negotiation meeting. Since we are aiming for the GRIHA 3 Star rating, it is mandated that all products have to be accordingly compliant and if the contractor has not accounted for it in his cost, he WILL NOT be liable for any further compensation and will have to provide in the same cost.
3. The contractor shall submit all TECHNICAL SUBMITTALS in a spiral bound format to the respective engineering/architectural consultant for approval, where all the catalogues of items of the BOQ shall be compiled. This master approval document shall be vetted and duly approved by the Green Building Consultant, before ordering and procurement.
4. Minimum allowable luminous efficacy of all the lamps shall be as per the table below:-

Light Source	Minimum allowable luminous efficacy (lm/W)
CFL (Compact Fluorescent Lamp)	50
FL (Fluorescent Lamp)	75
MH (Metal Halide)	75
HPSV (High Pressure Sodium Vapour)	90
LEDs (Light Emitting Diodes)	50

7. **Photographs :**

During various stages of construction, the photographs shall be taken by contractor and submitted to the Engineer-In-charge, showing details of specific requirements / measures being taken by the contractor towards above for documentary compliance and records.

8. Contractor shall coordinate with suppliers of various materials and equipment to be procured by him for use in works and provide all required details with respect to their manufacturing facilities; raw materials etc as per requirements of GRIHA Certification guidelines. Preference should be given to GRIHA compliant products/ materials.

Indian Pharmacopoeia Commission
GHAZIABAD, U.P.
(An Autonomous Institution of Ministry of Health & Family Welfare)

Tender No. IPC/GZB/HLL/ID/2015

Request for Proposal (RFP)
for

**Construction of State of Art Laboratory Building for Indian
Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh**

VOLUME - III

TECHNICAL SPECIFICATIONS



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(May, 2015)

Construction of State of Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh

Technical Specifications

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Construction of State of Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh

Chapter A

A BRIEF OF REQUIREMENT OF THE WORK:

1. General Scope of Work :

The scope of proposed work consists of Construction of State of Art Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh. The building consists of Ground plus two floors with infrastructure facilities including External Development Works.

The work includes a number of specialized Civil / Electrical / HVAC / Mechanical / Electronic services etc. to be executed as integral parts of the project.

2. The following are the salient features of the Works:

- a. Foundations & other works like underground water tank.
- b. Super structure
- c. Internal and External water supply, sewerage, Storm water
- d. Infrastructure Development i.e. Roads, Parking etc.
- e. Electrical Installation (Internal & External)
- f. Comprehensive Fire Fighting/Protection /Alarm System
- g. HT & LT Installation, Substation, DG Sets
- h. Comprehensive HVAC
- i. Lifts
- j. PA, CCTV & Security Systems, EPABX/ Communication Systems, NET/LAN Systems, BMS, UPS
- k. Solar Energy System
- l. Medical Gas Pipeline System
- m. Façade and other works for the existing building

3. Appointment of agencies for execution of works mentioned in Para 2:

Contractor shall submit credentials of the agencies proposed to be engaged by him/them for execution of sub heads excluding a. to d. above of works mentioned in Para 2 above to the Client / HLL. Particular agency shall be approved by Client/ HLL and only such agencies shall be allowed to execute the work on behalf of the contractor.

Latest CPWD Specifications for Civil, Electrical and all other works with up to date correction slips for all sub heads of work as applicable, and, Technical Specifications included in the tender documents, wherever applicable.

4. The work shall in general conform to the Latest CPWD Specifications for Civil, Electrical and all other works with up to date correction slips for all sub heads of work as applicable, and, Technical Specifications included in the tender documents, wherever applicable. Wherever any aspect of design / construction / material standards is not covered under the above mentioned specification, relevant standards shall be referred to in the order of precedence which shall be as follows. In case of discrepancy between the Schedule of Quantities, the Specifications and /or the Drawings, the following order of preference shall be observed –
- a. Description of Schedule of Quantities
 - b. Particular specification and Specific Condition, if any.
 - c. Drawings
 - d. CPWD Specifications
 - e. Indian Standard Specifications of B.I.S/ IRC/ BS/ ASTM/ DIN/ NBC.
 - f. For items not covered by any of the above, the work shall be done, as per sound engineering practices and as directed by the Engineer-in-charge.

Chapter B

TECHNICAL SPECIFICATIONS AND CONDITIONS - CIVIL WORKS

1. EARTH WORK: As per relevant CPWD specifications.

- i. Irrespective of the stipulations in the relevant CPWD Specifications or elsewhere in the Contract, the surplus excavated earth shall be disposed off by the contractor at his own cost to the place as directed by Engineer – in-charge and/or permitted by the local authority after obtaining written permission of the Engineer – in-charge and no payment will be made by the HLL for disposal of this excavated earth.
- ii. The Contractor shall, at his own expense and without extra charges, make provision for all shoring, pumping, dredging or bailing out water, encountered from any sources such as rains, floods, springs, subsoil water table being high or due to any other cause whatsoever. The foundation trenches shall be kept free from water while all the works below ground level are in progress without any extra payment.
- iii. Filling in plinth shall be consolidated with water and compacted with pneumatic rammers, to achieve 90% relative density on testing. One test is to be carried out for 1000 sq.ms. of compacted area.

2. PLAIN CEMENT CONCRETE AND REINFORCED CEMENT CONCRETE WORK:

a. STONE AGGREGATE:

- i. Stone aggregate used in the work shall be of hard broken stone to be obtained from approved source (Quarries to be approved by the Engineer in charge) and shall conform to relevant provision in the Latest CPWD Specifications for works.

b. SAND

- i. Sand to be used for the work shall be of as specified in CPWD specifications 2009. Sand shall be obtained from the source to be got approved by the Engineer in charge and washed if required, with appropriate equipment to bring down the chemical, inorganic and organic impurities within the permissible limits as per the direction of the Engineer in charge. The same shall consist of hard siliceous materials.

Note: Where only one variety of sand is available the sand will be sieved for use in finishing work as directed by the Engineer – in – charge in order to obtain smooth surface and nothing extra will be paid on this account.

- ii. Nothing extra shall be paid for screening or washing the sand as prescribed above.

c. FLYASH

Flyash conforming to grade 1 of IS 3812 (Part 1) may be used as part replacement of OPC provided uniform blending with cement is ensured in accordance with clauses 5.2 and 5.2.1 of I.S.456-2000 in the items of BMC and RMC. However this shall not override the provisions of the respective items.

d. CENTERING SHUTTERING AND SCAFFOLDING:

- i. All Scaffolding centering for RCC shall be with properly designed system and brought to site well in advance so that the progress of the work is not hampered for non-availability of the same.

- ii. All shuttering for RCC work except soffits of slab shall be in water proof shuttering Ply. Shuttering for slab and soffits shall be in water proof shuttering ply or in good quality mild steel plates free of dents, bends or warping and rusting as approved by the Engineer in charge.
 - iii. Contractor should deploy complete one set of shuttering materials for minimum one complete floor and the shuttering material for beam bottom shall be minimum for two complete floors.
- e. REINFORCEMENT:**
- i. TMT reinforcement steel shall be used shall be as per design and conforming to IS: 1786 pertaining to Fe 500 OR Fe 500D grade of steel.
 - ii. TMT steel bars manufactured by main producers, as per list of makes, shall be allowed in the work. Contractor shall produce manufacturer Test Report for each dia and each lot Tests. Nothing extra will be paid for “straightening of bars” received from market in coils or with bends. All incidental charges of any kind whatsoever including cartage, storage, safe custody of materials, cutting and wastage etc. shall be borne by the contractor.
 - iii. The actual average sectional weight for dia up to 10 mm shall be arrived at from one meter long samples (minimum 3 from each dia) taken from each lot of steel. The discretion of the Engineer – in – charge shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site of work each day will constitute the single lot for this purpose.
 - iv. The weight of each lot of a particular diameter of 10mm and below shall be reckoned as the weight as per actual issue multiplied by a factor equal to the standard sectional weight of the particular diameter divided by the average sectional weight of the particular dia in a particular lot worked out as per above para. Adjustment for the steel shall be effected on the basis of the weight as modified above for quantity payable.
 - v. Measurement of all diameters of steel be on linear basis and will be converted into weight on the basis of standard sectional weight coefficients given in relevant CPWD specifications mentioned in schedule ‘F’ of General Conditions of Contract.
 - vi. Measurement of reinforcement shall be as per procedure described in the relevant CPWD specifications mentioned in schedule ‘F’ of General Conditions of Contract.
- f. Concrete Mix Design**
- The mix design shall be for moderate exposure and GOOD degree of quality control, unless otherwise specified.
- g. Concrete Batching Plant**
- i. The Concrete Batching Plant of suitable capacity to be installed within a period of 30 days from award of work. The contractor shall install batching plants (within 50 meters distance from the site of work) supplying Concrete at site. The batching plant proposed to be engaged by the contractor shall fulfill the following requirements.
 - 1. It shall be fully computerized.
 - 2. Facility to pump concrete upto the highest point of the building.
 - 3. It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.
 - 4. It should have sufficient capacity to meet the requirement as per schedule.

In case of failure of Batching Plant, RMC may be allowed with a written permission of the Engineer in Charge

- ii. Approved admixtures conforming to IS.9103 shall be permitted to be used. The chloride content in the admixture shall satisfy the requirement of BS 5075. The total amount of chloride content in the admixture mixed Concrete shall satisfy the requirement of IS 456-2000.
- iii. The concrete mix design with and without admixture will be carried out by the contractor through one of the following Laboratories / Test house to be approved by Engineer.
 - i) IIT, Delhi
 - ii) Shri Ram Institute of Industrial Research, Delhi
 - iii) Any other Govt Laboratory as approved by Engineer.

In the event of all the above laboratories being unable to carry out the requisite design / testing the contractor shall have to get the same done from any other reputed laboratory with prior approval of the Engineer.
- iv. The various ingredients for mix design / laboratory tests shall be sent to the lab test house through the Engineer and the sample of such ingredients sent shall be preserved at site by the department till completion of work or change in Design Mix whichever is earlier. The sample shall be taken from the approved materials which are proposed to be used in the work.
- v. The batching and mixing plant shall be fully automatic.
- vi. The contractor has to arrange to erect batching plant for the design mix concrete on his own.
- vii. The concrete shall be transported to the site in specially made Transit Mixers & shall have suitable retarders so that it should not set before placing in position. It should have sufficient flow so that at height the concrete shall be placed by pumping only.
- viii. Each Transit Mixer reaching site shall invariably have manufacturer's certificate containing details like truck number Grade of mix, time of leaving the plant, time of reaching a site etc. A copy of the same shall be handed over to E- in – C or his authorized representative.
- ix. However samples for testing etc. shall be taken as per the mandatory tests prescribed in latest CPWD specifications.
- x. All cubes shall be tested for 7 days and 28 days tests in conformity with the relevant CPWD specifications.
- xi. In respect of projected balconies, projected slabs at roof level and projected verandah, the payment for the RCC work shall be made under the items of RCC slabs. Nothing extra shall be paid for the side shuttering at the edges of these projected balconies and projected verandah. All the exposed edge shall however be finished as per specifications and nothing extra shall be paid for this.
- xii. In the items of RCC walls, railings and roofs etc. nothing extra shall be paid for making designs as per patterns given by Engineer-in-Charge or for thickness of sections.
- xiii. The water will be tested with regard to its suitability for use in CC/RCC work and nothing extra will be paid for on this account.
- xiv. To receive anchor bolt / foundation for machines to be installed at later date, pocket of size minimum 110x100x300 mm shall be kept while concreting of RCC/ CC members and shall be filled with CC 1:1:2 with plasticizer and as per the direction of Engineer in charge

h. Ready Mix Concrete

- i. The contractor shall engage Ready Mix Concrete (RMC) producing plants (Distance of plant from site to be approved by Engineer in Charge) to supply RMC for the work. The RMC plant proposed to be engaged by the contractor shall fulfill the following requirements.
 - a) It shall be fully computerised.
 - b) It should have supplied RMC for Govt. projects of similar magnitude.
 - c) It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.
- ii. The contractor shall, within 10 days of award of the work submit list of at least three RMC plant companies from the approved makes along with details of such plants including details of transit mixer, pumps etc. to be deployed indicating name of owner/company, its location, capacity, technical establishment, past experience and text of MOU proposed to be entered between purchaser (the contractor) and supplier (RMC Plant) to the Engineer who shall give approval in writing (Subject to drawl of MOU).
- iii. The Engineer reserves the right to exercise over the:-
 - a) Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials recordings of test results and declaring the material fit or unfit for use in production of mix.
 - b) Calibration check of the RMC.
 - c) Weight and quality check on the ingredient, water and admixture added for batch mixing.
 - d) Time of mixing of concrete.
 - e) Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action.

For exercising such control, the Engineer shall periodically depute his authorized representative at the RMC plant. It shall be the responsibility of the contractor to ensure that the necessary equipment manpower & facilities are made available to Engineer and/or his authorized representative at RMC plant
- iv. Ingredients, admixtures & water declared unfit for use in production of mix shall not be used. A batch mix found unfit for use shall not be loaded into the truck for transportation.
- v. All required relevant records of RMC shall be made available to the Engineer or his authorized representative. Engineer shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production and transportation of concrete mix which shall be binding on the contractor & the RMC plant.
- vi. 43 grade OPC (Conforming to IS-8112) of brand/make/source approved by Engineer shall only be used for production of concrete.
- vii. It shall be the responsibility of the Contractor to ensure that the RMC producer provides all necessary testing equipment and takes all necessary measures to ensure Quality control of ready -mixed concrete. In general the required measures shall be:-

a) **CONTROL OF PURCHASED MATERIAL QUALITY**

RMC producer shall ensure that the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standards with the material Supplier and the requirement of the product mix design and quality control producer's. This shall be accomplished by visual checks, sampling and testing, certification from materials suppliers and information /data from material supplier. Necessary equipment for the testing of all material shall be provided and maintained in calibration condition at the plant by the RMC producer.

b) **CONTROL OF MATERIAL STORAGE**

Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for prevention of contamination, reliable transfer and feed system, drainage of aggregates, prevention of freeing or excessive solar heating of Aggregate etc,

c) **RECORD OF MIX DESIGN AND MIX DESIGN MODIFICATION**

RMC producer shall ensure that record of mix design and mix design modification is available in his computer at RMC plant for inspection of Engineer or his representative at any time.

d) **COMPUTER PRINT OUTS OF EACH TRUCK LOAD**

Each truckload / transit mixer dispatched to site shall carry computer printout of the ingredients of the concrete it is carrying. The printout shall be produced to Engineer or his representative at site before RMC issued in work.

e) **TRANSFER AND WEIGHING EQUIPMENT RMC**

Producer shall ensure that a documented calibration is in place. Proper calibration records shall be made available indicating date of next calibration due, corrective action taken etc. RMC producer shall ensure additional calibration checks whenever required by the Engineer in writing to contractor. RMC producer shall also maintain a daily production record including details of mixes supplied. Record shall be maintained of what materials were used for that day's production including water and admixtures.

The accuracy of measuring equipment shall be within +2% of quantity of cement +/- 3% of quantity of aggregate, admixture and water being measured.

f) **MAINTENANCE OF PLANT, TRUCK Mixers AND PUMPS**

Plant, Truck Mixers and Pumps should be well maintained so that it does not hamper any operation of production, transportation and placement.

g) **PRODUCTION OF CONCRETE**

The following precautions shall be taken during the production of RMC at the plant

- i. Weighing (correct reading of batch data and accurate weighing):- For each load, written, printed or graphical records shall be made of the weights of the materials batched, the estimated slump, the total amount of water added to load the delivery tickets number for that load and the time of loading the concrete into the truck.
- ii. Visual observation of concrete during production and delivery or during sampling and testing of fresh concrete assessment of uniformity, cohesion, workability adjustment to water content. The workability of the concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.

- iii. Use of adequate equipment at the plant to measure surface moisture content of aggregates, particularly fine aggregates or the workability of the concrete, cube tests etc. shall also be ensured.
- iv. Making corresponding adjustment at the plant automatically or manually to batched quantities to allow for observed, measured or reported changes in materials or concrete qualities.
- v. Sampling of concrete, testing monitoring of results.
- vi. Diagnosis and correction of faults identified from observations /complaints.

The RMC plant produced concrete shall be accepted by Engineer at site after receipt of the same after fulfilling all the requirements of mix mentioned in the tender documents.

- vii. The rate for the Item of design mix cement concrete shall be inclusive of all the ingredients including admixtures, if required, labour, machinery T&P etc. (except shuttering which will be measured & paid for separately) required for a design mix concrete of required strength and workability. The rate quoted by the agency shall be net & nothing extra shall be payable on account of change in quantities of concrete, ingredients like cement and aggregates and admixtures etc. as per the approved mix design.
- viii. Ready mix concrete shall be arranged in quantity as required at site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by Engineer.
- ix. Frequency of sampling and standards of acceptance shall be as per CPWD specifications.
 - i) No addition of water or other ingredients shall be permitted in the RMC at site or during transit.
 - ii) The RMC shall be placed by pump of suitable capacity and the contractor shall arrange sufficient length of pipe at site to place the RMC in the minimum required time. The contractor shall co-ordinate with RMC supplier and pumps hirer to have effective concrete placement.
 - iii) Pre-paid delivery tickets shall be produced with each truck load of RMC.
 - iv) The representative of RMC supplier shall attend the site meeting as and when decided by the Engineer
- x. i) The contractor shall assess the quantity of RMC requirement at site well in advance and order accordingly to the RMC supplier. In case excess RMC is received at site, the department shall not be under any obligation to get extra quantities utilized and no payment for such RMC shall be made.
- ii) The contractor shall have to employ labour in shifts to ensure continuous casting of raft and other RCC members. No extra payment on this account shall be made.

3. WATER PROOFING TREATMENT BY CHEMICAL INJECTION SYSTEM (PRE-CONSTRUCTION)

a. HORIZONTAL SURFACE (RAFT SLAB)

- i. Before the raft reinforcement is placed in position:
 - a. Laying PCC as per drawings and specifications.(payable under the corresponding item)
 - b. Cement slurry (cement and polymer based water proofing compound) is spread on the

PCC for proper bonding with subsequent water proofing treatment.

- c. Water Proofing Course of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) mixed with polymer based water proofing compound is laid over the slurry. Stone aggregates 12mm down is embedded at random.
 - d. After 24 hours, spreading cement slurry (cement and polymer based water proofing compound) on the 1st layer of mortar.
 - e. Providing and laying 2nd layer of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) mixed with polymer based water proofing compound. Stone aggregate 12mm down size is embedded at random.
 - f. After curing for two days, spread cement slurry mixed with water proofing compound over the 2nd layer of cement mortar. Thereafter, the 3rd and final layer of 20mm thick cement mortar in 1:4 (1 cement: 4 coarse sand) mixed with water proofing compound is laid and finished smooth to receive raft foundation.
 - g. The total thickness of the treatment from operation 1.2 to 1.6 will be about 60mm.
- ii. After The reinforcement of raft is placed in position:
- a. Providing and fixing 25mm dia GI threaded grouting nozzles of adequate length at the specified locations @ 1.50 metre c/c or as shown in the drawing all over the slab. The grouting nozzles are tied with reinforcement in such a manner as not to choke its end during concrete operations. The top of these nozzles protrudes above the raft concrete.
 - b. After minimum 7 days of concreting, cement grout of cement and polymer based water proofing compound (non shrinkage grouting compound) in proportion as specified is injected, through these nozzles at the pressure of 2.5 to 3.0 Kg/Sq.cm.
 - c. After grouting, top of the nozzles is cut and the space is filled with cement mortar 1:2 (1 cement: 2 coarse sand) mixed with polymer based water proofing compound.

b. Retaining Wall

- a. The external surface is prepared and polymer based cement slurry is applied.
- b. Providing and laying 25mm thick cement mortar in 1:4 (1 cement : 4 coarse sand) mixed with polymer based water proofing compound in two layers with chicken wire mesh 26 or 24 gauge 25mm size in between the two layers.
- c. The G.I. pipes are placed at 1.5m c/c and at location indicated as per drawing and securely fastened to the reinforcement prior to shuttering and concreting or alternately by drilling holes (25mm to 32mm dia) in the concrete upto a depth as shown in the drawing all over the wall surface @ 1.50mt. C/C and as shown in the drawing. Treatment along all construction joints by providing nozzles, as above, shall also be executed.
- d. Fixing 25mm dia G.I. threaded nozzles in these holes with cement mortar 1:4 (1 cement: 4 coarse sand) mixed with water proofing compound.
- e. Injecting cement grout of cement and polymer based water proofing compound (non shrinkage grouting compound) in proportion as specified in these nozzles at a pressure of 2.5 to 3.0 Kg/Sq.cm.
- f. After the grout the nozzles are cut and filled with cement mortar 1:2 mixed with polymer based water proofing compound in proportion as specified and finished smooth.

Note: The proportion of acrylic based polymer compound to be used in respect of ordinary cement shall be 1% by weight or as specified by the manufacturer. Acrylic based integral water proof compound shall satisfy the provision IS: 2645.

c. Guarantee for water proofing:

Work to be get executed through a approved specialized agency & covered by a 10 years guarantee by the main contractor against leakage, seepage and dampness etc. for which necessary performance guarantee for requisite indicated value of work shall be furnished by the contractor before completion.

d. Measurements:

The length and breadth shall be measured correct to cm. The flooring area shall be measured in sq.ms. actually executed in raft slab. Inside wall surfaces of the basement upto ground level from top of raft slab shall be measured in sq.m. Columns cross sections area not to be deducted from the plan area.

e. Rate:

Rates shall be inclusive of all operations including labour, material, T&P, scaffolding etc. complete. Nothing extra shall be payable on any account.

4. BRICK WORK

- a. Bricks used in the work shall be obtained from kilns to be got approved from the Engineer in charge and shall be best quality well burnt ground moulded bricks as available in the vicinity. They shall have a compressive strength of not less than 75 Kgs/sq.cm and an absorption percentage of not more than 15 (Fifteen) % of its dry weight when immersed in water for 24 hours. In all other respects they shall conform to the provision in Latest CPWD Specifications for works.
- b. Both the face of wall of thickness more than 23cm shall be kept in the proper plane. Walls of half brick thickness or less shall be measured separately and paid in sqm.
- c. Bricks wall beyond half brick thickness shall be measured in multiple of half brick (i.e.115mm) which shall be deemed to be inclusive of mortar joints. In all other respects they shall conform to the provision in relevant specifications of the work.

5. WOOD WORK:

- a. Timber required for manufacture of chowkhats and shutters for doors, windows, ventilators, partitions etc shall be Forest Stewardship council (FSC) certified wood and it shall be seasoned and preservative treated.
- b. The moisture contents of the wood used in the work shall not be more than that stipulated in the relevant clause of Latest CPWD Specifications for works. The rate quoted for various items shall be inclusive of kiln seasoning and preservative treatment of wood. In all other respects the wood used in the work shall conform to the provision in latest CPWD specification for works.
- c. The sample of species to be used shall be deposited by the contractor with the Engineer-in – charge before commencement of the work. The contractor shall produce cash voucher and certificate from standard kiln seasoning plant operator about the timber section to be used on the work having been kiln seasoned by them failing which it would not be so accepted as kiln seasoned.

d. Glass :-

- i. Transparent sheet glass (Float glass) conforming to IS 1761 – 1970 shall be used.
- ii. Minimum thickness shall be governed as under, unless otherwise specified in the item.

AREA of Glazing	Max. Unsupported length	Thickness
For glazing area up to 0.5 sqm	120 cm	4 mm
For glazing area more than 0.5 sqm	120 cm	5.5 mm

- iii. Glazing for toilet and in fixed ventilators shall be of frosted type.

e. Shutters:-

- i. Factory made shutters, as specified shall be obtained from factories to be approved by the Engineer – in - charge and shall conform to IS 2202 (Part –I) 1977. The contractor shall inform well in advance to the Engineer – in – charge the name address of the factory from where the contractor intends to get the shutters manufactured.
- ii. The contractor will place order for manufacture of shutters only after written approval of Engineer – in – charge in this regard is obtained. The contractor is bound to abide by the decision of the Engineer – in-charge. In case the factory already proposed by the contractor is not found competent to manufacture quality shutters, the Engineer – in – charge will recommend the name of another factory from the approved list.
- iii. The contractor will also arrange stage wise inspection of the shutters at factory with the Engineer in charge or his subordinate authorized representatives. Contractor will have no claim, if the shutters brought at site are rejected by the Engineer in charge in part or in full lot due to bad workmanship / quality or damages caused during their shifting from factory to site. Such shutters will not be measured and paid and the contractor shall remove the same from the site of work within 7 days after the written instruction in this regards are issued by the Engineer in charge or his authorized representatives.

6. STEEL GRILL WORK:

- a. All steel grills shall be according to the Architectural detailed drawings and obtained from approved suppliers. These shall conform to Latest CPWD Specifications for works.
- b. In case of grills an approved quality priming coat of zinc chromate shall be applied over and above a shop coat of primer. Nothing extra shall be payable for providing shop coat primer, but the zinc chromate primer will be paid for separately.
- c. The welded steel works shall be tested for quality of weld as laid in IS 822-1978 before actual erection.

7. ALUMINIUM WORK:

- a. The scope of the work is the fabrication, supply and erection at site of all types of Aluminium glazed doors, windows and ventilators in accordance with the drawings and specifications.
- b. The supply and erection will include all parts such as but not restricted to frames, tracks, guides, mullions, styles, rails, couplers, transoms, rails, plates glazing bars, glass, hinges, arrangement, spring catches, cord and pulley arrangements, spring catches, cord and pulley arrangements door closers floor springs etc., required for the whole work whether the parts/ items are individually and specifically referred to in the schedules/ specifications/drawings or not provided that the supply

and installation of such parts can be inferred there from and are necessary to make the work complete, unless separate provision is made in the bills of quantities for supply to such parts/items.

- c. The doors, windows, ventilators, will be fabricated to suit the finished clear openings in the building/structure which the tenderer will himself measure.

d. Materials:-

- i. The members will be made out of aluminum alloy corresponding to IS:733 and will consist of extruded sections and of other shapes, and to sized gauges as shown in the drawings/ described in accordance with the relevant IS codes. The members shall be chosen to provide strength/ stability and maximum resistance to wear and tear.
- ii. The Sections will be as per approved makes, extruded sections. As indicated in the drawings the tenderer should specifically mention which sections he is using.
- iii. The weight of sections and the corresponding catalogue numbers are mentioned. The IS specifications are to be strictly adhered.
- iv. The alloy of extruded aluminum should be BS or IS old HE9, Alcon 50 SWP to this effect test certificate has to be provided from the extruder.

e. Finishing:

- i. The extruded aluminum section has to be mechanically finished to remove all scratches; extrusion marks etc and subsequently thoroughly cleared in all alkali baths prior to anodizing.
- ii. The polyester powder coating, if required as per item of work, shall be of desired shade with minimum average thickness to 50 microns or other shades as required and to this effect the tenderer must have to produce test certificate from authorized institutions Bureau of Indian Standard.
- iii. The polyester powder coated material should be properly wrapped in gummed tape before fabrication to avoid scratches during fabricated and erection shall be kept protected till handing over.

f. Fabrication:

- i. Before commencing the fabrication the contractor shall submit to the Engineer – in - charge for their approval detailed shop drawings, based on the Architectural drawings and corresponding specification showing junctions, fittings, accessories such as hinges flush bolts, locks, latches, latching arrangements, peg stays, rotor arms, anodize pivots gaskets rubber packing door felts, mastic, sealant etc., including fixing and sealing arrangements . Type and method of scaffolding he intends to use, Fabrication is to be taken up only after approval by the Engineer – in - charge and in accordance with the approved drawings. Sections for fabrication of door/ window/ventilators etc shall be as per architectural drawings or as approved by the the Engineer – in - charge.
- ii. A sample of finished door / windows/ ventilator railing etc.shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication,
- iii. The doors, window, ventilators and partitions shall as per thickness given in the BOQ item / specifications, Polyester Powder coating shall be as specified in the item specifications.
- iv. All materials shall conform to relevant IS. Codes and in the absence of IS code, they should correspond to the best engineering practice; decision of the the Engineer – in - charge shall be final and binding on the contractor.
- v. Fabrication shall be done true to the drawing/ sample approved and in correspondence to the finished openings at the site. All joints shall be mitered at the corners, true right angles, and

joints to be finished neatly to hairlines, with concealed fasteners, wherever possible joints shall be made in concealed locations.

- vi. All fabricated/finished items shall be packed and carted properly to site to prevent any damage in transit. On receipt at site they shall be carefully stacked in protected storage to avoid distortion/damage.
- vii. Site installation shall be with concealed screws, self-tapping or other approved fasteners or may be by welding, due precautions shall be taken to avoid any distortion/ discoloration /damage to the finished items.
- viii. Wood work faces /parts coming in contact with masonry shall before shifting to the site be given a heavy coat of alkali resistance bitumen paint. Steel items coming in contact with other incompatible materials shall be given a thick coat of zinc chromate primer.
- g. **Glazing:** Glazing shall be done with flawless sheet glass of best approved quality without waviness, distortion, coloration / discoloration, of specified thickness in sizes as shown in the drawings, fixed as required with special glazing clips, putty, neoprene/PVC gaskets. All glass shall be cleaned thoroughly before they are fixed in position. Unless otherwise specified the minimum thickness shall be 5.5 mm thick.

8. **FIRE CHECK DOORS:-**

a. **General:-**

- i. The door shall be procured from approved manufacturer of CPWD / CBRI. The fire and smoke / hot gases check door shall be conforming to IS-3614 (Part-II)). The manufacturer shall have a prototype door tested and certified by CBRI Roorkee, of 120 min. fire rating confirming to BS : 476 part 22 & IS : 3614 Part II .
- ii. The fire and smoke / hot gases check door shall not collapse during the rated period of the fire under the specified fire conditions.
- iii. The fire and smoke / hot gases check door shall not allow the passage of hot gases or the flames through the rebate of the gap between the door frame and shutter or through the holes, developed in the shutter during fire.
- iv. **Material:** -Door frames and shutter shall be made from materials specified in the bill of quantities. In this work, wooden door frames and shutters are specified.
- v. **Shop drawing:-** The contractor shall submit including required designing shop drawing for doorframes, shutters complete with
 - a. Plan, elevation with relative position of adjacent works
 - b. Glazing details with type size and fixing
 - c. Fitting and fixtures with type size, brand and fixing details.
 - d. Finishing details.
- vi. **Sample Approval:-** A sample of fire check door including fittings and fixtures, shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication

- b. **Door Frames:** - Door frame shall be manufactured from 2nd class teakwood (Ivory Coast) door frame of section as per BOQ. It shall have heat activated intumescent fire seal strip of section 10mm x 4mm 2 No. of approved make. The frame shall be coated with one coat anti-termite fire retardant primer of approved brand.

c. **Door Shutter:-**

- i. The Door shutter shall be of thickness 50 mm minimum but not more than 55mm or as per BOQ, suitable for mounting on the door frame. It shall comprise of two non-combustible boards 12mm to 18 mm thick sandwiching 10 mm to 20 mm fire resistant insulation filler veneered with 3mm thick commercial ply on both faces and pasting of minimum 1 mm thick laminate over wooden fire comprising of two 12 mm thick calcium silicate board of approved brand a 100% without Asbestos, Bructile and merschaum, having density not more than 1150 kg/m³ and thermal conductivity 0.14 W/m K sandwiching 20mm thick fire resistance insulation filler coated with FR silicon sealant and face with 3mm thick commercial ply facing on both side and faced 1.5mm laminate on both sides with heat activated intumescent fire seal strip of size 20mm x 4mm of approved mounted in the grooves of teakwood lipping on all sides except bottom.
- ii. The intumescent sealant shall be used to fill the gaps between board and internal wooden lipping.
- iii. **Vision Panel:-** Vision Panel shall be rated vision panels with 6mm thick clear glass (2 hours fire rating) made from Spin turned Rings (380mm dia circular vision panel) or press formed (300mm Square vision panel). Glass shall be fixed with glazing gasket of self-sticking ceramic glass fibre having a classification temperature of 1260° C.
- iv. **Finish:** - The door frame and door shutter shall be finished with thermo setting acrylic paint for scratch resistance and durability. The paint shall be of approved brand and quality.
- v. **Ironmongry Hinges:** - Stainless steel ball bearing butt hinges, 3mm thick shall be fixed flushed to the frame and shutter.
- d. **Lock:** - Mortice sash lock with internal thumb turn and external key operation with lever handles shall be provided.
- e. **Flush Bolts (For Double Door):-** 300mm concealed extended lever action flush bolts satin finish, fixed to top and bottom of the inactive blade shall be provided.
- f. **Automatic Door Closer:** - Dual adjustable speed automatic door closer with rack and prinion method shall be provided.
- g. **Smoke Seals:** - Heavy duty smoke seals for smoke check doors shall be provided.
- h. **Acoustic Seals:** - Acoustic seals of appropriate design duly fixed in shutter as well as door frame shall be provided.
- i. **Opening Width:** - Opening width of door mentioned in the drawings shall be width measured with both door shutters fully open in straight position.
- j. **Measurement:** - Frames and shutters shall be measured in square meter out to out.
- k. **Testing:** - The Engineer – in - charge holds the right to get the door tested for fire rating at the cost of the contractor/vendor. In case the Engineer-in-charge desires to get the doors tested, then one door shall be selected at random out of the entire lot and shall be tested for two hour fire rating. The testing shall be got done from either CBRI, Roorkee or from any other laboratory approved by the Engineer-in-charge. The cost of material for testing and transportation / packing & other incidental testing charges shall be borne by the contractor. In case the door fails to meet the requirement, the entire lot shall be rejected.
- l. **Rates:** - The rates shall be inclusive of all material, T&P, Labour, etc. complete including the cost of fittings, testing etc. as described above.

9. GLASS ENTRANCES AND GLAZING WITH PATCH FITTING

a. General

- i. The contractor shall be responsible for design, fabrication, supply, installation, test and guarantee of all items including taking all measures that may be required to complete the work as per Architectural concept drawings and specifications details.
- ii. The specialist agency engaged to carry out the external glazing installation and supply shall have at least 5 years of relevant experience and have completed external glazing systems of similar nature and equivalent scale of works as shown in the tender documents.
- iii. The specialist contractor shall submit an outline of recent comparable works (illustrated by appropriate drawings, sketches, photographs, brochures) by the firm / its technical partner to illustrate the competence, experience and suitability of the firm.

b. The scope of work shall include:

- i. Design, preparation of shop drawings, calculations, engineering data and test reports.
- ii. Fabrication and installation of Glass Entrances and Glazing with Patch Fittings system.
- iii. All anchors, fixings, attachments, reinforcements, steel reinforcing for mullions and transoms required for a complete installation, except those specifically indicated as being provided by other trades.
- iv. Exposed Architectural mullions and other support members.
- v. Finishes, protection coatings and treatments.
- vi. Sealing with approved sealants within and around the perimeter.
- vii. All thermal insulation, firesafing etc. including supports and/or backing.
- viii. All caulking, sealing, electrometric and metal flashing, and gaskets including sealing at junctions with roof, ground-floor waterproofing and building expansion joints between structures.
- ix. Electrical bonding and earthing of all metal cladding elements.
- x. Provisions to receive electrical outlets and cutouts for conduits and other electrical work.
- xi. Glass and glazing.
- xii. Transportation, storage, handling, protection and cleaning.

c. Submittals

- i. Product Data: Include construction details, material descriptions, dimensions of individual components, profiles and finishes.
- ii. Shop Drawings

d. Fabrication and installation details, including followings

- i. Plans, elevations and sections.
- ii. Details of fittings and glazing.
- iii. Hardware quantities, locations and installation requirements.
- iv. Sample for verification, for each type of exposed finish required for
 1. Metal finish: 150mm long section of patch fittings, rails and other items.
 2. Glass: 150mm square, showing exposed edge finish.

e. Materials

- i. Glass

1. Glass shall be as specified in drawing or BOQ or as per design requirement. It shall be Indian / imported hard coated reflective bronze and heat strengthened glass. It shall be of approved make.
2. In toughening of Glass, rolling direction shall be parallel to the width of the glass panel such that waviness if any is parallel to the horizontal and no waviness parallel to the vertical and to ensure that such waviness is of negligible order.

ii. Components

1. Patch fittings: Stainless steel clad aluminium
2. Floating Transom Bar: Steel clad in metal matching fittings and in sizes recommended by manufacturer for application indicated. Include stainless steel support rods, lateral adjustment and ceiling channel. Support fins to be metal, finished to match transom bar.
3. Rails: Stainless steel clad aluminium.
4. Accessory Fittings : Matching with patch fittings and rails metal and finish for overhead door stop, Centre hosing lock, glass support fin brackets and other as shown in drawing.
5. Anchors and fastenings: Concealed
6. Weather stripping: Sweep type

iii. Hardware

1. Hardware should be heavy duty in matching finish
2. Concealed Floor Closer and Top Pivots
 - a. Centre hung; BHMA A156.4, Grade 1; including cases, bottom arm, top walking beam pivots, plates, and accessories required for complete installation.
 - b. Swing : Double acting; Positive dead stop, concealed with hold open angle
 - c. Delayed action closing
 - d. Concealed Overhead Holder: Grade 1, with dead stop setting coordinated with concealed floor closer.
 - e. Push-pull set : Stainless steel finish
3. Lock set of approved make.

f. Fabrication

1. Provide holes and cutouts in glass to receive hardware, fittings, rails and accessories before tempering glass. Fully temper glass using horizontal (roller-hearth) process and fabricate so, when installed, roll wave distortion is parallel with bottom edge of door or tile.
2. Factory assembled components and factory installed hardware to greatest extent possible.

g. Execution

1. Examine areas and condition for compliance with requirements for installation tolerances and other conditions affecting performance of work.
2. Install all glass system and associated components according to manufacturer's written instructions.
3. Set units in level and plumb.
4. Maintain uniform clearances between adjacent components.
5. Lubricate hardware and other moving parts according to manufacturer's written instructions.

6. Set, seal and grout floor closer cases as required suiting hardware and substrate indicated.

h. Cleaning

1. The Contractor shall ensure that all actions are taken during installation to eliminate the effects of corrosive substances on the finishes.
 2. The Contractor shall clean both internal and external surfaces to remove corrosive substances, dust or cement / mortar dropping during the installation as may be directed and instructed by the Engineer – in - charge.
 3. The internal surfaces of glass and aluminum frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.
 4. The Contractor shall provide written verification that cleaning agents are compatible with aluminum, stainless steel, glass coatings, granite, glazing materials and sealants. In no case shall alkaline or abrasive agent be used to clean the surface. Care shall be taken during cleaning to avoid scratching of the surface by grit particles.
 5. Prior to snagging inspections the Contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all glass and aluminum.
 6. The Contractor shall also make good any physical damage to the structure including scratches, dents, abrasions, pitting, etc. to the satisfaction of the Engineer – in - charge.
 7. Manufacturer's delivery or job markings on glass and adhesive for manufacturer's labels shall be either a neutral or slightly acidic material. In no case shall such material be alkaline; any staining of glass by alkaline material will be cause for rejection of the glass.
 8. After the installation of each pane of glass all markings and labels shall be carefully and completely removed from the panes. Thereafter no markings or labels of any sort shall be placed on the glass.
 9. Glazed openings shall be identified by suitable warning tapes or flags attached with a non-staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall not be in contact with glass.
 10. As soon as it is practically possible after the issuance of the occupation Permit for the Building, the Contractor is to carry out a complete cleaning of the external face.
- i. **Performance Guarantee:** The contractor shall offer a minimum of 10 year Performance Warranty for the entire installation carried out.
 - j. **Measurements:** - Measurements shall be in Sq m of actual area covered.
 - k. **Rate:** - Rate shall include all required labour, material, designing, drawing conveyance, testing at approved laboratory breakage, wastage, supervision, protection till hand over and free maintenance during defect liability period etc. complete.

10. FLOORING:

- a. The flooring in the building shall be as per the approved floor finish drawings and laid in such a way that limits in floor levels would not exceed the limits provided in the latest CPWD specifications or manufactures specifications.
- b. Wherever Vitrified Tile flooring is done, it shall be with multy grade/range 1st Quality tiles.
- c. Slope in floors shall be provided as per architectural drawings, else the levels at any place when checked over a distance of one meters in any direction should not show variation in floor level more than 3 mm.

- d. Rate for the items of flooring is inclusive of provision of sunken flooring and finishing edges of the same in bath kitchen, toilets, cutting holes for traps/ pipes etc., and nothing extra shall be paid on this account unless otherwise specified.

11. FALSE CEILING: - False ceiling items in general are carried out as per the description of the item in the Bill of quantities and also as per the manufacturer's specifications / as directed by the Engineer – in – Charge. Location of particular type of false ceiling shall be as per relevant drawing, in its absence written approval of the Engineer – in - charge shall be obtained.

12. ALUMINIUM COMPOSITE PANELS (ACP) CLADDING

- a. Scope of Work includes providing and fixing Aluminium Composite panel cladding including framing as per the elevation, section and the plan drawings provided, fabricated out of heavy duty Aluminium extruded profiles conforming to alloy 643900 WP with chemical composition and mechanical properties as per IS-733 and as per specifications. The scope of work shall be read in conjunction with the specification of curtain walling / structural Glazing System.
- b. The contractor shall design, supply, fabricate, deliver and install and guarantee all construction necessary to provide a complete aluminium composite panel cladding, complete with all necessary anchors, hardware and fittings to provide a total installation, fully in conformity with the requirements and intent of the drawing and specification as per item description.
- c. The contractor shall design the cladding as per the prevalent site conditions and building elevations profiles. The design parameters shall be in conformity the structural glazing system. No extra claims shall be entertained at any stage for aluminum profile/ wall thickness and size dimensions. The Contractor must quote rates accordingly.
- d. The anchoring / bracing of the wall cladding to the RCC beams/ columns shall be done with non-corrosive galvanized brackets of approved design, (Galvanizing to be done conforming to IS 4759-1996 up to 610 gms. Per Sq. M. (80- 90 micron thickness).
- e. The framework shall be aligned for the entire height of each Mullion and of the entire width of each Transom by laser beam equipment to ensure 100 percent 'X' axis and 'Y' axis alignment.
- f. The system should also provide for pressure equalization. The details for pressure equalization to be submitted by the contractor and got approved by the Engineer-in-charge.
- g. EPDM Gaskets of suitable profiles (to accommodate shall be provided including the labour element for fixing in appropriate locations is to be included in the rate).
- h. The Periphery of the framework shall be sealed both from inside and outside with silicon weather sealant to make the cladding watertight.
- i. Cost of Aluminium composite panel consisting of a core of polyethylene sandwiched between two aluminium skins of 0.5mm thickness with a mild edge. 4 mm total thickness with surface finish of PVDF coating as approved by the Engineer-in-charge, as shown in the elevation, plan and cross section drawings along with labour element for cutting stacking, carrying to heights and fixing to appropriate locations is included in the rates.
- j. All the vertical and horizontal section grooves are to be sealed non staining silicon sealant of make as specified in the list of approved make to make the entire system synchronous with the basic structural glazing/curtain wall structure and also make the system air tight and watertight. The

fixing details should be got approved by the Engineer-in-charge. The peel off foil should be removed at the time of handing over as may be required by the Engineer-in-charge.

- k. Any joint provided between cladding elements to cater for individual panel installation and shall be sealed off with extruded EPDM gasket or silicon sealant.

l. Product

- i. ACP shall be as approved with high fibre filled sandwiched panel 4mm install on Aluminium framing and Galvanised brackets. Aluminium cladding panel to be PVDF fluorocarbon coated factory applied colours. Reverse side to be in mill finish. All the joints shall be sealed with silicon sealant of approved make. The colour of sealant to be decided by Engineer-in-Charge.
- ii. A sample of panels and installation methods to be submitted to the Engineer-in-Charge for approval.

m. Manufacture

The panels must be visually flat. Any stiffener applied to compensate for wind load must not read through.

n. Installation

The panels shall be fixed in accordance with manufacture's recommendations.

o. Technical Properties of Aluminium Composite Panels

A	Composition	4.0 mm thick aluminium composite panel comprising of high mineral filled core sandwiched between two skins of aluminium alloy, Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene.
B	Dimensions	Panel thickness : 4mm
C	Tolerance	Width ± 2.0 mm Length ± 4.0 mm Thickness ± 0.02 mm
D	Principal Properties	Panel weight: 5.5 kg/sq.m Thermal expansion: 1mm/M/60 deg.C. Moment of Inertia: 0.347 cm ⁴ /m
E	Acoustic Properties	Average airborne sound transmission loss R/N 25db (DIN 4109)
F	Mechanical Properties	Tensile strength ≥ 130 N / mm ² 0.2 % proof stress 90 N / mm ² Elongation 5 % Modules of elasticity 70,000 N/mm ²
G	Thermal Transmittance	R = 0.014 m ² °C/W
	Finish	PVDF stove lacquered (Fluoro carbon) on one side and reverse side in mill finish.
	Colour	Colour to be selected by Engineer-in-Charge using standard PVDF colour chart from manufacturer.
	Panel size: Width	1000 / 1250 / 1500mm
	Length between	1500 and 5000mm
	Aluminium Extrusions	Extrusions shall be of aluminium alloy 6063 T5, conforming to BS-1470 – 1475: 1972 in mill finish.

- p. **Protection:** The finished surface shall be protected with 80 microns self adhesive Peel Off film with two layers of white and black tested to withstand at least 6 months exposure to local weather condition, without losing the original peel off characteristic or causing stains or other damages. Protection should not be removed until after installation.

- q. **Warranties;** The Contractor shall provide a data to confirm compliance with specific requirements for resistance and fire properties. The guarantee should be for a 20 salt spray resistance and fire properties. The guarantee should be for a 20 year period against peeling chalking (No. 8 rating), fading, blistering, flaking, chipping and cracking.
- r. **Measurement:** The measurement shall be for exposed actual surface area with grooves cladded on plain/ curved surface excluding the concealed trims.
- s. **Technical Data:** - The technical data provided hereunder is for guidelines. The data, specific for the site location, shall be got approved by the contractor from the Client/ Engineer-in-Charge for the design of the ACP and structural Glazing System.

i. **Design Wind Loading**

- 850 N/m² positive and negative to Podium.
- 1150 N/m² positive and negative to Tower.
- 1500 N/m² positive and negative to Crown to Tower.

No cladding element shall sustain permanent deformation of failure under loading equivalent 1.5 times the design wind pressure specified.

ii. **Deflection**

Deflection of any aluminium frame shall not exceed 1/175 of the clear span.

iii. **Expansion and Contraction**

The cladding shall be so fabricated and erected as to provide for all expansion and contraction of the components. Any temperature change due to climatic conditions shall not cause harmful buckling, opening of joints, undue stress on fastening and anchors, noise of any kind or other defects.

iv. **Flatness**

The cladding surface taken individually shall not have any irregularities such as oil canning, waves, buckles and other imperfections when viewed at any position but not less than at an angle of 15 degrees to the true plane of the panel with natural lighting of incident of not less than the same angle.

v. **Water Tightness**

The panel cladding shall be so constructed to be water tight with provision for rear ventilation.

vi. **Acoustic Treatment**

The cladding panel system shall be designed so as to dampen noise caused by splashing water.

a. **Fixings**

- i. Fastners including concealed screws, nuts, bolts and other items required for connecting aluminium to aluminium shall be of non-magnetic stainless steel.
- ii. Rivets used for fastening panel to aluminium sub-frame shall be of alloy aluminium large flange head type with stainless steel mandrel.
- iii. All fixing anchors, brackets and similar attachments used in the erection shall be of aluminium or non-magnetic stainless steel.

b. **Weather seal**

- i. All exposed joints between panels which are required to be water tight, shall be sealed

with extruded EPDM gasket of hardness approx. 75 SHORE.

- ii. All secondary weather seal shall be of self-adhesive tape as approved by the Engineer-in-charge.

13. STRUCTURAL GLAZING SYSTEM

a. Scope Of Work

- i. The contractor shall design, engineer, test, fabricate, deliver, install, and guarantee all construction necessary to provide a complete structural glazing system to the proposed building, all in conformity with the Drawings as shown. Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the Drawings and/or without limiting the generalities of the foregoing, the structural glazing Systems shall include, without being limited to, the followings:
 - Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings metal closure, windows etc.
 - All anchors, attachments, reinforcement and steel reinforcing for the systems required for the complete installations.
 - All thermal insulation associated with the system. All fire protection associated with the system.
 - All copings, end closure and metal cladding to complete the system.
 - All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.
 - Isolation of dissimilar metals and moving parts.
 - Anticorrosive treatment on all metals used in the system. Polyester powder coating aluminium sections.
- ii. The contractor shall also be responsible for providing the followings:
 - Engineering Proposals, Shop Drawings, Engineering data and Structural Calculations in connection with the design of the structural glazing System.
 - Scheduling and Monitoring of the Work.
 - Mock-ups, samples and test units.
 - Performance testing of the structural glazing framing and glazing assembly.
 - Co-ordination with work of other trades.
 - Protection.
 - All final exterior and interior cleaning and finishing of the structural glazing System
 - As-built record drawings and photographs.
 - Guarantees and Warranties.
 - All hoisting, staging and temporary services.
 - Conceptualising and design of a suitable maintenance system for structural glazing.

- iii. The water tightness and structural stability of the whole structural glazing System are the prime responsibility of the Contractor. Any defect or leakage found within the Guarantee Period shall be sealed and made good all at the expense of the Contractor.
- iv. The structural glazing system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects. Specific details should be designed to accommodate thermal and building movements.

b. Building Regulations

Structural glazing shall comply with all Government Codes and Regulations including IS codes, if any.

All structural glazing; individual aluminium and glass components and all completed work shall be designed and erected to comply with the following:

- i. Design load and deflection.
- ii. Structural glazing construction in its entirety shall be fabricated and erected to withstand without damage or permanent deformation inward (positive) and outwards (negative) pressure, all acting normal to the construction plane with a maximum deflection of not exceeding 1/175 of the clear span between structural support or 20mm maximum whichever is less.
- iii. Structural performance of all parts of structural glazing system shall conform to relevant IS codes, wind load as per IS-875 and seismic loads as per IS-1893. Deflection shall cause no permanent set in excess of 1/1000 of span nor evidence of structure failure.
- iv. **Design Wind Loading**
 - 850 N/m² positive and negative to Podium.
 - 1150 N/m² positive and negative to Tower.
 - 1500 N/m² positive and negative to Crown to Tower.

No cladding element shall sustain permanent deformation of failure under loading equivalent 1.5 times the design wind pressure specified.

c. Measurements

Measurements of the structural glazing shall be in the metric system in sq.m correct to two places of decimal. The area considered for measurement shall be net area as fixed on the exterior face of the structural glazing including open able windows as part of structural glazing. The contractor shall be responsible for verifying all the dimensions and actual conditions on site.

d. Rate

The rates shall include the cost of all the operations described above including the cost of all materials, labour, design, fabrication, erection, finishing, scaffolding and testing of water tightness etc.

e. Tender Drawings and Specifications

The tender drawings indicate profile and configuration required together with relationship to structural frame and interior building elements.

The Specification and tender drawings is of the performance type and includes only the minimum requirements of the /structural glazing Wall System without limiting the Contractor to the method of achieving desired performance.

f. Post Tender Requirements

i. Design Proposals

The contractor shall propose the final design in such a way that all basic functional and architectural requirements are fulfilled and get the same approved by Deptt. However, basic design requirements as described in the specification and other Architectural requirements such as the size of window, net glass area, ventilator, configuration of windows and spandrels shall be retained.

The design proposals shall be in the form of drawings, drawn to full scale as far as practical and specification shown in or describing all items of work including:

- Request details as indicated on the tender drawings.
- Metal quality, finishes and thickness.
- Glass quality, coating and thickness and proposed manufacturer's brand names.
- Sections of the mullion and transom together with structural calculations.
- Arrangement and jointing of components.
- Field connections especially mullion to mullion and transom to mullion.
- Fixing and anchorage system of typical wall unit together with structural calculations.
- Drainage system and provision in respect of water leakage in the curtain wall/structural glazing system.
- Provisions for thermal movements.
- Sealant and sealing method.
- Glazing method.
- Wind load and seismic load and any other specific load considered in the design.
- Lightning protection link-up system of the curtain wall/structural glazing for connection and incorporation into the lightning conductor system of the building. Design concept must be stated in the proposal.

The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case this tolerance exceed those specified in the Specification.

Any parts of the curtain wall/structural glazing, when completed, shall be within the following tolerances:

Deviation from plumb, level or dimensioned angle must not exceed 3mm per 3.5m of length of any member, or 6mm in any total run in any line.

Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle, must not exceed 9mm total at any location.

Change in deviation must not exceed 3mm for any 3.5m run in any direction.

ii. Samples

The contractor shall also submit samples of mullion and transom sections in

lengths of 300mm with the same finish and workmanship along with the proposals and 300mmx300mm samples of glass (samples to include exposed screws and other exposed securing devices, if any).

iii. Preliminary Programme

The tenderer shall also submit a preliminary programme of the contract works showing the various stages of design sampling, testing, fabrication, delivery and installation of the works.

iv. Upon approval of the shop drawings, at least 4 copies shall be submitted by the Contractor.

v. The Contractor/Sub-contractor shall submit a maintenance manual for the curtain wall/structural glazing system inclusive of all metal parts, glass and finish etc.

vi. During detailed design and execution any details may increase as per actual requirement at site, these variations shall be executed without any extra cost implications to the client.

g. Execution:- Performance Testing

The performance tests are to be conducted on the structural glazing system, if the area of the structural glazing system exceeds 2500 Sq.ms from the certified laboratories accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories), Department of Science and Technology, India. The decision of the Client/Engineer-in-charge about the necessity of testing of shall be final and binding.

i. General Requirements

Mock-up units shall be constructed by the contractor and tested to determine the structural stability as well as air and water infiltration or leakage at glazing beads and all other joints designed into the façade.

After approval of structural calculations and shop drawings for the structural glazing, one (1) Test Unit for performance testing of the structural glazing shall be constructed by the contractor at a laboratory approved by the Department (Refer BOQ).

Erect mock-up under manufacturer's/installer's direct supervision and employ workmen as they would be employed during the actual erection at the job site.

Test procedures test schedules and test locations shall be submitted to Client for approval before testing.

Prior to fabrication of Test Units, the contractor shall submit shop drawings and calculations of the Test Unit for the Engineer-in-Charge's approval.

Production for final job site erection shall not start until approval has been obtained as a result of the mock-up test.

ii. Test of Wind Pressure

The equivalent load of wind pressure or wind suction shall be given to the Test Unit as increasing or decreasing the inside pressure in the 'Pressure Chamber' at which the Test Unit is fixed.

The static wind pressure shall be applied up to 1.5 Kpa at maximum wind pressure. The variation of dynamic pressure shall be of any approximate sine-cure-line.

Deflection on each observational points of the Test Unit shall be observed and

recorded under the Static pressure as described above.

Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.

The deflection on the main structural parts in these conditions shall not exceed:

1/175 of the span between supports or 20mm, whichever is the lesser for vertical elements.

1/250 of the span between supports for horizontal elements.

The extent of recovery of deformation 15 minutes after the removal of the test load is to be least 95%.

iii. Test of Lateral Deflection Per Floor Height

Lateral deflection per floor height shall be occurred on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

The deflection of every + 2.5mm shall be increased upto + 13mm on the Test Unit (Static Deflection Test).

The dynamic deflection shall be applied upto + 13mm.

The variation of dynamic deflection shall be of an approximate sine-curve-line, one period of 3 seconds.

The dimension of the deflection on each observational points of the Test Unit shall be measured under the condition as described above, the damage shall be observed.

Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall/structural glazing except sealant at maximum deflection.

iv. Test of Water-tightness

Water shall be sprinkled to the Test Unit under the wind pressure. Pressure shall not be applied to the Test Unit.

The volume of the sprinkling water in one minute shall be 5 litres/m² min. (0.1 gal/sq.ft.).

All water leakage and drainage system at the joint and openable sash of the curtain wall/structural glazing system shall be observed from the outside of the chamber.

Hold the test 2 times, in sequence as described below, conforming to the above mentioned conditions.

Install the test unit.

Hold 1st water-tightness test.

Hold test of wind pressure as described above. Host 2nd water-tightness test.

Lateral deflection test.

Water leakage at all parts of the Test Unit shall not be observed inside during the 1st water- tightness test.

v. Test Report

The Contractor is required to submit five (5) copies of test reports to the Client.

vi. Cost of Performance Test

The Contractor shall allow in his tender for the cost of the performance testing and of fabrication, erection, corrections to and demolition of the Test Units including any special provision required in the testing laboratory for the tests mentioned above.

The Contractor shall allow for amendments and adjustments to the mock-up as required by the Employer.

If the Test Unit fails to pass the initial testing, the Contractor shall make the necessary corrections to the Test Unit and shall have to get the Test Unit retested by the Testing Laboratory till it passes the tests.

Cost of corrections to the Test Unit and cost of re-testing shall be borne by the Contractor at no additional cost to the Employer.

vii. Shop Drawings and Calculations for the Performance Testing

Prior to fabrication of Test Unit, the Contractor shall submit shop drawings and calculations of the Test Unit for Client/employer's approval.

viii. Record Drawings

The testing laboratory shall keep copy of approved Test Unit shop drawings and calculations at testing laboratory during testing of Test Unit.

The testing laboratory shall accurately and neatly record on the above mentioned shop drawings all changes, revisions, modification etc. made to Test Unit, which shall become the record drawings.

At completion of testing and after approval of test reports the testing laboratory shall submit the marked-up record drawings to the Client.

ix. Contractor's Representatives

Full time attendance by Approved Representatives of the Contractor & subcontractor associated with the erection of curtain wall/structural glazing shall be provided for the erection of the Test Unit and for all testing of the Test Unit.

h. Performance Guarantee

The tenderer shall provide a performance guarantee of requisite value to be indicated in the General Conditions of Contract for a period of five years, to provide for expenses, to cover the risk and cost of rectification of defect, noticed during the five years guarantee period. Guarantee period to start from the date of completion of the project.

14. STAINLESS STEEL RAILINGS

- a. The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the stainless steel railing till completion and handing over of the work.
- b. The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-in-Charge.
- c. The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns. The details of the joints in the stainless steel railing including location, etc. shall also be shown in the shop drawings.
- d. The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock

up for approval of Engineer-in-Charge / Consultant. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge / Consultant. The mock-up shall be dismantled and removed by the contractor as per the directions of the Engineer-in-Charge. Nothing extra shall be payable on this account.

- e. The stainless steel shall be of grade 304 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.
- f. The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade. Nothing extra shall be payable on this account.
- g. One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.
- h. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.
- i. The item includes the cost of all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T & P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.
- j. The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.
- k. The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of Engineer-In-Charge.

15. GLASS:

- a. All glass and glazing material shall be verified and coordinate with the applicable Performance requirement.
- b. All glass shall be cut to require size and ready for glazing. All glass shall be accurate sizes with clear undamaged edges and surfaces which are not disfigured. Any panel which does not fit any section of the curtain wall and shop front will be rejected and a replacement made at the Contractor's expense.
- c. Glass shall conform to the quality, thickness and dimensional requirement specified in US Federal specifications DD – G0415C.
- d. Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm with in 260mm of leading or trailing edge, or 0.076mm in centre. Direction of ripple shall be consistent and is acceptable to Engineer-in-Charge. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be unidirectional and surface compression shall be in the range of 320-450 Kg/cm². All glass shall be delivered to site with the manufacturer's label of identification attached.

- e. The glass glazed panel / structural glazing frames for the structural glazing system shall be designed to withstand lateral imposed loads and comply with requirement of local building codes.
- f. Glass shall be free from defect or impurities detrimental to its performance. Defects such as bubbles, waves, spots scratches, spalls, discoloration, visibly imperfect coating, chipping, and bubbles delaminating of opacifier film shall be limited in accordance with the Manufacturer's / trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass should be consistent in colour.
- g. Double glazed units shall be procured only from approved manufacturer. Quality control tests shall be performed for mixing, curing, adhesion and dew point. The unit shall be guaranteed against condensation and dirt between the panes, failure of seal and damage to internal coating.
- h. All glass breakage caused by the Contractor or his sub-contractor because of negligence or caused by the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.

16. WATER PROOFING TREATMENT:

All the items for water proofing treatment with cement based water proofing treatment for roof slab and sunken portion in schedule of quantities shall be guaranteed for TEN YEARS the case of cement based treatment by the contractor as per Performa prescribed. The water proofing treatment work should be got done through specialized agency approved by EIC.

17. INTEGRAL CEMENT BASED WATER PROOFING TREATMENT FOR ROOF /SUNKEN FLOORS OF W.C'S ETC.

- a. The proprietary water proofing compound shall conform to I.S.2645 – 1975 in cement based water proofing treatment, stone aggregate shall be used instead of brick aggregate without any extra cost wherever required by the Engineer in – charge.
- b. The finished surface after water proofing treatment shall have required slope.
- c. While treatment of sunken floors is done it shall be ensured that the 'S' or 'P' traps as the case may be have been fixed / eased and rounded off properly the work shall be carried out as per relevant CPWD specifications.
- d. **GURANTEE:** The above water proofing, treatment shall be guaranteed for TEN YEARS against any leakage etc. the contractor shall have to execute a bond, 10 % of cost of items executed for water proofing shall be retained for 10 years as security (Refer GCC provisions)

18. CLEAN ROOM PARTITIONS

a. Wall panels (80mm thick)

- i. The Wall panel shall be double skin type, 80 mm thick, sandwiched with self-extinguishing quality PUF of density not less than 40 ± 2 kg/cum. The inner and outer skin shall be of powder coated steel sheet, the thickness of inner skin and outer skin of the panel shall not less than 0.8mm GPSP GI Sheet with epoxy polyester powder coating both side of the panel shall be smooth finished and both side of the panel shall be off- white colour, the coating thickness shall be not less than 80 microns including the primer and finished coat, the panels shall be covered with peel off film to ensure that the material is protected against scratches and indentation during transit and storage The Panels are designed to have a flush finish with coved corners for easy cleaning.

- ii. The wall panels shall have a recessed male edge on one side and roll formed female edge on the other side, which creates an interlock, thus ensuring panel finished and snug insulation to insulation fit. All the wall joints shall be filled with suitable length as required in a continuous length lamination. All the wall joints shall be filled with suitable sealant material.
- iii. Suitable reinforcement shall be provided between the panels from the floor to ceiling wherever the room doors are shown in the drawing.
- iv. Clean room walls shall have view windows of size not less than 900mm width X 1100mm height placed at 1000mm above the ground level on the wall panel of the modular clean room and these double glass view windows shall have toughened glass panels of thickness not less than 5mm and all the joints between toughened glass and wall panels shall be sealed. These view windows (glazed) shall be covered with yellow films
- v. Wall panels shall be fixed with necessary bottom floor track and top runner 'U' channels, anchor fasteners screw etc., for fixing the door suitable 'L' and 'C' sections shall be used, All the wall joints shall be filled with suitable sealant for effective sealing.
- vi. Suitable Coving of Radius 50 mm made out of anodized Aluminium material shall be fixed along the joints between wall & the Floor, wall & the false ceiling joints between the Wall panels, 3D covings at the Corners as required.
- vii. The wall panels shall be embedded with conduits for wiring and utilities etc., wherever required. The panels shall be offered for inspection for Site Engineers during fabrication at manufacturing works if required. The supplier shall furnish test certificate indicating the values of epoxy polyester coating coverage, powder coating thickness, material of inner and outer skin, thickness of inner and outer skin etc., as applicable for panels.

b. Ceiling Panels

- i. Ceiling panel shall be double skin type ,44 mm thick, sandwiched with self-extinguishing quality PUF of density not less than 40 ± 2 kg / cum .The inner and outer skin shall be of power coated steel sheet, the thickness of inner skin and outer skin of the panel shall not less than 0.8mm the powder coated GPSP GI sheet shall be hot dip galvanized with epoxy polyester powder coating not less than 180 gm / sq m both side of the panel shall be smooth finished and both side of the panel shall be off white color, the coating thickness shall not be less than 50 microns including the primer and finished coat, the panels shall be covered with peel off film to ensure that the material is protected against scratches and indentation during transit and storage.
- ii. The Ceiling panels shall have a recessed male edge on one side and roll formed female edge on the other side, which creates an interlock, thus ensuring panel finished and snug insulation to insulation fit. All the wall joints shall be filled with suitable length as required in a continuous length lamination.
- iii. Necessary services/trap doors shall be provided to the false ceiling for maintenance on the top of the false ceiling.
- iv. All the joints and corners between ceiling and wall panels, wall panels and wall panels, wall panel to floor of modular clean room shall be provided with Aluminium R 50 coving same panel finish and color.
- v. The panels shall be offered for inspection for Site Engineers during fabrication at manufacturing works.
- vi. The suppliers shall furnish test certificate indicating the values of epoxy polyester powder coating thickness, materials of inner and outer skin, thickness of inner and outer skin etc., as applicable for panels.

c. Cut out in Wall panel and Ceiling panel

- i. Cut-outs wherever required shall be provided in the wall panel/ceiling panel as applicable for fan filter units, terminal HEPA filters, light fixture, return air grills, power sockets, communication outlets, LAN outlets, cables. pipes, exhaust ducts, gauges, smoke sensors, pendants, utilities, etc, as required.
- ii. All cut-outs made in the wall panel and ceiling shall be finished properly as required for clean room environment.

d. Clean Room Doors

- i. Flush door, roller hinged type single leaf shall be fabricated out of similar material to wall panels as mentioned in the tender specification above, the size of the single door shall be 900mm x 2100 & Double Doors shall be 1500 mm X 2100 mm, single leaf emergency door shall be 900 x 2100mm clear size measured inner to inner of frames, subject to site requirements.
- ii. The view window of size 900mm width x 1100mm height placed at 1000mm above floor, subject to site requirements, shall have 5mm thick double glass duly fixed and sealed to the door panels. The door shall be provided with door closer and lock. The door handles, push plate and hinges shall be of stainless steel. The thickness of door shall not be less than 44 mm.
- iii. Nothing extra is payable for change in size of door/ windows as per site requirements.

e. Clean Room Emergency Doors

- i. Flush door, roller hinged type single leaf shall be fabricated out of similar material to wall panels as mentioned in the tender specification above, the size of the single door shall be 900mm x 2100 & Double Doors shall be 1500 mm X 2100 mm, single leaf emergency door shall be 900 x 2100mm clear size measured inner to inner of frames, subject to site requirements.
- ii. Nothing extra is payable for change in size of door/ windows as per site requirements.

19. Flooring for Microbiology Lab

Heavy duty coloured Epoxy flooring, complying with flooring requirements as per Good Laboratory Practices norms as detailed as per specifications in the Bill of Quantity.

20. Antibacterial Paint

- a. The Antibacterial Paint shall be able to provide anti-Microbial Protection:
- b. The scope of work includes providing & applying approved makes anti-Microbial Paint on wall surfaces as per manufacturer's specifications complete in all respect & as directed by Engineer-in-charge. Following are the desired characteristic of the paint:
 - i. Protection: The product hygiene coatings to start the biocidal action as soon as the microorganism land on the surface, and prevents the growth of mould, bacteria and yeasts for at least 5 years.
 - ii. Lily Cycle Savings: The unparalleled durability of hygiene coatings should help to extend the maintenance cycle and to minimize all related material, labour and shut down costs.
 - iii. Chemical Persistence: The hygiene coatings should be highly resistant to abrasives, detergents and weak acids and alkalis used in cleaning regimes. Furthermore, they

can be regularly steam cleaned without any loss of performance or adhesion to the substrate.

21. BORE WELL

a. Scope of Work

The general character and the scope of work to be carried out under this contract are illustrated in the following specifications. It gives only general guidance as regards design, drilling and construction of tube wells. Before selecting the method of construction to be adopted, the contractor shall give due consideration to site condition and Geological data of the site. The construction and testing of tubewells shall be as per IS 2800- 1979 (Part 1 and 2). This contract is an item rate contract. All payments shall be made for the actual work executed. The Contractor shall ensure the required minimum yield.

b. Selection of Site

The site where the tubewell is proposed shall be examined by tenderer, and changes if required shall be discussed with the engineer prior to start of work. Any previous data available with the Contractor regarding nearby tubewells should be made use of to evolve suitable procedure for drilling, developing, testing etc.

c. Geological Data

During the drilling operation, contractor shall collect the samples of different strata from suitable intervals or where change in strata is met with. It shall be carefully examined and analysed and the data shall be preserved carefully and handed over to Engineer. The contractor shall make one drilling time log during the execution of work for the bore well.

d. Design and lowering of pipe assembly

The length and diameter of the housing pipe shall be selected on the basis of static water level, the draw down and the discharge expected from the well and the size of the pump to be installed. The size and length of blind pipes and the slotted/ strainer pipes shall be selected according to the expected discharge and the depth of tubewell. The size and distribution of the slots shall be as per IS 8110. After completion of the bore hole the contractor shall assemble the tube well assembly according to the water bearing strata met during boring, after getting the same approved from the Engineer and shall lower in to the drilled hole the same keeping the slotted strainer opposite to water bearing strata from which the water is to be extracted . The bail plug shall rest on firm ground. Before the bail plug is lowered, about one metre depth of the bore hole shall be packed with the gravel to avoid sinking of the assembly. In case part of a bore hole is not proposed to be utilized, it shall be filled with gravel before lowering the assembly. The slotted pipe and other pipes shall be provided with proper guides to keep them in the centre of the bore to ensure uniform gravel packing all around.

e. Gravel Packing

All gravel shall consist of hard rounded particles reasonably uniform in diameter and shall be of size, determined after analyzing the character of the water bearing formation tapped. The gravel shroud around the screen shall be uniform. It should be free from dust, dirt and other vegetable matters. Gravel packing once started shall be carried out continuously until it is completed. Pea gravel/Stone Chips shall be thoroughly washed.

f. Development of Borewell

The well shall be developed either by surging and agitating or by over pumping and back washing with an air lift and high velocity jetting. The tube well shall be developed as per IS 2800 -1979 or latest by air compressor to be arranged by the contractor as required and stipulated in BOQ to obtain the maximum discharge available from the completed tubewell.

Another acceptable method may also be adopted. This development process shall be continued until the stabilisation of sand and gravel particles has taken place. The development shall continue until the gravel should stop sinking, discharge of depression ceases to improve and the sand content is not more than 20 parts per million. A record of the hours of working of Air compressor shall be maintained by Employer Engineer which will be signed by the contractor or his authorised representative. Payment for development of tubewell shall be made at the hourly rate indicated in the schedule of quantities for the actual period during which the Air-Condition has worked. A statement showing the quantity of gravel initially filled in the bore and the quantity added during development should be prepared by the contractor and got signed by the representative of the Engineer.

g. Disinfection

The well shall be disinfected after completion of test for yield. All the exterior parts of the pump coming in contact with the water shall be thoroughly cleaned and dusted with powdered chlorine compound. In fact it shall be disinfected every time a new pump is installed or the one installed is replaced after repairs.

The stock solution of chlorine may be prepared by dissolving fresh chlorinated lime. For obtaining an applied standard concentration of 50 ppm, 1 litre of the stock solution shall be used to treat 300 litres of water.

h. Grouting and sealing

Grouting and sealing of tubewell may be done, if required depending upon the site conditions and the quality of the discharge of the strata encountered. To ensure that the grout shall be provided a satisfactory seal, it shall be applied in one continuous operation. Sealing of the tube well may be done by grouting the annular space between bore and the housing pipe, with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4: coarse aggregate 20 mm nominal size) to a depth of 5m below the grouted level.

i. Handing over of the bore well.

The tube well shall be handed over in complete shape. The housing pipe shall be closed by a well cap for the period between the completion of the tube well and the installation of the pump set.

The following information shall be furnished by the drilling agency on completion of the tube well:

- i. Strata chart of the tube well indicating the different types of soils met with, at different depths.
- ii. Samples of strata collected, neatly packed and correctly marked in sample bags.
- iii. Chart of actual pipe assembly lowered indicating the size of pipes, depth ranges, where slotted/ strainer pipes have been used, depth and diameter of housing pipe, reduced level of the top of the housing pipe and the diameter and depth of the bore hole.
- iv. Position of every joint in the well assembly.
- v. Hours of development done by the compressed air, pump sets or by other means.
- vi. Pumping water level at the developed discharge.
- vii. Two copies of test certificates of the water samples results from approved testing agency.
- viii. Results of development along with levels of static subsoil water and depth of draw for steady discharge.
- ix. Results of mechanical (sieve) analysis of samples of aquifer materials wherever applicable.
- x. Yield analysis and recommendation on the safe pumping yield, pump settings and specifications for suitable pumps etc.

- xi. Verticality tests results to be recorded in accordance with IS:2800-1979
- xii. TUBEWELL DATA: - Shall be decided by the Engineer-in-charge.
- j. Water for drilling – Contractor shall make his own arrangement for water required for drilling purposes as well for development purposes.
- k. The design for the tube well indicating the depth range of the aquifer zones to be tapped shall be given after a detailed study of the data collected during drilling operations.
- l. The slotted pipes should have an effective open area of at least 15% and the slotted size should be 1.6 mm. All pipes shall be painted fresh before lowering. The pipes shall be welded thoroughly all round to prevent leakage and breakage. Centering guides may be used to maintain the verticality of the tube wells which shall be tested.
- m. The annular space between the bore well and tube well assembly shall be packed with well-graded pea gravel of good quality, durability and high sphericity.

22. Restroom Cubicle System

- a. **SCOPE:** - The scope of work shall include providing and fixing of cubicle partitions as per manufacturer's guide under the supervision of the Engineer-in-charge.
- b. **GENERAL:** - Restroom Cubicle System shall be highly resistant against water, chemical and impact.
- c. **MATERIALS**
 - i. All accessories shall be made of powder-coated Aluminium grade 6063-T5. The doors, pilasters and intermediate partitions shall be 12 mm thick High Pressure Laminates (HPL) compact board (or phenolic board) with chamfered edges.
 - ii. The HPL compact boards are manufactured from sheets of special kraft and decor papers, impregnated with thermosetting synthetic resins which are fused together under heat and high pressure. HPL compact boards are laminated on both sides with suede finish. Top surfaces shall be Melamine- coated which is scratch and impact resistant.
- d. **DOORS**

All doors shall be of single colour, 12 mm thick HPL compact board with chamfered edge. Each will be supported by 3 Nylon Hinges (4 for accessible restroom) affixed to the pilaster, completed with Nylon Coat Hook and Nylon Door Knob. Door stopper channel is provided at its vertical end and incorporated with Rubber Lining to dampen noise.
- e. **PILASTERS**

All pilasters shall be of same colour as doors, 12 mm thick HPL compact board with chamfered edge, completed with Nylon thumb turn for locking doors. Colours different from the doors, if required, shall be provided as per the directions of the Engineer-in-charge. The pilaster is affixed to the Top Rail and secured from the top of the Top Rail. The floor clearance is 150 mm. all pilasters shall be supported by adjustable foot and non-corrosive steel inserts or as per approved by the Engineer-in-charge. The base of the adjustable foot shall be anchored to the floor with a clearance height of 150mm.
- f. **TOP RAIL**

Heavy-duty Aluminium H-section Top Rail Channel, 70 mm x 125 mm x 5 mm (cross-section dimension, W x H x T), shall be anchored to the wall with Mild Steel Wall Bracket. Pilaster shall be section-fixed onto the bottom slot of the Top Rail for maximum strength, stability and alignment of the system.

g. INTERMEDIATE PARTITIONS

All intermediate partitions shall be one continuous panel without any joints and of same colour as door, 12 mm thick HPL compact board with Aluminium U channel, affixed at its ends (to the wall and pilaster) with edges chamfered. For ultimate stability of the system, the length of the intermediate panel shall not exceed 1800 mm. The intermediate panel shall be anchored to the wall with powder coated or anodized Aluminium U channel.

h. ACCESSORIES

Each restroom cubicle will be equipped with the following accessories (as per BOQ):

- i. Heat & Bacteria Resistant Polyamide / Nylon door knob/ nylon door knob
- ii. Heat & bacteria resistant polyamide / nylon privacy thumb turn thumb-turn with occupancy indicator.
- iii. Heat & bacteria resistant polyamide / nylon coat hook
- iv. Heat & bacteria resistant polyamide / nylon cover gravity hinges with 3 choices of standard, gravity –to-open or gravity-to-close.
- v. Aluminum door stopper channel
- vi. Rubber door stopper lining.

i. COMPARTMENT DIMENSIONS

The compartment dimensions shall be as per site dimensions / detailed drawings. The contractor shall submit shop drawings for the approval of Engineer-in-charge prior to its execution at site. However, for guidance purpose, following are the representative dimensions subject to site conditions:-

- Width - 900 mm
- Door - 600 mm
- Depth - 1550 mm
- Height - 2105 mm (including 150 mm gap from bottom)

j. FINISHES

HPL compact boards are available in a variety of brilliant colours and wood-grains. The contractor shall get the finishes approved before execution of work at site.

k. INSTALLATION

Installation shall be executed under the supervision of manufacturer's site supervisor(s) and shall be carried out in accordance with the manufacturer's installation instructions and in accordance with the instruction / approval of the Engineer-in-charge.

l. METHOD OF MEASUREMENT

Complete work of partitions shall be measured for floor area treated. This includes all partitions, doors and related fittings and accessories.

23. SAMPLES OF MATERIALS:

- a. Sample of all materials/ fittings and fixture to be used in the work such as doors, windows, tiles, sanitary, water supply, drainage fittings and fixtures shall be submitted well in advance by the contractor for approval from the Engineer-in charge of work in writing before placing orders for the entire quantity required for completion of work. Samples approved by the EIC/ Client shall be kept in **Sample Room under the charge of EIC** and shall retain till completion of work.
- b. Finished items in respect of typical portion of works of repetitive nature such as typical room, toilet, railing, door, window or any other work desired by the engineer-in- charge shall be prepared by the contractor to the satisfaction of Engineer-in – charge and got approved from him in writing before the commencement of these items for the entire work.
- c. The requirements for preparation of samples shall be observed and fulfilled by the contractor well in advance to avoid any detriment to the general progress of work. In other words, this will not be allowed to have any effects on the general progress of work or on any of the terms and conditions of the contract. No claims of any kind whatsoever including the claims of extension of time will be entertained due to the incorporation of this requirement.

24. GRIHA requirements;

Materials shall be procured by the contractor keeping in view the recycled content to **conform** the GRIHA requirements as detailed in SCC and elsewhere.

25. VARIATION IN CONSUMPTION OF MATERIALS:

The variation in consumption of material shall be governed as per CPWD specification and clauses of the contract to the extent applicable.

26. MISCELLANEOUS: -

Materials manufacture by reputed firms and approved by Engineer – in charge shall only be used. Only articles classified as “First Quality” by the manufactures shall be used unless otherwise specified. Preference shall be given to those articles which bear ISI certification marks. In case articles bearing ISI certification marks are not available the quality of sample brought by the contractor shall be judged by the standards laid down in the latest CPWD specifications. For items not covered by the latest CPWD specification, relevant ISI standards shall apply.

27. TESTS:

- a. Materials brought at site of work shall not be used in the work before getting satisfactory test results for Mandatory tests as per relevant provisions in Latest CPWD Specifications for works. Normally, part rate payment shall be allowed in the running account bills only if the materials are tested and test results are found to be satisfactory to by the Engineer-in-charge. These tests shall be got done from laboratories certified and approved by competent central/state Governments or the laboratory set up by the contractor at site as per directions of EIC/ Consultant.

- b. The Engineer-in - charge of work shall check the test results and satisfy himself before allowing any payment in the running /final bill.

Chapter C

TECHNICAL SPECIFICATIONS PLUMBING & SANITARY WORKS

SECTION 1 GENERAL REQUIREMENT

1. Scope of work

The work shall in general conform to the Latest CPWD Specifications for works as mentioned in Schedule 'F' of the GCC. Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the schedule of quantities and/or shown on the plumbing drawings.

SECTION 2 PLUMBING FIXTURES

1. Scope of work

- a. Work under this Part shall consist of furnishing all materials & labour necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories as required by the drawings and specified in the Bill of Quantities.
- b. Without restricting to the generality of the foregoing the sanitary fixtures shall include the following:-
 - i. Sanitary fixtures
 - ii. Bath tubs, shower trays
 - iii. Chromium plated fittings
 - iv. Porcelain or stainless steel sinks
 - v. Accessories e.g. towel rods, toilet paper holders, soap dish etc.
 - vi. Whether specifically mentioned or not, the rates quoted for the installation of the fixtures, appliances and accessories shall be provided with all fixing devices, nuts, bolts, screws, hangers, fasteners as required.
 - vii. All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

2. General

- a. All sanitary fixtures, CP Fittings and CP/SS accessories shall be supplied at site of work as per manufacturers' standard supply.
- b. All fixtures and fittings shall be provided with all such accessories and fixing devices as are required to complete the item in working condition, even if the same is not specifically mentioned the Bill of Quantities, Specifications or shown on the drawings. The rate quoted will include all devices for proper fixing arrangement, nuts, bolts, screws and required connection pieces etc.
- c. Fixing screws shall be half round head stainless steel wood screws or bolts with Stainless Steel washers. Iron screws rust and will not be permitted.
- d. All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's 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, tiling or terrace shall be made good at Contractor's cost.

- e. Contractor shall provide poly-sulphide sealant appropriate for its use for all fixtures fixed near wall, marble core seal and edges.

3. Water Closets

a. European W.C.

- i. W.C. shall be any one of the following types:
- ii. Wall hung wash down or single or double siphon type
- iii. Each W.C. set shall be provided with an approved type of plastic/wooden seat of approved finish compatible and fitting appropriately with the WC set with rubber buffers and hinges. The WC seat shall be those approved and accepted for fixing on a particular type of WC.
- iv. The seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.
- v. The edge between the fixture and the wall shall be sealed with approved type of poly-sulphide sealant.

b. 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 Engineer-in-charge. The angle valve and flange shall be paid under relevant item with ablation tap.

4. Wash Basins

- a. Wash basins shall wall mounted type or for under over/counter installation as specified in the BOQ.
- b. Each basin shall be supported on MS galvanized or painted C.I. brackets and the basin securely fixed to wall or under/above counter installation. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.
- c. Each basin shall be provided with 32 mm dia. C.P. waste with overflow/ pop-up or standard waste with rubber plug and chain, 32 mm dia. C.P. brass bottle trap with CP pipe to wall and flange as specified in the BOQ.
- d. Each basin shall be provided with a single tap a hot & cold CP mixer with or without pop up waste fittings, 32 mm dia. CP cast brass bottle trap with outlet pipe and wall flange.
- e. The edge between the fixture and the wall or the counter shall be sealed with approved type of poly-sulphide sealant
- f. Washbasins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cm or as directed by Engineer-in-charge.
- g. Each washbasin connection (separately for hot and cold) shall be provided with angle valves with CP wall flange and CP connecting pipe and of required length.

5. Sinks

- a. Sinks used shall be of any of the following types:
- b. For kitchens, pantries, and designated utility rooms the sinks shall be stainless steel sinks with or without drain boards.

- c. Each sink shall be supported by **MS galvanized** or painted C.I. brackets and clips and the basin securely fixed to wall or on the counter. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.
- d. Stainless steel sinks shall be provided with 40 mm dia. C.P. basket waste with plug (as supplied by manufacturer), 40 mm dia. C.P. brass "P" trap with CP pipe to wall and flange.
- e. Each sink shall be provided with hot & cold CP mixer with approved type of a neck spout or individual taps as directed by the Project Manager.

6. Shower set

- a. Shower set shall comprise of hot & cold water mixer, C.P. shower arm with wall flange and shower head adjustable type.
- b. Mixer shall be exposed type, single lever, concealed stop cocks with diverter and spout as selected by the Engineer-in-charge.

7. Accessories

- a. Accessories shall be of any of the following types:
 - i. Towel rails
 - ii. Towel rings
 - iii. Coat hooks
 - iv. Soap dispensers
 - v. Soap dishes
- b. 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.
- c. 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.

8. Measurement & Rates

- a. Sanitary fixtures shall be measured by numbers or as specified in BOQ.
- b. Rates for all items mentioned above shall be inclusive of cutting holes and chases and making good the same, stainless steel screws, nuts, bolts, fastener and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

SECTION 3 Soils, Waste, Vent & Rainwater Pipes & Fittings

1. Scope of work

- a. Work under this Part shall consist of furnishing all labour, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings, and given in the Schedule of Quantities.
- b. Without restricting to the generality of the foregoing, the system shall include the following:-
 - i. Vertical and horizontal soil, waste, vent and rain water pipes, and fittings, joints, clamps and connections to fixtures.
 - ii. C.I. soil & uPVC rainwater pipes.
 - iii. Connection of all pipes to sewer lines as shown on the drawings at ground floor levels.

- iv. Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads/Khurras.
- v. Testing of all pipe lines.

2. General requirements

- a. All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-charge.
- b. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- c. 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.
- d. Pipes shall be securely fixed to walls and ceilings by suitable clamps intervals specified.
- e. Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

3. Piping System

- a. Soil, Waste & Vent Pipes
 - i. The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in BIS: having separate pipes for waste for kitchen sinks, showers, washbasins, AHU's condensate drains and floor drains and is approved by Engineer-in-charge.
 - ii. All waste water from AHU's plant and pump rooms, floor channels in basements will be provided with a deep seal trap before connecting to the main drain or vertical stack.
 - iii. Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement ceiling or to an external manhole directly where feasible and shown on the drawings.
 - iv. Floors of toilets, kitchens and other service areas located on structural slab are SUNK below the finished floor level (FFL).
- b. Rainwater Pipes
 - i. All terraces shall be drained by providing down-takes rainwater pipes.
 - ii. Rainwater pipes are separate and independent and connected to the storm water drainage system as shown on the drawings.
 - iii. Rainwater in enclosed courtyards shall be collected in catch-basins and connected to storm water harvesting chambers as shown in drawings.
 - iv. Any dry weather flow from waste appliances, AHU's pump rooms, shall not be connected to the sewerage system.
- c. Balcony/Planter drainage
 - i. All balconies, terraces, planters and other formal landscape areas will be drained by vertical down takes as per the landscape/architectural drawings and details
- d. Cast iron pipes & fittings (for Soil, waste, anti-siphon age pipes)
 - i. Pipes
 - 1. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. Pipes shall be centrifugally spun iron soil pipes conforming to sand cast to I.S. 3989.
 - 2. Standard weight dimensions and drip seal required for joints shall be as follows:-

- a. Sand Cast Iron Pipes & Matching Fitting shall be to I.S. 1729
- b. Centrifugally cast (spun) iron pipes and fittings to I.S. 3989

Nominal diameter		thickness	Overall Weight of 1.83 ms length	Internal Diameter of Socket	Drip seal length
Inches	mm	mm	Kgs.	mm	mm
2	50	5	11.41	76	25
3	75	5	16.52	101	25
4	100	5	21.67	129	25
6	150	5	31.91	181	38

Tolerance as per the I.S. code

e. uPVC pipes & fittings (For Rain Water Pipes etc.)

- i. Where specified, Polythene pipes shall be uPVC pipes confirming to I.S: 4985-1988. The details of the nominal outer diameter, weight and working pressure shall be as per the standards, for the respective pressure rating as specified in the B.O.Q.
- ii. Polythene pipes may be cold bending to a radius of not less than eight times of their external diameter. Pipes bent for smaller radius may be made by hot bending.
- iii. Fittings used for Polythene pipes shall be compression moulded fittings matching to the above specifications.

f. Jointing

- i. All Polythene pipes shall be Drip seal/Sealant and jointed as per manufacturer's specifications and relevant I.S codes.
- ii. All pipes shall be tested after installation for a pressure equal to twice the maximum working pressure in the line as per manufacturer's specifications.

g. Fittings

1. Fittings shall conform to the same Indian Standard as for pipes. Pipes and fittings must be of matching IS Specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.
2. Fittings shall be of the required degree of curvature with or without access door.
3. Access door shall be made up with 3 mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal later. The fixing shall be air and water tight.

h. Fixing

1. All vertical pipes shall be fixed by galvanized structural support clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).
2. Horizontal pipes running along ceiling shall be fixed on galvanized structural adjustable clamps (Clevis clamps) of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.
3. Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Project Manager/Building Contractor

for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

4. Clamps

1. Holder bat clamps shall be of standard design and fabricated from galvanized M.S. standard flats 40x3 mm thick and 12 mm dia. GI Rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1:2:4 mix blocks 10x10x10 cm deep.
2. Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with galvanized 40x3 mm flat iron "U" type clamps with anchor fasteners of approved design or 6 mm nuts and bolts.
3. Structural clamps shall be fabricated by electro-welding from G.I. structural members e.g. rods, angles, channels flats as per detailed drawing. Contractor shall provide G.I. all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be hot dipped galvanized before using.
4. Galvanized slotted angle/ channel supports on walls shall be provided wherever shown on drawings. Angles/ channels shall be of sizes shown on drawings or specified in schedule of quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.
5. Wherever G.I. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 mm stone aggregate 20 mm nominal size) as directed by the Engineer-in-charge.
6. For sleeves, RCC cutting, hole, chasing etc. anchor fasteners and clamp spacing chart see Special Conditions.
7. All the clamping and supporting material are included in rates nothing to be paid extra in any head.

5. Traps

a. Floor traps

Floor traps shall be siphon type full bore P or S type cast iron having a minimum 50 mm deep seal. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centring for the blocks. Size of the block shall be 30x30 cm of the required depth.

b. Urinal traps

Urinal traps/horn shall be cast iron P or S traps with or without vent and set in cement concrete block specified for floor traps.

c. Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting fabricated from G.I. pipe without, with one, two or three inlet sockets welded on side to connect the waste pipe. Joint between waste and hopper inlet socket shall be Drip Seal. Inlet shall be connected to a C.I. P or S trap. Floor trap inlet hoppers and the traps shall be set in cement concrete blocks as specified in para above without extra charge.

d. Gratings for traps

Floor and urinal traps shall be provided with 100-150mm square or round C.P./Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4 mm or as specified in the Schedule of Quantities.

e. Jointing

Soil, waste vent, anti-syphonage and rainwater pipes shall be jointed with refined drip seal conforming to I.S. 27-1977ket. Sufficient skein of jute rope shall be caulked to leave a minimum space for the Drip seal as given in Para 3.4.3 to be poured in. After the pouring the lead shall be caulked in to the joint with caulking tool and hammer.

6. Cleanout Plugs

a. Cleanout Plug on soil pipes

Clean out plug for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" 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 suitable for the Pipe dia. With screwed to a G.I. socket. The socket shall be Drip seal caulked to the drain pipes.

b. Cleanout Plug on Drainage Pipes

- i. Cleanout plugs shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Engineer-in-charge. Cleanout plugs shall be of size matching the full bore of the pipe but not exceeding 150 mm dia. Cleanout Plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.
- ii. Cleanout Plug at Ceiling Pipes: - Cleanouts provided at ceiling level pipe shall be fixed to a CI flanged tail piece. The cleanout doors shall be specially fabricated from light weight galvanised sheets and angles with hinged type doors with fly nuts, gasket etc., as per drawing.

7. Waste pipe from appliances

a. General

- i. Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of heavy galvanized steel /CPVC as given in the Schedule of Quantities or shown on the drawings.
- ii. All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per good engineering practice approved by the Project Manager.

b. Galvanized pipes

Waste pipes from appliances shall be galvanized steel tubes conforming to I.S.1239 (Heavy class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. tees, couplings, bends, elbows, unions, reducers, nipples, plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter. Pipes in chase shall be wrapped with bitumen tape and then painted with two coats of black bitumen paint. Exposed pipes with one coat of Zinc cromate with etch coating primer and two or more coats of synthetic enamel paint or as given in the Schedule of Quantities. Colour shall be as per the approved colour code.

8. Cast iron pipes for drainage

- a. All drainage lines passing under building, in exposed position above ground e.g. basement ceiling etc. shall be cast iron pipes. Position of such pipes shall generally be shown on the drawings.
- b. Cast iron pipes shall be spigot & socket (S&S) centrifugally spun iron pipes conforming to I.S. 1536. (Class LA) suitable for pre-moulded rubber joints / Tyton joints. Quality certificates shall be furnished.
- c. Fittings
Fittings used for C.I. drainage pipe shall conform to I.S. 1538 (Heavy class). Wherever possible junction from branch pipes shall be made by a Y- tee.
- d. Joints
 - i. Joints between pipes shall be made with pre-moulded rubber joints (Tyton Joints) supplied by the manufacturer to ensure compatibility and water tightness.
 - ii. Joints between pipes and fittings shall be made by caulked spun yarn dipped in tar and molten drip seal 45 mm deep by hammering with caulking tools.

9. Encasing pipe in Cement Concrete

Cast iron soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8 m. Rate for concrete round pipes shall be inclusive of pillars, supports, shuttering and centring.

10. Painting

- a. All cast iron, soil, waste vent, anti-siphon age and rainwater pipes in exposed location in shafts and pipe spaces shall be painted with two or more coats of synthetic enamel paint to over a priming coat to give an even shade.
- b. Paint shall be of approved quality and shade. Where directed pipes shall be painted in accordance with approved pipe colour code.
- c. G.I. waste pipes in chase shall be painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint over each priming coat.
- d. C.I. soil and waste pipes below ground and covered in cement concrete or lead pipes shall not be painted.

11. Cutting and making good

- a. Pipes shall be fixed and tested as building proceeds.
- b. Contractor shall provide all necessary holes cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or brick work in cement mortar 1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

12. Testing

- a. Testing procedure specified below apply to all soil, waste and vent pipes above ground including C.I. LA pipes laid in basement ceiling.

- b. Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing shall be certified for its calibration by an approved laboratory.
- c. All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site. All testing equipment must be calibrated and shall carry certificate from an approved laboratory.
- d. Testing soil, waste and rainwater pipes
 - i. Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.
 - ii. After installation all connections from fixtures, vertical stacks and horizontal drains including C.I. LA pipes shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.
 - iii. The entire installation shall be tested by smoke testing machine. The test can be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging all inlets by bellow plugs. Apply dense smoke keeping the top of stack open and observe for leakages. Rectify or replace defective sections.
 - iv. After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self-draining, has no leakages, blockages etc. Rectify and replace where required.
- e. Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of Engineer-in-charge and signed by both.

13. Measurements

- a. General
 - i. Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities.
 - ii. Rates are applicable for the work under floors, in shafts at ceiling level area for all heights and depths.
 - iii. Rates are inclusive of cutting holes and chases in RCC and masonry work and making good the same.
 - iv. Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.
 - v. Pipes (Unit of measurement, linear meter to the nearest Centimetre) or as specified in CPWD specifications.
- b. All C.I. Soil, waste, vent, anti-syphonage and rain water pipes shall be measured net when fixed correct to a centimetre including all fittings along its length. No allowance shall be made for the portions of pipe lengths entering the sockets of the adjacent pipes or fittings. The above will apply to both case i.e. whether pipes

are fixed on wall face or pillars or embedded in masonry or pipes running at ceiling level.

- c. Pipes shall be measured per running metre correct to a centimetre for the finished work which shall include fittings e.g. bends, tees, elbows, reducers, crosses, sockets, nipples and nuts. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal diameter of internal bore. The pipes shall be described as including all cutting and waste. In case of fittings of unequal bore, the largest bore shall be measured.
- d. Cement concrete around pipes shall be measured along the centre of the pipe line measured per linear metre and include any masonry supports, shuttering and centring cutting complete as described in the relevant specifications.
- e. Slotted angles/channels shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.
- f. Fittings
Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.
- g. Painting
Painting of pipes shall be measured per running metre and shall be inclusive of all fittings and clamps. No deduction for fittings shall be made.
- h. Excavation for soil pipes
No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for cast iron soil and waste pipes laid below ground, in sunken slabs.
- i. Engineer-in-charge's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION 4 Water Supply Systems

1. Scope of work

- a. 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.
- b. Without restricting to the generality of the foregoing, the water supply system shall include the following:-
 - i. Rising main from water supply pumps to all overhead tanks.
 - ii. Distribution system from overhead tank to all fixtures and appliances for cold & hot water.
 - iii. Insulation to hot water pipes within toilets.
 - iv. Connections to all plumbing fixtures, and appliances.

2. General requirements

- a. All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-charge.
- b. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- c. 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.
- d. As far as possible all bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 25 mm dia. Bends and elbows may be used for pipe dia. greater than 32 mm.
- e. 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.
- f. Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals approved by the Project Manager.
- g. Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3. Water Supply System

- a. Contractor should study the site plan and water supply system diagram for overviews of the system.
- b. Source
 - i. Water supply will be acquired from Clients mains line (water report enclosed).
 - ii. The rising mains will be connected to the main fire static tank and then overflow into the main domestic water tank located in basement.
- c. Water supply piping for garden hydrant and sprinkler and irrigation system will be separate and independent connected to a different pumping system.

4. G.I/ CPVC Pipes & Fittings

- a. All pipe inside the building and where specified, outside the building shall be galvanized / CPCV steel tubes conforming to I.S. 1239 of class specified. When class is not specified they shall be heavy class.
- b. Fittings shall be malleable iron galvanized /CPCV of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I. /CPCV pipe shall include couplings, bends tees, reducers, nipples, union and bushes. Fittings shall conform to I.S. 1879-(Section I to X).
- c. Pipe and fittings shall be joined with screwed joints, after cutting a pipe with a hacksaw or a cutting machine care shall be taken to remove burr from the end of the pipe after reaming with a proper file.
- d. Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply.(Use of red and white lead sutli will not be permitted for screwed joints)
- e. 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./CPCV pipes inside shall be fixed in wall chases well above the floor. No floor shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings.

f. Clamps

- i. G.I./CPCV pipes in the shaft and other locations shall be supported by galvanized M.S. clamps of design approved by Project Manager. Pipes in wall chases shall be anchored by G.I hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from G.I. Structural. Pipes in typical shaft shall be supported G.I. slotted angles / channels as per standard drawings.
- ii. Spacing of clamps, hooks etc. Shall be as per good engineering practice approved by the Engineer-in-charge

g. Unions

Contractor shall provide adequate number of unions on pipes 50mm and below to enable easy dismantling later when required .Unions shall be provided near each gunmetal valve , stop clock , or check valve and go on straight runs as necessary at appropriate locations as required and /or direct by Project Manager.

5. Flanges

- a. Flanged connections shall be provided on pipes 65 mm and above as required or where shown on the drawings generally as follows:
 1. On straight runs not exceeding 30 m, near bends and at connections to main branch lines.
 2. On all valves ends
 3. On equipment /pump connections as necessary and required or as directed by Engineer – in - charge.
- b. Flanged connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion neoprene gaskets Bolt hole dia. for flanges shall conform to match the specification for C.I. sluice valve to I.S. 780. and C.I. butterfly valve to IS: 13095.

6. Trenches

- a. 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 cm	75 cm
65 mm to 100 mm	45 cm	100 cm

b. Sand filling

Where specified in the Schedule of Quantities all G.I. pipes in trenches shall be protected with fine sand 15 cm all around before filling in the trenches.

- c. Where shown on the drawings main pipe lines may be run in masonry trenches from the pump house to the buildings in phase I & II , filled up with sand and buried in ground as per architectural /landscape details.

d. Painting

All pipes above ground shall be painted with one coat Zinc with each coating and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code specified by Engineer-in-charge.

e. Pipe protection

- i. Where specified in the Schedule of Quantities all pipes in chase or below floor shall be protected against corrosion by the application of two coats of bitumen paint covered with bitumen tape and a final coat of bitumen paint before covering up the pipe.
- ii. All G.I. /CPVC water supply pipes below ground shall be protected against corrosion by applying one layer of 4 mm thick multilayer anticorrosive polymeric mix tape applied over a coat of primer as per recommendations of the manufacturers. (Pypcoat)

7. Insulation

Hot water pipes within a toilet /kitchen from hot water header shall be insulated with fire resistance closed cell chemically cross linked polyethene is used in the forms of rolls, sheets and tubes. The thickness of insulation is 13mm on all sizes of pipes. Density of insulation is 30±2kg/cum.

8. Valves

a. Ball valves

Valves 50 mm dia. and below 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 B.S. 5351.

b. Butterfly Valves

- i. Valves 65 mm dia. and above shall be cast iron butterfly valve to be used for isolation and/or flow regulation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction. Valves shall be provided with matching flanges with neoprene insertion gasket 3 mm thick .P.N 1.6
- ii. Butterfly valve shall be of best quality conforming to IS: 13095.

c. Non Return Valve

- i. Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only, It shall be single door swing check type of best quality conforming to IS: 5312.P.N1.6
- ii. Each butterfly and slim type swing check valves shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanized nuts, bolts and double washers of correct length.
- iii. Sluice valve shall be of approved makes conforming to I.S.:780 of class as specified.

9. Storage Tanks

a. Overhead Tanks

Overhead water storage tanks for water supply shall be reinforced cement concrete .

b. Tank connection and accessories

- i. Contractor shall provide the following to each tanks:
 - 1. Inlet and outlet connections to pumps, equipment and main pipe lines.
 - 2. Tank overflows with mosquito proof gratings
 - 3. Scour drain and valve as per drawings
 - 4. Water level gauge with approved type of brass gauges, plastic tube, a wooden board with level marking.

- ii. Electronic level controllers, cabling, sequence controllers and all related equipment shall be provided by agency executing the pumping system work. Plumbing contractor shall provide necessary G.I. sleeves and co-operate with the contractor to ensure that the work is successfully executed.

10. Testing

- a. 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 12 hours without any drop & withstand for 8 hrs.
- b. A test register shall be maintained and all entries shall be counter-signed by Contractor(s) in the presence of Engineer-in-charge.
- c. 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.
- d. 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.

11. Measurements

- a. G.I./CPVC pipes
 - i. G.I./CPVC pipes above ground shall be measured per linear metre (to the nearest cm) and shall be inclusive of all fittings e.g. couplings, tees, bends, elbows, unions, and flanges. Deduction for valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chases and making good the same and all items mentioned in the specifications and Schedule of Quantities.
 - ii. G.I./CPVC pipes below ground shall be measured per linear metre (to the nearest cm) and shall be inclusive of fittings, e.g. couplings, tees, bends, elbows, unions. Deduction for valves shall be made. Rates quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus earth, cutting holes and chases and making good and all other items mentioned in the specifications and Schedule of Quantities.
- b. Gunmetal, cast iron, butterfly and non-return valves puddle flanges, level indicators and meters shall be measured by numbers.
- c. Brick masonry chamber for valves and meters shall be measured by number and include all items given in the Bill of quantities.
- d. Painting/pipe protection
- e. Painting/pipe protection for pipes shall be measured per linear metre over finished surface and shall include all valves and fittings for which no deduction shall be made.
- f. Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION – 5 Water Supply Pumping System & Allied services

1. Scope of work

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required for the satisfactory supply, installation, completion and commissioning of water supply pumping system and allied works as described hereinafter, as specified in the schedule of quantities and/or shown on the plumbing drawings and described in the scope of work .

2. The System

The system described below is for the contractors bidding for the works to understand the extent and scope of work and the intent in the manner in which the water supply system is planned and shall be executed. This does not form a part of the contractor's scope of work with respect to the various elements that are described in this paragraph.

a. Sources of supply

Local water supply for which a water main from the main road/borewell to the underground water tank will be laid by contractor.

b. Underground water tanks

- i. **Static fire water storage tanks** in compartments .Connections from the tube well water supply lines will be made into these tanks. Water will overflow into the raw water tanks
- ii. Raw Water Tank to hold the tube well as well as CWS Supply water will be made to:
 1. A set of pumps will be connected to supply water from under ground tank to overhead tank located in new proposed building. All piping and connections for this system are a part of this contract.
 2. Domestic Water Pumping Systems
- iii. Water supply to the various buildings will be made from a set of pumping sets to the overhead water and supplementary fire tanks located on the terrace of each building in the following order:

3. Rising Mains & level control system

- a. To control the level in each tank and enable it to fill as the water demand so requires, each tank will be provided with a ball cock to shut off the water supply when the tank is full.
- b. A set of electronic level sensing probes will be installed in each tank The probes installed in each pumping system will be wired to a central electronic panel which will activate the pump when any one of the tank probe signals low water conditions and top up all tanks. No excess flow will occur due to the ball cock in the tank.

4. Level Controllers

- a. Level controllers shall be electronic magnetic 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:-
 - i. Provide a audible high water alarm when water level in the sump reaches a pre-determined high level in the sump location at MCC panel installed in wall near sump location

b. Overhead tank level controller cum indicators

- i. Each OHT to be provided with required number of stainless steel electronically operated probes (housed in a stainless steel protective housing) and connected by a control cable to a central junction box connected to MCC panel located in the pump house at basement. A common multi-core cable from each group of buildings will be laid to the pump room in basement. The probes will function as follows:
- ii. To cut off the water supply pumps when all the OHT is full and to start the pump if any OHT level reaches at pre-determined low level.
- iii. Provision shall be made to enable the operation of the second duty pump in case the water level does not rise above a pre-determined level in the tank due to water demand which is higher than capacity of duty pump no.1 to meet.
- iv. Indicate the water level in each OHT in the level indicating panel installed in the pump room
- v. Each OHT are also provided with a float valve to stop the supply in individual OHT when level reaches a cut off high level.

c. Control & Indicating Panel (For overhead and underground water tanks)

- i. A centralized indicating stand-alone wall mounted panel fabricated from 14 g. with seven tank process MS sheet and painted inside and outside with stove enamelled finish with clear vertical panels for each group of buildings & tanks shall indicate water level in each tank by means of digital display unit to indicate water level in each tank in four levels ($\frac{1}{4}$ th, $\frac{1}{2}$, $\frac{3}{4}$ and full). The panel shall be installed on the control console panel located in the pump room or as directed by the Project Engineer. The panel shall have:
- ii. Digital level indicator panel meter for each water tank.
- iii. Etched plate identification plates.
- iv. Control cabling from MCC to the panel installed in the control room as directed by the Project Manager.
- v. Cabling from PHT sensing probes to the panel

5. **Pressure filters for Water Supply System** – As per requirements

a. Specification shall apply for water filtration system

- i. Pressure filters shall be manufactured with factory made bobbin wound polyester fibre glass multilayer filters fitted with internal GI 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, G.I. face piping, accessories testing and commissioning complete, Working Pressure 2.4 kg/cm² (Test pressure 3.75 kg/cm²). Along with bfv & nrv & gauge, prv etc.
- ii. Each vessel will be provided with suitable pressure tight manhole cover appropriately located for inspection and repairs.
- iii. The diameter and height of each vessel shall be as per the design requirement and given in the BOQ and as per site conditions.

b. Multi-Port Valves

- i. 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.
 - ii. Provide suitable sampling cocks to draw water samples for raw water and treated water.
- c. Face Piping
 - i. Each vessel shall be provided with non-corrosive face piping from the inlet to the outlet. Face piping shall be CPVC (IS 4985) 10 kg/cm² all CPVC fittings are heavy grade to pipe and solvent weld and flanged joints
 - ii. 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.
- d. Water Filtration Plant (For Domestic Water)- As per requirement**
 - i. Design parameters for the proposed filter shall be as follows:
 - 1. Filter media:- Graded aggregate of required size selected coarse and fine silica sand as per latest water treatment practice. Aggregate and sand to be acid washed and having purity of 99.9%.
 - 2. Depth of filter media:- Approx. 750-900 mm deep (as per manufacturer's design)
 - 3. Back washing :- By air scouring through air blower (approx. 5.1 lpm/m² of filter surface area and water supply from raw water pumps by reverse flow)
 - 4. Output Water Quality for Domestic Filters: To conform to IS 10500 for the relevant design criteria
- e. Chemical Dosing Pumps - As per requirement**
 - i. Pump applications
 - 1. Chlorination of raw water from tube wells,
 - ii. Dosing system comprising of an electronic metering pump with, 100 lit capacity uPVC/HDPE solution tank with level gauge and lid on top.
 - iii. 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.
- f. Air Blower for Back Washing - As per requirement**
 - i. Low pressure air blower with TEFC electrical motor, belt driven or direct drive, all mounted on a common structural based plate with oil and water separator.
 - ii. Air blowers will be used for back washing operations. The air blower shall be designed for operation of one filter at a time. Blowers will be designed for air flow of approx 5.1 lpm/m² air capacity at 0.5 kg/cm² pressure. (This may be modified to suit manufacturer's requirement for filters offered.)
 - iii. The electrical switchgear shall be included in the respective MCC panel of the system

SECTION 6 Pipes & Fittings

1. Headers, piping and connections

- a. All pipes within the plant room building in exposed locations and shafts including connections buried under floor and for suction and delivery headers shall be G.I. /CPVC pipes medium class and thickness specified. Pipes up to 150 mm dia. shall conform to I.S. 1239.
- b. Pipe 200 mm dia. and above shall be G.I. ERW tubes to IS 3589. If black pipes are available they shall be galvanized before use.
- c. Fittings for G.I. pipes shall be approved type malleable iron or wrought iron screwed galvanized fittings for screwed joints. Fittings 200 mm dia. may be shop fabricated but shall be shop galvanized after fabrication.
- d. All M.S. structural supports and clamps shall be galvanised. All the pipe work within plant room shall be adequately supported with G.I. structural supports from floor or ceiling as required and directed by Project Manager.

2. Jointing**a. G.I. Pipes (Screwed joints)**

Pipe shall be provided with metal to metal threaded joints. Teflon tape shall be used for lubrication and rust prevention. (USE OF LEAD /ZINC BASED JOINTING COMPOUND ARE NOT PERMITTED)

b. Flanged joints / Dead Joints

Flanges shall be provided on:

- i. Straight runs not exceeding 12-15 m on pipe lines 80 mm dia and above.
- ii. Both ends of any fabricated fittings e.g. bends, tees etc. of 50 mm dia or larger diameter. (When Permitted)
- iii. Both end of all suction delivery and other headers.
- iv. For jointing valves, appurtenances, pumps, connections with pipes, to water tanks and other places necessary and required as good for engineering practice.
- v. Flanges shall be as per applicable I.S. with appropriate number of G.I. nuts and bolts, 3 mm insertion rubber gasket complete.
- vi. The cost of flanges is included in the rates of pipes along with fittings.

c. Unions

Provide approved type of dismountable unions on pipes lines 50 mm and below near valves or inspector test/drain and assemblies and as required as per site conditions.

d. Vibration Eliminators

All suction and delivery lines and as shown on the drawings double flanged reinforced neoprene bellow type 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 connectors shall be as per site requirements in accordance with manufacturer's details.

3. Valves**a. Sluice valves**

- i. Full way Sluice Valves shall be used on the suction connection to pumps and headers.

- ii. Sluice valves (80 mm dia. and above) shall be C.I. double flanged sluice valves with rising stem. Each sluice valve shall be provided with wheel in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for sluice valves with cap tops.
- iii. Sluice valves shall be of approved makes conforming to I.S.780 PN1.6 class
- b. Butterfly Valves (PN 1.6 rating)
 - i. Butterfly Valves shall be used in all other locations as required conforming to IS 13095.PN 1.6
 - ii. They shall have a cast iron body.
 - iii. Disc shall be CI heavy duty electrolyses nickel plated abrasion resistant.
 - iv. The shaft to be EN-8 Carbon Steel with low friction nylon bearings.
 - v. The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.
 - vi. Built in flanged rubber seals.
 - vii. Actuator to level operated for valves above ground and T Key operated for valves below Ground.
 - viii. Built in flanges for screwed on flanged connections. Manufacturer's details on fixing and Installation will be followed.
- c. Non Return Valves (NRV PN 1.6 rating))
 - i. Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.
 - ii. NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges. Valves shall conform relevant IS or match the butterfly valves.PN 1.6
 - iii. Built in flanges for screwed on flanged connections.
- d. Ball Valves

Ball Valves up to 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 coupling and steel handles (to B.S. 5351.

4. 'Y' Strainers (PN 1.6 rating)

Provide cast iron 'Y' type strainers with gunmetal internal strainers, CI screwed plug to be provided on all water tank suction connections to pumps.

5. Measurements (Part 1, 2 & 3)

a. General

- i. Unit rate for individual items, e.g., pressure tanks, MCC, level controller, water tank are for purposes of payments only. Piping, headers, valves, accessories, cabling and MCC to measured separately in this contract only.
- ii. All items must include all accessories fittings as described in the specifications, BOQ and shown on the drawings.

b. Drainage Pumps & Sewage 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.

c. Level controllers & Alarms

Level controllers for each set of pumps shall be measured by number and inclusive of probes, cabling up to 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.

d. Piping Work

- i. Suction and delivery headers for each pumping system shall be measured per set with required length and shall include all items as given in the schedule of quantities. Painting shall be included in rate of headers.
- ii. CPVC pipes between various filters and units 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.
- iii. Vibration eliminators, "Y" strainers, butterfly valves, slim non return valves, ball valves shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications except from pump room.

SECTION 7 Specifications for Electrical Installation

1. Electrical Control Panels

a. General

- i. 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.
- ii. The Switch Boards shall comply with the latest edition with up to date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

b. Switch Board Configuration

- i. The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipment as called for in the Schedule of Quantities.
- ii. 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.
- iii. The Switch Boards shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear.

c. Equipment Specifications

- i. 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.

d. Constructional Features

- i. The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.

- ii. 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 gasket with synthetic rubber and shall be lockable.
- iii. The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.
- iv. All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.
- v. 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.

e. Switchboard Dimensional Limitations

- i. A base channel 100 mm x 50 mm x 6 mm thick shall be provided at the bottom.
- ii. A minimum of 200 mm blank space between the floor of switch board and bottom most unit shall be provided.
- iii. The overall height of the Switch Board shall be limited to 2300 mm
- iv. The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

f. Switch Board Compartmentalisation

- i. The Switch Board shall be divided into distinct separate compartments comprising.
- ii. A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical bus bars.
- iii. Each circuit breaker and MCCB shall be housed in separate compartments enclosed on all sides.
- iv. Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "on" and "off" position.
- v. 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, bus bars and connections.
- vi. A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
- vii. 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.
- viii. Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from top.
- ix. Adequate and proper support shall be provided in cable compartments to support cables.

g. Switch Board Bus Bars

- i. 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.
- ii. The bus bars and interconnections shall be insulated with insulation tape/ fiber glass.
- iii. The bus bars shall be extensible on either side of the Switch Board.
- iv. 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.
- v. All bus bars shall be colour coded.
- vi. 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.

h. Switch Board Interconnections

- i. 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.
- ii. For unit ratings up to 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.

i. Draw out Features

- i. Air Circuit Breakers shall be provided in fully draw out cubicles. These cubicles shall be such that draw out 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 draw out cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

j. Instrument Accommodation

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

k. 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.

l. Cable Terminations

- i. 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.
- ii. The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear / top of the panel.
- iii. 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.
- iv. 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.

m. 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.

n. 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.

o. 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 can be tap from main earthing.

p. Sheet Steel Treatment and Painting

- i. 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.
- ii. 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.

q. 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.

2. Testing

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 as per relevant clause of SCC

3. Testing at Site

- a. Pre-commissioning tests as required and as per manufacturers recommendations shall be carried out on each switchboard at site before energizing the switchboards including but not restricted to the following.

- i. 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.
- ii. Physical checking and inspections of Inter panel wiring
- iii. Checking free movement of ACBs/MCCBs/SFUs
- iv. Checking of operation of breakers
- v. Insulation tests of bus bar supports and control wiring etc. with 1.1 kV megger.
- vi. Primary & secondary injection tests of relays and CTs.
- vii. Checking of Interlocking function.

4. Cables

i. Medium Voltage Cables

- a. Medium voltage cables shall be aluminium conductor PVC insulated, PVC sheathed armoured conforming to IS 1554. Cables shall be rated for a 1100 Volts. The conductor of cables from 16 Sq. mm. to 50 mm² shall be stranded. Sector shaped stranded conductors shall be used for cables of 50 mm² and above. Conductors shall be made of electrical purity aluminium 3/4 H or H temper. Conductors shall be insulated with high quality PVC 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 PVC 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 PVC insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Cores	:	Red and Black
3 Cores	:	Red, Yellow and Blue
3 1/2 /4 Cores	:	Red, Yellow, Blue and Black

- b. Current ratings shall be based on the following conditions.
 - i. Maximum conductor temperature 70° C
 - ii. Ambient air temperature 45° C
 - iii. Ground temperature 30° C
 - iv. Depth of laying 1000 mm
- c. Short circuit rating of cables shall be as specified in IS 1554 Part-I.
- d. 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.
- e. M.V. cables shall be PVC insulated aluminium/copper conductor and armoured cables conforming to IS Codes. Cables shall be armoured and suitable for laying in trenches, duct and on cable trays as required. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and un armoured cables.

ii. On Trays/Walls

- a. Wherever so specified, cables shall be laid along walls/ceiling or on cable trays. Cable shall be secured in position and dressed properly by means of suitable clamps, hooks, saddles etc. such that the minimum clear spacing between cables is diameter of the cable. Clamping of cables shall be at minimum intervals as below.

Type of Cable	Size	Clamping by	Fixing Interval
MV	Up to and including 25 sq mm	Saddles 1 mm thick	45 cms
MV & HV	35 sq mm to 120 sq mm	Clamps 3 mm thick 25 mm wide	60 cms
MV & HV	150 sq mm and above	Clamps 3 mm thick 40 mm wide	60 cms

Note: The fixing intervals specified apply to straight runs. In the case of bends, additional clamping shall be provided at 30 cm from the centre of the bend on both sides.

b. Cable trays

- i. Channel or of ladder design as specified in BOQ. Cable trays shall be fabricated from sheet G.I of thickness as per BOQ Cable trays, of sizes as per schedule of quantities and drawings shall be of perforated doubled bend and shall be complete with tees, elbows, risers, and all necessary hardware.
- ii. Trays shall have suitable strength and rigidity to provide proper support for all the 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 painted with two coats of red oxide zinc chromate primer after proper surface preparation and two finishing coats of synthetic enamel paint of approved make or as specified in BOQ. Cable trays shall have side rails or equivalent structural members.
- iii. Cable trays shall be mounted on support structure as specified by means of specified size of threaded rods and suitable fasteners. Spacing of the support structure shall be such that the cable trays shall remain perfectly horizontal without buckling when fully loaded with cable runs. The support structure shall be suspended from ceiling slab or grouted to walls in an approved manner. Width of the horizontal arms of the support structure shall be same as the tray width plus length required for threading /bolting /welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers required. Cable trays shall be bolted/ welded to the support structure. Minimum clearance between the top most tray tier and the ceiling shall be 300 mm. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. 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. Cables shall be fixed to the tray by clamps fabricated from minimum 3 mm thick GI sheets. The cables shall be dressed properly so as to provide minimum one cable diameter clearance between adjacent cables and from tray ends. Cable trays shall be earthed by 2 runs of 25 mm x 3 mm GI strips throughout their lengths.

5. LAYING OF CABLES

Cables shall be so laid that the maximum bending radius is 12 times the overall diameter of the cable for medium voltage cables. Cables shall be laid in masonry trenches, directly on walls/cable trays, directly buried in ground or in pipes/ducts as elaborated below. Cables of different voltages and also power and control cables shall be laid in different trenches with adequate separation. Wherever available space is restricted such that this requirement

cannot be met, medium voltage cables shall be laid above HT cables. Where more than one cable is laid side by side, cable marker tags of approved type inscribed with cable identification details shall be permanently attached to cables at entry points to the building, at specified intervals for cables laid direct in grounds and in locations like manholes, pull pits etc.

6. Drawings

Shop drawings for control panels and wiring of equipment showing the route of conduit cable shall be submitted by the contractor for approval of Engineer-in-charge before starting the fabrication of panel and starting the work. On completion, all details like location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the contractor.

7. Measurement

Panels shall be counted as number of units. The quoted rate of panel shall also include all accessories, switch gear, fuses, contractor, indicating meters and lights as per the specification. Cable tray, Power & Control cable shall be measured in running meter.

SECTION 8 Commissioning and Guarantees

1. Scope of work

The 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:

- a. Work under this Part shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this Part
- b. Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.
- c. 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

- a. On completion of the installation of all pumps, piping, valves, pipe connections, electrical wiring, motor control panels and water level controlling devices the contractor shall proceed as follows:-
 - i. Testing of M.C.C
 - ii. Tests to be carried out for motor control centres shall be:
 - iii. Insulation resistance test with 500 volt megger, before and after high voltage test, on all power and control wiring.
 - iv. High voltage test sat 2000 volts A.C. for one minute on all power and control wiring.
 - v. Low voltage continuity test (6 volts) on power wiring of each feeder, between bus bars and the outgoing terminals with switches and contactors in closed position.
 - vi. Low Voltage continuity test (6 volts) on all control wiring.

- vii. Operation test for all feeders with only control supply made 'on' to ensure correctness of control wiring, operation of the various equipment used such as push buttons, protective devices, indicating lamps and relays etc. All contactors shall be checked and there shall be no chattering.
- viii. Earth continuity test with voltage not exceeding 6 volts between various non-current carrying metallic parts of equipment, steel work etc. And the earth bus provided in the MCC.
- ix. Operation of all instruments and meters provided on the MCC.

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 Part of the specifications. If any leakage is found, rectify the same and retest the pipes.
- iii. Check all face piping and valves
- iv. check air blower connections

4. Commissioning & testing

a. All pumping sets

Start the duty pump on manual controls, check its operation and then test run on auto controls. Change over the duty pump and test it in the same manner as the first pump.

b. Test runs the entire system to ensure satisfactory performance.

5. Handing Over

- a. 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 authorized representative.
- b. Contractor shall also hand over, to the Project Manager, all maintenance & operation manuals, 4 sets of As Built drawings and all other items as per the terms of the contract with soft copy.

6. Guarantees

- a. The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.
- b. The form of warranty shall be as approved by the Engineer-in-charge.
- c. The warranty shall be valid for a period of one year from the after getting virtual completion certificate.
- d. 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.
- e. 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.
- f. The contractor shall separately submit with this offer his charges per month for operation of mechanical equipment(s) after commissioning and handing over.

SECTION 9 I.S. Codes

Following codes and Indian standards shall be applicable as amended up to date-

1. Electrical equipment

- i. Marking & arrangement for switch gear bus bars, main connections and auxiliary wiring- I.S. 375
- ii. Direct acting electrical indicating instruments- I.S.1248
- iii. Metal enclosed switch gear and control gear- I.S. 3427
- iv. A.C. Contactors of voltage not exceeding 1000 volts. - I.S. 2959
- v. A.C. Motor starters of voltage not exceeding 1000 volts.- I.S. 1822
- vi. Air breaks isolation for voltages not exceeding 1000 volts.- I.S. 2607
- vii. Heavy duty air break switches and composite unit of air break switches and fuses for voltage not exceeding 1000 volts. - I.S. 4047
- viii. PVC insulated cables (for voltage Up to 1100 volts with copper/ aluminium conductors)(Section I & II)- I.S. 694
- ix. Normal duty air break switches and composite units of air break switches and fuses for voltage not exceeding 1000 volts.-I.S. 4064
- x. Code of practice for earthing - I.S. 3043
- xi. Pumps & motors
 - a. Centrifugal pumps- I.S. 1520
 - b. Electrical Motors - I.S.7538
- xii. Pipes
 - a. G.I. Pipes - I.S. 1239
- xiii. Valves
 - a. Butterfly Valves-IS 23339/13095
 - b. Slim Type NRV-I.S. 7312
 - c. Sluice valve -I.S. 780
- xiv. Vibration Eliminator
- xv. Water Shock Absorbers
- xvi. Pipe Colour Code as per I.S. 2379-1983.

SECTION 10 Technical Information for Water Supply & Drainage Pumps to be furnished by Bidder:

i. Pumps

- a. Make
- b. Model
- c. Pump Discharge - Max/Min
- d. Pump Head Min/Max,
- e. Impeller Material
- f. Motor HP

(Specify make, class of insulation & rated voltage \pm %)

- g. Shaft Seal Type & make
- h. Type of Coupling
- i. Efficiency of Pump
- j. Type of Bearings
- k. RPM

ii. **Pressure Tanks (Where specified)**

- a. Make
- b. Material of Construction
- c. Internal finish
- d. External finish
- e. Air balloon/ diaphragm
- f. specifications

iii. **Submersible pumps - Basement Sewage**

- a. Make
- b. Model No.
- c. Pump discharge lpm - max / min
- d. Pump head min/max,
- e. Impeller material
- f. Motor HP (Specify make, class of insulation & rated voltage \pm %)
- g. Shaft seal Type & make
- h. Type of coupling
- i. Efficiency of pump
- j. Type of bearings
- k. RPM

iv. **Motor Control Centres (Give detail on separate sheets if required)**

- a. Make
- b. Type (floor/wall mounted)
- c. Make of switch gear
- d. Make of meters
- e. Make of accessories
- f. Confirm that all switch gear starters match the capacities of pumps offered.

v. **Power & control cables**

- a. Make

vi. **Electronic Level controllers**

- a. Make
- b. Model No.

vii. **Electronic High Water Alarm**

- a. Make
- b. Model No.

viii. **Electronic Level Indicator**

- a. Make
- b. Model

- ix. **Pipes /CPVC**
 - a. Make offered
 - i. Heavy Class 150 mm dia. & below
 - ii. Heavy Class 200 mm dia. & above
 - b. CPVC Pipe
- x. **Butterfly Valves**
 - a. Make
 - b. Material
 - c. Test pressure
- xi. **NRV Slim Type**
 - a. Make
 - b. Material
 - c. Test pressure
- xii. **Vibration eliminators**
 - a. Make
 - b. Material
 - c. Test pressure
- xiii. **Pressure**
 - a. Working pressure
 - b. Test pressure
 - c. Filtration/holding Capacity
 - d. Inlet/outlet sizes
- xiv. **Painting/coating**
 - a. Inside
 - b. Outside
- xv. **Equipment -**

Air Blower	Chlorinator
a. Make	
b. Model	
c. Pump Discharge -Max/Min	
d. Pump Head - Min/Max,	
e. Impeller Material	
f. Motor HP (Specify make, class of insulation & rated voltage \pm %)	
g. Shaft Seal	
h. Type of Coupling	
i. Efficiency of Pump	
j. Type of Bearings	
k. Speed of Pumps	
- xvi. **Motor control centres**
 - a. Type (floor/wall mounted)
 - b. Make of switch gear
 - c. Make of panel meters
 - d. Confirm that all switch gear starters are of capacities for pumps offered.
- xvii. Pipe fitting scheduled.
- xviii. C.I. Pipe

- xix. RCC Pipe.
- xx. L.A. Pipe.
- xxi. HDPE Pipe.
- xxii. Insulation Material
- xxiii. Flow Meter.
- xxiv. PRV
- xxv. Hyroneumatic Pump.
- xxvi. Water meter.

CHAPTER D

TECHNICAL SPECIFICATIONS - HORTICULTURE WORKS:

1. Scope of work

The work shall in general conform to the Latest CPWD Specifications for works. Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the schedule of quantities for Horticulture works.

2. GRASSING

a. Preparation

- i. During period prior to planting the ground shall be maintained free from weeds.
- ii. Grading and final leveling of the lawn shall be completed at least three weeks prior to the actual sowing. Clods of excavated earth shall then be broken upto the size not more than 75mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds that re-germinate shall be uprooted carefully. The rubbish arising from this operation shall be removed and disposed of in a manner directed by Engineer. Regular watering shall be continued until sowing by dividing the lawn area into portion or approx 5 mts. Square by constructing small bunds to retain water. These 'bunds' shall be level just prior to sowing of grass plants. At the time of actual planting of grass, it shall be ensured that the soil has completely settled.
- iii. Slight unevenness, ups and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the final levels by adding suitable quantities of good earth brought from outside, if necessary as directed by the Engineer. In fine dressing, the soil at the surface and for 40mm depth below shall be broken down to particles of size not exceeding 6mm in any direction.

- b. **SOIL:** The soil itself shall be ensured to satisfaction of Engineer to be a good, fibrous loam, rich in humus.

c. SOWING THE GRASS ROOTS :

- i. Grass roots (Cynodon dactylon or a local approved by the Engineer) shall be obtained from a grass patch, seen and approved beforehand.
- ii. The grass roots stock received at site shall be manually cleaned of all weeds and water sprayed over the same after keeping the stock in a place protected from sun and dry winds.
- iii. Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

d. EXECUTION :

- i. Small roots shall be debbled about 15 cms (or at other spacings as per BOQ item) apart into the prepared grounds. Dead grass and weeds shall not be planted.
- ii. Grass areas will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed.

- iii. All planting is to be done in moderately dry to moist (not wet) soil and at times when wind does not exceed a velocity of 8 kilometer per hours.

e. MAINTENANCE OF LAWN

- i. As soon as the grass is approximately an inch high it shall be rolled with a light wooder, roller in fine, dry weather and when it has grown to 2 to 3 inches above the ground, weeds must be removed and regular cutting with the scythe and rolling must be begun. A top dressing of announce of guano to the square yard on well decomposed well broken sludge manure will help on the young grass. The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine. It should be possible to use the inch above the normal level of the first two or three cuttings. That is to day the grass should be cut so that it is from 1 to 2 inches in length, instead of the $\frac{1}{2}$ to $\frac{3}{4}$ of an inch necessary for mature grass.
- ii. In absence of rain the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 25 cms.
- iii. Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the contractor.
- iv. Any shrinkage below the specified levels during the contract or defects liability period shall be rectified at the contractor's expense.
- v. The contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.
- f. **ROLING:** A light roller shall be used periodically, taking care that the lawn is not too wet and sodden. Rolling should not be resorted to, to correct the levels in case certain depressions are formed due to watering
- g. **EDGING:** The contractor shall establish a neat edge where planting areas meet grass areas with spade or edging tool immediately after all planting, including lawn planting, is completed. Particular care shall be exercised in edging to establish good flowing curves as shown on the plans or as directed by the Engineer. Edging must be cut regularly and shall be maintained by the contractor.
- h. **FERTILIZING:** The lawn shall be fed once a month with liquid manure prepared by dissolving 45 grams of ammonia sulphate in 5 litres of water.
- i. **WATERING:** Water shall be applied daily during dry weather. Watering whenever done should be thorough and should wet the soil at least upto a depth of 20 cms to eliminate air pockets and settle the soil.
- j. **WEEDING:** Prior to regular mowing the contractor shall carefully remove rank and unsightly weeds.
- 3. **MAINTENANCE:** The landscape contractor shall maintain all planted area within the landscape 1contract boundaries until the period of one year after the complete plantation. Maintenance shall include replacement of dead plants. Watering, weeding, cultivating, control of insects, fungicide and other disease by means of spraying with an approved insecticide or fungicide, pruning and other horticulture operations necessary for the proper growth of the plants and for keeping the landscape sub-contract area neat in appearance.
- 4. **PRUNING & REPAIRS:** Upon completion of planting work on the landscape sub-contract all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches

and to compensate for the loss of roots and the results of transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of the trees. In general, one third to one fourth branching structure of the plants to be removed to compensate the loss of roots during transplantation by thinning or shortening branches but no leaders shall be cut. All pruning shall be done with sharp tools in accordance with instructions of the consultant. Pruning cuts shall be painted with recommended paints.

5. **TREE GUARDS:** Where tree guards are necessary, care should be taken to ensure that they do not impede movement or restrict growth.
6. **NURSERY STOCK:** Planting should be carried out as soon possible after reaching site. Where planting must, of necessity, be delayed, care should be taken to protect the plants from pilfering or damage from people or animals. Plants with bare roots should be heeled in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly labeled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.
7. **PROTECTIVE FENCING:** According to local environment shrubs may have to be protected adequately from vandalism until established.
8. **COMPLETION:** On completion the ground should be formed over and left tidy.
9. **RATE:** The rates quoted for the horticulture items listed in BOQ shall provide for the cost involved in all the operations described above.

CHAPTER E

SPECIAL CONDITIONS FOR ELECTRICAL SERVICES

1.0 GENERAL

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects. Any materials or accessories which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost of the purchaser. This shall also include spares for commissioning of the equipment.

2.0 The contractor shall obtain all sanctions (electrical loads, approval of drawing/ ESS/ D.G.'s estimator/ approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. All actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the contractor shall obtain NOC from SEB & Director of Safety of the concerned state; a copy of the same shall be delivered to the Engineer-in-Charge. Contractor shall be responsible for handing over to SEB and other authorities shall be responsibility of contractor till commissioning and getting electricity in the complex.

The Engineer-in-Charge /Client shall have full power regarding the materials or work got tested by independent agency at the electrical contractor's expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by Consultant/ independent agency through HLL/Client at his own expenses.

The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations as amended up to date, thereunder and special requirements, if any, of the State Electricity Boards etc. The bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/perform the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

3.0 DRAWINGS

i) The list of drawings along with these specifications is given in Annexure. These drawings are meant to give general idea to bidder regarding the nature of work covered by these specifications.

ii) Any information/data shown/not shown in these drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications. Additional information required by the bidder/tenderer for successfully completing the work shall be obtained by him.

iii) Shop Drawings

The contractor shall prepare detailed coordinated electrical shop drawing indicating lighting/lighting fixtures, convenience outlets, D.G.'s, H.T., Transformer, M.V. Panel Boards/Relay Panel, PCC, DB's, Rising Mains, Cable Schedule with other relevant services and submit to the Consultant for approval or the Engineer-in-Charge before commencing the work. The shop drawings shall indicate all setting out details and physical dimensions of all components with wiring and cable details including system operating write up in the system i.e. 11 KV Panel Board, Control and Relay Panel Package Substation, D.G.'s, PCC's, MCC's, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above

mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings do not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet with the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution.

iv) Completion Drawings/As Built Drawings

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the consultant 4 sets along with soft copy of 'As Built' drawings (in AutoCAD & PDF format) of the work along with 01 Nos. cloth tracing originals including write up (trouble shooting, installation, operation and maintenance manual with instructions) incorporating all such changes and modifications during engineering and execution along with warrantee & guarantee certificates from manufacturers.

These drawings must provide:

- Run and size of conduit, inspection and pull boxes including routing and locations.
- Number and size of conductor in each conduit.
- Locations and rating of sockets and switches controlling the light and power outlet.
- A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.
- Location of outlets of various services, junction boxes, light fixtures.
- Location of all earthing stations route and size of all earthing conductors.
- Layout and particulars of all cables.
- Location and details of PCC's, MCC's, Feeder Pillars, capacitor control panels, PLC D.G. set panel, UPS panel, and relay panels with description detailed control wiring diagram.
- Location of transformer and its details and control wiring diagram.
- Location of Hume pipe and manhole including HT/LT cable layout and scheduling.
- Location of D.G.'s, exhaust and auxiliary equipment with schematic drawings.
- Layout of cable trays with support and their fixing details.
- Location of all earthing station, route and size of all earthing conductor.
- Layout and particulars of rising mains with fixing details.

v) Position of HT/LT Switch Boards/Transformer & D.G.'S

The recommended position of the switch boards, transformer & D.G.'s as shown on the layout drawings will be adhered to as far as practicable.

The contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the Client. For all non-specified items, approval of the Engineer-in-Charge shall be obtained prior to procurement of the same. Engineer-in-Charge /Client shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

4.0 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/equipment to be used on this job, covering points not specifically mentioned in this document, manufacturers' instructions should be followed.

5.0 MATERIALS AND EQUIPMENT

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by the Engineer-in-Charge, only the best quality materials and equipment shall be used.

The contractor shall fill in the data sheet for capital equipment as attached elsewhere in this document. The Material/Equipment shall be rejected due to not giving / filling in the details of the said equipment.

6.0 GENERAL DETAILS

6.01 Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

6.02 Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

6.03 Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

6.04 Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specification / BOQ whenever it is not mentioned it shall be as given below.

- Installed out door: IP-55.
- Installed indoor in air-conditioned area: IP-52.
- Installed in covered area: IP-52.
- Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-42.
- For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

6.05 Rating Plates, Name Plates and Labels

Main PCC, PCC's, MDB and auxiliaries items installed in the building are to permanently attach

to it in a conspicuous position. A rating plate of non-corrosive material with engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions of equipment in question has been designed to operate and such diagram plates as may be required by the purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.06 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/soldering/brazing material for all copper/G.I. earthing and essential chemicals etc. which will be required to put the equipment/scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. If for any reason, Contractor wishes to deviate from specification, prior permission from the Engineer-in-Charge will be sought.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

8.0 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Purchaser's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following:

- His organization structure for the management and implementation of the proposed quality assurance programme.
- Documentation control system.
- Qualification data for bidder's key personnel.
- The procedure for purchases of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.
- Control of non-conforming items and system for corrective actions.
- Inspection and test procedure both for manufacture and field activities.
- Control of calibration and testing of measuring instruments and field activities.

- System for indication and appraisal of inspection status.
- System for quality audits.
- System for authorizing release of manufactured product to the Purchaser.
- System for maintenance of records.
- System for handling storage and delivery.
- A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his Vendor's quality management and control activities.

9.0 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance Documents within three weeks after dispatch of the equipment.

- All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.
- Welder and welding operator qualification certificates.
- Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.
- Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.
- Stress relief time temperature charts/oil impregnation time temperature charts.
- Factory test results for testing required as per applicable codes/mutually agreed quality plan/standards referred in the technical specification.
- The quality plan with verification of various customer inspection points (CIP) as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

10.0 INSPECTION, TESTING AND INSPECTION CERTIFICATE

- The Purchaser and the Consultant or duly authorized representative shall have at all reasonable times free access to the Contractor's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.
- All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

Bidder shall submit the type tests reports for approval. The Contractor shall intimate the Engineer-in-Charge the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies. If for any item type test is pending payment would be made on successful completion of type/routine test(s) actually carried out as per Engineer-in-Charge instructions.

- The Contractor shall give the Engineer-in-Charge thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account. The Engineer-in-Charge unless witnessing of the tests is virtually waived will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the presence of Engineer-in-Charge and he shall forthwith forward to the Engineer-in-Charge duly certified copies of tests in triplicate.
- The Engineer-in-Charge shall within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.
- When the factory tests have been completed at the Contractor's or Sub-contractor's works, the Engineer-in-Charge shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer-in-Charge, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer-in-Charge. Failure of the issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should, it, on further tests after erection, is found not to comply with the Specification. The equipment shall be dispatched to site only after approval of test reports and issuance of clearance by the Client / Engineer-in-Charge.
- The contractor shall arrange all necessary instruction and testing facilities free of cost for this purpose including air travel, lodging and boarding expenses.
- For tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by Engineer-in-Charge or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.
- The inspection by Engineer-in-Charge and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
- The Engineer-in-Charge will have the right of having at his own expenses any other tests(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests to satisfy that the material comply with the specifications.
- The Engineer-in-Charge reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Contractor.

11.0 TESTS

11.01 Charging

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Engineer-in-Charge and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-commissioning tests to be performed as per relevant I.S. given and shall be included in the Contractor's quality assurance programme.

11.02 Commissioning Tests

- The available instrumentation and control equipment will be used during such tests and the Contractor will calibrate all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.
- All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.
- The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment. However necessary fee shall be reimbursed by Client on production of requisite documents.

12.0 PACKAGING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Engineer-in-Charge takes no responsibility of the availability of any special packaging/transporting arrangement.

13.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

14.0 FINISHING OF METAL SURFACES

14.01 General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS: 2629.

14.02 Hot Dip Galvanizing

- The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.
- The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.
- Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
 - Coating thickness,
 - Uniformity of zinc,
 - Adhesion test,
 - Mass of zinc coating.
- Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

14.03 Painting

- All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, staving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be shoved.

- Powder coating/electrostatic painting of approved shade shall be applied.
- The exterior color of the paint shall be as per shade no.697 of IS-5 or as approved by Engineer-in-Charge and inside shall be white or as approved by Engineer-in-Charge. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required.
- In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for Engineer-in-Charge's review and approval.

15.0 HANDLING, STORING AND INSTALLATION

- In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's Engineer(s) and shall extend full co-operation to them.
- In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Engineer-in-Charge. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer's drawings/instructions correctly.
- Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- The Contractor shall submit to the Engineer-in-Charge every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
- The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Engineer-in-Charge in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Engineer-in-Charge, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.
- The words 'erection' and 'installation' used in the specification are synonymous.
- Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

- The minimum phase to earth, phase to phase and section clearance along with other technical parameters for the various voltage levels shall be maintained as per relevant IS.

16.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

17.0 DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

18.0 DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer-in-Charge, and the Client during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

19.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.

CHAPTER F

TECHNICAL SPECIFICATIONS FOR ELECTRICAL SERVICES- GENERAL REQUIREMENTS

1 GENERAL

To provide a complete electrical system for the distribution of electric power from the point of supply (SEB), D.G.s to the utilization equipment, all as shown in the drawings and described in these specifications. The quantities mentioned in BOQ are tentative. It will be the bidder's responsibility to work out the exact quantities from drawings or from work site, which trade provides said equipment, materials, tools and labour.

2 SCOPE

The bidder shall supply, install and commission along with requisite spare, maintenance tools and tackles the following equipment and system in the Project. The bidder shall integrate his network to the existing electrical network (HT panel ,LT Panels, APFC panels etc.) of the building. The transformers shall also be connected to the existing panels. The scope also covers the detailed engineering and calculations of the various equipment/system mentioned hereunder and the same shall be approved by the Engineer-in-Charge prior to execution of the job.

- 11 KV /0.44KV Transformers
- Medium voltage switchgear.
- Earthing.
- Lightning protection system.
- Capacitor with control panels.(if required)
- Laying and termination of cables.
- Conduiting for Fire Alarm and Public Address System
- Rising Main / Distribution Boards / Sub-Distribution Board.
- Complete internal building wiring as per specification.
- Safety to personnel and equipment during both operation and maintenance.
- Reliability of Service.
- Minimum fire risk.
- Ease of maintenance and convenience of operation.
- Automatic protection of all electrical equipment through selective relaying system.
- Electrical supply to equipment and machinery within the design operating limits.
- Adequate provision for future expansion and modification.
- Maximum interchange ability of equipment.
- Fail-safe feature.
- Suitability for applicable environmental factors.

This specification defines the basic guidelines to develop a suitable electrical system as necessary for the commercial complex. All data required in this regard shall be taken into consideration to develop a detailed engineering of the system. Site conditions as applicable are mentioned elsewhere.

Compliance with these specifications and/or approval of any of the Contractor's documents

shall in no case relieve the Contractor of his contractual obligations.

All work to be performed and supplies shall be affected as a part of contract requires specific approval/review of Engineer-in-Charge or his authorised representative. Major activities requiring approval/review shall include but not be limited to the following:

The engineering activities shall comprise the submission for approval of the following:

- Basic engineering documents e.g. overall single line diagram, area classification drawing, overall cable layout, testing, type test report, guaranteed particulars of all equipment and maintenance manuals.
- Quality assurance procedures.
- Field testing and commissioning procedures.
- Basic engineering calculations viz. load analysis; load flow, fault level calculations, and voltage drop calculations during motor start-up/re-acceleration etc.
- Control and protection schemes.
- Load sharing and annunciation scheme,
- Sizing calculation for cable trays/cable trenches.
- Area-wise illumination level calculation and preparation of power supply distribution drawing.
- Calculation for earthing system and lightning protection.

Bidder shall be responsible for:

- Detailed co-ordination with other services, shop drawings for various electrical layouts such as equipment layout, lighting layouts, cabling layouts, earthing and lightning protection layouts, including equipment installation and cable termination details etc. prior to start of work.
- Preparation of bill of materials for cabling, lighting, earthing and miscellaneous items etc.
- Cable schedule.
- Lighting/power panel schedule.
- Interconnection drawing.
- Protection co-ordination drawings/tables for complete power system.
- Shop inspection and testing procedures.
- Field testing and commissioning procedures.
- Preparation of as built drawings for all services.
- Any other work/activity which is not listed above however is necessary for completeness of electrical system.

3 CODES & STANDARDS

The design engineering manufacturing and the installation shall be in accordance with established codes, sound engineering practices, and specifications and shall conform to the statutory regulations applicable in the country. Contractor shall obtain all approvals from statutory authorities' e.g. Electrical inspector, pollution control boards, SEB as applicable before commissioning of electrical/DGs.

- Indian Electricity Act.
- Indian Electricity Rules.
- Factory Act.
- Pollution Control Act.

IS-732:	Code of practice for electrical wiring installation system voltage not exceeding 650V.
IS-3043:	Earthing.
IS-2309:	Code of practice for the protection of buildings and allied structure against
Lightning	
IS-7689:	Guide for control of undesirable static electricity.
IS-3716:	Insulation co-ordination application guide.
IS-8130:	Conductors for insulated electrical cables and flexible cords.
IS-5831:	PVC insulation and sheath of electric cables.
IS-3975:	Mild steel wire, strips & tapes for armouring cable.
IS-3961:	Current rating of cables
IS-694:	PVC insulated (heavy duty) electric cables for working. Voltage up to and including 1100 volts.
IS-424- 1475 (F-3):	Power cable flexibility test.
IEC-439/IS-7098:	Specification for cross linked polyethylene insulated PVC sheathed cable for working voltage up to 1.1 KV.
IS-1554:	PVC insulated cables up to 1100 volts.
IS-10810:	Test procedures for cables.
IS-6121:	Cable glands.
IS-10418:	Cable drums.
IEC-754(1):	FRLS PVC insulated cable.
ASTM-D-2863:	Standard method for measuring minimum oxygen concentration to support candle-like combustion of plastic (oxygen index).
ASTM-D-2843:	Standard test method for measuring the density of smoke from burning or decomposition.
ASTM E-662/IEC 754(A)	Standard test method for specific optical density of smoke generated by solid materials.
IEEE-383:	Standard for type test class-IE, electric cables, field splicers and connections for power generation station.
IS 13947/IEC 947:	Air circuit breaker/moulded case circuit breaker.
IS-8623:	Specification for factory built assemblies of switch gear and control gear for voltage upto and including 1000vac/1200vdc
IS 1018:	Switchgear and control gear selection/installation and maintenance
IS-1248:	Direct acting indicating analogue electrical measuring instruments and testing accessories.
IS-13779:	Digital measuring instruments and testing accessories.
IS-3156:	Voltage transformer
IS-2705:	Current transformer for metering and protection with classification burden and insulation.
IS -2147:	Degree of protection provided by enclosures for low voltage.
	PART 1,11,111 Switchgear and control gear
IS-3427:	Metal enclosed switchgear and control gear
BS-162:	Safety clearance
IS-3202:	Code of practice for climate proofing of electrical equipment.

IS-375:	Marking and arrangement for switchgear, bus bars, main connections and auxiliary wiring.
IS-722:	Ac electric meters
IS-3231:	Electrical relays for power system protection.
IEC-255	
IS-5082:	Electrolytic copper/aluminium bus bars
IS-2834:	Capacitors
IS-2713:	Steel tubular pole
IS-335:	Specification for insulating oil
IS-3837:	Specifications for accessories for rigid steel conduit for electrical wiring.
IS-2026&335:	Distribution transformer (PART I,II,III) GI/STEEL /PVC conduit pipe for electrical wiring.
IS-2274:	Code of practice for electrical wiring installation system voltages exceeding 650 volts.
IS-6665:	Code of practice for industrial lighting
IS-3646:	Interior insulation part 1&2
IS-1944:	Code of practice for lighting of public through fares.
IS-7752:	Guide for improvement of power factor consumer's installation.
IS-13346:	General requirement for electrical for explosive gas atmosphere.
IS-13408:	Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
IS-12360:	Voltage and frequency for ac transmission & distribution system.
IS-5572:	Classification of hazardous area for electrical installations.
IS-5571:	Guide for selection of electrical equipment for hazardous area.
IS-4201:	Application guide for Current Transformer
IS-4146:	Application guide for Voltage Transformer
IS-10028:	Code of practice for installation and maintenance of transformer
IS-8478:	Application guide for on load tap changer
IS-10561:	Application guide for power transformer
IS-1646:	Code of practice for fire safety of buildings electrical installation
IS-3034:	Code of practice for fire safety of industrial building-electrical generating and distribution station
IP-30:	National electrical code (NEC) BIS publication.
IS-4722:	Rotating electrical machines.
IS-4889:	Method of determination of efficiency of rotating electrical machines.
IS-325:	Three phase induction motors.
IS-4729:	Measurement and evaluation of vibration of rotating electrical machines.
IS-900:	Installation and maintenance of induction motors.
IS-4029:	Air break switches.
IS-2208-9224:	HRC cartridge fuses.
IS-2959:	Contactors.
IS-9537:	Rigid steel conduit.
IS-1030-1982:	Specification for carbon steel castings for general engineering purpose.
IS-1601/ BS-649:	Performance& testing of Internal Combustion (IC) engines for general purpose.
AIEE-606(1959):	Recommended specification for speed governing of I.C. engine generator units.
BS-5514/IS-3046 8528(Part-2):	Reciprocating IC engine driven A.C. generators.

Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.

In case of any deviation /conflict of this specification with the codes & standards, the following order of precedence shall govern.

- a) Specification, particular specification if any, and drawings.
- b) Indian regulations/codes and standards.

4 SITE CONDITIONS

i)	Design ambient	50 Deg.C. Maximum, 2 Deg. C. minimum
ii)	Relative Humidity	85% maximum
iii)	Site environment	Normal

5 DESIGN CRITERIA

I. Electrical Details of Incoming Supply

a)	Supply Voltage	11 KV as per SEB approved.
b)	Fault level (sym.) at supply of point (designed)	350 MVA (to be confirmed from State Electricity Board by Tenderer).
c)	Neutral Earthing	Solid Earthing
d)	Voltage Regulation	$\pm 10\%$
e)	Frequency Regulations	$\pm 3\%$
f)	Combined	$\pm 10\%$

II. L.T. Power Distribution Systems

a)	Voltage	415 V / 240 V
b)	Frequency	50 Hz
c)	Neutral Earthing	Grounded
d)	Short Circuit Fault withstand Capacity	10 KA - 50 KA (1 Sec.) or as per B.O.Q.

iii. Emergency Lighting (Battery Operated With Self Charger)

a)	Voltage	12 V, DC
b)	Source	Mains/D.G. Set

iv. Control Supply for Electrical System

The various supply voltage to be used in the control panels for main equipment are:

a)	Spring Charge Motor	230 Volt A/C
b)	Closing/Trip Coil	24 V DC / 230V AC
c)	Alarm/Indication/Relay	24 V DC/ 230 V AC
d)	Heaters	230 V AC

- | | | |
|-----|---|---|
| v. | Power Supply Load Control/
Distribution Panel. | 433 V TPN / 240 V 1 phase A.C. (other
supply if required shall be derived by |
| vi. | Painting of Panel. | Powder coating of approved shade. |
| ii. | Painting of Cable Tray & Structure | Powder coated of approved shade. |

6 CABLE DETAILS

- | | | |
|---|----------------------|---|
| . | Internal Wiring. | Copper conductor PVC insulated 1.1 KV grade as called for in BOQ. |
| . | Power Cables (L.T.). | XLPE insulated Al. Armoured Cable as per BOQ. |
| . | 11 KV. | Aluminium conductor XLPE insulated armoured cable. |
| . | Grounding Conductor. | Copper/G.I. strip as per BOQ. |
| . | Lightning Conductor. | G.I. Strip. |

7 ACCURACY CLASS OF METERS

- | | | |
|----|---|--|
| a) | Revenue Metres. | Class-0.5 or as per SEB approved. |
| b) | Ammeter, Voltmeter and Other Instruments. | Class – I Digital / Analogue as per
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CHAPTER G

TECHNICAL SPECIFICATIONS FOR ELECTRIFICATION

1. GENERAL

1.1. STANDARDS

All equipment, material and components shall comply with the requirements of the latest editions of Indian Standards with updated amendments. Standards and Regulations applicable in the area where equipment is to be installed shall also be followed.

The equipment offered complying with other standards, these standards shall be equal to or superior to those specified and full details of the differences shall be furnished along with the tender.

Some of the relevant Indian and British Standards are listed below:

IS 13947 - A.C. Circuit Breakers (Relevant Parts/SCC)

IS 13941 - High voltage Circuit Breaker (Relevant Parts/SCC)

IS 3427 - Metal enclosed Switchgear & Control Gear

BS 162 - Safety Clearances

IS 2705 - Current Transformers (Parts 1 to 4)

IS 3156 - Voltage Transformers (Parts 1 to 4)

IS 3202 - Code of Practice for climate proofing of electrical equipment

IS 375 - Marking & Arrangement for Switchgear Bus Bars, main connections and auxiliary wiring.

IS 722 - A.C. Electric Meters

IS 1248 - Direct acting Electrical Indicating Instruments

IS 3231 - Electrical Relays for Power System Protection

IS 2544 - Epoxy Cast Resin Insulators

IS 5082 - Electrolytic Copper and Aluminium

IS 5792 - High Voltage HRC fuses

IEC 60694- High Voltage Switchgear

IEC 60947- High voltage Circuit Breaker

IEC 60298- Metal Enclosed High Voltage Switchgear

1.2 DETAIL OF DESIGN

i. CONSTRUCTION

The switch boards shall be cubicle type, suitable for indoor/outdoor installation, floor mounting and free standing. The design shall be totally enclosed, dust - tight, dam proof and vermin proof offering degree of protection not less than IP-42 for Indoor Application & IP-54 for Outdoor application.

Separate segregated compartments shall be provided for circuit breakers, bus bars, cable box, voltage transformers, wire ways, relays, and instrument and control

devices. Switchgear cubicles/ modules shall be provided with hinged doors in front with facility for padlocking door handles.

Vent openings shall be covered with grills so arranged that hot gases cannot be discharged through them in a manner that can injure the operating personnel. These vent openings shall be vermin proof.

All the High Voltage compartments i.e. Circuit Breaker, Bus Bar, and Cable Compartments shall be separated from each other by metallic partitions in line with IEC-600298. These compartments must have pressure relief flaps for exit of gas due to internal arc to ensure operators safety. All the HV design must ensure conformity to IEC-600298 and must be Type tested for Internal Arc Test. The supplier shall submit Type Test report from CPRI or other independent agency to prove the above.

All panels shall be of same height, width and depth. Panels shall be bolted together to form a continuous flush front switch board, suitable for front of board operation.

The switchgear cubicles shall be rigid and robust in design and construction, fabricated out of CRCA sheet steel. Cubicles shall be made from rigid welded structural frames made of structural steel sections or of pressed/formed sheet steel of not less than 2mm thickness. The frames shall be enclosed by sheet steel of at least 2mm thickness, smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary. Height of the operating handle, push button etc. shall be restricted between 300 mm to 2000 mm from the finish floor level. Fixing screws and nuts shall be used. Self-tapping screws shall not be used in the construction.

All doors, panels, removable covers shall be provided with non deteriorating (neoprene) gaskets all around the perimeter.

All doors shall be removable and supported by concealed type hinges. The hinges shall be strong and braced to ensure freedom from sagging, bending and general distortion of panel or hinged part.

Floor mounted cubicles with minimum 75 mm high channel and 5 mm thick channel base frame. Approx 200 mm-blank space between the floor of the switchboard and bottom most unit shall be provided. The total height of the cubicle shall not exceed 2400mm.

ii. BUSBARS & BUSBAR CHAMBER

Three phase bus bars shall be of high conductivity electrolytic copper as stated in B.O.Q. The bus bars shall be air insulated and housed in a separate compartment, which segregated from all other compartments, in case of Vacuum Circuit Breaker. Current density of Cu.Bus-Bar shall not exceed 1.2 Amps / mm²

Bus bars & bus bar connections shall be of uniform cross section shall be suitable for carrying rated current continuously and short circuit current for specified duration without overheating. The bus bars connections shall be adequately supported on insulators to withstand dynamic stresses due to short circuit current specified. Normal operating temperature for bus bars shall be 85 Deg.C. Short circuit rating of the bus bars shall be 35 KA for 1 sec.

All bus bar joints and bus tap joints shall be silver or tin plated. Joints shall be bolted type and shall be insulated. Spring/Lock washers shall be provided to ensure good contact the joints.

Direct access to accidental contact with bus bars and primary connections shall be avoided by providing shrouds. All apertures and slots shall be protected by barriers to prevent accidental shorting of bus bars. To provide a tight seal between cubicles,

bushings or insulating panels shall be provided for bus bars crossing from one cubicle into another.

All insulating materials used shall be non-hygroscopic and shall be treated for preventing fungus growth. Surface of insulators shall be highly glazed and treated with silicone compounds to minimize accumulation of dust, condensation and tracking.

iii. CIRCUIT BREAKERS

The circuit breakers shall be Triple Pole double break type and the Insulation and Arc interruption medium shall be Vacuum. The Breaker shall be enclosed in a sealed Vacuum Tank.

The circuit breakers shall be of horizontal draw out construction with horizontal/vertical isolation. The circuit breaker including its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow easy movement on the circuit breaker. There shall be three discrete positions viz. Service, Test and Isolated. Locking facility in all three positions shall be available. Position indicator shall be provided on the panel to indicate the position of the circuit breaker. Test position shall offer testing of circuit breaker operation/interlocks without energizing the power circuit.

Circuit breakers shall have stored energy spring mechanism charged by manually operated handle as well as electrically operated mechanism. The closing mechanism of the circuit breakers shall be Motor operated, spring charged with a provision for manual charging.

The operating mechanism shall be mechanically and electrically trip free and non-pumping. Anti-pumping feature may be built in or separate anti-pumping relay may be provided. In case spring charged mechanism, spring charged indication shall be provided.

Local manual trip device shall be provided on the operating mechanism. The trip device shall be suitable for front operation and positive mechanical 'ON-OFF' indication shall be provided.

Main contacts of circuit breaker shall have ample area and adequate contact pressure to carry the rated and short time current without excessive temperature rise. The contacts shall be adjustable for wear and easily replaceable. Main contacts shall open before and close after the arcing contacts when these are provided. Arcing contacts shall be easily accessible for inspection and replacement in case of VCB.

Each breaker shall normally be provided with auxiliary contacts of 6 NO+6NC directly operated from breaker operating mechanism. These contacts shall be in addition to those used in circuit breaker internal wiring. These contacts shall be rated for 10 Amps at 240V AC and 20 Amp (inductive breaking) at 220V D.C. If more breaker auxiliary contacts are required latching relay shall be used to multiply the contacts.

Shunt trip coil as called for shall be provided for tripping the circuit breaker. The trip coil/s shall operate satisfactorily between 50% - 110% of rated control voltage. Wattage of trip coils will be sufficiently high to prevent it from picking up or holding on with specified number of trip circuit supervisory indicating lamps wired in series.

It shall be possible to trip the breaker, in case of failure of control supply

Circuit breaker type duty and rating shall be submitted in Data Sheet by the Contractor.

Circuit breakers of similar rating shall be interchangeable.

iv. RING MAIN UNIT/ LOAD BREAK SWITCHES

All the live parts of the Load break switches, Copper Bus Bars of the RMU shall be enclosed in SF6 gas medium sealed in stainless steel tank. All connection for Bus-bars shall be capable for short time rating of 21 KA for 3 seconds and shall also be capable of breaking full load current and having fault making capacity of 52 KA.

The RMU shall be equipped with following mechanical Interlocks:

- a) Between Load break switch & earth switch, i.e., load break switch only can be turned on when the earth switch is in OFF position and vice versa.
- b) Between breaker, off load break switch (disconnecter) & earth switch: The breaker must be in OFF position to operate the off load break switch & earth switch. When the earthing switch is in closed position it will be impossible to operate the disconnecter.
- c) Between Earth switch & Cable compartment doors, i.e., doors are accessible only when the earth switch is ON; further the main isolator switch/ breaker disconnectors cannot be switched ON unless the doors are closed.

v. CURRENT TRANSFORMERS

Current transformers shall be of ratio, burden (shall be worked out by panel supplier), class/accuracy as specified in Single Line Diagram/BOQ.

Current transformers shall conform to latest edition to relevant standards. Current transformers shall be epoxy resin cast with bar Primary or ring type.

CT core laminations shall be of high grade silicon steel. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses due to the maximum short circuit current of the circuit.

The current transformer shall preferably be capable of being left open circuited on the secondary side with primary carrying rated full load current, without overheating or damage. Short time current rating and rated withstand time shall be same as corresponding C.B.

Secondary terminals of CT shall be brought out to a terminal block which will be easily accessible for testing and external connections. Facility shall be provided for short circuiting and earthing of CT secondary leads through a removable and accessible link with provision for attaching test link.

Rating plate details and terminal markings shall be according to the latest edition of relevant Indian Standard specification.

Current transformers (core) shall be used for metering and protection. Each CT shall be provided with rating plate indicating: Name and Make, Serial number, Transformer Ratio, Rated burden, Rated voltage and Accuracy class.

vi. POTENTIAL TRANSFORMERS

Potential Transformers shall conform to latest edition of "IS-3156 (Part I, II & III) as applicable relevant standards.

Potential transformers shall be dry, cast epoxy resin type. The PTs shall be of single phase construction.

The PT shall be capable of operating continuously at 110% of the rated voltage without any damage. When star - star connection is required in non-effectively or

ungrounded system, the PTs shall be suitable for continuous operation with a persistent phase to ground fault.

Maximum temperature rise of the transformer at rated burden and with rated primary voltage and frequency shall not exceed 40 Deg.C above an ambient of 45 Deg.C.

The PT's shall be fixed at rear bottom / top of the panel as called for. An interlock or automatic shutters shall be provided to prevent access to live HV parts when PT is withdrawn.

HRC Fuses shall be provided both primary & secondary side. It shall be possible to replace PT fuses easily without having to de-energize the main bus bars. Prospective interrupting current rating of the fuses shall be same as the system fault level.

Voltage transformer ratio, output and class shall be as specified in the BOQ and shall be stated in data sheet by the Vendor/Contractor. Nameplate as per relevant standards shall be provided on the PT.

vii. PROTECTIVE RELAYS

Relays type and numbers shall be in accordance with the protective scheme required or as per drawings and B.O.Q.

Relays shall be digital microprocessor based or analogue type, as called for in BoQ. It shall be enclosed in rectangular shaped cases, suitable for flush mounting only, dust tight covers projecting from the front cover panel. The case shall be dust tight, damp proof and tropicalized. The relays shall be either self-powered or a 24V DC Power-pack of suitable capacity with charging device shall be provided within the HT panel.

Relays shall be accessible for setting from the front. Access to setting devices shall be possible only after removal of front cover.

Protective relays shall be drawing out type. Where it is not possible to provide protective relays of the draw out pattern, fixed type relays with facilities for plugging in a portable test plug shall be provided. Necessary test plugs shall be furnished along with the relays.

Relays shall be provided with positive action self-reset type with indicator. The indicator/s shall be visible from the front.

Relays conform to relevant standards in all respects. Relays shall be provided with minimum two pairs of self or hand reset type contacts as specified. Auxiliary relays shall have the number of NO and NC contacts as required and shall be in data sheet by the Vendor / Contractor.

viii. SAFETY/PROTECTION INTERLOCKS/FEATURES

Following interlocks and features shall be incorporated for equipment protection and personnel safety under mal-operation. No deviations on these interlocks and safety features are allowed. These interlocks and safety features shall be fail-safe, positive and full-proof.

- a) It shall not be possible to plug-in or isolate a closed circuit breaker. An attempt to do so shall trip the breaker. (In case of breakers with vertical isolation, this will apply to raising and lowering). There shall be a positive locking facility to prevent closing of circuit unless it is in Service or Test position.
- b) Closing and opening operations shall be possible only in discrete, well defined Test and Service positions and not in any position midway. An extension adapter cable

with plugs and sockets shall be preferably be provided so that the closing and opening operation of the circuit breaker can be done in fully withdrawn position outside the cable.

- c) Slow operation of circuit breakers shall be possible only in the circuit breaker in Test or Isolated position.
- d) Isolating switches if provided shall be interlocked with respective circuit breakers to prevent them making or breaking the current.
- e) 1 no. bus earthing truck shall be supplied with each panel to earth the out going cable of the VCB.
- f) Automatic safety shutters for all openings which will lead to access to the live parts of the switchgear upon withdrawal or any operation the switchgear components/parts shall be provided, preferably with a padlocking facility.
- g) Spring of motor operated spring charged mechanism shall not discharge until they are fully charged and charging means are fully disconnected.
- h) Where key interlocking is employed, tripping of a closed circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism.
- i) Annunciation window shall be provided for winding temperature trip / alarm as required.
- j) Any other interlocks which manufacturer may deem to be required for safety and specifically specified separately required for the system shall be included.
- k) All terminals, connections which may be live and exposed for accidental contact shall be adequately shrouded.
- l) Components within cubicles shall be properly labelled to facilitate testing.

ix. EARTHING

The switch board shall be provided at the bottom throughout its entire length with a earth bus of copper of adequate size to carry the fault current for the duration same as short time rating of the circuit breaker. Earth bus shall have two earthing connection facility at its both ends of earthing conductor.

All non-current carrying metal parts, frames and equipment mounted in the switchboard shall be bonded to earth bus.

Earthing of moving carriage of drawout equipment shall be achieved by scraping earthing device. The earthing device shall maintain positive earth continuity in all Service Test and Isolated positions.

It shall be possible to connect each circuit or set of three phase bus bars to earth either through earthing trucks or through the circuit breakers.

One earthing trolley suitable for earthing of cables or bus bars and common for all circuit breakers of the same type/rating shall be provided.

x. INSTRUMENT & METERS

Electrical indicating instruments shall be digital type with zero adjustment, probe from outside the cover.

Multi-function meter of CL 1.0 accuracy with RS 485 port shall be provided.

Instruments/meters shall be suitable for flush mounting on the panel with flanges protecting outside the panel.

All meters shall be industrial grade with accuracy of class 1.0 unless specifically indicated.

xi. CONTROL WIRING

All wiring for control, protection, alarm, indicating circuits and remote tripping mechanism on all equipment shall be carried out with at least 650V grade, PVC insulated, stranded, copper, 2.5 Sq.mm conductors.

All wiring shall be run on the sides of the panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel. Where wiring enters or passes through compartments containing HT apparatus then they shall be in earthed metallic conduits or ducts.

All wiring shall be taken to terminal blocks without joints or tees in their run.

All wiring shall be colour coded as follows:

Instrument Transformer AC circuit	-	Red, Yellow & Blue determined by the phase with which the wire is associated.
AC Phase Wire	-	White
AC Neutral	-	Black
DC Circuits	-	Grey
Earth connections	-	Green

Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted to each wire. Ferrules shall fit tightly on the wires, without falling off when wire is removed. Ferrules shall be of white colour with black lettering. Each wire shall be identified by letter to denote its function followed by a number to denote its identity at both ends.

All wiring for external connections shall be brought out to individual terminals on a readily accessible terminal block.

All unused auxiliary contacts of the circuit breaker and relays shall be wired upto terminal block.

xii. FITTINGS AND ACCESSORIES

Indicating Lamps:

Neon type indicating lamps or LED indicators shall be provided everywhere except where low voltage filament type with series resistor called for.

Lamp covers shall be provided with interchangeable colored lenses of Perspex or equivalent unbreakable material. The lenses shall not discolor in course of time due to heat of the lamp.

Bulbs and lenses shall be interchangeable and replaceable from the front.

Following colors shall be used for the function indicated:

Red	-	Circuit Breaker 'ON'
Green	-	Circuit Breaker 'OFF'
White	-	Continuous trip supply supervision
Amber	-	Auto trip
Blue	-	Spring charged

R.Y.B	-	Potential indication
Green	-	Earth

Push Buttons:

All push buttons shall be push to actuate the contact type.

Start & Stop push buttons shall be colored green and red respectively. Reset push buttons shall be yellow in color and test push buttons shall be blue in color. All other push buttons shall be black in color.

Emergency stop push buttons shall be lockable in the operated position, i.e. push to operate and key to release type. Push buttons for emergency stop shall be recessed/shrouded type to avoid accidental operation.

Control & Selector Switches:

Control and Selector switches shall be of rotary type, having enclosed contacts accessible only after removal of cover.

All control and selector switches for circuit breakers and instruments shall be mounted on the front of the panel. Control switches for space heater/s and control supplies shall be mounted inside the panel.

Circuit Breaker control switches shall be provided with pistol grip handles. Selector switches shall be provided with round, knurled handles. All handles shall be black in colour. Properly designated escutcheon plates clearly marked to show the operating positions shall be provided on all switches.

All other instruments and selector switches shall have stay put contacts.

Circuit breaker control switches shall normally have three positions close - Normal - Trip with spring return to normal position. Switch operating mechanism shall prevent the switch from being operated twice successively in the same direction. Circuit breaker control switch shall have one NO-NC contact along with other contacts as required.

Contacts of all control and selector switches shall be rated for 10 Amps at 240V AC or 20 Amps at 220V dc (inductive break). Switch for space heater supply and control voltage supply shall normally be two pole rated for 25A A.C.

Control Terminal Blocks:

Box - clamp type, 650V grade line up terminals of minimum 2.5 Sq.mm size shall be provided. Connection to terminals shall be from front.

Not more than one wire on each side shall be connected on any terminal. Where duplication of terminals block/s is necessary, suitable solid bonding links shall be incorporated. Terminal blocks at different voltage shall be segregated into groups and distinctly labelled. Current transformer secondary leads shall be brought to terminal blocks having facility for short circuiting and grounding the secondary.

Terminals shall be numbered for identification and grouped according to function. Engraved back on white PVC labels shall be provided on the terminal blocks describing the function of the circuit.

Separate terminal stems shall be provided for internal and external wiring.

Control terminal blocks shall be so located that control cables are fully segregated from power cables. Suitable insulated or earthed metal race ways shall be provided

for control wiring. Separate undrilled removable gland plate shall be provided for the control cables at the bottom of each panel.

Minimum 10% of total number spare terminals shall be provided for future use.

xiii. NAME PLATES AND LABELS

One Name plate giving designation of the HV switchboard shall be affixed prominently on top of the switch board. Details of designation will be specified.

Labels giving following details shall be affixed on each feeder panel:

- i) Feeder Name.
- ii) Equipment reference no. & Description
- iii) Rating (KVA/Amp.)

All components whether mounted inside or on the door shall be permanently and clearly labelled with reference number/letter or their function. Rating of fuse shall be part of fuse designation. Paper labels, stickers or labels fixed with adhesives are not acceptable. All labels shall be properly fixed by screws with provision to prevent distortion due to expansion.

All labels shall be non-corroding, preferably laminated plastic or rear engraved perspex with white letters on black background.

Labels for feeder panel designation fixed on front side shall be fitted with chrome plate, self-tapping, and counter sunk head screws. These labels shall be of identical size to permit interchange.

SPACE HEATERS:

Adequately rated anti-condensation space heaters shall be provided in each cubicle.

Space heater/s shall be trip type, rated with operation voltage of 240V, 50 Hz. AC supply.

Each space heater shall be complete with a 2P MCB, 10KA and a control thermostat.

The space heater shall be rated for maintaining the panel inside temperature 10 Deg.C above outside ambient temperature.

CUBICLE LIGHTING:

Each cubicle shall be provided with interior lighting by means of CFL light fixture. An ON/OFF switch/door switch shall be provided. The lighting fixture shall be suitable for operation from a 240V single phase, 50 Hz. A.C. supply.

AUXILIARY SUPPLY:

Auxiliary supply for control, indication, space heater etc. shall be made available at one point on the switch board. Vendor shall provide suitable auxiliary supply in the switch board.

FUSES:

All fuses in control, indication and metering circuit shall be HRC link type of approved make. Mounting of fuse fitting shall ensure adequate dissipation of heat generated and shall facilitate inspection and easy replacement of fuse.

CABLE TERMINATION:

The switch board panel shall be provided with separate compartment for cable termination complete with suitable cable end termination for XLPE insulated cables

suitable for bottom entry. Cable and sealing box shall preferably be mounted inside the panel. Cable compartment doors shall be self-locking type, interlocked and shall have Arc withstand capability due to short circuit. The compartment shall be provided with cable testing facility in case of gas insulated medium. For XLPE cables adequate space and clearances shall be made for heat/cold shrinkable termination e.g. Reychem or cold flowing stress grading joints.

Two earthing terminals shall be provided in each panel in cable box/cabling chamber for earthing armour/screen.

Where more than one core is terminated on each phase, links suitably designed and properly supported shall be provided to avoid unnecessary bending of cable cores without decreasing the length of insulated cable tail. Electrical clearances which would normally be required when using one core per phase shall be maintained.

Where core balance type current transformers are provided on switchgear feeder circuit cable/s for earth fault protection sufficient space, clearance and support, mounting arrangement shall be provided for the CT.

PAINTING:

All steel work shall be pretreated in tanks and finally powder coated of approved shade of the levels not less than 100 microns.

xiv. TESTING & INSPECTION

Four copies of all test certificates and certificates from sub-vendor shall be furnished. After completion of all work at the manufacturer's works the switchboards shall be inspected and tested in presence of Purchaser's/Consultant's representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

- i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.
- ii) Test for protective relay operation by secondary injection method.
- iii) Operation of all meters.
- iv) Secondary wiring continuity test
- v) Insulation test with 1000 Volts megger, before and after voltage test.
- vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)
- vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.
- viii) Measurement of power required for closing/trip coil of the breaker.
- ix) Pick up and drop out voltages for shunt trip and closing coils.
- x) CT Polarity test.
- xi) Power frequency voltage withstand test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before dispatch of switch boards.

xv. DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

- i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cut-outs/trenches for external cables and elevations, transport sections and weights.
- ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.
- iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.
- iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.
- v) Relay wiring diagrams.
- vi) Equipment List.
- vii) Bus bar sizing calculations.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.

The information furnished shall include the following:

- i) Technical literature giving complete information of the equipment.
- ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.
- iii) A comprehensive spare parts catalogue.

xvi. TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools individually priced with his quotation.

xvii. SPARES

Contractor shall also quote separately for the maintenance spares for 2 years normal operation for Client to decide for placement of order at a later date. The quote shall remain valid at least for 6 months. The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

xviii. QUALITY ASSURANCE

Quality Assurance shall follow the requirements of Engineer-in-Charge /Client as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

xix. DEVIATIONS

Clause wise deviation for the specification must be stated in writing at the quotation stage. In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

2. DISTRIBUTION TRANSFORMER -OIL TYPE DISTRIBUTION TRANSFORMER with OLTC

Outdoor type step-down transformer shall be **11 KV to 0.415 KV**, Delta/Star three phase 50 cycles copper wound of rating **500 KVA** respectively. Transformer shall be having high efficiency, low magnetic field and impedance shall not exceed 6.25 %. Transformer shall not exceed 3.6 and 12 KW at 50% and 100% loading respectively. It shall be double wound core type with ONAN cooling having delta connection on HT side and star on secondary side having automatic On load tap changing device on high tension side for tapping –10% to +5% in step of 1.25%. The transformer shall be complete with the following accessories.

- On Load tap changer with Remote tap changing control panel with Automatic Voltage Regulating relay.
- OLTC conservator with drain valve, filling hole with cover and silica gel breather and oil level indicator.
- Oil conservator with sump and drain valve with cover plate.
- Dehydrating breather with silica gel and oil seal.
- Oil filling valve 32mm dia with cover plate.
- Thermometer pockets with thermometer.
- 150mm dia magnetic oil level indicator with low-level alarm and trip contacts and minimum filling and maximum level markings. Plain oil level gauge with minimum level marking.
- Diagram, rating plate, terminal-marking plate.
- Two earthing terminals.
- Lifting lugs for active part only.
- Four bi-directional plain rollers.
- First filling of oil.
- Double diaphragm explosion vent pipe with sight glass.
- 150mm dial type winding temperature indicator with maximum reading pointer and alarm and trip contacts. Pocket for above item.
- 150mm dia magnetic oil level indicator with low level alarm and trip contacts and minimum filling and maximum level markings
- Double float Buchholz relay with testing sampling cocks, alarm and trip contacts.
- Marshaling Box for contacts for alarm & trip for OTI, WTI, OSR, MOG & Bucholtz relay.
- Air release plug on tank cover.
- Isolation valve on both sides of bucholtz relay.
- W.P. thermo / plastic junction box.
- Detachable radiator with top and bottom stop valves and drain and air release plugs.

- Jacking pads with haulage holes.
- Oil surge relay for OLTC.
- Shut off valve for OLTC oil surge relay.
- Access windows for OLTC connections.
- Drain cum bottom filter valve 32mm with cover plate.
- Vector group – Dyn11
- Cable end box suitable for 1 No. 3 core x **240 Sq.mm** XLPE cable, **11 KV (E)**
- Cable end box suitable for 8 Nos. **3.5 core x 400 Sq.mm** XLPE cable, for connection in L.T. side (1100 Volt grade).
- Extra neutral bushing for solid earthing.
- Pressure equalizer pipe.
- Provision of terminals & Space for mounting Neutral CT for REF relay.

The transformer shall be rated for a maximum temperature rise of 50 Deg. C for oil and 55 Deg. C for winding over 45 Deg. C ambient temperatures.

The transformer shall conform to the IS: 335 and 2026/1977.

i. WINDINGS

Windings shall be subjected to shirking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service.

Coils shall be supported at frequent intervals by means of wedge type insulation spacers permanently secured in place and arranged to ensure proper oil circulation. To ensure permanent lighteners of winding assembly, the insulation spacers shall be dried and compressed at high pressure before use.

All low voltage windings for use in the circular coil concentric winding shall be wound on a preformed insulating cylinder for mechanical protection of the winding in handling and placing around the core.

Windings shall not contain sharp bends, which might damage the insulation or produce high dielectric stresses. No strip conductor wound on edge shall have width exceeding six times the thickness.

Materials used in the insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil, and shall not soften or be otherwise affected under the operating conditions.

Varnish application on coil windings may be given only for mechanical protection and not for improvement in dielectric properties. In no case varnish or other adhesive be used which will seal the coil and prevent evacuation of air and moisture and impregnation by oil.

All threaded connections shall be locked. Leads from the winding to the terminal board and bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.

Windings and connections shall be braced to withstand shocks during transport or short circuits.

Coil clamping rings shall be of steel or of a suitable insulating material.

Permanent current carrying joints in the windings and leads shall be welded or brazed. Clamping bolts for current carrying parts inside oil shall be made of oil resistance material which shall not be affected by acidity in the oil. Steel bolts, if used, shall be suitably treated.

Terminate of all windings, also of stabilizing windings, shall be brought out of the tank for external connections.

Windings shall be of copper, the conductors shall be transposed at sufficient intervals in order to minimize eddy currents and equalize the distribution of currents and temperatures along with the windings.

The completed core and coil assembly shall be dried in vacuum at not more than 0.5mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum over tank or in the transformer tank. Vapor phase dry-out shall be preferred.

ii. TANK

Tank shall be made from good commercial grade low carbon steel and shall be of welded construction.

Tank shall be designed to permit lifting, by crane or jacks or the complete transformer assembly filled with oil. Suitable lugs and bosses shall be provided for this purpose.

Tank together with radiators, coolers, conservator, bushings, vessel and other fittings shall be designed to withstand without permanent distortion the following conditions:

- a) Full vacuum of 760mm of Hg. for filling with oil by vacuum.
- b) Internal gas pressure of 0.35 Kg/cm² (5 lbs/sq.in) with oil at operating level.

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

Manholes with bolted covers shall be provided in the top or sides of transformer for easy access to the lower ends of bushings, tap changers and to permit replacement auxiliaries without removing tank cover.

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

The transformer base shall be designed to permit skidding of the complete transformer unit in any direction, when using plates or rails. The under base shall be detachable unless transport facilities permit a fixed base. Pulling eyes shall be provided for moving the transformer in either direction.

The material used for gaskets shall be cork-neoprene or approved equivalent. Gasketed joints for tank and manhole covers, bushings and other bolted attachments shall be so designed that the gasket will not be exposed to the weather. Spare gaskets shall be provided for all openings as shipping gaskets will not be reused.

Tank shall be provided with valves etc. as required.

Tank shall be provided with a pressure release device which shall be operated at a pressure below the test pressure for the tank and radiators. The device shall be rain-proof after blowing and shall be provided with a device visible from ground to indicate operation. An equalizer pipe connecting the pressure relief device to the conservator shall be supplied. Explosion vent shall be equipped with remote monitoring/alarm contracts with oil indicator.

The transformer be rated for a maximum temperature rise of 50 Deg. C by thermometer in oil and 55 Deg. C by resistance at CTR with a daily average ambient temperature of 45 Deg. C and peak ambient temperature of 50 Deg. C.

The external surface of transformer shall be painted with epoxy paint shade of IS: 631.

iii. **ON LOAD TAP CHANGING (OLTC)**

The diverter switch contacts shall be housing in separate oil chamber not communicating with oil of the main transformer tank. The contacts shall be accessible for inspection without lowering oil level in the main tank and the contact tips shall be replaceable.

The OLTC oil chamber shall have oil filling and drain plug, relief vent and level glass. It shall also be fitted with a separate oil surge relay. The outlet of this relay shall be connected to a separate conservator tank or a totally partitioned compartment of the main conservator. A magnetic oil level gauge with separate potential free contacts for alarm and trip shall be provided.

The equipment shall be suitable for local and remote electrical control and local manual control. The features to be provided with these controls are detailed below:

i) Manual Control

The cranking device for manual operation of OLTC gear shall be removable and suitable for operation by a man standing on ground level. The mechanism shall be complete with the following:

- a) Mechanical tap position indicator which shall be clearly visible from near the transformer.
- b) Mechanical operation counter.
- c) Mechanical stoppers to prevent over cranking of the mechanism beyond the extreme position.
- d) The manual control considered as backup to the motor operated tap control shall be interlocked with the motor to block motor start up during manual operation. The manual operating mechanism shall be labeled to show the direction of operations for raising the secondary voltage and vice-versa.

ii) Electrical Control

This includes the following:

- a) Electrical local control from transformer marshal box.
- b) Electrical remote control from remote control (RTCC Panel).
- c) The control scheme shall have the following features:
 - i) An interlock to cut off electrical control automatically upon recourse being taken to manual control.
 - ii) Selection of point of control local or remote, it shall not be possible for any two electrical controls to be in operation at same time.
- d) Reinforcement of the initiating impulse for a tap change, ensuring a positive completion once initiated.
- e) Step by step operation, ensuring only one tap change for each tap changing command.
- f) An interlock to cutoff the electrical control when it tends to perate the gear beyond either of the extreme tap positions.

- g) An interlock to block a counter command for reverse tap change during a tap change until the mechanism comes to rest and resets the circuits for a fresh operation.

The equipment shall be so arranged so as to ensure that when a tap change has commenced it shall be completed independent of the control relays and switches. If a failure of auxiliary supply during a tap change or any other contingency would result in the movement not being completed adequate means shall be provided to safeguard the transformers and its auxiliary equipment. A supply monitoring relay with alarm contacts shall be provided for the tap changer.

The auxiliary device for electrical controls of the OLTC shall be housed either in the OLTC driving mechanism box or in Transformers marshalling box. It shall be provided with a circuit breaker with magnetic and thermal O/L devices for controlling the auxiliary supply of the OLTC motor.

Tap position indicator shall be supplied loose for mounting on the RTCC.

On the RTCC there shall be following components also:

- i) Raise/Lower switch for manual operation.
- ii) Lamp indicating ON LOAD TAP CHANGE in progress.

RTCC panel shall have automatic tap changing feature i.e. whenever voltage fluctuations occur the tap switch shall change automatically to set net output voltage of $0.415 \text{ KV} \pm 1\%$. For this purpose, an Auto/ Manual selector switch shall be provided in RTCC.

OLTC shall have separate breather.

iv. Erection & Installation

The installation, testing and commissioning shall conform to IS Code of Practice IS: 1886-1967 with latest amendment and regulations of local authorities.

When lifting a transformer core shall be taken to see that lifting chain will not interfere with any part of the transformer. Never fix the sling to any other part of the transformer except the lifting lugs. Lifting lugs and jacking pads shall be used for lifting of the transformer. While using jacking pads utmost care shall be taken in proper application of jacks. Where transformer is dragged or pulled on sleeper or rollers the traction eyes provided at the bottom frame shall be used with suitable wire ropes and shackles. Tank cover should always be fitted lifting the tank.

The transformer shall be lifted by lugs or shackles or by any other suitable means (such as dragging on rollers) and mounted on MS channel embedded in cement concrete. Care shall be taken to see that transformer is not tilted during lifting and erection of transformer. The rollers shall be choked to prevent movement of the transformer after being positioned on the plinth. Adequate and necessary clearances from wall etc.. shall be provided as required as per IS: 1886 - 1967.

Before energizing the transformer the oil must be got tested and approved from any of the Government Test House or from approved appropriate authority. The oil shall be tested in accordance with the requirement of IS - 335/1970. In case the results obtained are substandard the entire quantity of oil is replaced with the approved quality of oil and test taken again. The process shall be repeated till satisfactory results are achieved. In case of presence of foreign matter/moisture etc., in the oil, the oil may be got filtered through oil filtration plant. The temperature of oil in the spray tank shall not exceed 80 Deg. C. during the purification process. The minimum IR value by the end of purification process shall be at least 20 Mega-ohm at an oil temperature of 60 Deg. C. Topping up of oil if required shall be done with tested oil.

The insulation resistance of the winding shall be measured with 2500 V DC meggar and results shall correspond to the factory test results. The transformer shall be charged only after the above tests are conducted and approval of local authorities is obtained.

- a) Transformers will be delivered without oil, filled with inert gas and without externally mounted accessories.
- b) The Contractor shall place the transformer on its foundation assemble parts, erect the separate cooler banks where provided, erect the supporting structure for detachable type cable chamber, conduit and wiring connecting and filling of transformer with oil.
- c) The Contractor shall arrange to fill transformer oil and also arrange for oil filtration before filling. H.V. Test/Breakdown strength of transformer oil shall be carried out taking a sample from individual transformer and till the result is not found to satisfaction of Engineer, oil conditioning shall have to be carried out.
- d) Jack for the above transformers shall have to be provided by the Contractor.
- e) If vacuum oil filling in transformer is envisaged the Contractor shall arrange the necessary equipment.
- f) All the cable terminations and control wiring is to be carried out by Contractor.

v. TESTING OF TRANSFORMER

The transformers shall be subjected to the following routine tests at the manufacturer's works before dispatch.

- a) Measurement of winding resistance.
- b) Voltage ratio, polarity and phase relationship
- c) Measurement of impedance voltage
- d) Excitation Current Measurement
- e) Load losses
- f) No load losses and no load current
- g) Induced over voltage withstand
- h) Separate source voltage withstand
- i) Partial discharges tests.
- j) Insulation resistance measurement test.

The insulation resistance of the winding shall be measured with 2500 V DC meggar and results shall correspond to the factory test results. The transformer shall be charged only after the above tests are conducted and approval of local authorities is obtained.

The power frequency test voltage for the secondary winding shall be 2.5 KV R.M.S. The transformer shall be charged only after the tests are conducted and approval of local authorities is obtained.

vi. CONTROL WIRING

All the cable terminations and control wiring is to be carried out by Contractor.

The Contractor shall supply, install, test and commission all control/instruments wiring as found necessary. The job is turnkey and shall remain the responsibility of Contractor to ensure its functioning in useful and defined manner.

All the indoor control wiring shall have copper conductor and PVC insulated.

The indoor control wiring shall conform to IS: 694 for voltage grade of 1.1 KV for A.C./230 V for D.C.

The conductor cross sectional are shall not be less than 2.5 Sq.mm.

The indoor wiring shall be in surface conduit neatly placed on wall or ceiling either in horizontal or vertical run.

The control wiring which are to be placed outdoor or which are to run in cable trench shall be of 650/1100 voltage grade and shall conform to IS: 1554. The cable shall have minimum dia of conductor to 2.5 sq.mm.

vii. TESTING AND INSPECTION

- a) The Contractor shall draw up and carry out a comprehensive inspection and testing programme during manufacture and commissioning of the transformer. The programme shall be duly approved by the Consultant/Client.
- b) Contractor shall ensure that type tested equipment only is offered and routine tests shall be conducted as per relevant standards. Type test certificates shall be submitted along with the bid.

viii. DRAWING AND INFORMATION

The vendor shall furnish following drawings/documents in accordance with enclosed requirement.

- a) General arrangement of transformer.
- b) General arrangement of HV cable box with connection diagram.
- c) General arrangement of LV Bus duct flange/Cable box and connection arrangement.
- d) General arrangement of marshalling box and wiring diagram.
- e) Rating and diagram plate indicating % impedance etc.
- f) Type test and guaranteed technical parameters.

ix. QUALITY ASSURANCE PROGRAMME

Quality Assurance Programme shall follow the requirements of Engineer-in-Charge as applicable.

Quality Assurance Programme involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

x. DEVIATIONS

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

3. L.T. PANELS & SWITCHGEARS

Medium voltage switch boards/distribution boards, the combination of both these and components shall conform to the equipments of the latest revision including amendments of the following codes and standards.

The drawings, specification and BOQ complement each other and which is shown or called for one shall be interpreted as being called for on both. Material, if any, which may not have been specified but fairly required to make a complete assembly of switch gear as shown on the

drawing, specifications shall be construed as being required and no extra charges shall be payable on this account.

CODES & STANDARDS

The design, manufacture and performance of equipment shall comply with all the currently applicable statues, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (B.S.), International Dutro Technical Commission (IEC) Publication, NEMA, IDE & DEMA standard as amended upto date.

- a) IS: 13947- 1993/IEC 60947-1989: Air circuit breaker/moulded case circuit breaker.
- b) IS:3156 Voltage transformers.
- c) IS:2705 Current transformers for metering and protection with classification Part-I, II burden and insulation & III 1964
- d) IS:9224 Low voltage fuse and protection.
- e) IS:3231 Specification for electrical relays for power system protection.
- f) IS:8623 Specification for factory built assemblies of switchgear and control gear for voltage upto and including 1000-V AC/1200 V-DC.
- g) IS:4237 General requirements for switch gear and control gear for voltage not exceeding gear.
- h) IS:2147 Degree of protection provided by enclosures for low voltage switch gear and control gear.
- i) IS:1018 Switchgear and control gear selection/installation and maintenance.
- j) IS:1248 Direct acting electrical indicating instruments.
- k) IS:375 Arrangement for switchgear, bus bars, main connections, auxiliary wiring and marking.
- l) IS:2959 AC contactors for voltage not exceeding 1000V.
- m) IS:5578 Guide for marking of insulated conductors.
- n) IS:11050 Guide for forming system of marking and identification of conductors & apparatus terminal.
- o) IS:1248 Direct acting indicating analogue electrical measuring instruments and Testing accessories.
- p) IS:600 Code of practice for phosphating of iron & steel.

The board shall be metal enclosed single front, indoor, floor mounted, free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-55. However bus bar chamber shall have IP: 42 degree of protection incase bus bar rating exceed 1600 Amps. Keeping in view the operating height of the top switch 1750mm from finish floor. 400mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and 50mm height.

All cutouts and covers shall be provided with synthetic rubber gaskets (preferably neoprene).

The panel shall be divided into distinct vertical sections each comprising of:

- i) Complete enclosed bus bar compartment for running horizontal and vertical bus bars.
- ii) Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB/MPCB with starters etc.

- iii) Compartment for power and control cables of at least 300mm width covering entire height provided.
- iv) **The panel shall have sufficient space at least 20% of outgoing feeders for future use.**

The front of each compartment shall be provided with hinged single leaf door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators and MCCB/ACBs and accessories shall be of fixed/drawout type as per BOQ.

Each feeder shall have compartmentalized or non-compartmentalized for MCB feeders only. Ri-tall type with separate construction cable entry shall be from top/bottom (3mm thick gland plate with suitable numbers & sizes of knockout holes (as called for in schematic/ fabrication drawings) shall be provided.

The panel shall be provided with three phase buses & neutral bus bars of high conductivity electrolytic copper/Aluminium sections throughout the length of the panel & shall be adequately supported and braced to withstand the stressed due to the short circuit current of 35 KA rms. for 1 sec. as called for in BOQ/Data Sheet. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 Deg.C over an ambient temperature of 50 Deg.C. The Current density of Bus Bar shall be 1.0 Amp/mm² for Aluminium and 1.5 Sq.mm/mm² for copper.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 32mm minimum. Bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength SMC or polyester fiberglass moulded material.

All bus bars shall be colour coded as per IS: 375.

Copper /G.I./Aluminium earth bus of suitable size shall be provided at the bottom of the panel throughout the length. Similarly suitable size of strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

Sheet steel hinged lockable doors shall be interlocked with MCCB to prevent opening of the panel when MCCB is on position. Safety interlock with operating handle shall be provided.

Contactors shall be electromagnetic type with interrupted duty as per IS: 2959. The main contacts shall be of silver or silver alloy, provided with minimum 2 NO and 2 NC auxiliary contacts. The push button should be of shrouded type and each should be provided with 1 NO and 1 NC contact. Colour coding shall be as per IS: 6875 (Part-II).

ACB (IEC 60947-2; IS 13947)

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IEC with a rupturing capacity of not less than 35 MVA at 415 volts or as specified elsewhere (The service short circuit breaking capacity shall be as specified and equal to the short circuit with stand value $I_{cs} = I_{cu}$). The breaker shall be provided with variable microprocessor based releases within built fault differentiation for integral over load, short circuit and earth fault & other protection as called for in BOQ, LED indication for type of fault, CT's for protection and measurement class as called for in BOQ, and LCD display of curves and parameters. Electrical endurance without maintenance shall be greater than 2000 cycles.

Mechanical & electrical anti pumping devices shall be provided in breaker, as required.

The breaker shall have memory for logging history for type of fault, load, time & date and the Vendor shall mention in the data sheet for no. of loggings available in the breaker memory.

The breaker shall consist of a horizontal draw out pattern triple/four pole, fully interlocked, independent manual/motorized spring operated mechanism. The mechanism should be such that the circuit breaker is at all times free to open immediately. The trip coil is energized.

Current carrying parts should be silver plated and suitable arcing contacts shall be provided to protect the main contact arc-chutes for each pole shall be provided and shall be lifted out for the inspection of main and arcing contact.

Self-aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes. The breaker should have 3 distinct positions - SERVICE/TEST/ISOLATED within the cubicle.

The ACB shall be with molded housing class II front fuse and shall be suitable for Isolation as per the annexure 7.1.2 in the standard.

Breaker shall be provided with automatic safety shutters to screen the main live contact when the breaker is withdrawn. The frame of the circuit breaker could be positively earthed when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

- i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.
- ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.
- iii) Interlock to prevent the breaker being closed unless it is fully raised.
- iv) Interlock to prevent the breaker from being made alive without its rack in position.

Protection Releases

Self-powered & true RMS sensing microprocessor based release with following features.

a) Incomer ACB of Panels:

Long time short circuit protection with time delay. Instantaneous and earth fault protection with LCD display to show RMS current in all three phases, neutral (for 4pole) simultaneously. The other features of the release to be as under.

- The release should display distinct fault indication for each type of tripping for faster fault diagnosis and reduce down time & should protect ACB from over temperature and Phase unbalance.
- Release should provide contact wear indication in display no. of operation seen by the breaker for case of maintenance.
- The release shall be self-diagnosis & should provide fault history including cause of fault as well as level of fault current. It should be possible to store minimum 20 last trip data with nonvolatile memory.
- The protection setting of release should be accessible to change locally.
- LCD display should be at least 4 line display and should be able to display current in all the 3 phases and neutral (4 pole) simultaneously.

b) For Outgoing ACB feeder:

Long time Short circuit protection with time delay (for discrimination), instantaneous. The other features of the release to be as under.

The release should have distinct fault indication for each type of tripping for faster fault diagnosis and reduced down time and shall protect ACB from over temperature and phase unbalance.

- Operation counter
- Alarm and warning indication

Type test certificate : The ACB's shall be type tested and certified for compliance is to IS 13947/equivalent / EC standard from Indian / International testing authority, supplier to submit certificate of the same.

MOULDED CASE CIRCUIT BREAKER (MCCB)

MCCB shall conform to the latest IS13947-1993/IEC 60947. The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as specified.

MCCB shall be Current Limiting and comprise of Quick Make – Quick Break switching mechanism & Double Break Contact system. The arc extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating molded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload short circuit and earth fault adjustment with thermo-magnetic releases upto 250A and with electronic release above 250A onwards.

The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as called for in BOQ and is the required minimum value for that feeders/ panel, however if the rating of feeder mentioned is not available, the contractor shall use next higher rating without any extra charges. The service short circuit breaking capacity shall be equal to ultimate breaking capacity of MCCB, i.e. $I_{cs} = 100\%I_{cu}$

The trip command shall override all other commands. MCCB shall employ maintenance free double break contact system to minimize the let thru' energies and capable of achieving discrimination upto the full short circuit capacity of downstream MCCB. The manufacturer shall provide both the discrimination tables and let thru' energy curves. The MCCB shall not be restricted to Line/Load connections.

The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection upto full rating. The remote tripping coil should be of continuous duty. The general-purpose control switch shall be provided for ON/OFF Auto/Manual. The switch shall be provided with engraving plates on the front with the complete inscription.

The switch shall be normally a fixed control box type heavy-duty unit.

Indicating lamps shall be of the panel mounting, LED type and shall have execution plates marked with its function wherever necessary. The color of the lamp cover shall be red for 'ON' and green for 'OFF' indicating lamps shall be provided with series resistor. MCCB shall be provided with interlocking device for interlocking the door of switchboard. Following shall be included if specified in the drawing or in the schedule of quantities:

- Under voltage trip
- Shunt trip
- Alarm Switch
- Auxiliary switch

CONTACTORS

The contactors should comply with the latest IEC947-4 and the corresponding IS13947-4 standards. They shall have UL and CSA approval. The contactors should be rated for AC3 duty at 415V and 50Hz. The contacts should be fast closing and fast opening type. The making and breaking capacity values of the contactors should be as follows (as per IEC947-4):

For AC3 Duty

- Making Capacity equal to or more than 10 le
- Breaking Capacity equal to or more than 8 le

For AC4 Duty

- Making Capacity equal to or more than 12 le
- Breaking Capacity equal to or more than 10 le

The contactors should be capable of frequent switching and should operate without derating at 600C for AC3 applications. They should be climate proof as standard. The coil of the contactor should have class H insulation to support frequent switching.

The rated voltage of the contactor shall be equal or superior at 690 V, and rated insulation voltage shall be 690 V. The rated impulse voltage of the contactor should be 8 KV.

The contactor should be modular in design with minimum inventory requirements and built in mechanically interlocked 1NO 1NC auxiliary contact up to 32A. They should be suitable for the addition of auxiliary contacts and other electrical auxiliaries without any compromise on the performance or the operation of the contactors. The contactors from 4 KW to 400 KW will be associated with the same auxiliary contact block range.

Wherever D.C control is required, the contactor should have wide range (0.7 to 1.25Uc) D.C coil with built in interference suppression as standard.

The control and power terminals should be at separate **layers preferably with colour coding (black for power and white for control)**

All contactors power connection will be **finger safe (IP2X)** as standard.

They should be capable of being integrated into automated system (PLCs etc.) without any interposing components in minimum operating conditions.

The thermal over load relay if used will be directly mounting under the contactor without any specific connections.

NAME PLATES & LABELS

- i) Panel and all modules shall be provided with prominent engraved identification plates. The module identification designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.
- ii) All nameplates shall be of non-rusting metal or 3-ply lamcold, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to Engineer-in-Charge's approval.
- iii) Suitable stencilled paint marks shall be provided inside the panel/module identification of all equipments in addition to the plastic sticker labels. These labels shall be partitioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring design.

PAINTING

All steel work shall be pretreated in tanks and finally powder coated of approved shade.

WIRING

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 2.5sq.mm cross section. The colour coding shall be as per latest edition of IS: 375.

Each wire shall be identified by plastic ferrule. All wire termination shall be made with type connection. Wire shall not be taped or spliced between terminal points.

Terminal blocks shall preferably be grouped according to circuit function and each terminal block group shall have at least 20% spare capacity.

Not more than one wire shall be connected to any terminal block. All doorframe of L.T. switchboard shall be earthed with bare braided copper wire.

TESTING & INSPECTION

After completion of all work at the manufacturer's works the switchboards shall be inspected and tested in presence of Purchaser's representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

- i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.
- ii) Test for protective relay operation by primary or secondary injection method.
- iii) Operation of all meters.
- iv) Secondary wiring continuity test.
- v) Insulation test with 1000 Volts megger, before and after voltage test.
- vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)
- vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.
- viii) Measurement of power required for closing/trip coil of the breaker.
- ix) Pick up and drop out voltages for shunt trip and closing coils.
- x) CT Polarity test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out alongwith copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before despatch of switchboards.

DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

- i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.
- ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.
- iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

- iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.
- v) Relay wiring diagrams.
- vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.

The information furnished shall include the following:

- i) Technical literature giving complete information of the equipment.
- ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.
- iii) A comprehensive spare parts catalogue.

TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools with his quotation.

SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

QUALITY ASSURANCE

Quality Assurance shall follow the requirements of Engineer-in-Charge as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

DEVIATIONS

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

4. Battery & Battery Charger- N.A

5. EARTHING

All electrical equipment is to be earthed by connecting two earth tapes from the frame of the equipment to a main earth ring. The earthing ring will be connected via several earth electrodes. The cable armour will be earthed through cable glands. Earthing shall be in conformity with provision of rules 32, 61, 62, 67 & 68 of Indian Electricity Rules 1956 and as per IS-3843-1966.

The following shall be earthed:

1. Transformer & D.G. Set neutrals.

2. Transformer Housing.
3. H.T. Panels.
4. Non-current carrying metallic parts of electrical equipment such as switchgear, bus ducts, rising mains, panel boards, motor control centres, power panels, distribution boards, cable trays, metal conduits, welding sockets etc.
5. Generator & motor frames.
6. All fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with PVC insulated copper wire as specified in item of work. The earth wires ends shall be connected with solderless bottle type copper lugs.
7. The third pin of Outlets on UPS shall be provided with separate PVC insulated Cu. Wire (green with yellow stripe) as Isolated ground earth wire apart from the earthing of box.

The earth connections shall be properly made. A small copper loop to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastened bolts, when there is a lightning surge, high voltage surge or failure of bushings.

The shop drawing for earthing system shall be prepared by the contractor and be got approved by Client/ Engineer-in-Charge. The work shall be done in accordance with approved drawings.

All earth electrodes shall be given to a depth sufficient to reach permanently moist soil. Their location shall be marked and approval taken from Engineer-in-Charge before excavation for the same.

The earth electrodes shall be tested for earth resistance by means of a standard earth test ohms meter. All tests shall take place during the dry months, preferably after a protected dry spell.

The resistance between earthing system and the general mass of earth shall not be greater than 1 ohm.

The earth loop resistance to any point in the electrical system shall not be in excess of 1 ohms in order to ensure satisfactory operation of protective devices.

The resistance to earth shall be measured at the following: -

- a) At each electrical system ground or system neutral ground.
- b) At one point on each grounding system used to ground electrical equipment enclosures.
- c) At one point on each grounding system used to ground wiring system enclosures such as metal conduits and cable sheaths or armoured.

All earthing conductors shall be of high conductivity copper/ G.I. as per B.O.Q. and shall be protected against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor. However, the contractor shall use the sizes specified in the bill of quantities of the Tender.

Pipe Earth Electrode

G.I. pipe shall be of medium class and of the size and dia as specified in BOQ. G.I. Pipe electrode shall be cut tapered at bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2m of length from bottom. The electrode shall be buried in the ground vertically with its top not less than 20cm below ground level.

Plate Earth Electrode

The plate earth electrode shall consist of copper plate or G.I. plate as per item of work. The plate electrode shall be buried in ground with its faces vertical and top not less than 2.5m below Ground level. The plate shall be filled with charcoal dust and common salt filling, extending 15cm around it on all sides.

A watering pipe as specified in BOQ, of medium class G.I pipe shall be provided. The top of the pipe shall be provided with a funnel and a G.I. mesh screen for watering the earth. In the case of pipe electrode a removable plug shall be provided as per drawing. This will be housed in a masonry sump (with cement plastering) of not less than 40 cm square and 40 cm deep. A C.I. frame with hinged cover of 10mm thickness and locking arrangement shall be suitably provided over the sump. The earthing lead from electrode onwards shall be suitably protected from mechanical injury by a suitable dia medium class PVC/ HDPE pipe. The overlapping in G.I. strips in joints shall be rivetted with revets and welded in approved manner. The protection pipe within ground shall be buried at least 30 cm deep (to be increased to 60cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth. In the case of plate earth electrode, two nos. 50mm x 6mm GI/Cu. Strip the earthing lead shall be securely bolted to the plate with two zinc passivated bolts, nuts, checknuts and washers. In case of pipe electrode, it shall be connected by means of a through bolt, nuts and washers and cable socket. Main earthing conductor is taken from the earth electrode with which the connection is to be made.

No earth pit shall be fixed within 2.5M of a wall of foundation. The location of the earth electrode will be such where the soil has reasonable chance of remaining moist. Effort shall be made to locate them in grass lawns or near flowerbeds or water taps. The distance between two earthing stations shall be at least 3.0 meters.

Testing and Commissioning

Testing and commissioning shall be done as per the programme/ instructions to be given by Engineer-in-Charge's authorised representative. All testing equipments necessary to carry out the tests shall be arranged by the electrical Contractor.

Before the electrical system is made live, the electrical Contractor shall carry out suitable tests to the satisfaction of Engineer-in-Charge that all equipment wiring and connections have been correctly done and are in good working condition and will operate as intended.

All tests shall be conducted in the presence of the Engineer-in-Charge authorised representative by the electrical Contractor and shall be notified one week before tests are to take place.

All measurements shall conform to establish minimum acceptable test values. Engineer-in-Charge reserves the right to approve all test results before circuit or equipments are energised for the first time.

6. LIGHTNING PROTECTION SYSTEM

Protection of buildings against lightning shall generally be done in accordance with latest IS-Code. The installation shall be done as per routes and location of equipment indicated on the drawing and bill of quantities. The conductors and the earth electrode conductor shall be fixed so that they are free to expand and contract. Special care shall be taken in the fixing of support to allow free movement.

The materials of lightning conductors, down conductors, earth termination etc. shall be reliably resistant to corrosion or be adequately protected against corrosion. All air terminations shall be GI and the conductors shall be GI.

The entire lightning protection system should be mechanically strong to withstand the mechanical forces produced in case of a lightning strike. The system shall be installed such that it does not spoil the architectural or aesthetic beauty of the buildings but on other hand it should meet IS code/safety code.

Horizontal air terminations should be so interconnected that no part of the roof is more than 9 metres away from the nearest horizontal conductor. For a flat roof horizontal air termination along the outer perimeter of the roof is used. For a roof of larger area a network of parallel horizontal conductors shall be installed. Horizontal air terminations shall be laid along contours such as ridges, parapets and edges of flat roofs and where necessary area flat surfaces in such a way as to connect each air termination to the rest and shall, they form a closed network.

All metallic finials, chimneys, ducts, vent pipes, railings, gutters, metallic flag staff, on or above the main surface of the roof of the structure shall be bonded to and form part of the air termination network. All air terminations shall be effectively recessed against over turning either by attachment to the object to be protected or by means of substantial braces and fixing which shall be permanently and rigidly attached to the buildings.

Down conductors shall be distributed around the outside walls of the structure. They shall preferably be run along the corners and other projection, due considerations being given to the locations of air terminations and earth terminations. Lift shafts shall not be used for fixing down conductors. Metal pipes leading rainwater from the roof to the ground may be connected to the down conductors but cannot replace them. Such conductors shall have disconnecting joints. All vertical conductors shall be plumbed before fixing. Insulation shall be provided between down conductors and wall.

The lightning protective system shall have as few joints in it as possible. Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective. The joint overlap shall not be less than the width of the tape. In the down conductor below ground level there shall be no joint. The joints may be clamped, screwed, bolted, revitted, sweated, braced or welded. The bonding of the external metal forming part of a structural or drain water pipe shall have a cross sectional area not less than that employed for the main conductors. Gas pipe, however, in no case shall be bonded to the earth termination system.

Conductors shall be securely attached to the building to be protected by fasteners, which shall be substantial in construction, not subject to breakage and shall be of steel. The conductors shall be secured at not more than 900mm apart for horizontal run and 750mm for vertical run.

Where tape are required to pass through roof asphaltting or other waterproofing membranes, a special seal shall be used comprising a 38mm diameter plastic, copper or aluminum tube with 100mm diameter flange 50mm from the top of the tube. The tube length shall suit the thickness of the roof through which the conductor passes, allowing for the tube to protrude 50mm above the membrane. The seal is to be asphalted in position and the conductor shall be sealed in the tube by a setting waterproof compartment.

Each down conductor shall have an independent earth termination. The interconnection of all the earth termination shall be preferable. It should be capable of isolation for testing purpose by "testing joints" at position approachable easily for the meggar testing. The whole of the system could have a combined resistance to earth not exceeding 2 ohm before any bonding has been affected to metal in or on structure or two surfaces below ground.

7. CAPACITORS & CAPACITOR CONTROL PANEL

Power factor correction capacitors shall conform in all respects to IS 2834-1964. The capacitors shall be suitable for 3 phases 415V at 50Hz. frequency and shall be available in units as per B.O.Q. to form a bank of capacitors of desired capacity. All these units shall be connected in parallel by

means of high conductivity electrolytic copper busbars of adequate current carrying capacity having S.C rating of 25 KA for 1 sec. Each capacitor bank shall be for PVC insulated aluminum conductor armoured cables. Two separate earthing terminals shall be provided for each bank for earth connection. The capacitor bank shall be housed indoor.

The capacitor bank shall be subject to routine tests as specified in relevant Indian Standard and the test certificate shall be furnished. The capacitor shall be suitable for indoor use upto 45 Deg.C over and above ambient temperature of 50degree C. The permissible overloads shall be as given below:

- a) Voltage overload shall be 10% for continuous operation and 15% for 6 hours in a 24 hours cycle.
- b) Current overloads 15% for continuous operation and 50% for 6 hours in a 24 hours cycle.
- c) Overload of 30% continuously and 45% for 6 hours in a 24 hours cycle.

The capacitor banks shall be floor mounting type indoor housing using minimum floor space with protective guard or fencing. The capacitor bank shall be provided with 7% Detuned reactor filter to compensate third harmonics from being generated.

Capacitors shall be of aluminum foil and craft paper. Hermetically sealed in sturdy corrosion-proof sheet steel 2mm thick containers and impregnated with non-inflammable synthetic liquid and of low power loss version. Every element of each capacitor unit shall be provided with its own built in silvered fuse. The capacitor shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 V 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 voltage of 2500V AC supply for 1 minute.

The insulation resistance between capacitor terminals and containers when test voltage of 500V A.C. is applied shall not be less than 50 meg-ohms.

- Capacitor bank and switching equipments shall be housed in a cubicle having degree of protection IP-51 and constructed with sheet steel of minimum 2mm thickness.
- Capacitors shall be unit type having non-PCB, non-flammable non-toxic dielectric.
- Necessary discharge resistor shall be provided externally to reduce the terminal voltage to or less then 50V in 60 seconds of disconnection from supply.
- Testing shall be done as per applicable standards for shunt capacitors.

Capacitor Control Panel

The capacitor control panel shall general comprise of the following:

- a) Automatic power factor correction relay.
- b) Step controller with reversing motor.
- c) Time delay and no-volt relays.
- d) Protection MCCB / MCB.
- e) Contactor (AC-3 duty) for individual capacitors of suitable rating.
- f) Change over switch for either automatic operation or manual operation with push button control.
- g) C.T.s with ammeter and selector switch as asked for in BOQ.
- h) Voltmeter with selector switch.

i) Indicating lights RYB.

All the capacitors and contactors shall be interconnected with PVC insulated copper conductor wires of adequate size in a neat and acceptable manner. Three phases and neutral bus bar shall be provided in panel as required.

The above control gear, P.F. meter, Digital Microprocessor based P.F. correction relay, push button station etc. shall be housed in a sheet steel metal enclosure cubical type, free standing front operated with lockable doors. The panel shall be fabricated from MS sheet steel 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam-welded. The panel shall be totally enclosed design completely dust tight and vermin proof. Gaskets between all adjacent units and beneath all covers shall be used to render the joints effectively.

All sheet steel material used in the construction of capacitor control panel should have undergone a rigorous rust proofing process comprising Alkaline Degreasing, descaling in dilute sulphuric acid and recognised phosphating process. The steel work should then receive two coats of primer before applying final coat of epoxy paint of approved shade.

Quality Assurance

Quality Assurance shall follow the requirement of Client/ Consultant. Q.A. documents as applicable.

Q.A. involvement will commence at enquiry and follow through to commissioning and acceptable thus ensuring total conformity to purchaser's requirement.

Deviations

Deviations from the specification must be stated in writing at the quotation stage.

In the absence of such a statement it will be assumed that the requirements of the specifications are met without exception.

SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

8. H.T. CABLE (XLPE) (33 KV & 11 KV)

The cross-linked polyethylene (XLPE) cable shall be aluminum conductor PVC outer sheath steel strip armoured over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1977 and (Part-II) 1973. The screening shall be done on individual cover. The armouring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.

The termination and jointing techniques for XLPE cables shall be by using heat shrinkable or push on cable jointing kits.

While laying underground cables in ducts care should be taken so that any underground structures such as water pipes, sewerage lines etc. are not damaged. Any telephone or other cable coming in the way shall be properly protected as per instructions of the Engineer-in-charge. The H.T. cable shall be laid at least 900mm for cable upto 33 KV (E) below the ground level in a trench 450mm wide.

Insulation tests shall be done before and after laying of cables.

After laying and jointing work is completed a high POT test shall be performed in presence of Engineer and test results submitted for approval in order to ensure that they have not been damaged during or after the laying operation. In case, the test results are unsatisfactory, the cost of all repairs and replacement and all extra work of removal and relaying will be made good by the contractor without any extra cost.

9. L.T. CABLES & WIRE

a) Wires

The design manufacture, testing and supply of single core **LEAD FREE FRLS PVC** insulated 1.1 KV grade multi-stranded twisted wires under this specification shall comply with latest edition of following standards.

IS : 3961 Current rating for cables.

IS: 5831 PVC insulation and sheath of electric cables.

IS : 694 PVC insulated cables for working voltage upto and including 1100 volts.

IEC: 754(i) FRLS PVC insulated cable.

Copper multi-stranded twisted conductor FRLS PVC insulated wires shall be used in conduit as per item of work.

The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth.

Progressive automatic in line indelible, legible and sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of wire.

The material & insulation of wires shall be **ROHS compliant** (Reduction of Hazardous Substance) and shall comply the following directives:

- EU Directive 2002/95/EC Issued Jan 2003
- EU Directive 94/62/EC and 2004/12/EC (amendment)
- EU Directive 91/338/EEC
- EU Directive 91/157/EEC & 98/101/EC (amendment)

Summary on related directives

Directive Ref.	Date	Objective	Remarks
2002/95/EC	27 Jan 03	Restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) and to contribute to the protection of human health and the environmentally sound recovery and disposal of waste EEE.	<p>6 banned materials included Pb (Lead), Hg (mercury), Cr6+ (Hexavalent Chromium), Cd (Cadmium) and Flame Retardants- Polybrominated Biphenyls – PBB 1000ppm & Polybrominated Diphenyls Esters- PBDE 1000ppm.</p> <ul style="list-style-type: none"> • <i>Max. conc. value - 0.1% by weight in homogeneous material for Pb, Hg, Cr6+, PBB/ PBDE</i> • <i>Max. conc. value - 0.01% weight in homogenous material for Cd.</i>

94/62/EC 2004/12/EC (amendment)	20Dec94 2Nov04	Amending directive 94/62/EC, on Packaging and Packaging Waste is to prevent packaging waste by encouraging packaging re-use and recycling while at the same time avoid distortions in the internal market.	The targets defined are the following: <ul style="list-style-type: none"> • Recovery of <i>minimum 60%</i> by weight of the packaging waste • Recycling of <i>at least 55%</i> and a maximum 80% by weight of the totally of packaging materials, with a material-specific minimum recycling rate for plastic of 22.5% • Max. sum of concentration levels of <i>Pb, Cd, Hg and Cr6+ > 100 ppm</i> by weight
91/338/EEC	18Jun91	Restriction on the use of Cadmium pigment (amending for the 10th time Directive 76/769/EEC)	The cadmium content (expressed as Cd metal) exceeds 0.01 % by mass is prohibited in the finished products or components of products manufactured from polymers or copolymers of vinyl chloride and stabilized by substances.

b) Cables

The design, manufacture, testing and supply of the cable under this specification shall comply with latest edition of following standards:

- IS: 8130 Conductors for insulated electric cables and flexible cords.
- IS: 7098 XLPE insulation and sheath of electric cables.
- IS: 3975 Mild steel wires, strips and tapes for armouring cables.
- IS: 7098 Current rating of cables.
- IS: 7098 XLPE insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.
- IS: 424-1475(F-3) Power cable-flammability test.

Specification for cross-linked polyethylene insulated XLPE sheathed cable for working voltage upto 1.1 KV.

Specification for XLPE insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.

- ASTM-D: 2863 Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).
- ASTM-D: 2843 Standard test method for measuring the density of smoke from the burning or decomposition.
- IEEE : 383 Standard for type of test Class-IE, Electric cables, feild splicers and connections for power generation station.
- ASTME:662IEC:754(x) Standard test method for specific optical density of smoke generated by solid materials.
- IS : 10418 Cable drums.

c) Technical Requirements:

- i. The cables shall be suitable for laying in racks, ducts, trenches conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

- ii. They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.
- iii. The aluminium/copper wires used for manufacturing the cables shall be true circular/sector in shape before stranding and shall be of uniformly good quality, free from defects. The conductor used in manufacture of the cable shall be of H2 grade.
- iv. The cable should withstand 25 KA for 0.5 sec with insulation armour insulated at one end. Bidder shall furnish calculation in support of capability to withstand the earth fault currents. The current carrying capacity of armour and screen (as applicable) shall not be less than the earth fault current values and duration.
- v. The fillers and inner sheath shall be of non-hygroscopic fire retardant materials and shall be suitable for the operating temperature of the cable. Filler and inner sheath shall not stick to insulation and outer sheath.
- vi. Progressive automatic in line indelible, legible and sequential marking of the length of the cable in metres at every one metres shall be provided on the outer sheath of all cables and at every 5 metre 'FRLS' marking in case of 'FRLS' cables.
- vii. Strip/Wire armouring following method (b) mentioned in IS: 3975 shall only be acceptable. For single core cable aluminium wire armouring shall be used.
- viii. Allowable tolerance on the overall diameter of the cables shall be + 2mm.
- ix. The normal current rating of all XLPE insulated cables shall be as per IS: 7098.
- x. A distinct inner sheath shall be provided by pressure extrusion process for all multicore armoured and unarmoured cables as per IS: 5831.
- xi. Outer sheath shall be provided by extrusion process as per IS: 5831
- xii. The breaking load of armour joint shall not be less than 95% of that armour wire. Zinc rich paint shall be applied on armoured joint surface.
- xiii. In plant repairs to the cables shall not be accepted.
- xiv. All the cables shall be supplied in non-returnable drums as per IS: 10418.

d) In Case of FRLS Cables

- i. The outer sheath of cables shall have an oxygen index of not less than 29 as per ASIMD: 2863.
- ii. The maximum acid gas generation by weight as per IEC: 754 (i) shall not be more than 20% for outer sheath material of all cables. Bidder shall also guarantee the maximum theoretical acid gas generation with 20% by weight of outer sheath.
- iii. The cables outer sheath shall meet the requirement of light transmission of 40% (minimum and shall be tested as per ISTMD: 2843). In case the test for light transmission is conducted as per ASTM E: 662. The bidder shall furnish smoke density values as per this standard and shall co-relate the anticipated light transmission when tested as per ASTM D: 2843.
- iv. The cable shall pass the fire resistance test as per SS: 42, 41, 475 (I) and flammability test as per EEE: 383.

e) Inspection:

All cables shall be inspected on receipt of the same at site and checked for any damage during transit.

f) Joint in Cables

The contractor shall take care that the cables received at site are distributed to various locations in such a manner as to ensure maximum utilisation and avoidance of cable jointing. Cable shall be rechecked before cutting in lengths, where the joints are unavoidable, and the location of such joints shall be got approved from the Engineer-in-Charge. The joints shall be done by qualified jointer strictly in accordance with manufacturer's instruction/drawings.

g) Joint Boxes for Cables

The cable joint boxes shall be of appropriate size suitable for type of cable of particular voltage rating.

h) Jointing of Cables

All straight through joints shall be done in epoxy mould boxes with epoxy resins. Straight through joints shall not be permitted unless the length of run is in excess of cable drum.

End terminations of cables more than 1.1 KV grade shall be done with epoxy mould boxed and epoxy resin. Cable glands shall be 1.1KV grade double compression type and made to tin plated heavy-duty brass casting and machine finished. Glands shall be of robust construction capable of clamping cable and cable armour, firmly without injury of cable.

All washers and hardwares shall be made of brass tinned. Rubber components used in the glands shall be made of neoprene of tested quality.

Cable lugs shall be tinned copper/aluminium solderless crimping type conforming to IS: 8309 suitable for aluminium or copper conductor.

Crimping of terminals shall be done by using Corrosion inhibitory compound, with crimping tool.

Fire resistant paint has to be applied 1 Metre on either side of cable joint.

The contractor shall liaise fully with all other contractors to achieve an efficient and properly coordinated installation where equipment has to be re-positioned due to lack of site liaison; no extra cost shall be incurred by the client.

i) Testing of Cables

Cables shall be tested at factory as per requirement of IS: 7098 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to laying of cables, following tests shall be carried out:

- i) Insulation test between phases and phase to earth for each length of cable before and after jointing.

On completion of cable laying work, the following test shall be conducted in the presence of Engineer-in-Charge/ Client.

- ii) Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.
- iii) Continuity resistance test.
- iv) Sheathing continuity test.
- v) Earth test.

j) Laying of Cable

The cable drum shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming links. At all changes in directions in horizontal &

vertical places, the cable shall be bent with a radius of bend not less than 8 times the diameter of cable.

The cable of 1.1KV grade shall be laid not less than 750mm below ground level in a 375mm wide trench (throughout), where more than one cable is to be laid in the same trench, the width of the trench shall be increased such that the interaxial spacing between the cables except where otherwise specified shall at least be 150mm minimum or as per site requirements or as approved by the Engineer-in-charge. Where single core cables are used in multiphase systems, the cables shall be installed in trefoil where possible.

In case the cables are laid in vertical formation due to unavoidable circumstance the depth per tier shall be increased by 200mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable curvature shall be i.e. either 12 times the diameter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever is less. Minimum 3-meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming 'Kinks'. The cable drum shall in-verbally convey on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Cables laid in trenches in single tier formation, 10 cms. All around sand cushioning is provided below and above the cable before a protective cover is laid. For every additional vertical tier. The 30cm of sand cushion are provided over the initial tier. The cable shall be protected by 2nd class bricks of size not less than 230x115x75mm, stone tiles/RCC curved channel be placed on top of the sand breadth wise for the full length of the cable and where more than one cable is to be laid in the same trench the brick shall cover all cables and project at least 8 cms. Over the outer sides of the end cables.

Filling of trenches shall be done after the sand cushioning and laying of tiles or bricks are carried out to the satisfaction of the Engineer-in-charge (Refer drawing). Back fill for trenches shall be filled in layer not exceeding 150 mm. Each layer shall be properly rammed & consolidate before laying the next layer.

PVC pipe shall be provided for all road crossing. The size of the pipe shall be according to the cable and a minimum 100mm dia. pipe shall be provided. The pipe shall be laid in ground with special arrangement and shall be cement jointed and concreting with 1:5:10 shall be made as per relevant IS with latest amendment. Location of cables laid directly underground shall be indicated by cable marker at an interval of 30 meters & with change of direction. Aluminium strip cable tag of 20mm wide with engraved tag no. shall be provided at both ends of cable.

Where the cables are to be laid in ducts (pucca trenches) in side the building, they will have to be laid on MS rack/ on MS cable trays grouted in walls trenches. Cables sizing through floors shall be protected from mechanical damage by a steel channel to a height of one meter above the floor where cable pass through wall they shall be sleeved with PVC/steel conduit.

Where the cables are laid in open (in building) along walls, ceiling or above false ceiling, cable rack (ladder type) or cable tray shall be provided. The size of the cable tray or rack shall depend on the number of cables to pass over that rack. Cable tray/rack shall be properly supported through wall/ceiling according to the site conditions. Cable laid on tray & riser shall be neatly dressed & clamped at an interval of 1000 mm & 750mm for horizontal & vertical cable run respectively either side at each bend of cable. All power cables shall be

clamped individually & control cables shall be clamped in groups of three or four cables. Clamps for multicore cables shall be fabricated of 25x3 GI flats. Single core power cable shall be laid in trefoil formation & clamped with trefoil clamps made of PVC/fibre glass.

Cable openings in wall/floor shall be sealed by the contractor suitably by hession tape & bitumen compound or by any other proven to prevent ingress of water.

After the cables are laid, these shall be tested as per IS and the results submitted to Engineer-in-Charge and in case the results found unsatisfactory, all the repairing/ replacing of cables will be done by the contractor free of charge.

k) Fire Seal System

- i) All the floor/wall opening provided for cable crossing shall be sealed by fire seal system.
- ii) The fire proof sealing system shall fully comply with the requirements of relevant IS/BS: 476 Part-B. The fireproof seal system shall have minimum one hour fire resistance rating.
- iii) The fire proof seal system shall be physically, chemically, thermally stable and shall be mechanically secured to the masonry concrete members. The system shall be completely gas and smoke tight, **antirodent** and anti-termite.
- iv) The material used in fireproof seal system shall be non-toxic and harmless to the working personnel.
- v) Type of fireproof seal system shall be foaming type or **flamemastic** type compound or approved equivalent.

After laying and jointing work is completed, high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is not fault in the jointing.

Cables for use on low and medium voltage system (1.1KV grade cables) should withstand for 15 minutes a pressure of 3000V DC applied between conductors and also between each conductor and sheaths. In the absence of pressure testing facilities it is sufficient to test for one minute with a 1000V insulation tester In case the test results are unsatisfactory the cost of repairs and replacements and extra work of removal & laying will be made good by the contractor.

Cable shall be installed so that separation shown in the table below are observed.

HV Cable (11 KV/ 33 KV) - HV Cable (11 KV/ 33 KV)	50 mm
ELV & LV 230 V/433 V - ELV & LV cable 230 V/433 V	Equal to the diameter of the bigger cable.
HV cables (11 KV/33 KV) - ELV & LV cables 230 V/433 V	300 mm
LV cables 433 V - Telephone/Instrument cable	350 mm
All cables - All hot pipe work	200 mm

l) Quality Assurance

Quality Assurance shall follow the requirements of Engineer-in-Charge as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

m) Deviations

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

n) Spares for Commissioning Including Consumables

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools and consumables. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

10. CABLE TRAYS

a. Ladder type Cable tray – for Power Cables only

Cable trays shall be ladder type fabricated out of mild steel/slotted angles and flats of required width as per design. Bends shall be prefabricated. The cable tray shall be hot dip galvanized or primed and painted with powder coating as asked for in BoQ or as approved by Engineer-in-Charge. The minimum weight of the zinc coating shall be 460 gm/sq.m and minimum thickness of coating shall not be less than 75 microns.

b. Perforated Cable tray – for Power Cables & Low current service both

The perforated cable trays are fabricated out of 1.6mm thick CRCA sheet steel having minimum 50mm depth or as called for in BOQ, hot dip galvanized or epoxy coated of approved shade. Perforations are maximum 10mm spaced at maximum 20mm distance. The cables shall be tied with the cable tray with nylon strip/aluminium clamps/M.S. clamps as per requirements.

Suitable provision shall be made where a tray crosses expansion joints. The width of the tray shall allow for a suitable separation between cables the design shall allow for adequate bending radius for the sizes of cables. No sharp bend to be allowed in cable tray. Joints between sections shall be bolted.

The tray shall be suspended from the surface of the concrete slab by means of approved steel hangers spaced at a distance of not more than 125cms. Suitable bushes shall be provided where cables pass through apertures in the tray. Cables must be securely fixed to the tray with clamps or cable ties. In routing necessary barrier and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angle and these two shall not run in close proximity. Full details of the tray shall be approved by the Consultant/Site Engineer before fabrication. Earth continuity shall be maintained between each section of cable tray and each total run of tray shall be effectively bonded to the nearest earth continuity conductor. All nuts and bolts used shall be of galvanised steel.

Depending on the size of cable trays space of 20-33% has to be maintained for future expansion.

Cable tray is manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA).

11.0 INTERNAL ELECTRICAL WORKS

A. Conducting (M.S Conduit)

All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and of 14 (2 mm) gauge for sizes higher than this. Both inner and outer surfaces shall be smooth without burrs, dents and kinks. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle. Conduit shall conform to specifications of IS: 9537 (Part-II) and the capacity of conduits shall be in accordance with the standards and shall never be exceeded. The minimum size of the conduit shall be 20mm dia.

Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit shall be used.

B. PVC Conduit

All conduits shall be high impact rigid 2mm thickness PVC heavy duty type and shall comply with I.E.E. regulations for non-metallic conduit 2mm thick as per IS-9537/1983 (Part-III). All sections of conduit and relevant boxes shall be properly cleaned and glued by using epoxy resin glue and the proper connecting pieces. Inspection type conduit fittings such as inspection boxes, drawn boxes, fan boxes and outlet boxes shall be M.S. or otherwise mentioned. Conduit shall be terminated with adopter/PVC glands as required.

Accessories

Conduit accessories such as normal bends, unions, circular junction boxes and pull boxes, locknuts etc. shall be heavy gauge type and approved make. Conduit accessories shall conform in all respects to IS: 3837-1966 with latest amendment. Wherever several conduits are running together, adequately sized adoptable boxes common to all runs shall be used to avoid inserting inspection boxes in the individual run. Where it is necessary to segregate wiring metal filler shall be fixed with in the box.

Conduits shall be laid before casting in the upper portion of a slab or otherwise, as may be instructed or in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Vertical drops shall be buried in columns or walls. Wherever necessary, chases will be cut by the contractor with the help of chase cutting m/c or by hand. Nothing extra shall be paid to the contractor on this account. 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. Sufficient depth of the chases will be made to accommodate the required number of conduits. The chase will be filled with cement, coarse sand mortar (1:3) and properly cured by watering for one week.

If a chase is cut in an already finished surface the contractor shall fill the chase and finish it to match the existing finish. Contractor must not cut any iron bars to fix conduits. Conduits shall be kept at a minimum distance of 100mm from the pipes of other non-electrical services. Where the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting, conduits in chases shall be held by steel hooks of approved design at maximum of 100 cm centres. The embedding of conduits in walls shall be so arranged as to allow at least 12mm plaster cover the same. All threaded joints of conduit pipes shall be treated with some approved 'preservative compound' to secure protection against rust.

Suitable expansion joints fittings of approved make and design shall be provided at all the points where the conduit crosses the expansion joint in the building. (Preferably with Pilca metallic watertight conduits). Conduits shall cross at right angles of the joints only.

Separate conduit shall be used for:

- 1) Normal light, fan call bell
- 2) 16 A power outlets
- 3) Emergency Light Point
- 4) Fire alarm System
- 5) Computer Outlets
- 6) P.A System
- 7) Telephone system

- 8) TV Network
- 9) Or any other services not mentioned here.

Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc. shall be installed in flexible conduits. Flexible conduits shall be formed from a continuous length of spirally wound interlocked wire steel with a fused zinc coating on both sides. The conduit shall be provided with approved type adaptor. A separate and accessible earth connection shall bond across the flexible conduit.

Conduit runs on surfaces shall be supported with metal 1.2 mm thick saddles, which in turn are properly secured on to GI spacer to the wall or ceiling. Fixing screws shall be with round or cheese head and of rust proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building and shall be painted in color matching the adjoining area. Unseemly conduit bends and offsets shall be avoided by using better appearance. Cross cover of conduits shall be minimum and entire conduit installation shall be clean and with good appearance. For surface work, the boxes shall be raised back pattern type, designed for use with distance saddles to give clearance of 6mm between the back of conduit and the fixing surface.

Where conduits are run on steel work, they will be fixed by means of purpose made GI Caddy clips in manner meeting with the approval of the Engineer prior to the installation being carried out. Other methods of fixing may be agreed in special circumstances, but approval must first be obtained from the site engineer.

The spacing of saddles shall be not more than 600mm centers for up to 32mm diameter conduits and at 750mm for conduit sizes of 40mm diameter and above in case of MS conduit and not more than 600 mm for PVC conduit. In addition, saddles shall be fixed at each side of any bend/Tee, or set at a distance of 200mm from the bend/Tee. The holes in the brickwork or concrete for fixing plugs shall be neatly drilled by means of a masonry drill of the appropriate size.

All the GI sheet steel /passivated boxes used for housing switches, plugs, fan regulator etc. shall be five sided conforming to IS: 5133 Part I-1969. Suitable size of boxes shall be provided a minimum of 2 adjustable fixing lugs on vertical sides. Suitable earth terminal inside each box shall be provided. All fixing lugs shall be threaded to receive standard machined chromium plated brass screws. Sufficient number of knockouts shall be provided for conduit entry. Conduits carrying wires of different circuit can terminate in common J.B having metal compartments. Necessary GI pull wires shall be inserted into the conduit for drawings wires. In case conduit pipe is required to cross any RCC beam special adaptor boxes shall be provided for crossing & nothing shall be paid extra.

Where conduits are used for non-air-conditioned space to air-conditioned space or into a fan chamber or duct, a junction box shall be installed to break the continuity of such conduit at the point of entry or just outside and conduit shall be sealed around the conductors.

Particular care shall be taken during the progress of the work to prevent the ingress of dirt and rubbish such as plaster droppings into erected conduits. Conduit which has become so clogged shall be entirely freed from these accumulations or will be replaced. Screwed plastic or metal caps or turned wooden plugs shall be employed to protect all open ends. Plugs of waste wood, paper, cotton or other fibrous matter shall not be used. All unused conduit entries shall be blanked off in an approved manner and where conduits terminate in adaptable boxes, all removable box covers shall be firmly secured to provide complete enclosure. If considered necessary by the Engineer-in-charge, the conduits shall be swabbed out by drawing swabs of rag through the conduit to remove moisture prior to any cables being drawn in.

All conduit installations must be completed and erected in their totality before they are wired and must be fully rewirable from outlets to distribution boards or trunking systems etc. to

which they connect. No wiring of any part of the installation shall be commenced until instructions are received to do so by the Engineer-in-charge at such time as he is satisfied that the wiring will not be damaged due to building operations.

Conduits shall be installed so that they are self-draining in the event of ingress of moisture due to condensation or any other reason. A suitable drainage hole shall be drilled at the bottom of the lowest conduit box in every 9-meter of horizontal run.

PVC bush of good quality shall be used in each conduit termination in a switch box, draw box, lighting fixtures and circular junction boxes.

Exposed conduits running above false ceilings shall be suitably clamped independently along with the dropped ceiling. Perforated straphangers or twisted attachment shall not be acceptable. In no case shall raceways be supported or fastened to other pipe for repair and maintenance. They shall be arranged symmetrically and in the most compact design, in no way unduly criss-crossing each other. Proper spacing shall be maintained when two or more conduits run side by side. The layout of the pipes shall be co-ordinated with other services if any. The junction boxes and conduits used in hazardous areas shall be flameproof type with cast iron construction complete with threaded covers. The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirements by means of special approved type of earthing clamp efficiently fastened to conduit pipe in a workman like manner for a perfect continuity between the earth and conduit.

The conduit system shall be so laid out that it will obviate the use of tees, elbows and sharp bends. No length of conduit shall have more than the equivalent of two-quarter bends from inlet to outlet. The conduit itself being given required smooth bend with radius of bends suiting to the site conditions but not less than 6 times overall diameter.

Outlet boxes shall be of heavy-duty sheet steel installed as to maintain continuity throughout. These shall be so protected at the time of laying that no mortar finds its way inside during concrete filling or plastering. For fluorescent fittings, the outlet boxes heavy duty shall be provided 300mm off centre for a 1200mm fitting and 150mm off centre for a 600mm fittings or as per B.O.Q.

Draw boxes of ample dimensions shall be provided at convenient points to facilitate pulling of long runs of cables. They shall be completely concealed with MS covers flush with plasterwork painted to match the wall. These boxes will be as few as possible and located where found suitable by the Engineer-in-charge.

Switch Boxes

The switch boxes shall be zinc passivated & shall not be less than 18 SWG thick or shall be as called for in BOQ. It will be so designed that accessories could be mounted on integral pedestals or on adjustable flat iron mounting straps with tapped holes by brass machine screw, leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on either side of their walls. These shall be completely concealed leaving edges flush with wall surfaces. Earthing terminal inside box shall be provided.

Moulded plate switches screw less as specified in item of work shall be provided. No timber shall be used for any supports. Boxes, which come within concrete, shall be installed at the time of casting. Care shall be taken to fix the box rigidly so that its position is not shifted while concreting.

Wiring

All the wiring installation shall be as per IS: 732 with latest amendment. PVC insulated copper conductor cables as specified in bills of quantity shall be used for sub-circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be twisted copper conductors with thermoplastic insulations of 660/1100 volts grade. Colour Code for wiring shall be followed.

Looping system of wiring shall be used, wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors with prior permission of the consultant. No reduction of strands is permitted at terminations. No wire smaller than 1.5 sq.mm shall be used and shall be as per B.O.Q. Wherever wiring is run through trunkings or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indicating the circuit and DB number shall be used for submains sub-circuit wiring. The ferrules shall be provided at both end of each submain and sub-circuit.

Where single-phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain the wiring fed from more than one phase. In any one room in the premises where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply. Circuits fed from distinct sources of supply or from different distribution boards or through switches or MCBs shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phase, no two single-phase switches connected to different phase shall be mounted within one box.

All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.

Industrial sockets shall be of moulded plastic BoQ and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have self-adjustable spring loaded protective cap. Socket shall have MCB/ELCB/RCCB as specified in the schedule of work.

Maximum number of PVC insulated 650/1100 V grade/copper conductor cable conforming to IS: 694-1990.

Conduit size	20mm		25mm		32mm		40mm		50mm		60mm	
Wire size in sq.mm.	S	B	S	B	S	B	S	B	S	B	S	B
1.50	7	5	12	10	20	14	-	-	-	-	-	-
2.50	6	5	10	8	18	12	-	-	-	-	-	-
4	4	3	7	6	12	10	-	-	-	-	-	-
6	3	2	6	5	10	8	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	-	4	3	7	6	-	-	-	-
25	-	-	-	-	3	2	5	4	8	6	9	7

Notes:

- 1) The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
- 2) The columns heads 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns heads 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
- 3) Conduit sizes are the nominal external diametres.

14.0 Uninterrupted Power Supply

SYSTEM: SPECIFICATION FOR THE UPS.

Quality power Supply

The UPS shall be ON-LINE double conversion with filter, stabilized and reliable voltage that is free from all mains interference (Over voltage, frequency variations, voltage drops).

The battery cabinets used in the UPS shall be for longer runtime, The UPS shall have Optional filters, Isolation transformer module, LCD-based remote control panel, LED-based remote control panel & Communication software "professional" version.

The Operating mode of UPS

It should operate in on-line operating mode as follows.

- **Economy Mode:** The UPS should use Line Interactive technology, i.e. the load is powered from the mains; the energy consumption is reduced with a subsequent improvement in efficiency (98%).
- **Smart active mode:** The UPS should automatically selects On Line or Line Interactive operating mode according to the quality of the mains supply, by monitoring the number, frequency and type of disturbances at the mains power input.
- **Stand-by-off mode:** With the mains available the UPS should normally not powered and consequently the power consumption is almost nil. Only when the mains fails or falls outside a preset range, does the inverter take over in 200ms using power from the batteries. This mode shall be suitable for Emergency escape lighting as pr standard **EN 50171**.

The UPS shall have Expandable feature. The units can be connected in parallel up to 8 units to increase power availability or redundancy. The system can be expanded at any time. For the expandability there shall be "Hot System Expansion" feature, the additional unit can be connected in parallel while the other units are on-line and supplying regular power to the load. The new UPS is on-line and will receive the updated information automatically.

High Reliability

The UPS should be connected in parallel up to 8 units to exponentially increase the reliability of the system.

Maximum battery care

In the UPS there shall be an automatic battery test which shall be able to periodically check the efficiency of the batteries. The batteries should not be used during micro-interruption (40ms), as the required energy is drawn from a group of capacitor. (Battery saving).

Maximum safety for personal

There should be a feedback protection device in the UPS to prevent any voltage back feed in the upstream distribution board, thus ensuring the maintenance personal.

For Advanced communication there shall be software system which displays the most important information such as the input and output Voltage, the load applied, the remaining back-up time, etc. It should also be able to provide information even in the event of a failure, to support the fault diagnostics.

It should also contain the following hardware interfaces:

- RS232 serial port
- Dry contacts
- EPO (Emergency Power Off)
- Contact for UPS shutdown using the remote emergency button.

To allow easy and intuitive operation of the UPS There should be Mimic Panel. This helps in accessing the most important parameters: status and alarm, control and commands, input, output, battery measurements (power, current, voltage, frequency and temperature) and settings.

Low Input Harmonic Distortion, The UPS shall have The Power Factor Correction (PFC), standard on all modules, so that the input power factor level to 0.95 for any load percentages so that it is ideal in conjunction with motor generator or in installation with other sensitive loads. There shall be built in Active Filter designed to reduce the level of THDi to less than 4% and to increase the input power factor up to 0.99.

This Active filter shall be based on the IGBT's Technologies controlled by the Digital Signal Processor (DSP). This DSP instantly monitors and controls the inputs current absorbed by the UPS in order to eliminate the unlike harmonics and maintain the THDi less than 4%. With the effect of Active Filter the UPS can also be connected to the low loads. These active filters shall be fitted inside the UPS so that no additional footprint is required.

Less harmonics in the UPS input reduces the neutral cable size and consequently the installation cost. Also it gives maximum reliability as any failure of the optional Active Filter has no influence on the power supplied to the load; the only consequence is the increase of current harmonics level rejected to the mains, which gives maximum reliability for the load.

The input requirement of the UPS are as follows:

Voltage	:	400 V three-phase + N
Voltage tolerance	:	± 20%+
Frequency	:	45-65 Hz
Current distortion	:	<4% with active filter
Power factor	:	0.99 with active filter

The Bypass of the UPS are as follows:

Rated voltage	:	400 V three-phase + N
Phases number	:	3 + N
Voltage tolerance	:	± 15%
Rated frequency	:	50 Hz
Frequency tolerance	:	± 2%
By-pass	:	Static and manual for maintenance

Transfer time : nil

The Battery for the UPS are as follows:

Type of battery : maintenance-free sealed lead-acid

Battery blocks : 12 V

Recharge time minimum : 6 Hr

The Output of UPS are as follows:

Rated power : 30 KVA & 10 KVA

Active power : 29.4 KW & 9.8 KW

Phases number : 3 + N

Waveform : Sinewave

Rated voltage : 415V

Frequency : 50 Hz

Dynamic stability : $\pm 5\%$

Static stability : $\pm 1\%$

Crest factor : 3 : 1

Overload : 110% for 5h, 125% for 10', 150% for 1

The System of UPS is as follows:

AC/AC efficiency : 92% in On-line mode, 98% in Economy Mode / Smart active mode/ Emergency mode.

Noise : 50-56 Db a 1 m.

Operating temperature : -2° - 45°C

Relative humidity : 95% non-condensing

Remote controls : EPO & Bypass

Remote signals : volt free contacts

Protection degree : IP20

Communication : Double RS232/C + slot for SNMP Adapter

Colour : Dark grey RAL 7024

The Standard of UPS are as follows:

1. Safety EN 62040-1
2. EMC IEC 62040-2
3. EN 50091-2 lev. A
4. Directives 73/23, 93/68, 89/336 EEC
5. EN 62040-3.

All the Work desk in front office & Back of the House area Meeting room, Business center shall be provided with 3 Nos 6A 5pin with International outlets option shall be provided for Computers/ Laptops.

All Outlets for power in IT room, Audio-visual media room, EPABX room, Fire Officer Room & Security room shall be on UPS.

A dedicated UPS system (consisting 2 set of equal capacity of UPS rack for Parallel redundancy) shall be provided for IT room & AV room equipments.

All Isolated ground and UPS receptacles should be identified using a different colour, e.g. Orange or Yellow with Green Stripe

15.0 DISTRIBUTION BOARDS & MCBs

General

Distribution boards shall be of standard make with MCBs as per approved make given. Distribution boards shall be constructed out of steel sheet all weld enclosure with double door IP42 protection and shall be powder coated. Ample clearance between the conductors of opposite pole, between conductors and sheet steel body shall be maintained in order to obviate any chance of short circuit. Removable conduits entry or knockouts plates shall be provided at top and bottom to facilitate drilling holes at site to suit individual requirements. Also on additional/separate adopter box of suitable length and size shall be provided to accommodate wires and cables. No. of conduits etc. and nothing shall be payable on this account. The MCBs shall be mounted on high-grade rigid insulating support and connected by electrolytic copper bus bars. Each incoming MCB isolator shall be provided with solderless cable sockets for crimping. Phase separation barriers made out of arc resistant materials shall be provided between the phases. Bus bars shall be colour coded for phase identification.

Distribution boards shall be recessed in wall nitch or if required mounted on the surface of the wall with necessary clamp bolts etc. The mounting height shall not exceed 1200mm from finished floor level. Distribution board shall be provided with proper circuit identification nameplate and danger sticker/plate as per requirements.

All the distribution boards shall be provided with engraved nameplates with 'lighting', 'power' or 'UPS' with DB Nos., as the case may be. Each DB shall be provided with a circuit list giving details of each circuit. All the outgoing circuit wiring shall be provided with identification ferrules giving the circuit number & phase.

Each distribution board shall have a separate neutral connection bar and a separate earth connection bar mounted within the DB each having the same number of terminals as the total number of outgoing individual circuits from the distribution board. Conduit & cable armouring shall be bonded together & connected to the distribution board earth bar.

Where oversized cables are specified due to voltage drop problems, it shall be contractors responsibility to ensure that satisfactory terminal arrangements are provided without an extra cost.

Earth Leakage Circuit Breaker

ELCB shall be 4 pole 415 volts 50Hz, 30-300mA sensitivity. These shall be of approved make. The rating of the ELCB shall be as specified in BOQ. These shall be suitable for manual closing and opening and automatic tripping under earth fault circuit of 30-300mA as specified in item of work. The enclosure of the ELCB shall be moulded from high quality insulating material. The material shall be fire retardent, anti-tracking, non-hygroscopic, impact resistant and shall with stand high temperature. All parts of switching mechanism shall be non-greasing, self-lubricating material so as to provide consistent and trouble free operation. Operation of ELCB shall be independent of mounting position and shall be trip free type. The RCCB shall be protected against nuisance tripping by protective device.

Miniature Circuit Breaker

1. The MCB shall be current limiting type and suitable for manual closing and opening and automatic tripping under overcurrent and short circuit. The MCB shall also be trip free type.
2. Single pole/three pole versions shall be furnished as required.
3. The MCB shall be rated for 10 KA/15 KA fault level.
4. The MCB shall be suitable for its housing in the distribution boards and shall be suitable for connection at the outgoing side by tinned cable lugs and for bus-bars connection on the incoming side.
5. The terminal of the MCBs and the open and close conditions shall be clearly and indelibly marked.
6. The MCB shall generally conform to IS: 8828. -1996
7. The MCB shall have 20,000 electrical operation upto 63A.
8. The MCB shall have minimum power-loss (Watts) as per I.S./ IEC.

16.0 SOLAR POWER PLANT

This specification is intended to cover supply, installation, testing and commissioning of Solar Power Plant. The Scope covers the following, but not limited to it, to ensure Completeness & Satisfactory operation. It is the responsibility of the Vendor to include all items as required.

This specification defines the basic guidelines to develop a suitable electrical system for solar power system and all data required in this regard shall be taken into consideration to develop a detailed engineering of the system.

The Solar Plant shall be comprises of the following:

- a. Mono-crystalline silicon Type Inter Connected Photo-Voltaic Solar panels.
- b. Support / structure for mounting of panels
- c. Solar Charger Controller
- d. Multi-Strand Copper Wiring/cables for interconnections.
- e. Protections & Indications for Working & Faulty Conditions.
- f. Earthing of all the equipments & structure.
- g. Maintenance Free Valve Regulated Lead Acid Battery as per IS: 15549-2005 of in modules of 12V, 200AH Capacity for 14hours Back-up.
- h. UPS/ Invertors complete with Battery Charger, Protection for O/L, S.C., LCD Display Panel etc Complete with all accessories
- i. MS Rack Coated with Acid-Resistant paint of suitable size as required for Battery bank.
- j. All necessary accessories & hardware as required for commissioning.

No. of Modules: As per Standards to achieve rated Power Output defined in the BOQ for min. 14Hours operation

Site conditions are as under:

Ambient temperature	:	45 Degree \pm 5 Degree
Related Humidity	:	0 – 90%
Altitude	:	225M from sea level

Codes and Standards

NFPA - 99	:	Standard for Healthcare Facilities
IS – 3043	:	Earthing
IS – 732	:	Code of Practice for Electrical Installation not exceeding 660 volts.
IS – 7689	:	Guide for Control of Undesirable Static Electricity.
IS – 3716	:	Insulation Co-ordination Application Guide.

Scope

- Safety to personnel and equipment during both operation and maintenance.
- Reliability of services.
- Ease of maintenance and convenience of operation.
- Automatic protection of all electrical equipment through selective relay system.
- Electrical supply to equipment within design operating limits.
- Maximum interchange ability of equipments.
- Fail safe feature.
- Suitability for applicable environmental factors.

Design Parameters:

a) Supply Voltage	220V
b) Phase	Single
c) Frequency	50 Hz
d) Voltage Regulation	\pm 3%
e) Frequency Regulations	\pm 3%
f) Combined	\pm 10%
g) Operating Temp. Range	20-90 °C
h) Operating Hours	14 Hrs. Min.
i) Efficiency	Not less than 90%

Details to be furnished by Vendor.

- a) Max. Power Rating
- b) I_r
- c) V_r
- d) Open Circuit Voltage

- e) Panel Dimensions
- f) Tech. submittals & Drawings

Individual Warranty as below.

- a) PV Modules 15 years
- b) Battery Bank 3 years
- c) UPS/ Inverter System 3 Years
- d) The whole System shall have 2 years Warranty for satisfactory operation.

Earthing & Wiring

Earthing shall be done as per NEPA / NEC / IS code of practice. Wiring where these panels are being installed the electrical wiring shall be carried out with XLPE LT cables / wires.

General

A. Quality Assurance: The contractor shall submit the following quality assurance documents within 2 (two) weeks after award of work.

- * All non-destructive examination procedure, stress relief and weld repair procedure actually used during fabrication and reports etc. including painting.
- * Design calculation and detailed circuit diagram of equipment.
- * Factory routine and type test to be carried out with testing procedures and minimum acceptable values as well as for field.

B. Inspection and Testing

- * All equipments being supported shall conform to routine and type tests as per recommended code and the price shall be included in bid price and breakup of the same shall also be submitted alongwith bid. In case the price is not indicated it will be presumed that the tests (routine and type tests) has been offered free of cost.
- * The contractor shall give Engineer-in-Charge thirty (30) days' notice in writing about the readiness of equipment for the tests. The cost will be borne by the contractor.
- * No material shall be dispatched until and unless the tests material for the physical inspection tests has been carried out by Consultant and Employer jointly.

After installation at site, all the routine / functional tests shall be carried out at site in the presence of Engineer-in-Charge and shall also be witness their presence in writing.

CHAPTER H

TECHNICAL SPECIFICATIONS FOR D.G.SETS

1.0 SPECIAL CONDITIONS OF CONTRACT FOR D.G.SETS

DRAWINGS

The drawings, specifications and bill of quantities shall be considered, as a part of this contract and any work or materials shown on the drawings and not called for in the specifications or vice-versa, shall be executed as if specification called for in both. The contract drawings indicate the extent and general arrangement of various equipments and their wiring, etc. and are essentially diagrammatic. The drawings indicate the point of termination for conduit runs and broadly suggest the routes to be followed. The work shall be done as indicated on the drawings. However, any minor change if found essential to co-ordinate the installation of this work with other traders shall be made without any additional cost to the Engineer-in-Charge. The data given herein and on the drawings is as could be secured but its complete accuracy is not guaranteed. The drawings and specifications are for the assistance and guidance of the contractor. The exact location, distances and levels etc. will be governed by the space conditions. The contractor shall examine all Architectural, structural, Plumbing and Sanitary, Air-conditioning and electrical drawings before starting the work and report to the Engineer-in-Charge any discrepancies, which in his opinion appear, on them, and get them clarified. He shall not be entitled to any extras, for omissions or defects in electrical drawings or when they conflict with other works.

SHOP DRAWINGS

The Contractor shall prepare and submit to Engineer-in-Charge for their approval detailed shop drawings within 30 days of signing of the contract or before 7 days of particular work or whichever is earlier. The shop drawings shall clearly indicate.

- a) The general arrangement and schematic diagram of main D.G Panel, PLC Panel, clearly stipulating the material, size of sheet steel, bus bar, inter connections detail, make and rating of switchgear and other equipment etc.
- b) Number, size and route of the Cable Tray, and fixing details.
- c) Total number of cable runs, size make, material and type of cables with clear routing, trenches / trays detail, installation mode, starting and termination point of each and individual cable etc.
- d) The shop drawings shall also show all setting out details and physical dimensions of all equipments components used in the system, location of manholes fixing, cutout details etc.

QUALITY

The Employer's / Consultants decision with regard to the quality of the material and workmanship will be final and binding, any material rejected by the Employer / Consultant shall be immediately removed by the Contractor from the site. The Employer / Consultant or their representative shall at all reasonable times have free access to the works and / or to the workshops, factories or other places where materials are being prepared or constructed for the contract and also to any place where the material lying or from which they are being obtained, and the contractor shall give every facility necessary for inspection and examinations and test of the material and workmanship free of cost.

COST OF SAMPLES AND TESTS

The Contractor at his own cost shall supply all samples and the cost of making any test as per specifications shall be borne by the contractor. The Contractor shall submit four copies of all

brochures, manufacturers' description data and similar literature. One copy will be returned to the Contractor after approval.

COMPLETION DRAWINGS

The Contractors shall submit to the Engineer-in-Charge, layout drawings drawn at approved scale in six sets and a reproductive (original) copy clearly showing.

- a) Location of distribution and PLC Panel
- b) All types of cables (L.T. / Control etc.) layout.
- c) Layout of DG Room and switchgears and associated equipments.
- d) Layout of Diesel Generator Sets.
- e) Location of Fuel Tank, Cooling Towers, Pumps and fuel and water piping layout.
- f) As built drawing with equipments operation and maintenance literature. - After the completion of the work and before issuance of certificate of virtual completion.

FOREMAN / SUPERVISOR

The Contractor shall employ a competent, licensed qualified full time electrical engg./ foreman/ supervisors to direct the work of electrical installations in accordance with the drawings and specifications. The foreman / supervisor shall be available at all times on the site to receive instructions from the Engineer-in-Charge in the day to day activities throughout the duration of the Contract and as long as there after as the consultants may consider necessary until the expiration of the "Defect Liability Period". The Foreman / Supervisor shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of the Local Government. The Contractor shall on the request of the consultants immediately dismiss from the works any person employed there on who may, in the opinion of the consultants, be unsuitable or incompetent or who may misconduct himself and such person shall not be again employed or allowed on the work without the permission of consultants/Employee.

INSPECTION AND TESTING

Contractor shall employ a full time qualified Engineer who shall be available at all working hours at site for taking instructions and to look after the quality of the work. Instructions given to the Engineer of the contractor shall be construed as issued to the contractor.

Contractor shall maintain at site the following tools and instruments, but not limited to the list below in working conditions.

- a) Clip-on Ammeter and voltmeter
- b) 1000 V Meggar and 5 KV Meggar
- c) Steel tapes of various lengths
- d) Sprit Level
- e) Hydraulic Crimping Tool
- f) Earth Testing Meggar
- g) Pipe bending Tool, thread-cutting die, bench vice etc.
- h) Cable jointing kit

The contractor shall provide at least four permanent benchmark at site, which shall be preserved till the completion of works. These are essential for laying of cables at correct levels.

CLEARANCE FROM LOCAL AUTHORITIES

The Contractor shall get the entire installation tested inspected and approved by Local Authorities like Electrical inspectorate pollution control explosive clearance and any other agency required to take permission for commissioning of the installation. He will also undertake the Liaison work with local Electricity Supply Company for obtaining the Electrical Service Connection.

SCOPE

In general, the contractor shall supply, store, erect test and commission all the equipment required for electrical installation. The contractor shall furnish all the materials, labour, tools and equipment for electrical work, as shown in the accompanying drawings and in the bill of quantities and specifications hereinafter described.

CONTRACTOR

The contractor shall be a licensed electrical contractor, possessing a valid electrical contractor's in the state, employing licensed supervisors and skilled workers having valid permits as per the regulation of Indian Electricity Rules and Local Electrical Inspector's requirements.

2.0 Preamble to BOQ for D.G. Set:

1. All items of work under this Contract shall be executed strictly to fulfil the requirements laid down under the specifications. Type of equipment, material specifications, methods of installation and testing, and type of controls shall be in accordance with the Specifications, approved shop Drawings and the relevant Indian Standards, however, capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.
2. The rate for each item of work included in the Bill of Quantities shall, unless expressly stated otherwise, include cost of:
 - a. All materials, fixing materials, accessories, appliances, tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of the work called for in the item and as per Specifications and Drawings.
 - b. Wastage on materials and labour.
 - c. Loading, transporting, unloading, handling / double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and to fully complete the job in accordance with the contract documents, good practice and recognized principles.
 - d. Liabilities, obligations and risks arising out of Conditions of Contract.
 - e. All requirements of specifications, whether such requirements are mentioned in the item or not. The specifications and drawings where available, are to be read as complimentary to and part of the Schedule of Quantities and any work called for in one shall be taken as required for all.
 - f. In the event of conflict between Bill of Quantities and other documents including the specifications, the most stringent shall apply and the interpretation of the consultants shall be final and binding.
3. The unit rate for each equipment or materials shall include cost in Rupees for equipment and material including the excise duty, and also including forwarding, freight and insurance up to Contractor's store at site, storage, installation, testing balancing, commissioning and other works required.

The extension for (total) amounts against each item shall be based on the quantities indicated in this Schedule.

4. All equipment, quantities and technical data indicated in this Schedule are for the Contractors guidance only; these are based on the documents prepared by the Consultants. The contractor shall assess the required quantity of cables, cable trays, piping etc that are required for completion of the work. This schedule must be read in conjunction with these documents. The Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved shop drawings at the contract rates.
5. The quantities given in this schedule are provisional, the Engineer-in-Charge reserves the right to increase or decrease the quantities of work or to totally omit any items of work and the Contractor shall not be entitled to claim any extras or damages on these grounds. These variations shall be permitted until such time Contractors shop drawings are approved.
6. This schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK.
7. No alteration whatsoever is to be made to the text or quantities of this Schedule unless such alteration is authorized in writing by the Consultants. Any such alterations, notes or additions shall unless authorized in writing be disregarded when tender documents are considered.
8. In the event of an error occurring in the amount column of the Schedule, as a result of wrong extension of the unit rate and quantity, the unit rate quoted by the tenderer shall be regarded as firm and the extensions shall be amended on the basis of the rates.
9. Any errors in totaling in the amount column and in carrying forwarded totals shall be corrected. Any error, in description or in quantity or commission of items from this schedule shall not vitiate this contract but shall be corrected and deemed to be a variation required by the Consultants.

3.0 D.G. SET- 625 KVA

The D.G. set shall be provided with Diesel Engine of Model no. & no. of Cylinder as given below, vertical 4 stroke cycle, **Air cooled radiator** having turbo charged after cooled Engine at 1500 RPM under NTP conditions of BS: 5514. The D.G. set shall be provided with electrical starting arrangement and shall give the electrical output of as given below at 0.8 power factor, 415 Volts at the alternator terminal.

Other accessories of the engine would be as under:

COOLING SYSTEM

- ▣ Thermostat
- ▣ Corrosion Inhibitor
- ▣ Self-contained piping

FUEL SYSTEM

- ▣ PT fuel pump
- ▣ Injectors
- ▣ Fuel filters
- ▣ Self-contained piping

LUBRICATING SYSTEM

- ▣ Oil pump

- Strainer
- Lub oil cooler
- Oil filter
- Bypass filter
- Self-contained piping

AIR INTAKE SYSTEM

- Dry type filter
- Air intake manifold with necessary connections
- Turbo charged after Cooled

EXHAUST SYSTEM

- Exhaust manifold
- Flexible piping
- Silencer

GOVERNING SYSTEM

- Electronic Governor

STARTING SYSTEM

- Starter, 24V, DC
- Battery charging Alternator
- With in-built Regulator

ENGINE CONTROL PANEL (ECP) (it will display)

- Lub oil pressure
- Jacket water temperature
- Engine RPM
- Battery voltage
- Engine Running Hours

SAFETY SYSTEM

- Low lub oil pressure
- High water temperature
- Over speed

OTHER SYSTEM

- Flywheel
- Flywheel housing

ALTERNATOR:

Output i) 625 KVA
 Power factor : 0.8
 Rated Generating Voltage: 415 Volts

Voltage regulation	: +/- 1% all load between no load to full load & factor 0.8 to unity
Frequency	: 50 Hz
Speed	: 1500 RPM
Class of insulation	: H
Winding connection	: Star connection (all six leads will be brought out of stator frame)
Overload capacity	: 10% for one hour in any 12 hours of operation without exceeding temperature rise limits specified in BS:2613 or BS:5000 when corrected to ambient temperature at site.
Bearings	: Long life single bearing
Enclosures	: Drip proof & screen protected IP-23
Parallel operations	: All machines shall be suitable for operation in parallel. Damper winding shall be provided to facilitate parallel operation

Power Command Paralleling Genset Controls (PCC3.3 of Cummins or equivalent)

The features shall be given as below:-

- ▣ Digital governing
- ▣ Digital Voltage regulation
- ▣ AmpSentry Protection for true alternator O/C protection on PCC 3.3 for solo / paralleling applications.
- ▣ Analog/ Bargraph/ Digital AC output Metering
- ▣ Battery Monitoring System to sense and warn against a weak battery condition
- ▣ Digital Alarm and Status Message Display
- ▣ Genset Monitoring : Displays status of all critical engine and generator set functions
- ▣ Smart Starting Control System : Integrated fuel ramping to limit black smoke and frequency over shoot
- ▣ Advanced serviceability
- ▣ Synchronizers and load sharing controls
- ▣ KVAR and power factor controls
- ▣ Import / Export controls for paralleling with utility / main bus.

The alternator shall be of self-excited, self-regulated, self-ventilated in brush less design, provided with suitable automatic voltage regulator and shall conform to BS:2613 or BS : 5000 and shall give rated output at NTP conditions.

ESSENTIAL ACCESSORIES:

One set of essential accessories shall be supplied with each D.G. Set. This set of accessories shall comprise of the following:

BASE FRAME:

One no. MS Fabricated adequately machine Channel Common Base Frame with lifting facility, pre-drilled foundation holes suitable for permanent installation on concrete foundation for direct grouting or on anti-vibration mountings which will be suitable to receive the offered

engine and alternator duly coupled through a flexible coupling. A suitable coupling guard shall also be provided.

FUEL TANK:

One no. Daily fuel tank of 990 LITRES capacity / **or as per OEM Supplier Specification** for each DG set made out of 3 mm thick MS sheet complete with inlet and outlet connections, drain plug, manhole, etc. & suitable for mounting on floor with mounting pedestals. Wire-braided hoses shall also be supplied with fuel tank.

BATTERIES:

For electrical control circuit of 24 volt DC, 2 Nos. batteries of 12 volts 180 AH for **each set** respectively (dry and uncharged) of approved make with battery leads for electrical starting of each DG Set.

4.0 DIESEL GENERATING SET

DESIGN

- 1.1 The engine alternation set shall be capable of working at ambient temperature between 0°C to 50°C and relative humidity upto 95%.

The operating capacity of each set shall be arrived at after considering a load with power factor of 0.8 lagging, and after taking into consideration suitable de-rating on account of above parameters of the station.

- 1.2 The engine/alternator set shall be capable of taking 10% over-load for a period of one hour during any 12 hours period, while operating continuously at full rated load.
- 1.3 Nominal output voltage of engine/alternator set shall be 415 volts 50 Hz AC Supply with manual adjustment at all conditions of load with coarse and fine controls with a range of $\pm 5\%$.

The frequency shall be maintained at 50 Hz $\pm 2\%$ for the set.

- 1.4 The output wave-form shall be sinusoidal at all load conditions.
- 1.5 The engine/alternator set shall be selected for a high degree of performance with over all low fuel consumption for the normal life of the alternator set.
- 1.6 The engine/alternator set shall meet the requirements of all linear & non-linear loads, but over-sizing of the alternator in order to meet the non-linear characteristics of loads in not envisaged.
- 1.7 The Engine shall be capable to minimum 60% bulk load of the rating during transfer of the load from NO Load position without tripping.

SYSTEM OPERATION

The set may be idle for a long time except for periodical test whenever there is a electrical supply failure, the set may require to run continuously for period even exceeding 24 hours.

SYSTEM FEATURE

The entire work shall confirm to Bureau of Indian Standards safety standards; British Standards, and C.P.W.D. specifications.

DETAILS OF ENGINE/ALTERNATOR

Scope

The scope of this section covers general requirement for reciprocating diesel engine and alternator complete with drive, safety controls, lubricating system, cooling system, instruments etc., including erection, testing and successful commissioning on load.

Diesel Engine

Diesel engine shall be multi-cylinder, 1500 RPM reciprocating, 4-stroke internal combustion conforming to BS 649 and shall be of welded construction or of fine grain cast iron. The crank case shall be of iron alloy, casting, crank shaft shall be of high tensile forging corresponding to medium carbon steel of 1045 (AISI) grade, Main B.E bearing shall be of high grade bearing material, connecting rod shall be of 1 beam high grade of drop forged steel corresponding to carbon steel of 1139 grade, cylinder liner shall be wet type cast alloy iron with specially machined groomed in the bores to serve as oil retaining surfaces, piston shall be of low expansion aluminum alloy with machined surfaces.

The engine shall be equipped with all required standard accessories:

Fly wheel & housing

Oil bath air cleaner

Exhaust turbo charger & after coolers **as called for.**

Flexible coupling and coupling guard

Flexible connection between heat Exchanger and water pipe.

Lubricating pump and fuel injection pump

Nozzles

Electronic / hydraulic Governor as called for in BOQ.

Oil pressure gauge and water temp gauge

Fuel filter, fuel tank and fuel lines

Turbo charged aspiration

Water-cooled radiator/ Heat Exchanger as called for in BoQ.

12 cylinders or as required.

Other fittings as recommended by the manufacturer.

The lubricating system shall be positive pressure type for all moving parts. No moving parts shall require lubricating by hand, either prior to starting or while in operation.

The lubricating system shall consist of following major components.

Oil pan

Oil pump

Oil filter

Oil pipe/hose

Oil cooler

Piston cooling nozzle

Oil temperature & gauge

Oil pressure gauge

By-pass filters.

Lubricating oil filter shall be provided for operation of 500 hour without any necessity of replacement or cleaning.

The engine shall be water cooled with Heat Exchanger. All standard accessories like inlet, outlet connection, fuel connection, drain plug etc. shall be provided.

Engines shall be suitable for running at 1500 RPM the speed of the engine shall be controlled by means of a governor which may sense the actual speed and make adjustment to the fuel system when required. The speed governing system shall be Class A hydraulic type as per BS 649. The maximum change in speed of engine shall be not more than 10% or 4% when the full load is either taken off or thrown ON temporary or permanently as the case may be. The engine/alternator set shall be able to attain the steady speed within a time period of 3 seconds from the time load change takes place.

Engine Starting

The engine shall be self-starting type. The starter motor shall conform to BS-2613-1970. Time required for starting of engine from cold conditions shall be 10-20 secs maximum.

Fuel Tanks

Fuel tank(s) shall be fabricated from 3 mm thick MS sheet and of 990 litres capacity. Fuel lines shall be of MS "C" class welded pipe & standard hose pipes. The fuel tank shall have all standard fittings like outlet, fuel return, drain & vent connection. The fuel tank shall also level indicator so as to indicate the quantity of fuel present in litres with calibration chart. It shall be provided with high & low level switches having potential free contacts for annunciation and also for auto control of fuel oil pump.

Exhaust System

Industrial type Air intake filter shall be provided in the turbo charger assembly of the engine unit. The exhaust system shall consist of turbo charger with clad pipe inter connecting it with the cylinder head inlet. The exhaust manifold shall be suitably lagged and covered as well. The exhaust pipe shall discharge the exhaustible smoke at the top of the building.

The exhaust system, which carries away the products of combustion from the engine to the atmosphere, shall be such as to restrict the backpressure within prescribed limit (below 75 mm of Hg) to ensure proper engine operation. The exhaust system shall consist exhaust pipe, flexible pipe of minimum 30 cm length, and exhaust noise suppressor silencer, and catalytic converter.

The silencer shall be which can provide suppression in noise as per specifications. A test certificate to this effect shall be furnished.

The exhaust piping system shall have a provision of condensate trap with drain plug valves. Exhaust piping shall be insulated with a layer of 75 mm dia glass wool with aluminium cladding rope to minimize the heat radiated to the room.

DETAILS OF D.G.SET

Engine Instrumentation on Engine

Speedometer with time totalizer.

Lub oil pressure gauge.

Lub oil temperature gauge.

Cooling water temperature gauge.

Battery Charger (Separate).

Starting switch with key.

Over speed relays.

Run/Idle toggle switch

Alarms/Trip (Audio and Visual)

Over speed.

High Cooling water temperature.

Low lub oil pressure.

Alternator

Screen protected, drip proof, 3 phase 415 Volts, 4 wire, 50 Hz, 0.8 p.f., 1500 RPM, self-regulated, class H insulation, brushless alternator; continuous rating as per relevant Indian Standards, A removable gland plate shall be provided for the cables. Also an automatic voltage regulator at 415 Volts \pm 2.5% shall be provided. Enclosure shall be as per IP-23. Rated voltage shall be 415 V suitable for 50° ambient temperature and overload capacity shall be 10% for one hour during 12 hours continuous running must have droop characteristics and others for synchronizing system and fine adjustment of voltages.

Exciter

Self-excited, self-regulated, providing alternator output regulation at plus or minus 2.5%, from no load to full load along P.F. between unity to 0.8 lagging, with 4% speed variable, of the engine. Solid state excitation system is preferred.

BATTERY CHARGING EQUIPMENT

Battery charging equipment should be incorporated in the generator control panel and shall comprise of:

- AC and DC "ON" and "OFF" switches with HRC fuses.
- Indicating lamps for indicating mains "ON" and battery charging.
- Ballast to give charging.
- Single phase double wound (copper conductor) impregnated natural air cooled mains transformer for rectifier stack.
- Rotary switch to give step control.
- Single phase full wave bridge connected silicon rectifier stack.
- Moving coil ammeter to indicate charging current.
- Moving coil Voltmeter with a selector switch to measure the battery/charger voltage.
- Silicon blocking diodes connected to a suitable tap to maintain continuity of DC supply. Trickle and boost arrangement must be there.
- AC and DC contactors of suitable rating as required

SPECIFICATION OF MATERIALS

Exhaust Silencer Piping

The exhaust silencer piping system shall be of heavy duty MS pipes conforming to Class C. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendations of the manufacturer. MS screwed flanges and bends shall be used as per site requirements.

Exhaust pipe inside the building shall be lagged with 75 mm dia glass wool with aluminium cladding and suitably bonded with asbestos cloth.

Water Piping and Oil Piping

Water Piping shall be of C class MS pipe. Oil piping shall be of MS or braided flexible type only. Cooling water and oil piping shall be tested in accordance with ASA-B 31.1 pressure piping code.

Wiring

All the wiring outside the panel shall be drawn to 16 gauge MS conduits.

The minimum size of wires outside the panel shall be 2.5 sq. mm stranded copper conductor.

The minimum size of control cables inside the panel shall be 1.5 sq. mm stranded copper conductor.

All the wires and cables suitable for 650/1100 Volts. As per IS-694-1990 latest amendment.

INSTALLATION OF GENERATING SET

The engine and alternator shall be mounted on specially designed common MS base plate and frame of extremely rigid welded construction, so as to provide no deflection.

The engine/alternator set shall be installed over the Dunlop-make, S-type anti-vibration cushy base in order to isolate the transmission of vibrations to the floor or building structures.

The exhaust system shall be designed and installed in such a manner that it avoids excessive stresses on the exhaust manifold of turbocharger, washing spray or any other source.

The exhaust pipe shall pass through an oversized collar, filled with glass wool when crossing floor/wall.

All exposed metal parts shall be suitably painted to prohibit corrosion under the climatic conditions at site.

The installation of fuel piping, power distribution and control panels shall be carried out in accordance with the specification of respective items.

PRELIMINARY TRIALS

After completion of erection of generating sets and before carrying out main trials, preliminary trials shall be conducted in the presence of the ENGINEER-IN- CHARGE and the results shall be recorded in the test sheet at 30 minutes intervals. Alternator efficiencies as determined in works test shall be used as the basis of calculation for fuel consumption rate. A tolerance of 15% shall be allowed on the fuel oil consumption to cover possible errors of measurement.

Tests providing the satisfactory performance of all safety and operating controls shall be carried out. Governor trials shall be carried out as laid down in BS: 639. Alternator insulation resistance and commutation check shall be as per BS 2613/BS 5000. Starting time of sets shall be tested at least five times the sufficient time integral to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment has to be checked. A further reasonable trial as suggested by the Client shall be carried out with no extra charges. All instruments, materials and labour required for carrying out the trials shall be provided by the Contractor. Test sheets of trials shall be forwarded in quadruplicate to ENGINEER-IN-CHARGE. The successful bidder has to submit a list of recommended spares to client for purchasing the same. A set of tools and tackles has to be supplied alongwith each set. List of recommended spares shall be indicated to client.

DAY SERVICE TANK

Day service tank shall be of 3mm thick MS sheet fuel oil storage tank of capacity 990 litres for each set with all accessories such as oil level indicator, inlet pipe connection. Outlet pipe connection, with gun metal valve through to collect split oil, air vent pipe, manhole with cover, low level and full level float valve arrangements and interconnections between tanks and painting. The tank shall be provided with Suitable calibration scale. The tank shall be fabricated from 3mm thick MS sheet.

FOUNDATION

Foundation shall be casted as per the recommendations of the manufacturer in consultation with the Supplier and as per the requirements of the site. The successful bidder shall submit detailed foundation drawings within 7 days of award of work.

PAINTING

The Contractor shall paint all exposed metal parts and equipment supplied by him. All sheet metal work shall undergo a process of phosphating, passivating and then sprayed with high corrosion treatment of two coats of synthetic enamel paint of approved colour. All piping shall be colour coded.

5.0 VOLTS DC BATTERIES & BATTERY CHARGER

Lead acid type batteries, 2 x 12V - 25 plates: 180AH as required conforming to IS shall be provided for each set for starting purposes as per requirements. These batteries shall be fitted with electrolyte (specific gravity 1.280) and initially charged, discharged and recharged and placed in suitable enclosure, in ready to use shape.

SHOCK TREATMENT CHART

Shock treatment chart explaining the method of shock treatment in English, Hindi and local language shall be provided dully framed in glass in the diesel generating station.

WIRING

Providing conduits and drawing wires for the following: -

- Control wiring between diesel generating set and the automatic mains failure panel.
- All wiring associated with the fuel oil transfer pump and including level controllers and circulating water pumps.
- All wiring associated with DC supply.
- All earthing conductors associated with this installation.
- All wiring and cables shall be PVC insulated stranded copper conductor wires and cables suitable for 660/1100 volts minimum size of wires for control wiring shall be 2.5 sq. mm and minimum size of wire for pumps shall be 4 sq.mm. The wires would be as per IS.

CABLES

MV cables shall be XLPE aluminium conductor armoured cables, laid in trenches between diesel generating set and DG panel. All power & control cables will be rated for 1.1 KV grade. Storing, laying, jointing procedures as same as that for the LT cables stated elsewhere.

TEST PERFORMANCE

Scope

This section lay down the procedure for conducting test on the installation. In general the procedure laid down here shall be followed. However, if manufacturer of the equipment

has prescribed different procedure which is at variance, the same may be adopted. All required artificial load, testing equipment other required material required for testing purpose shall be supplied by agency.

Physical Test

- Particulars such as name plate details of all major component equipment shall be recorded and compared with what has been offered by the contractor as per agreement.
- Level of foundation.
- Firmness of mounting.
- Verticality of installed set.
- Tightness of nuts & bolts.
- Proper installation of exhaust pipe.
- Insulation of exhaust pipe with 75 mm dia glass wool with aluminium cladding.
- Provision of guard on engine/alternator set coupling joints.
- Termination of various cables.
- Rating of various fuses.
- Termination of earth leads on neutral & body.

Earth Resistance

The resistance shall be measured by isolating the connecting earth lead in respect of all earth stations.

Run Test

The engine shall be given a test run continuously for at least six hours with alternator supplying full rated load. During this run following observation shall be recorded.

S.No.	ITEMS	TIME AFTER START OF RUN/TEST						
		1 Hr	2 Hr	3 Hr	4 Hr	5 Hr	6 Hr	7Hr
1.	Lubricating oil pressure							
2.	Exhaust gas colour							
3.	Speed engine							
4.	Output voltage							
5.	Load current							
6.	Load (KW)							
7.	Noise Level (DB)							

Stator Temperature Rise Test

The alternator shall be loaded of full rated load and stator (alternator) body temperature be recorded as under at intervals of 30 minutes till such time that there consecutive readings are the same.

S.No.	TIME	AMBIENT TEMP	STATOR TEMP
	(Hr)	(°C)	(°C)

- a. The temperature rise shall be maintained within 60°C above the ambient.

Fuel Consumption Test

- Fuel consumption for half an hour shall be measured after the full load operation condition have stabilized.
- During this measurement the load shall be maintained unchanged.
- The fuel consumption shall be compared with values given in the technical particulars.

Over Load

- Over load test to the extent of 10% over the rated load shall be conducted immediately after the full load run test.
- The various parameters as in the case of run test shall regularly be monitored and recorded.
- After the over load test, the load shall be normalized to rated value and all parameters recorded.

Insulation Test

- Insulation test shall be conducted after testing the engine/alternator set at overload.
- The insulation resistance between the starter coil and from shall be measure with 5000 volts meggar.
- The insulation resistance of alternator winding shall be not below:
- Rated output voltage + 1 Mega Ohms

$$1000 + \text{Rated out in KVA}$$
- Insulation resistance of control wiring with 500 volts meggar shall be measure, which shall not be less than one mega ohms.

Regulation Test

- The voltage regulation from no load to full rated load at 0.8 p.f. and from no load to half the rated load at 0.8 p.f. shall be measured between phase & neutral under automatic and manual regulation mode, which shall not exceed 0.5% of the nominal rated output voltage.
- In automatic regulation mode, the recovery time shall be noted which shall not exceed 3 seconds.
- The frequency of output supply of various load conditions shall be noted and recorded.
- The variation shall be compared with the accuracy standards specified.
- Change in speed of engine with change in load shall be observed and compared with standard reading for the speed governor.

Data Sheet: Vendors shall fill in the performance data in the block columns of the attached Data sheets.

6.0 ACCOUSTIC ENCLOSURE

Construction Details

The Structure is fabricated using CRCA sheets of 14/16 SWG Thickness and steel members. The enclosure is fabricated on a MS Channel Frame work further strengthened by suitable cross members to make it robust and sturdy. Rock wool / Mineral wool of suitable thickness and density conforming to IS 8183 is used for acoustic insulation to reduce the sound level to 68 – 70 d b from the original sound level of 105 – 110 d b, when measured at 1mtr.distance from the D.G. Set. The acoustic enclosure consists of following:

a) Acoustic Insulation :

High density Fireproof Acoustic Enclosure Material i.e. resin bonded rock wool / fiber glass wool (75 – 100mm thick of 64Kg/m³ density) conforming to IS:8183 is provided on all doors and roof to absorb noise. The insulation material used is fire retardant. The insulation is covered with fiber glass cloth and is supported by perforated sheet. Sound attenuators / downstream silencers are provided at all openings for air inlet/outlet to facilitate free air flow but to absorb sound resulting in extremely low noise level. Detachable partitions are provided inside the enclosure to attain further noise attenuation of the engine.

b) Noise Suppressor :

A suitably designed absorption type Hospital noise suppressor is provided which minimize the exhaust noise of the engine.

c) Exhaust System :

The exhaust gas is taken out through a specially designed flexible pipe, which prevents any back pressure on the engine.

d) Thermal Insulation :

The exhaust system and noise suppressor is provided thermal insulation by using glass wool & covering it with Aluminum sheet. This prevents it from radiating excess heat on the engine, makes it safe for the operator and enhances aesthetics.

e) Surface Treatment :

The enclosure is surface treated and painted with high quality polyurethane epoxy paint with prior zinc oxide primer base, which makes it weather proof and suitable for outdoor application. The paint is highly resistant to acids, alkaline, salt sprays, halogens, solvents, lubricants etc and has very good dielectric properties and is resistant to abrasion and cracking.

f) Air Circulation & Ventilation System:

A suitable forced air circulation and ventilation system is designed to maintain safe operating temperatures inside the enclosure. Requisite air circulation for engine aspiration combustion and cooling is provided by means of Exhaust fans or tube axial fan driven by a 3 phase squirrel cage induction motor according to need of engine.

g) Vibration Isolation:

The engine and alternator is mounted on Anti-Vibration Mounting pads to eliminate engine vibration.

h) Hardware:

Inlet and Outlet for cable, draining of lube oil and diesel etc. are provided. The doors are gasketed with high quality EPDM gaskets to avoid leakage of sound. All doors are lockable.

i) Testing / R&D:

The Gen set shall be thoroughly tested on load before it is dispatched from factory.

Technical Data Sheet Diesel Generator (Alternator) 625 KVA		Project:.	
		Date:	
S.No.	Item	Data	
1	Serial		
2	Type		
3	Make		
4	Voltage, Phase, Frequency	415V,3PHASE, 50Hz	
5	Normal Continuous Rating	625 KVA	
6	Starting KVA	(PLEASE SPECIFY)	
7	Manufacturer		
8	MAXIMUM VALUE OF MOTORLOAD WHICH DOESNOTAFFECT STARTING	(PLEASE SPECIFY-minm. 60% of the rating)	
9	Power Factor	0.8	
10	Class of insulation	H	
11	Efficiency & losses at 0.8 p.f. and	AS REQUIRED / PER IS. Actual	
a)	1/4 th Full load		
b)	½ th Full load		
c)	¾ Full load		
d)	full load		
12	OVERLOAD CAPACITY	10%	
13	Build up time for voltage from no load to full load	20sec Maximum	
14	NO. of hours alternator can be run with no increase in temp under 10% over load	1hr Minimum	
Prepared by:		Name : Date:	
		Format no:	
		Page 1 of 2	

Technical Data Sheet Diesel Generator (Engine)		Project:
		Date:
S.No.	Item	Data
1	Serial	
2	Make	
3	Model	
4	Manufacturer	
5	BHP	@ 1500 rpm
6	Starting Torque	
7	Type of Cooling	Heat Exchanger
8	Specific oil consumption	gm / BHP / HR & __ litres/hr.
9	Lube oil consumption	
10	Efficiency & losses at 0.8 p.f.	
a)	1/4 th Full load	
b)	½ th Full load	
c)	¾ Full load	
d)	Full load	
11	Day oil tank	_____ LTR
12	Lube oil tank	_____ LTR
13	Temp. De-rating factor	
14	Altitude De-rating factor	
15	Noise level at 1 Mtrs.	
16	Vibration	
17	Emission Level	
18	Exhaust pipe diameter & Nos.	_____ mm dia.
Prepared by:		Name : _____ Date: _____
		Format no:
		Page 2 of 2

CHAPTER I

TECHNICAL SPECIFICATIONS FOR FIRE ALARM SYSTEM

1.1.0 GENERAL

- A.** This chapter of the specifications includes furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm network equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Network Fire Alarm Control Panels (FACP), Network Reporting Terminals (NRT), Network Liquid Crystal Display (NLCD), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.
- B.** The fire alarm system shall comply with requirements of IS:2189:1999 & 1996 NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification, or the stringent one of the two specification in case of any discrepancy. The system shall be electrically supervised and monitor the integrity of all conductors.
- C.** Fire Alarm System shall be integrated with P.A. system. A digitized pre-recorded voice message shall notify occupants that a fire condition has been reported. The message shall instruct the occupants with emergency instructions. Emergency manual voice override shall be provided.
- D.** The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and shall be in compliance with the UL listing for equivalent European standard EN54.
- E.** Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Alarm Control Room and designated personnel.
- F.** The FACP's shall be active/interrogative-type systems where each transponder is repetitively scanned, causing a signal to be transmitted to the fire alarm control panel node indicating that the transponder and its associated initiating device and notification appliance circuit wiring is functional. Loss of this signal at the FACP shall result in a trouble indication on both the FACP display and at the network display, as specified hereinafter for the particular input.
- G.** The system shall be arranged such that not less than 20 percent additional transponders may be inserted into any network communication loop.
- H.** The installing company shall employ technicians on site to guide the labours and to ensure the systems integrity.

1.2.0 SCOPE:

- A.** The Fire Alarm Panel of the existing building shall be used for the proposed building. In the present scope of the contract there is an Extension of the Existing system. The scope of work to be executed under the present contract shall be full compatible with the existing system. The contractor shall integrate the network of the proposed building into the Fire Alarm Panel available in the existing building. Necessary racks and interconnection ancillaries as required shall be in the scope of the present contract.

A new network intelligent reporting, microprocessor controlled fire detection and shall be compatible with PA system emergency voice alarm communication network shall be installed in accordance with the specifications and drawings.

- B. Basic Performance:**

1. Alarm and trouble signals from the FACP, NRT, and NLCD network nodes shall be digitally encoded by listed electronic devices onto a NFPA Style 9 looped multiplex communication system.
2. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto NFPA Style 6 (Class A) Signalling Line Circuits (SLC).
3. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D). Connected by the SLC.
4. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z). Connected by the SLC.
5. Power for initiating devices and notification appliances must be from the main fire alarm control panel, the transponder to which they are connected or to a Field Charging Power Supply (FCPS).
6. A single ground or open on any system signalling line circuit, initiating device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
7. Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
8. Digitized electronic signals shall employ check digits or multiple polling.
9. Transponder devices are to consist of low current, solid-state integrated circuits, and shall be powered locally from a primary power and standby power source.
10. F.A. System shall be integrated with P.A system & Car Calling system so that it can be used for Emergency evacuation under fire condition.

1.3.0 SUBMITTALS

A. General:

All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the following standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment does in fact equal or exceed the features, functions, performance, and quality of the specified equipment. Two copies of all submittals shall be submitted to the Engineer-in-Charge for review.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show equipment layout and main control panel, module layout, configurations and terminations.

C. Manuals:

Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets.

Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.

Provide a clear and concise description of operation, which gives the information required to properly operate the equipment and system.

Approvals will be based on complete submissions of manuals together with shop drawings.

D. Software Modifications

Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 2 hours.

Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm network on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

E. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer and trained on network applications. Include names and addresses in the certification.

1.4.0 DEFECT LIABILITY PERIOD:

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least Three (3) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this Three (3) year period shall be included in the submittal bid.

1.5.0 POST CONTRACT MAINTENANCE:

- A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of three (3) years after expiration of the guaranty.
- B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment and response travel costs for each year of the maintenance period. Submittals which do not identify all post contract maintenance costs will not be accepted. The rates and costs shall be valid for the period of three (3) years after expiration of the guaranty.
- C. Maintenance and testing shall be as required by the Local Statutory Authority. A preventive maintenance schedule shall be provided by the contractor describing the plan for preventive maintenance of all devices and subassemblies requiring regular maintenance. The schedule shall include:
 - Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow switches and all accessories of the fire alarm system.
 - Each circuit in the fire alarm network shall be tested semiannually.
 - Each smoke detector shall be tested in accordance with the requirements of Indian Standards/ NFPA.

1.6.0 APPLICABLE PUBLICATIONS:

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

- A. The fire alarm system shall comply with requirements of NFPA for protected premises signaling systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.
- B. Underwriters Laboratories Inc. (UL) - USA: / EN - 54
- C. Local and State Building Codes.
- D. All requirements of the Authority Having Jurisdiction (AHJ).

1.7.0 APPROVALS:

- A. The system must have proper listing and/or approval from the following nationally recognized agencies:

UL	Underwriters Laboratories Inc
FM	Factory Manual
ULC	Underwriters Laboratories Canada
CPWD	Central Public Work Department
BIS	Bureau of Indian Standards
EN 54 or Equivalent European Standards	

- B. The fire alarm control panel, network interface and all transponders shall meet the modular labeling requirements of Underwriters Laboratories, Inc. Each subassembly, including all printed circuits, shall include the appropriate UL modular label. Systems which do not include modular labels, which may require return to the manufacturer for system upgrades, and are not acceptable.

2.0 PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL:

- A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- B. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT AND WIRE:

A. M.S. Conduit:

1. Conduit shall be in accordance with the National Electrical Code (NEC), local and state requirements.
2. Where possible, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.
4. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter any FACP or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer.
6. The following specifications of Maharashtra Schedule of Rates shall be followed:-
 - a) WGMA/BW

2.2.1 Scope

Concealing of Rigid steel Conduits:

In walls / flooring:

Concealing of Rigid steel conduits and erecting in wall, flooring by making chases / grooves/ entries as per approved Method of Construction along with continuous earth wire and all required material including earth clips hardware such as 'U' nails, binding wire, fish wire; accessories such as MS junction / inspection boxes, check-nuts, flexible PVC pipe, drawing fish wires and making all piping rigid, refinishing the surface with cement mortar, removing debris from site.

Material:

Rigid Steel Conduits:

Rigid steel HG conduit minimum 20mm dia and 16 gauge, ERW grade duly processed for antirust treatment and painted with black enamel paint, accessories for rigid steel conduits such as check nuts, long bends, deep junction boxers for flooring, regular junction boxes for walls; of required ways all of the same make.

Earth continuity wire:

GI wire of 2.5 sq. mm GI earth clips 22 gauge, 100 mm width, for fixing earth wire along the conduits.

Junction boxes / Draw – in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; fabricated from 16 SWG CRCA sheet steel earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knock out holes in required numbers and dia for entry of conduit of conduit pipes and arrangement to fix cover plates on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20 gauge, GI fish wire, etc.

Method of Construction:

Concealing of Rigid Steel conduits:

General:

Work shall be done in co-ordination with civil work to suit final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No. 1/1, for Steel conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc; for which the distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. ¼ (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25 metre; in such manner so as to facilitate drawing of wires. All bending of conduits shall be done approved manner without changing the cross-section.

Concealing of Rigid Steel Conduits in walls/ flooring:

Chases shall be made in walls of adequate width with cutter and chiseling through it. Necessary finishing of the wall surface shall be done. Work in flooring shall not disturb RCC work, Conduits of adequate size shall be erected with use of appropriate accessories, and hardware like 'U' nails, etc. draw-in / inspection boxes shall be fixed with check-nut, flush with surrounding surface and earthed.

Testing:

Earth continuity:

Earth continuity shall be ensured at termination point of Earth wire, between the ends of metal conduit.

Mode of Measurement:

Measurement shall be carried out on the basis per running meter length of conduit.

b) WGMA/CC-

Scope:

Bunch of wires:

Providing specified wires and drawing them through provided conduits/ trunking and / or as directed with coated ferrules, harnessing the bunch of wires with necessary material when used in panel boards, duly connecting / terminating with lugs, and testing for safety and beneficial use.

Material:

Wires: in conduits/ trunking/ panel boards

Mains/ Sub- Main/ Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FR Grade insulation copper conductor of electrolytic tough pitch (ETP) grade having insulation of 1.1 kV grade, ISI marked of required colour coding as per Table No. 1/5.

Wires: Open

PVC insulated and PVC sheathed wire of specified size, minimum FR Grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked of required colour coding as per Table No. 1/5.

Earth Continuity wire:

PVC insulated wire minimum FR Grade insulation, copper conductor of electrolytic grade, having insulation of 1.1 kV grade of green/ green yellow colour, ISI marked of required colour coding as per Table No. 1/5.

Lugs:

Copper lugs of appropriate size & type.

Other material:

Rubber grommet, bush, harnessing material, flexible conduit etc.

Method of Construction:**Bunch of wires:****Drawing of wires: General**

Specified wires shall be drawn with adequate care. Correct colour coding as per Table No. 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) of two different phases, shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only, with appropriate type of size and lugs.

Drawing of wires: through PVC conduits.

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs/ sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/2.

Drawing of wires: through Rigid Steel conduits

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs/ sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/1.

Open wire bunch:

Open wires shall be erected with due care so as to avoid chances of any mechanical manner in panel boards or where ever necessary. For covering lead wires flexible conduit shall be used with gland as per necessity.

Testing:**Insulation resistance test:**

All wiring shall be tested with 500V Megger between phases, phase – neutral and to Earth. IR value shall not be less than 1 M-ohm.

Earth continuity:

Earth continuity shall be ensured between termination points of Earth wire.

Polarity Test:

Test shall be carried out for ensuring the correct polarity in switch and plug.

Mode of Measurement:

Measurement shall be carried out on the basis per running meter length of single wire or bunch as specified.

Table 1/1**Maximum Number of single core 1.1 KV cables that can be drawn in Rigid steel Conduits**

Size of cable mm ²		Size of Conduit mm													
Nominal Cross Sectional area	No. and dia of wires	16		20		25		32		40		50		63	
		S	B	S	B	S	B	S	B	S	B	S	B	S	B
1.0	1/1.12 Cu	5	4	7	5	13	10	20	14						
1.5	1/1.4	4	3	7	5	12	10	20	14						
2.5	1/1.8 3 / 1.06 Cu	3	2	0	5	10	8	18	12						
4.0	1 / 2.24 7/ 0.85 Cu	3	2	4	3	7	8	12	10						
6	1 / 2.80 7 / 1.06 Cu	2		3	2	6	5	10	8						
10	11/3.55 Al 7 / 1.40 Cu			2 2		5 4	4 3	8 6	7 5						
16	7 / 1.70					2		4	3	7	6				
25	7 / 2.24							3	2	5	4	8	6	9	7
35	7 / 2.50							2		4	3	7	5	8	6
50	7 / 3.0 Al 19 / 1.80									2		5	4	6	5

Note 1: Cu – applicable to only copper cable; Al – applicable to only Aluminium Cable.

Note 2: The table shows maximum capacity of conduits for the simultaneous drawing of cables. The columns headed 'S' apply to straight runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from straight by an angle more than 15°. The columns headed 'B' apply to bent runs of conduit, which deflect from the straight by an angle of more than 15°.

Note 3 : In case of inspection type draw in box has been provided and if the cable is first drawn through one straight conduit, then through the draw in box and then through the second straight conduit such system may be considered as that of straight conduit even if the conduit deflects through the straight by more than 15°.

Table 1/2**Maximum Number of single core 1.1 KV cables that can be drawn in Rigid Non-Metallic Conduits**

Size of cable sq. mm ²		Size of conduit mm					
Nominal cross sectional area	No. and dia of wires	16	20	25	32	40	50
1.0	1/1.12Cu	5	7	13	20		
1.5	1/1.4	4	6	10	14		
2.5	1/1.8 3/1.06 Cu	3	5	10	14		
4.0	1 / 2. 24, 7/0.85 Cu	2	3	6	10	14	
6	1 / 2.80 7/1.06 Cu		2	5	9	11	
10	11 / 3.55 Al 7/1.40 Cu			4	7	9	
16	7/1.70			2	4	5	12
25	7/2.24				2	2	6

35	7/2.50					2	5
50	7/3.0 Al					2	5
	19/1.80					2	3

Note 1: Cu- applicable to only copper cable; Al- applicable to only Aluminium cable.

Table No. 1/4

Colour Coding for Conduits in Wall entry

Conduit For	Colour
Light/ Power Circuit	Black
Security wiring	Blue
Fire Alarm wiring	Red
Low voltage circuits	Brown
UPS circuits	Green

Table 1/5

Colour code of Wires

Type	Colour
Phase	Red, yellow, Blue
Neutral	Black
Earthing	Green

B. Wire:

All fire alarm system wiring must be new, unless specified herein.

Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 1.5 sq.mm. for initiating device circuits and signaling line circuits for notification appliance circuits.

All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).

Wiring used for the signaling line circuit (SLC) shall be twisted and shielded and installed in conduit unless specifically excepted by the fire alarm equipment manufacturer.

All field wiring shall be completely supervised.

2.3 FIRE ALARM CONTROL PANELS AND FIRE CONTROL ROOM:

2.3.1 The Fire Alarm Control Panel shall be as per Section 7.33 of IS: 2189.

2.3.2 Each network FACP shall contain a microprocessor-based central processing unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable detectors, addressable modules, Panel modules including initiating circuit, control circuits, transponders, local and remote operator terminals, printers, annunciators, emergency voice communication systems, and other system controlled devices.

Each FACP on the network shall perform the following functions:

1. It shall Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
2. It shall supervise all initiating signaling and notification circuits throughout the facility by way of connection to monitor and control modules.
3. It shall detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.
4. It shall visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.
5. When a any of the following condition is detected and reported by one of the system initiating devices or appliances:
 - i. Fire Alarm Conduits
 - ii. Trouble Confirmation
 - iii. Supervisory Card
 - iv. Security Alarm
 - v. Pre Alarm

Then the following functions shall immediately occur:

- a. The FACP alarm LED on the FACP shall flash.
- b. A local piezo-electric indication for the event signal for the event in the FACP shall sound a distinctive Signal.
- c. The 640-character LCD display on the local FACP node and on the network displays shall indicate all information associated with the fire alarm condition, including the type of alarm point, and its location within the protected premises. This information shall also be displayed on the network reporting terminal.
- d. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.
- e. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on either local outputs or points located on other network nodes.

2.3.3 General FACP Configuration & Operation

- a. Each FACP node shall include a full featured operator interface control and annunciation panel which shall include a backlit 640 character Liquid Crystal Display (LCD), individual, color coded system status LEDs, and an alpha-numeric keypad for field programming and control of the node.

- b. All programming or editing of the existing programming in the system shall be achieved without special equipment or interrupting the alarm monitoring functions of the fire alarm control panel.
- c. FACP nodes shall be designed so that it permits continued local operation of remote transponders under both normal and abnormal network communication loop conditions. This shall be obtained by having transponders operate as local control panels upon loss of network communication.
- d. FACP nodes shall be modular in construction to allow ease of servicing. Each CPU and transponder shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems which require use of external programmers or change of EPROMs are not acceptable.
- e. The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients including RFI and EMI.
- f. Each transponder and peripheral device connected to the FACP node CPU shall be continuously scanned for proper operation. Data transmissions between network nodes, FACP CPUs, transponders, and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques. Failure of any transponder or peripheral device to respond to an interrogation shall be annunciated as a trouble condition.

The FACP shall be able to provide the following software and hardware features:

- 1. Pre- Signal and Positive Alarm Sequence: The system shall provide means to cause pre-alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-Second time period for acknowledge an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local remote outputs shall automatically immediately.
- 2. Smoke Detector Pre-Alarm indication at control panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-Alarm indication shall be available at the control.
 - i) Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.
 - ii) Action: if programmed for action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition, Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on alarm level.
- 3. The system shall be integrated with P.A. System Car Calling system for Emergency evacuation under fire.
- 4. Each FACP node shall be capable of providing the following features:
 - a) Block Acknowledge for Trouble Conditions.
 - b) Rate Charger Control
 - c) Control-By-Time (Delay, Pulse, time of day, etc.)
 - d) Automatic Day/Night Sensitivity Adjust (high/low)
 - e) Device Blink Control (turn of detector LED strobe)

- f) Environmental Drift Compensation (selectable ON or OFF)
- g) Smoke Detector Pre-alarm Indication at Control Panel
- h) NFPA 72 Smoke Detector Sensitivity Test
- i) System Status Reports
- j) Alarm Verification, by device, with tally
- k) Multiple Printer Interface
- l) Multiple CRT Display Interface
- m) Non-Fire Alarm Module Reporting
- n) Automatic NFPA 72 Detector Test
- o) Programmable Trouble Reminder
- p) Upload/Download System Database to BMS
- q) One-Man Walk Test
- r) Smoke Detector Maintenance Alert
- s) Security Monitor Points
- t) Alpha-numeric Pager Interface
- u) On-line or Off-line programming

The configuration, features & peripherals of FACP shall be given below:-

GSIDC/FPS/08-09/ Doc1	Standard Data Sheet
Client- GSIDC, Margao	System- Fire Protection system
Item	Floor Fire Alarm Panel
Purpose	Automatic fire detection and alarm
Interconnection	Peer to peer networked floor Panels
Type	Solid state micro-processor based analogue addressable
Loop capacity	6 Loop card slots
	Loop cards as per floor requirement
Compatibility	Photo electric smoke sensors Loop isolators Loop sounders Loop manual call points Loop input monitoring cards RS 485 cards for networking & RS 232 cards for printer & CRT Convention devises
No of devices	Each loop shall be able to cater to minimum 127 devised upto 199 devices Zone 50
Operation Voltage	15 V to 28 V DC, 3 amps
Input Voltage	230 V AC, 1 Ph 50HZ, 0.75 amps.
Stand by battery charging	28 V DC, 1.5 A

Wiring	2 core 1.5 mm ² , copper, PVC insulated, twisted, screened wires in concealed conduits wherever available & in other places by surface cable for notification loop, sounder loop, RS 232 & RS485 communication
Loop wire monitoring	Open circuit Short circuit Earth Leakage Device removed Wrong Device
Communication	To remote repeater panel through proprietary protocol over RS 485 link
Outputs	2 X programmable sounders on panel 1 X Fire Contact 1 X Fault Contact
Printer	24 character built in printer
Communication port	RS 485 RS 232
Selectable Features	Common sounders coincidence alarm RMC Fire
	RMC Fault Zone walk test Control Output
	Output delay Alarm counter Alarm Counter
	Alarm verification Sounder silence
Dialing Time	4second per loop for 127 devices, 3 second per loop for MCPs
Software	Firmware Field configuration programmable
Memory	EPROM nonvolatile for 600 event memory storage
Configuration	Power supply module
	CPU
	memory extension module
	memory buffer module
	printer interface module
	LCD interface module
	relay driver module
	1 no. 80 column external printer
	1 no. menu driven membrane switch keyboard
	1 set control switches
	1 set operator push buttons
	Loop cards
	Remote terminal unit connection port
	LCD display & driver module
Connectivity	To proprietary protocol compatible to analogue addressable detectors of type
LCD display	4 X 160 character alpha numeric LCD auto back-lit with occurrence of event or manual override
Display Format	Alarm/pre-alarm/fault/isolation

	Alarm & event acknowledge
	Commands/report/programming
	Time/day/date
Power supply	SMPS
Backup power supply	As per clause 7.5 of IS 2189
Power pack	SMF lead acid / Nicd 24 V DC 30 AH
Test features	Panel self test
	LCD test
	Fault test
	Detector test
	Battery fault
	Internal hooter test
	External hooter test
Control facility	Scroll/next
	Alarm silence
	Fault silence
	Lamp evacuate
	System reset
	LCD back Lighting
	Trouble Silence
Indications	System normal
	Priority 1 Alarm
	Priority 2 Alarm
	Fault
	Alarm Silence
	Power ON
	Battery ON
Event report	Type
	Address
	Location
	Time/day/date
	Date
	Time
Zone recording	In order of occurrence regardless of alarm priority
	Print Interrupt of occurrence of fresh event & on its record resume print
Testing facility	Possible with digital and analogue input and output digital simulation from panel through software
	Under maintenance mode testing possible with balance system in normal operation
Fire pattern	No alarm issue for short duration
	Quick response for fast smoke build up
	Early detection and suitable modification for of alarm level for dirt accumulation
	Programmed output actuation
	Access protection through 4 levels of pass words
	Hardware security lock
	Detector sensitivity adjustment and display of set value
	Disable/isolate detectors/ interface units

	Single button operation front panels keys
Software facility	Individual detector
	Sensitivity setting
	Trending
	Adjustable dual alarm thresholds
	Pre alert warning
	Cross zoning
	Alarm verifications
	Input/ output assignment
	Event history indexing
Local Sounder	Yes
Panel Sounder output	1 no. rated for 1 Amp.
Surge withstand	As per IEEE 472 for mains, input/ output/loops, 7 kv discharge on panel electronics except LCD display
Ambient	From (-) 5 deg. C to (+) 45 deg C Max.
Humidity	15% to 95% non-condensing
Mounting	Wall/ floor
Enclosure	1.6mm sheet steel, dust and vermin proof to IP 55
Enclosure treatment & painting	Degreased, de-rusted, pickled, rinsed, phosphattized, putty finished. Double primer and final epoxy painted FIRE RED shade
Front doors	Hinged and lockable with transparent visor for viewing LEDs etc.
Cable Entry	From both top & bottom, through 2 mm thick removable gland plate
Approval	EN/LPCB/UK/ UL listed

2.4 Network Repeater Panel (NRP)

A network control annunciator shall be provided to display all system intelligent points. The NRP shall be capable of displaying all information for all possible points on the network.

Network display devices which are only capable of displaying a subset of network points shall not be suitable substitutes.

The NRP shall include a minimum of 640 characters, backlit by a long life, solid state LCD display. It shall also include a keypad. Additionally, the network display shall include ten soft-keys for screen navigation and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc.

The network control annunciator shall have the ability to display up to eight events in order of priority and time of occurrence. Counters shall be provided to indicate the total number of events by type.

The NRP shall mount in any of the network node fire alarm control panels. Optionally, the network display may mount in a back box designed for this use.

The NRP shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals Silenced, Disabled Points, Other (non-fire) Events, and CPU Failure.

The network control annunciator shall include a Master password and up to nine User passwords. Each password shall be up to eight alpha-numeric characters in length. The Master password shall be authorized to access the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password.

The NRP shall allow editing of labels for all points within the network; control on/off of outputs; enable/disable of all network points; alter detector sensitivity; clear detector verification counters for any analog addressable detector within the network; clear any history log within the network; change the Time/Date settings; initiate a Walk Test.

For time keeping purposes the NRP shall include a time of day clock.

The configuration features & peripherals of the Repeater panel shall be given below:-

	STANDARD DATA SHEET
Client -	System - Fire protection System
Item	Network Repeater Panel
Purpose	Repeat indication
Compatibility	With networked analogue addressable floor fire alarm panel through proprietary communication protocol
Type	Solid state micro-processor based
Communication	By 2 core RS 485 twisted pair screened with networked floor fire alarm analogue addressable panels
Distance maximum	Up to 2 Km from nearest networked floor addressable fire alarm panel. Connection to system by tee off / spur / daisy chained
Power Supply	From power supply unit or from nearest floor addressable fire alarm panel.
Operating Voltage	15 V to 28 V DC
Monitoring	Panel power disconnection
	Floor / Loop / Zone indication LEDs (50 nos)
	Select keys for point addresses in display zone
	Fire
	Fault
	Disabled
	Accept / Reset / Silence / Sound alarm
	Control key for current Fire / Fault / Disabled status
Power consumption	100 mA mains fail state
	250 mA nominal

	350 mA max. draw
LCD display	Back lit, Alphanumeric, 4 line 160 character display
Data interface	RS 485 serial bus driver board
Mounting	Suitable for both surface & recess mounting
Enclosure	1.8 mm sheet steel, dust and vermin proof
	Hinged lockable double door
Ambient	From(-) 5° C to (+) 45° C Max
Humidity	15 % to 95 % non-condensing
Paint	Degreased, de - rusted, pickled, rinsed, phosphatized epoxy painted in FIRE RED paint
Local sounder	Yes
Approval	UL/FM/LPCB/UK / UL listed
Make	Notifier / Ziton / Morlay / Copper / System Sensor / Honeywell

2.5 Network Control Station

The NCS shall utilize a Microsoft(tm) operating system. Each Network Control Station shall be capable of graphically annunciating and controlling all network activity. Network display devices that are only capable of displaying a subset of network points shall not be suitable substitutes.

The PC for NCS (Network Control Station) shall be provided by the client/other Vendor.

The NCS shall be an IBM (or compatible) personal computer with the following minimum requirements: Intel Pentium II(tm)-processor, operating at a minimum of 400MHz, 128Mbytes of RAM, 8 Mbytes Video RAM, 1.44 Mbyte floppy drive, 3.2 Gbyte hard disk, mouse, 32X CD-ROM, 3PCI / 1 ISA expansion slots, internal 3.2 Gbyte tape drive, sound card, 200 watt power supply, and SVGA graphics with a screen resolution of 1024 x 768. The network control station shall include a 19-inch monitor.

The NCS shall be capable of storing over 100,000 network events in a history file. Events shall be stored on hard disk and shall be capable of back-up storage to a tape drive. The history buffer allows the operator to view events in a chronological order. A filter shall be available for displaying chronological events by operator, date, time, fire alarms, troubles (including security, supervisory and system/device), disabled points/zones, system programming, operator response and operator log in/log out. The ability to print NCS history files shall also be available.

The NCS shall use a Windows(tm) dialog box technology to address, interrogate, control, and/or modify intelligent points on each fire alarm node. This shall include, and not be limited to: Activating outputs, enabling or disabling points, adding or removing intelligent points, viewing intelligent detector sensitivity levels and modifying point information (custom messages, detector type, verification, day/night selection etc.)

The NCS shall include the ability to display system information in a graphical (floor plan) form. Each view, created using standard Windows bitmap files, shall include icons created for intelligent devices. These icons shall blink and change to the appropriate programmed icon when an event occurs. When the device has been acknowledged, the icon shall become steady. Once the point has returned to normal, the normal icon is displayed. In addition to the graphical representation of the device, the user shall be able to link pictures, documents and sound files to the device. The NCS shall also provide the ability to auto-vector to the floor plan (screen) of the device that is active. By selecting a device in the graphic presentation, the operator of the NCS shall have the ability to log onto the corresponding node and interrogate the associated intelligent point.

The NCS shall have the ability to provide the following information through a Windows(tm) pull down menu:

- a) An Event Counter that contains the number of new and total events on the network. The information that is displayed shall consist of Fire Alarms, Pre-Alarms, Security Alarms, Supervisory Alarms, and Troubles.
- b) A Detailed Event window that contains all Off-Normal events, both unacknowledged and acknowledged that are present in the system. It shall contain two views, Fire events and Non-fire events that shall be user selectable.
- c) A Current Event window that shall contain all network and local events as well as system messages with a maximum of 1,000 events displayed.
- d) A Disabled Device window that shall contain all disabled devices in the system.

The NCS shall have the option, from a Windows pull down menu, to connect to a third party paging service that allows the NCS to automatically send text-based messages regarding system status to a typical text pager.

The NCS shall have a flexible way of assigning operator passwords. There shall be an unlimited number of possible operators, each with specific levels of control. Each operator shall have his /her own password. Operator password and control selection shall be available to a high level "administrator" who shall have complete control over levels of control. If no action has taken place on the NCS after 10 minutes, the current operator shall be logged out and require a new log-in.

The NCS shall include help screens, available to aid the user without leaving the selected application screen and shall have a table top hardware configuration.

The NCS shall include an industry-standard EIA-232 port for a UL864 listed printer.

The NCS shall meet FCC regulations (Part-15, subpart-J) regardless of its connection means to the network and shall be UL-Listed for fire protection (UL864) and burglary (UL1076).

2.6 Water flow Indicators:

Water flow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.

Water flow Switches shall have an alarm transmission delay time, which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds.

All water flow switches shall come from a single manufacturer and series.

Water flow switches shall be provided and connected under this section but installed by the mechanical contractor.

Where possible, locate water flow switches a minimum of one (1) foot from a fitting, which changes the direction of the flow and a minimum of three (3) feet from a valve.

2.7 Non-Alarm Input Operation

Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

Combo Zone: - A special type code shall be available to allow water flow and supervisory devices to share a common addressable module. Water flow devices shall be wired in parallel, supervisory devices in series.

2.8 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

2.8.1 Addressable Devices - General

Addressable devices shall use simple to install and maintain decade, decimal Address Switches. Devices shall be capable of being set to an address in a range from 001 to the maximum address provided by SLC loop.

Addressable devices, which use a binary address setting method, such as a Dip switch, are not an allowable substitute.

Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the FACP Signaling line circuit.

Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

The fire alarm control panel shall permit detector sensitivity adjustment through field programming. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.

Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7 or EN 54.

The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base shall include a sounder base with a built-in (local) sounder rated at 85 DB minimum, a relay base and an isolator base designed for Class A applications.

The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (Photoelectric, Thermal& Photo-thermal).

Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

2.8.2 Programmable Electronic Exit Point Directional Sounders

Electronic sounders shall operate on 24 VDC nominal. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device. It shall be capable to broadcast preprogrammed Voice Message also and shall be flush or surface mounted as shown on plans. It shall produce broad-band directional sound to guide occupants to safe exists even in complete darkness.

Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria: The maximum pulse duration shall be 2/10 of one second.

Strobe intensity shall meet the requirements of UL 1971.

The flash rate shall meet the requirements of UL 1971.

2.8.3 Addressable Pull Box (manual station)

Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger.

2.8.4 Intelligent Multi-Co-Operative Sensing Photoelectric Smoke Detector (Not in scope of works)

- a. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall be in position to work in advance multi Co-Operative Sensing, on command from the control panel, send data to the panel representing the analog level of smoke density.
- b. Photo- electric Fire Alarm detector having photo electric smoke sensor and thermal sensor incorporated and shall send individual smoke sensitivity and temperature operation to panel having following technical specifications: -
 - Operating Temperature - 0 to 50°C
 - Humidity - 10 to 95%
 - Smoke sensor sensitivity - 0.2% to 3.7% per foot of smoke Obstruction
 - Smoke sensor Air velocity - 0-610 m/min

2.8.5 Intelligent Thermal Detectors (Not in scope of works)

Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a fixed rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

2.8.6 Intelligent Multi Criteria (Photo- Thermal) Acclimating Detector

The intelligent multi criteria Acclimate detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine it's environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

The detector shall have Isolator modules to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the campus.

If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

2.8.7 Two-Wire Detector Monitor Module

Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).

The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch x 1-1/4 inch x 1/2 inch. This version need not include Style D or an LED.

2.8.8 Addressable Control Module

Addressable control modules shall be provided to supervise and control the operation of Lifts, sprinkler, switch gears etc., one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay.

The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply.

The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30V DC.

2.8.9 Addressable Relay Module

Addressable Relay Modules shall be available for HVAC (AHUs & Ventilation Fans) control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

2.9 EXECUTION

2.9.1 INSTALLATION:

- a. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- b. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- c. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- d. Manual Pull Stations shall be suitable for surface mounting or semi flush mounting as shown on the plans, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.

2.9.2 TYPICAL OPERATION:

- Actuation of any manual station, smoke detector, heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:
- Activate all programmed speaker circuits.
- Actuate hooter units until the panel is reset.
- Light the associated indicators corresponding to active speaker circuits.
- Release all magnetic door holders to doors to adjacent zones on the floor from which the alarm was initiated.
- Where required, return all elevators to the primary or alternate floor of egress.
- A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.
- Smoke detectors in the elevator machine room or top of hoistway shall return all elevators in to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall do so in accordance with ANSI A17.1 requirements and be coordinated with the electrical contractor.
- Duct type smoke detectors shall, in addition to the above functions, shut down the ventilation system or close associated control dampers as appropriate.
- Activation of any sprinkler system low-pressure switch, on valve tamper switch, shall cause a system supervisory alarm indication.

2.9.3 HVAC/Smoke Control System Operation:

- On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan.
- The OFF LED shall be Yellow, the ON LED shall be green, and the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDS and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF

position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.

- Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.
- All HVAC switches (i.e., limit switches, vane switches, etc.) which shall be provided and installed by the HVAC contractor, but the detail of the switches required shall be provided by the vendor for fire alarm system as per the equipment layout in the building.
- It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic annunciators if the project requires such.

2.9.4 TEST

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system.

- a. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- b. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- c. Verify activation of all flow switches.
- d. Open initiating device circuits and verify that the trouble signal actuates.
- e. Open signaling line circuits and verify that the trouble signal actuates.
- f. Open and short notification appliance circuits and verify that trouble signal actuates.
- g. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
- h. Ground initiating device circuits and verify response of trouble signals.
- i. Ground signaling line circuits and verify response of trouble signals.
- j. Ground notification appliance circuits and verifies response of trouble signals.
- k. Check alert tone and prerecorded voice message to all alarm notification devices.
- l. Check installation, supervision, and operation of all intelligent smoke detectors using walk test.
- m. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- n. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

2.10 FINAL INSPECTION:

At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

2.11 INSTRUCTION:

Instruction shall be required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

CHAPTER J**TECHNICAL SPECIFICATIONS FOR HVAC SYSTEM****1.0 SITE DATA**

1.1	Owner/Client	:	IPC
1.2	Project	:	Pharmaceutical Lab
1.3	Nearest Railway Station	:	Ghaziabad
1.4	Nearest Airport	:	New Delhi
1.5	Location of Site	:	Ghaziabad
1.6	Latitude	:	28°35' (N)
1.7	Altitude	:	708 (mtrs) above mean sea level
1.8	Outside Conditions		
	Summer	Dry bulb temperature	: 110°F (43.3°C)
		Wet bulb temperature	: 75 °F (23.9°C)
		Relative Humidity	: 20%
	Monsoon	Dry bulb temperature	: 95°F (35.0°C)
		Wet bulb temperature	: 83°F (28.3°C)
		Relative Humidity	: 60%
	Winter	Dry bulb temperature	: 45°F (7.2°C)
		Wet bulb temperature	: 41°F (5.0°C)
		Relative Humidity	: 70%

HVAC SUMMARY SHEET FOR COMFORT AREAS

S.N.	ROOM NO	ROOM NAME	ROOM DIMENSION			AREA	ROOM TEMP.	MIN FRESH AIR	MIN SUPPLY AIR	SELECTED ROOM SUPPLY AIR	COOLING LOAD
			L(m)	W(m)	H(m)	(mts2)	(°C)	(ACPH)	(ACPH)	(CFM)	(TR)
		GROUND FLOOR									
A1	DUCTABLE	CONFERENCE CUM SEMINAR HALL	19.49	21.85	3.00	435.6	NMT 25	1	1	7765	30.86
		AV ROOM	2.85	3.42							
A2	SPLIT	PANTRY INSIDE CONFERENCE ROOM	2.10	3.13	3.00	6.6	NMT 25	1	1	230	0.60
A3	DUCTABLE	RECEPTION AND WAITING GND FLOOR	10.60	15.16	3.00	160.6	NMT 25	1	1	1415	4.27
A4	CASSETTE	EXECUTIVE WAITING	5.78	5.06	3.00	29.2	NMT 25	1	1	285	1.22
A5	CASSETTE	BOOK RACK DISCUSSION CUM READING ROOM	6.10	9.52	3.00	58.1	NMT 25	1	1	650	2.22
A6	DUCTABLE	ANALYTICAL R&D ROOM	19.11	19.71	3.00	376.7	NMT 25	1	1	7265	17.62
A7	CASSETTE	FACILITY ROOM	3.14	9.52	3.00	29.9	NMT 25	1	1	530	1.38
A8	DUCTABLE	UPS / BATTERIES CUM TECHNICAL ROOM	5.92	7.33	3.00	43.4	NMT 25	1	1	1845	4.05
A9	PRECISION AC	IT DATA CENTRE	5.22	7.34	3.00	38.3	NMT 25		1	2245	4.71
A10	CASSETTE	STAGING AND TESTING	3.14	9.55	3.00	30.0	NMT 25	1	1	570	1.55
A11	CASSETTE	CONFERENCE 1	3.35	4.28	3.00	14.3	NMT 25	1	1	270	0.75
A12	SPLIT	CUBICAL - 1	2.55	4.28	3.00	10.9	NMT 25	1	1	210	0.53
A13	SPLIT	CUBICAL - 2	2.55	4.28	3.00	10.9	NMT 25	1	1	210	0.53
A14	SPLIT	CUBICAL - 3	2.55	4.28	3.00	10.9	NMT 25	1	1	210	0.53
A15	SPLIT	CUBICAL - 4	2.55	4.28	3.00	10.9	NMT 25	1	1	210	0.53

A16	SPLIT	CUBICAL - 5	2.55	4.28	3.00	10.9	NMT 25	1	1	210	0.53
A17	SPLIT	CUBICAL - 6	2.55	4.28	3.00	10.9	NMT 25	1	1	210	0.53
A18	CASSETTE	COMPACTOR ROOM	3.94	9.55	3.00	37.6	NMT 25	1	1	940	2.15
A19	SPLIT	PANTRY 2 NEAR TOILET LOBBY	2.55	3.18	3.00	8.1	NMT 25	1	1	155	0.44
A20	DUCTABLE	CORRIDOR	12.04	2.50	3.00	56.0	NMT 25		1	240	0.65
			10.35	2.50							
						1390.0				25665	76
		FIRST FLOOR							1		
A21	DUCTABLE	MONOGRAPH DEVELOPMENT	16.41	9.60	3.00	157.5	NMT 25	1	1	2370	6.74
A22	DUCTABLE	ANALYTICAL LAB	16.41	12.11	3.00	198.7	NMT 25	1	1	3610	9.39
A23	CASSETTE	CONFERENCE 1	4.28	4.13	3.00	17.7	NMT 25	1	1	435	1.16
A24	SPLIT	OFFICE 1	4.26	2.70	3.00	11.5	NMT 25	1	1	215	0.55
A25	SPLIT	OFFICE 2	4.26	2.70	3.00	11.5	NMT 25	1	1	215	0.55
A26	SPLIT	OFFICE 3	4.26	2.70	3.00	11.5	NMT 25	1	1	215	0.55
A27	SPLIT	OFFICE 4	4.26	2.70	3.00	11.5	NMT 25	1	1	215	0.55
A28	SPLIT	OFFICE 5	4.26	2.70	3.00	11.5	NMT 25	1	1	215	0.55
A29	CASSETTE	CONFERENCE 2	4.28	2.70	3.00	11.6	NMT 25	1	1	425	1.13
A30	SPLIT	BALANCE ROOM 1	3.00	2.10	3.00	6.3	NMT 25	1	1	135	0.40
A31	SPLIT	CHANGING ROOM - GENTS 1	3.00	3.00	3.00	9.0	NMT 25	1	1	30	0.16
A32	SPLIT	CHANGING ROOM - LADIES 1	3.00	3.00	3.00	9.0	NMT 25	1	1	30	0.16
A33	SPLIT	BALANCE ROOM 2	3.00	1.75	3.00	5.3	NMT 25	1	1	105	0.36
A34	DUCTABLE	RECEPTION AND WAITING FIRST FLOOR	10.60	15.16	3.00	160.6	NMT 25	1	1	1135	4.36
A35	SPLIT	MEETING ROOM	3.32	3.96	3.00	13.1	NMT 25	1	1	170	0.65
A36	SPLIT	CHANGING ROOM - GENTS 2	3.32	3.24	3.00	10.8	NMT 25	1	1	40	0.19

A37	SPLIT	CHANGING ROOM - LADIES 2	3.32	3.24	3.00	10.8	NMT 25	1	1	40	0.19
A38	CASSETTE	QA / QC LAB	5.44	9.60	3.00	52.2	NMT 25	1	1	695	1.73
A39	DUCTABLE	2.5 MTR CORRIDOR	41.96	2.50	3.00	104.9	NMT 25	1	1	345	1.86
A40	CASSETTE	LAB INCHARGE	4.91	3.33	3.00	16.4	NMT 25	1	1	505	1.70
A41	CASSETTE	LAB OFFICE	4.91	6.20	3.00	30.4	NMT 25	1	1	520	2.00
A42	DUCTABLE	DISSOLUTION LAB	7.99	8.52	3.00	68.1	NMT 25	1	1	1625	5.64
A43	DUCTABLE	WEIGHING ROOM + PREPERATION ROOM	5.37	4.81	3.00	51.1	NMT 25	1	1	995	2.97
			5.37	4.71				1	1		
A44	DUCTABLE	WET CHEMISTRY ROOM + FUME HOODS + SERVICE ZONE	10.00	9.60	3.00	112.5	NMT 25	1	1	4130	11.39
			2.66	2.94					1		
			2.66	3.27					1		
A45	DUCTABLE	UPS BATTERIES	5.30	6.90	3.00	36.6	NMT 25	1	1	1860	4.04
A46	DUCTABLE	REF STD DEPT	6.73	9.60	3.00	64.6	NMT 25	1	1	1760	4.48
A47	CASSETTE	NEW DRUG ANALYSIS	4.67	9.60	3.00	44.8	NMT 25	1	1	960	2.69
A48	DUCTABLE	GENERAL TESTING AND CENTRAL INSTRUMENT + IPCMS ROOM	16.08	9.60	3.00	154.4	NMT 25	1	1	2625	8.42
A49	SPLIT	UPS / BATTERIES CUM TECHNICAL ROOM (UTILITIES ROOM)	1.77	3.39	3.00	6.0	NMT 25	1	1	20	0.11
						1410.0			1	25640	75
		SECOND FLOOR							1		
A50	DUCTABLE	GENERAL CORRIDOR + OFFICE AREA + MATERIAL STORAGE + DOCUMENT STORAGE	-	-	3.00	168.3	NMT 25	1	1	4105	9.84

A51	DUCTABLE	RECEPTION AND WAITING SECOND FLOOR	-	-	3.00	160.6	NMT 25	1	1	1335	4.45
A52	SPLIT	MEETING ROOM	3.32	3.96	3.00	13.1	NMT 25	1	1	225	0.72
A53	SPLIT	CHANGING ROOM GENTS	3.32	3.24	3.00	10.8	NMT 25	1	1	50	0.20
A54	SPLIT	CHANGING ROOM LADIES	3.32	3.24	3.00	10.8	NMT 25	1	1	95	0.25
A55	DUCTABLE	HERBEL LAB - 1	7.80	9.60	3.00	74.9	NMT 25	1	1	1270	4.39
A56	DUCTABLE	BIOTECHNOLOGY ROOM	8.70	8.96	3.00	78.0	NMT 25	1	1	1715	4.46
A57	SPLIT	SERVICE ZONE	2.70	2.04	3.00	5.5	NMT 25	1	1	30	0.10
A58	SPLIT	BALANCE ROOM	2.71	4.76	3.00	12.9	NMT 25	1	1	130	0.67
A59	SPLIT	BIOTRAILS	5.55	3.75	3.00	20.8	NMT 25	1	1	190	0.51
A60	DUCTABLE	BIOANALYSIS ROOM + ROOM 1 + ROOM 2	-	-	3.00	46.1	NMT 25	1	1	885	2.57
			2.48	2.85				1	1		
			2.48	2.85				1	1		
A61	DUCTABLE	DOCUMENTATION	8.00	9.60	3.00	76.8	NMT 25	1	1	780	2.85
A62	DUCTABLE	COMPACTOR ROOM	4.80	9.60	3.00	46.1	NMT 25	1	1	890	2.30
A63	DUCTABLE	2.5 MT CORRIDOR	41.96	2.50	3.00	104.9	NMT 25	1	1	485	1.98
A64	DUCTABLE	TECHNICAL CUM UTILITY AREA	5.30	9.60	3.00	50.9	NMT 25	1	1	415	1.14
A65	DUCTABLE	SYNTHESIS LAB	10.14	9.60	3.00	97.3	NMT 25	1	1	1275	4.33
A66	DUCTABLE	STABILITY STUDIES LAB	8.34	9.60	3.00	80.1	NMT 25	1	1	1105	3.36
A67	DUCTABLE	HERBEL LAB - 2 + WASH AREA	6.61	9.60	3.00	75.6	NMT 25	1	1	1285	4.36
			2.20	5.50				1	1		
						1133.4				16265	48
										67570	199

HVAC SUMMARY SHEET FOR CLASSIFIED AREAS

S.NO.	Ahu No	Room name	Area	Vol.	Room Temp.	Relative humidity RH	Cleanliness Class	Room Pressure	Ahu Static	Selecte d Fresh Air	Selected Room Supply Air	Room exh.	Room Return Air	Cooling load	Heating Load	Fan capacity
			(mts2)	(mts3)	(°C)	(%)	AT REST	(Pa)	mm of Wg	(CFM)	(CFM)		(CFM)	(TR)	(Kw)	(CFM)
A1	AHU - 01	Cooling	8.0	25.6	23± 2	" NMT 60 "	" CLASS B "	35 Pa	125	35	1205		1345	1.47	1.9	
A2	AHU - 01	Sterility LAB	11.9	38.1	23± 2	" NMT 60 "	" CLASS B "	50 Pa	125	45	1795		1604	1.69	2.9	
A3	AHU - 01	Air Lock +++ Next To Sterility Room	4.0	12.8	23± 2	" NMT 60 "	" CLASS B "	45 Pa	125	20	605		604	0.37	1.0	
A4	AHU - 01	Air lock ++ (in sterility area)	3.5	11.2	23± 2	" NMT 60 "	" CLASS B "	40 Pa	125	15	530		490	0.31	0.9	
			27.4							115	4135		4043	3.84	6.74	4158
A5	AHU - 02	Air Lock + (In Sterility Area)	4.0	12.8	23± 2	" NMT 60 "	" CLASS C "	25 Pa	125	20	305		305	0.31	1.0	
A6	AHU - 02	Bacterial Endotoxin	7.4	23.7	23± 2	" NMT 60 "	" CLASS C "	35 Pa	125	30	560		439	0.79	1.8	
A7	AHU - 02	Microbial Identification	12.0	38.4	23± 2	" NMT 60 "	" CLASS C "	35 Pa	125	50	905		784	1.30	2.9	
A8	AHU - 02	Airlock ++ (In Microbial Identification Area)	4.0	12.8	23± 2	" NMT 60 "	" CLASS C "	25 Pa	125	35	305		525	0.51	1.0	

A9	AHU - 02	MLT / TMC	5.0	16.0	23± 2	" NMT 60 "	" CLASS C "	35 Pa	125	20	420		300	0.78	1.2	
			32.4							155	2495		2353	3.69	8.01	2508
A10	AHU - 03	Incubation	18.9	60.4	23± 2	" NMT 60 "	" CLASS D "	15 Pa	125	270	1795		1725	4.45	5.09	
A11	AHU - 03	Media Preperation	11.9	38.1	23± 2	" NMT 60 "	" CLASS D "	15 Pa	125	170	1115		1045	2.81	3.21	
A12	AHU - 03	Washing	14.1	45.0	23± 2	" NMT 60 "	" CLASS D "	5 Pa	125	200	665	825		2.01	3.79	
A13	AHU - 03	Washing Area	3.9	12.5	23± 2	" NMT 60 "	" CLASS D "	0 Pa	125	60	185	235		0.64	1.06	
A14	AHU - 03	Decontamina tion + Bio Waste	14.2	45.4	23± 2	" NMT 60 "	" CLASS D "	5 Pa	125	110	1175		1285	2.46	3.61	
A15	AHU - 03	Clean corridor	36.0	115.2	23± 2	" NMT 60 "	" CLASS D "	10 Pa	125	275	1695		2025	3.28	9.14	
A16	AHU - 03	Secondary Gowning	2.9	9.1	23± 2	" NMT 60 "	" CLASS D "	15 Pa	125	25	135		15	0.28	0.73	
A17	AHU - 03	Reference Culture	10.2	32.5	23± 2	" NMT 60 "	" CLASS D "	5 Pa	125	80	715	300	485	1.59	2.58	
A18	AHU - 03	A/L EXIT	2.2	7.0	23± 2	" NMT 60 "	" CLASS D "	15 Pa	125	20	240		10	0.25	0.57	
A19	AHU - 03	Dirty Linen	2.6	8.3	23± 2	" NMT 60 "	" CLASS D "		125	20	125		125	0.24	0.66	
A20	AHU - 03	Cold Room	6.0	19.2	23± 2	" NMT 60 "	" CLASS D "	15 Pa	125	50	285		235	0.65	1.53	
A21	AHU - 03	Air Lock (Next To Change Room)	4.0	12.8	23± 2	" NMT 60 "	" CLASS D "	25Pa	125	35	190		50	0.40	1.03	
A22	AHU - 03	Change Room	5.0	16.0	23± 2	" NMT 60 "	" CLASS D "	20 Pa	125	40	285		285	0.64	1.27	
A23	AHU - 03	Air Lock at the Entry	9.0	28.8	23± 2	" NMT 60 "	" CLASS D "	15 Pa	125	70	425		335	1.04	2.29	
			140.8							1425	9030		7620	20.7	36.6	9045

2.0 TECHNICAL SPECIFICATIONS

A AIR HANDLING UNITS:

1.0 SCOPE OF WORK

This specification covers design, manufacturing, inspection, testing at works, packing, forwarding, supply and providing performance guarantee of air handling units. The scope also covers assembly/erection of units at site and commissioning.

The specification is to be read in conjunction with datasheets, standards and all attached annexure.

It is not the intent to specify all the details of design and construction of an air handling unit. Nevertheless, the equipment shall conform in all respects to high standards of engineering, design and workmanship. It shall meet all statutory requirements and be able to operate continuously meeting the contractor's guaranteed performance and acceptable to the Engineer-in-Charge who will have the power to reject the equipment in whole or in part if it is not in accordance with the specifications.

2.0 CODES & STANDARDS

a)	Electric Motor	:	IS: 325: 1996
b)	Motor	:	IS: 2148:1989, IS: 2147: 1989, IS: 5571: 1994
c)	Centrifugal Fan	:	IS: 4894: 1987

3.0 TYPE

The air handling units shall be double skin construction, draw through type comprising of various sections such as mixing chamber, pre-filter section, coil section, heater section, fan section and fine filter section as per arrangement shown in enclosed airflow diagrams.

3.1 Design Parameters

Maximum face velocity across pre-filters / fine filters and HEPA filters.	2.5 m/sec
Maximum velocity across cooling coils	2.25 m/ sec
Maximum fan outlet velocity	9.66 m/ sec
Maximum noise level (outside the AHU at 1 m distance)	80 dBA

4.0 Casing

- i. Double skinned panels to be fabricated with anodised extruded aluminum section framework bolted together with sandwich panel having powder coated 24 gauge G.I sheet for outer skin and plain galvanized 24 gauge G.I sheet for inner skin.
- ii. PUF insulation (43 mm thick) to be injected between the two panels. Construction should be such that inner skin is isolated from outer skin by insulation and condensation on outside skin is avoided completely. The aluminum framework shall have thermal break construction with no heat transfer path to outside.
- iii. The entire frame duly painted shall be mounted on a Mild steel channel base. The panels shall be sealed to the framework by heavy-duty 'O' ring gaskets held captive in the framed extrusion. All panels shall be detachable or hinged. Hinges shall be made of hard nylon and

be operational from both inside and outside of the unit.

- iv. Volume control dampers shall have opposed blades of extruded aluminum and casing to be of 22 SWG. Geared operation with self-lubricated bearings/ bushes shall be provided for dampers. If link operators are given then linkages to be mounted such that insulation is complete all over.
- v. Units shall have hinged, quick opening access door in the fan, coil and filter section. Access doors shall be double skin type.

5.0 Motor and Drive

The rating of the motor selected shall be of least 10% higher capacity than BHP of the fan. Fan motors shall be energy efficient as per IEEMA STD. 19-2000 with efficiency EFF2 and shall be suitable for $415 \pm 10\%$ volts, 50 cycles, three phase, totally enclosed fan-cooled class F, with IP-55 protection. Motors shall be especially designed for quiet operation and motor speed shall not preferably exceed 1440 rpm. Drive to fan shall be provided through 'V' belt drive arrangement. Belts shall be of the oil-resistant type and anti-static. Wherever specified the motor shall be flame proof.

6.0 Fan

- i. AHU fans needs to be selected such that maximum design CFM is achieved at 50Hz.
- ii. Fans shall be DIDW backward curved type. Fan casing shall be made from galvanized steel sheet. Fan wheels shall be made of galvanized steel. Fan shaft be ground C40 carbon steel and supported on a self-aligning Plummer block operating at less than 75% of first critical speed. Fan wheels shall be tested and precision balanced dynamically. The fan shall be isolated from the casing by a fire retardant rexin cloth with a double flexible connection mounted inside the casing of unit, The flexible connection shall not be less than 100 mm wide.
- iii. For Ventilation units Fans shall be DIDW, centrifugal, backward/forward inclined blades
- iv. Both fan and motors assemblies shall be mounted on a deep section aluminum alloy or galvanized steel (depending on size) base frame.
- v. Isolation shall be provided from the unit casing by combination spring and rubber anti vibration mounts and flame retardant, waterproof neoprene impregnated flexible connection on the fan discharge.

7.0 Cooling Coils.

- i. Cooling coil shall be constructed from copper tubes. They shall be minimum 27G thick with sine wave aluminum fins of minimum 0.15 mm thickness, firmly bonded to the copper tubes and assembled in a zinc coated steel frame. The fins shall be staggered in the direction of the air flow. The fin spacing should be kept at not exceeding 12 Fins / inch, and the design velocity of air across the coil face should not exceed 2.25 meters / second and water velocity inside tube shall not exceed 1.8 mps. The capacity of the coil should be as required under the schedule of equipment.
- ii. The maximum depth of a single section coil permitted is 6 Rows deep. For coils of 8 Rows deep and above, two sets of coils in series shall be provided.

- iii. Manual air vent is to be provided.

8.0 PRE FILTER: (10 Micron) EU-4 TYPE

Pre-Filters shall be washable HDPE type in AL frame construction and shall be 50 mm thick. Filter shall be tested as per EN-779 grade. The filters shall be with 90% efficiency down to 10 microns, and the design velocity across the filter shall not exceed 2.5 meters per second. The pressure drop through the filter shall not exceed 5.0 mm while clean. Filter shall be supported by a wire mesh and frame.

9.0 MICROVEE FILTERS: (3MICRON) EU-7 TYPE

Microvee filters in aluminium construction having an efficiency of 95% down to 5 microns (efficiency inferred as per EN-779) having a non-woven polyester media housed in necessary soldered plenum. This Filter shall also be reusable type by cleaning with water/air and the design velocity across the filter shall not exceed 2.5 meters per second. The pressure drop through the filter shall not exceed 12.0 mm while clean

10.0 Mixing Box Section

Two-way mixing box shall be designed for efficient mixing of fresh air and return air by means of interconnecting dampers. Mixing box dampers shall be opposed blade type.

11.0 Isolators

The unit shall be equipped with vibration eliminators of not less than 90% efficiency, for totally avoiding the transfer of vibration of the unit to the structure of the building.

12.0 Accessories

All air-handling units shall be supplied with following accessories.

- i. Supply air, return air, exhaust air and fresh air aluminium opposed blade volume control dampers.
- ii. Magnahelic gauge across filter section (Microvee Filter).
- iii. Interior lighting in fan sections with external on-off switch.
- iv. Viewing windows on all access doors for all AHUs with capacity higher than 10,000 cfm. They shall be double pane with air gap to avoid condensation on face.
- v. Stainless steel drain pan with insulation arrangement for proper draining of condensed water.
- vi. AHU nameplate shall provide the following information.
 - a. Fan Model/ Details.
 - b. Motor HP.
 - c. Motor Frame Size.
 - d. CFM Details.
 - e. Filter Sizes & Quantity.
 - f. Areas connected to the AHU & their CFM.

- g. Details of terminal Heaters.
- h. Schematic air flow diagrams.
- i. Valve Size & Type.
- j. Filters and Valve shall be numbered.

13.0 Inspection

- a. Inspection including witnessing of tests will be carried out by purchaser or his authorized representative, if required. However, in either case, test certificate shall be submitted and clearance obtained before dispatch of the assembled unit.
- b. Vendor shall notify purchaser or his authorized representative in writing at least fifteen (15) days prior to the schedule for inspection/ tests.
- c. Vendor shall submit calibration certificate for all instruments.

14.0 Testing and Commissioning

- a. Unit shall be tested for establishing the capacity and power consumption including all other standard parameters, as applicable.
- b. Refrigeration capacity of the unit shall be computed from measurement of water flow and entering and leaving water temperature and related tests shall be carried.
- c. Computed results shall tally with the specified capacities. All meters, gauges, thermometers, watt meters and similar items shall be duly calibrated and shall be supplied by vendor.

HORIZONTAL FLOOR MOUNTED AIR HANDING UNITS – DATA SHEET B

1.0	<u>GENERAL</u>	
1.1	Manufacturer	
1.2	Type of Unit	
1.3	Over All Dimensions (L x W x H) (mm)	
1.4	Weight (Including Water in circulation) Kg.	
1.5	Approximate Noise Level (DBA)	
1.6	Fan Discharge Position	
2.0	FAN SECTION	
2.1	Air Quantity (CFM)	
2.2	Total Static Pressure (mm of WG)	
2.3	Fan Speed (RPM)	
2.4	Fan Diameter (INCH) and no. Of fans	
2.5	Balancing (Static and / or dynamic)	
2.6	BHP	
2.7	Motor HP, RPM, Make & Type	
3.0	COOLING COIL – DX Type	
3.1	Coil Fin Material (Aluminum or copper)	
3.2	Tube Diameter (INCH) and material	
3.3	No. of circuits	
3.4	Fin Size (INCH)	
3.5	No of Fins / INCH	
3.6	Outside Coil Surface (SQFT)	
3.7	Face Area (SQFT) of Coil	
3.8	Rows Deep	

B AIR DISTRIBUTION SYSTEM:**1.0 General**

The design, construction/fabrication, erection and performance of ducting shall comply, in general, with all currently applicable standards, codes, regulations and safety measures as applicable. The items covered shall conform to the latest applicable SMACNA Standards. The ducting may be prefabricated at factory and delivered to site for erection.

2.0 Design Parameters

Refer design parameters and limits in Para 3 of this section.

Leak testing after installation is required; Leakage Limits shall be as per Class 'A' of SMACNA.

3.0 Material

Ducting shall be made out of G.I sheets, continuous galvanized with a Zinc coating of 120 g/m² on both sides. Sheets shall be flat and free from twists. Zinc coating shall be clean, even and free from ungalvanised spots. Sheets shall not crack or peel during bending or fabrication.

4.0 Fabrication

All duct fabrication shall be as per SMACNA Standard. Ducting shall be fabricated at factory/site on Pittsburg lock forming machine with slip type MS flange joints. Ducting shall be rectangular in cross section. As far as possible abrupt change of duct size and shape shall be avoided. In order to maintain decreased turbulence and low noise level, long radius elbow and gradual change in shape shall be adopted.

All lateral joints between two ducts shall be provided with food grade Neoprene rubber gaskets for the Angle Flange Ducting to render the joints leak proof. Branch take-offs shall be arranged to cut or slice into the air streams to minimize the losses in velocity head. All bends/elbows shall have suitable vanes to guide the air streams. Standard elbows with a R/D ratio of not less than 1.25 shall be used. The length of taper ducts shall be at least four times the maximum size difference between the ends. All duct pieces shall be properly aligned before connection to each other on both sides. The ducts shall be tapped 6 mm across the flanges. All flanges shall be connected to the ducts by rivets. All longitudinal and transverse joints shall be sealed by silicone RTV sealant. Food grade gasket & Sealant required for microbiology areas to be used for ductwork of microbiology areas.

5.0 Construction of Rectangular Ducts

The general construction of rectangular ducts shall be as per SMACNA standards for low / high pressure ducting.

Pressure rating of the ducting shall be appropriate to the duct section i.e. low pressure (2 inch wg) for duct section from return air terminals to AHU and high pressure (4 inch wg) between AHU fan and terminal HEPA filter.

Ducting sheet gauge, type of joint reinforcement and spacing of joints / reinforcement shall be selected as per SMACNA depending on pressure class and dimension of bigger side of duct. All sides shall have same gauge. Necessary calculation for selection of duct sheet gauge and reinforcement shall be submitted.

Table - I gives the thickness of sheets, the types of bracing, the types of transverse joints and details of supports for low velocity ducts of different sizes. The duct places shall be properly aligned before connecting together. The duct pieces having companion angles flanged joints shall be connected together with by galvanized bolts and nuts at about 125 mm centers. The size of nut - bolts shall be 6 mm (1/4") for ducts up to 1000 mm size and 10 mm (3/8") for ducts sizes larger than 1000 mm. All the angle iron flanges shall be welded and the holes for rivets and bolts shall be drilled through. The ducts shall be lapped 6 mm across the flanges. All the flanges shall be connected to the ducts by rivets about 100 mm centres. All the flanged joints shall have 3 mm thick sponge rubber packing stuck to the flanges with shellac varnish. The holes in the sponge rubber packing shall be punched through.

The ducts up to 750 mm shall be supported with 8mm G.I threaded rods and 25 x 25 x 3 mm MS angles while those of sizes between 751 mm and 1500 mm size shall be supported with 10 mm G.I threaded rods and 40 x 40 x3 mm MS angles. Ducts larger than 1500 mm size shall be supported with 10 mm G.I threaded rods and 50 x 50 x 3 mm MS angles. Ducts supports shall be at a distance of not more than 2400 mm.

TABLE-I**FOR STATIC PRESSURE UPTO 175 MM W.G. AND VELOCITY UPTO 2500 FPM**

Dimension of Larger size of Duct (mm)	Sheet thickness gauge	Transverse seems at joints.	Minimum bracing Angle size and maximum longitudinal spacing from joints (mm)	Round hanger's size.	Angle size	Max. Spacing of supports (mm)
Up to 750	24	Companion Angles flanged joints (25x25x3)	Cross bracing (see Note)	8mm	25x25x3	2400
751-1520	22	Companion Angles flanged joints (25x25x3) Class E	-DO-	10 mm	40x40x3	2400
1521 to 2285 mm	20	Companion Angles flanged joints (40x40x3) Class F	Cross bracing with 40x40x3 angle bracing	10 mm	50x50x3	2400
Above 2285	18	Companion Angles flanged joints (40x40x3)	-DO-	10 mm	50x50x3	2400

For comfort AREA TDF flange ducting to be considered as per SMACNA.

Note:

Cross brace shall not be provided for ducts that are to be finished with cement plaster. It is not necessary to cross break the air out connections of ducts (collars for grilles diffusers)

For fittings – refer to SMACNA standards

For high pressure ducting – refer to SMACNA standards.

Submitting of duct manufacturing quality assurance plan required before starting manufacturing of ducts. All ducts to be machine made.

Minimum gauge of ducting sheet shall be 24 g.

C – Cleats are not permitted for transverse joints.

6.0 Accessories

6.1 Splitters and Dampers

Splitters and volume control dampers shall be placed at all suitable points in Supply & Return duct for proportional volume control of the system.

Splitters shall consist of double thickness opposed blades hinged at the downstream edge and fabricated out of GI blades with suitable locking device, mounted outside the duct in accessible location.

Volume control dampers shall be multiple opposed blade type with extended lever for operation and shall be lockable.

Dampers blade edges shall have edge sealing by neoprene rubber gaskets.

6.2 Air Turning Devices

Air turning devices shall be provided at least for the first four outlet collars after fan. Turning blades shall be fabricated out of 22 S.W.G. galvanized steel sheets and equally spaced on side, runner to be riveted/bolted to duct sheets (As per SMACNA).

6.3 Access Doors & Inspection Window

Access doors shall be provided in the duct work where specified or in casing on the both sides of equipment to be serviced. All access doors to be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access doors shall be built-up construction structurally strong and each shall have at least two hinges. Inspection window of standard size shall be provided for inspection purpose, where specified.

6.4 Caulking

Where duct passes through wall, all openings between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoining space.

6.5 Curves & Bends

All curves, bends, offsets and other transformations shall be made for smooth and noiseless flow of air. The throat of every branch duct shall be sized to have the same velocity as in the main duct to which the branch duct is connected.

6.6 Duct Connections at Room

Where the duct is connected to discharge of fan units, a connection of at least 150 mm width shall be provided.

A standard tapping shall be provided next to flexible connection to facilitate the measurement of outlet air temperature. Where ducts are connected to the wall, such connections shall be made through mild steel frames fixed to the wall through suitable shear fasteners.

6.7 Duct Supporting Arrangement

The duct shall be supported at maximum 2400 mm distances. The G.I. support rods shall be hung from anchor fasteners to be fastened in the RCC ceiling with care of minimum damage. NEOPRENE rubber gasket shall be fixed in between ducts and M.S. angle. The steel rods shall be fastened with

the help of nut and bolts from structural members of roofing wherever required. Where ducts are to be supported from steel roof, contractor shall provide cross members from purling /truss and support the ducting from them.

All MS parts should be painted with one coat of red oxide and two coats of enamel paint.

In all, the duct shall not sag or vibrate due to lack of supports. All angles & rods shall be hot – dip galvanized and hardware shall be chrome plated.

Additional supports wherever considered necessary by the Engineers-in-charge shall be provided. The entire supporting system shall be met with the approval of the Engineers-in-charge.

6.8 Inspection & Testing

The duct branches, elbows, etc. shall be inspected and the joints, connections are to be checked before they assembled in position. After assembly of the system, it shall be checked for tightness, vibration and noise due to turbulence.

After assembly the entire ducting shall be tested for leakage test with specified pressure in presence of Engineers-in-charge, as per DW143

6.9 Ducting Measurement

The entire ducting assembly including supply air plenums shall be measured for its running length & perimeter to arrive at the total area of finished surface. Ducting erection shall be calculated on the basis of actual measurements taken at site in presence of contractor's representative/ a representative of the Consultant/Client. Payment will be based on actual surface area ducting, face areas of grilles/diffusers and dampers. Vendor shall not claim extra measurements for splitters, vanes wherever provided.

6.10 Fresh Air Intake & Exhaust Air Assembly

- i) Fresh air louvers shall be provided at all intake & exhaust air points. Louver traps shall be powder-coated Galvanised steel.
- ii) Non return dampers shall be provided.

6.11 Grilles & Diffusers

For Socially Clean Areas (Comfort non-classified air conditioning)

All grilles and diffusers shall be fabricated out of minimum 1.0 mm powder coated Aluminum extruded material. All duct collars terminating on to grille or diffuser shall be given two coats of black paint for a minimum length of 300mm. Grilles and diffusers shall be selected for an aerodynamic noise power value not in excess of NC35.

Supply air grilles shall be, in general, double deflection type with horizontal face bars and vertical rear bars placed in a rigid marginal frame. Bars shall be shaped and spaced at 18mm centers with pivot pins positively holding the deflection setting under all conditions of velocity and pressure. All supply & return grilles shall be provided with integral opposed blade, grille-face, key operated volume control dampers.

Return air grilles shall have fixed face bars set at 18mm centres.

Ceiling diffusers shall be round/square/rectangular as approved by Consultant, face flush type horizontal 4 way air diffusion pattern. The diffusers shall have ample margins, to minimize ceiling

smudge. All supply air diffusers shall be provided with face-operated volume control dampers and Return air diffusers should be without volume controlled damper.

Linear grilles and diffusers shall be die formed, flush mounted type with single or double directional airflow. The diffuser/ grilles shall be in a flange with minimum 20mm margin. Capped airflow connections shall be provided as necessary for testing and balancing of air distribution.

The shade of finished powder coated paint on Grilles/Diffuser shall be as approved by the client. Sample shall be submitted before approval.

6.12 Terminal Boxes

Terminal boxes in 18 G Extruded Aluminium construction duly powder coated with service floor operated volume control dampers complete with SS304 perforated sheet. These shall be cleanable, flush mounted on the ceiling. Box should have port for checking differential pressure across filters and PAO ports. Box should be complete with necessary supporting arrangements including box mounting clits, 8 mm G.I threaded rods.

6.13 Fire Damper

Fire damper shall be installed in order to isolate different fire rated areas connected by ducts from fire-affected areas. The location of the fire dampers shall be as per recommendation of NFPA Standard 90A.

Applicable Standards/Approvals;- Fire dampers shall be approved by CBRI, Roorkee.

Construction and Rating:- The fire dampers shall be rated for 90-minute fire resistance. Fire dampers shall be fabricated out of 16 gauge GSS with factory fitted GI Sleeves of 16 gauge. The Dampers shall be fabricated with multi louvers and louvers connected by suitable linkage to a controlling actuating device i.e. fusible link.

6.14 Testing Of Duct

Wherever specified duct system after installation shall be tested for leakage. The fan and flow measuring orifice capacity shall be suitable to test entire supply/return ducting of each system. Measured leakage of duct at maximum operating pressure should be less than 1% of supply air quantity.

The duct system shall be tested after connection with AHU and terminals and installation of all accessories are completed to find gross leak points for rectification.

6.15 Design Parameters and Limit

a)	Duct Air Flow Velocities	
	Main supply & Return Air ducts :	1200 – 1500 FPM
	Main branches :	1200 – 1500 FPM
	Branch ducts :	1000 – 1200 FPM
	Branches to air terminals :	750 – 1000 FPM
b)	Noise Level	
	NC rating of Diffusers :	35dB Max

6.16 Codes & Standards (Latest Edition as Applicable)

- | | | |
|-----|--|--|
| 1. | IS: 277-1977 | Galvanized Steel Sheet (plain & corrugated) |
| 2. | IS: 655-1963 | Metal Air Ducts (Amendment-2) |
| 3. | IS: 659-1964 | Safety Code for Air-conditioning (Amendment-1) |
| 4. | IS: 660-1963 | Safety Code for Mechanical Refrigeration |
| 5. | IS: 900-1992 | Code of Practice for installation and Maintenance of Induction Motors. |
| 6. | IS: 2441-1984 | Code Practice for Fixing Ceiling Covering |
| 7. | IS: 4894-1987 | Test Code for Centrifugal Fans |
| 8. | IS: 5111-1993 | Code of Practice and measurement Procedure for Testing Refrigerant Compressors (Amendment-1) |
| 9. | IS: 7613-1975 | Method of Testing of Panel Type Air Filters for Air- Conditioning and Ventilation. |
| 10. | IS: 3588-1987 | Specification for Electrical Axial Flow Fan |
| 11. | SMACNA | Sheet metal-Ducting, manufacturing & installing (Low & high pressure ducting). |
| 12. | DW 142 | Testing of Leakages in ducting |
| 13. | ISO 14644, | Clean rooms and associated controlled environments |
| 14. | IEST Recommended Practices
IES-RP-CC001.3 HEPA & ULPA filters
IES-RP-CC006.2 Testing Clean Rooms
IES-RP-CC012.1 Considerations in clean room design | |
| 15. | BS. EN 1882-1:1998 High efficiency air filters (HEPA & ULPA)
Classification, performance and testing | |
| 16. | BS. EN 779:1998 Air filters | |
| 17. | ANSI/ASHRAE Gravimetric and dust procedures for testing air cleaning devices
52.1/52.2:1992 | |

7.0 INSULATION

7.1 Scope of Work

The insulation contract includes supply and application of all necessary insulating materials, with accessories including scaffolding/weather protection etc. as specified in this specification.

The Contractor shall supply and install the insulating materials on the respective surfaces as described in these specifications.

The Contractor shall supply all necessary skilled and unskilled labour and supervision required for carrying out the installation as per these specifications and good engineering practice.

The insulation applications details specified herein need not necessarily be conclusive. Any additional information or deviation from these specifications to proposed practices of insulation application shall be brought to the notice of the Engineer-in-Charge and concurrence

shall be obtained. Sketches, details and diagrams for removable housings, insulation supports, flashing details, expansion joints etc shall support these.

The insulation work covered under this specification falls under the following categories:

- a) Thermal insulation for duct and cold service insulation for pipelines (IS7240-1990)
- b) Insulation for personnel protection.

Generally rigid preformed pipe sections and logs (IS 9842-1994) shall be used. Unbounded fibrous material shall not be used.

7.2 Thermal Insulation for Ducts:

7.2.1 General

Insulation work shall be carried out for ducts and refrigerant piping as per latest BS/American or equivalent IS standards for thermal insulation materials and finishing materials and also codes of practice for industrial applications.

7.2.2 Material

Insulation material shall be cross linked, closed cell polyethylene (PE) CFC free foam sealed/backed by aluminum sheet/ foil or equivalent as described in Bill of Quantities.

Thickness of the insulation shall be as specified for the individual application as given in table-1. Each lot of insulation material delivered at site shall be accompanied with manufacture's test certificate for thermal conductivity values and density.

Samples of insulation material from each lot delivered at site shall be selected at random for approval and shall be tested for thermal conductivity values and density, if needed by the Engineer-In-charge.

Adhesive used for setting the insulation shall be vapour proof adhesive, supplied by insulation manufacturer or approved equal, cold setting compound.

Duct Acoustic Insulation is to be done by the contractor with 12 mm thick resin bonded Glass wool Insulation upto half a mtr inside the duct followed by RP Tissue paper and 30 Al cladding. Inorder to make the system noise free.

The Duct Acoustic Insulation should be 12mm thick with a density of 24 Kg / cum.

8.0 SENSORS

8.1 Temperature Sensors

Temperature sensors shall be positive temperature coefficient type **RTD** sensors. They should be selected for high accuracy and reliability. These shall be conforming to following:

- 1) Duct temperature sensors shall be rigid stem or averaging type as specified and shall be suitable for duct installation.
- 2) Immersion temperature sensors shall be provided with matching stainless steel thermo well of lengths as required.
- 3) Out door air temperature sensors shall have weatherproof enclosures and shall be directly wall mounted.

- 4) Outside air, return air, discharge air, space and well sensors shall have an accuracy of $\pm 1.0^\circ \text{F}$ accuracy between 32°F & 212°F .

8.2 Relative Humidity Sensors

Relative humidity sensors shall be of standard 0-10 v DC or 4-20 mA type, well protected against solid and liquid contaminants with a permeable coating. The sensors shall be bulk polymer resistance sensor with electronic amplifier and calibrated to an accuracy of $\pm 3\%$ over 0 to 100% RH. Duct insertion relative humidity sensors shall have the sensing element enclosed in a protective, vented, metal sheath for insertion into duct, with external connectors provided for connection load. They shall be provided with sampling chamber.

Space relative humidity sensors shall have an external vented case protecting the sensing element within and shall be suitable for mounting on wall and/or metallic wall panels. Casing design and colour shall be similar to space temperature sensors, and shall be subject to approval by the Consultant. Wall mounted sensors shall be provided without covers identical to temperature sensors. Sensors housing shall plug into the base such that the same can be easily removed without disturbing the wiring.

Relative humidity sensors mounted external to building shall have proper shields to protect sensors.

8.3 Switches

Unless specified otherwise, the HVAC Contractor shall supply and install flow, pressure, level and sail switches necessary for the proper operation of the system. The switches shall comply with the requirements as specified herein.

9.0 VARIABLE FREQUENCY DRIVE (VFD)

9.1 Mechanical Protection:

The VFD must have a metal enclosure which will meet the requirements of IP54 unless specified otherwise in the schedule of work to ensure that an extra enclosure is not necessary and have integrated fans as required.

9.2 Operating Parameters:

The VFD must be able to operate under the following conditions:

- a) Rated input voltage 415V $\pm 10\%$, 3 phase, 50 Hz ± 3 Hz
- b) Ambient temperature as specified. The VFD must be suitable for manual as well as remote control.

9.3 Technical Features:

The VFD must be able to vary the output from 0 to 100 Hz and output voltage from 10% to full mains voltage even at -10% of full mains voltage. The VFD must regulate the output to continuously adapt as the case may be to the current load on the pump or the fan so as to minimise energy consumption.

The VFD must be able to work as a Stand-Alone unit, where all safety requirements have been fulfilled or as part of a larger BMS system (Building Management System), where the control is

centralized and operated via serial communication using the integrated RS 485 ports. The control panel must be detachable and be able to function in a central control panel, if used.

The VFD must be able to regulate all types of Indian standard motors without load reduction and without the motor temperature becoming higher than under normal mains operation.

The VFD must be able to control motors of different size connected in parallel and it must be possible to stop a machine during operation without the risk of tripping. The VFD must be able to run without the motor being connected, for the purpose of servicing. Servicing must not require access from the back of the VFD.

The following features should be incorporated

- i. Alphanumeric display (alphanumeric code)
- ii. Light diodes indicating "ON" and "ALARM"
- iii. Choice of 12 different display e.g. of output current, voltage, frequency, speed, output torque, motor temp. energy kwh.

9.4 Design Features:

The VFD must be able to avoid at least 4 bypass frequencies with adjustable bandwidth to avoid mechanical resonance. The VFD must have filters in the intermediate circuit to ensure that the 5th harmonic transmitted to the mains supply is limited to approx. 30%.

The current limiting function must be quick enough for the VFD to resist short-term earthing and short circuiting of the output terminals without any damage to the components.

The VFD must have integrated protection against the mains transients in accordance with VDE 0160.

The VFD must be able to give off a warning to stop the motor if the motor is overheated. This function must form an integral part of the VFD.

The output circuit is to ensure the possibility of unlimited switching between VFD and motor regardless of load and speed without any damage to the VFD and without extra equipment being required. The VFD must have an override function which in the case of overloads during operation and starting reduces the motor current to prevent damage.

The VFD must have a power factor of 1 on the supply side (AC) at all loads and speeds extra AC coils for stable operation must not be required.

9.5 Protection Features:

The following protection shall be provided.

- a) Inverter trip at 75 C or higher on the heat sink
- b) Protection against under voltage.
- c) Protection against over voltage.
- d) A lock to prevent unintended programming of the VFD.

9.6 Product Support:

The supplier must be able to provide technical documentation covering both catalogues and statements of dimensions and weight.

The local dealer must be able to provide full technical and maintenance assistance with full complements of spares.

10.0 Variable Refrigerant Volume System (VRV)

10.1 SCOPE:

All variable Refrigerant Volume Air Conditioners shall be fully Factory assembled, charged with refrigerant, wired, piped and tested at the factory.

The system shall comprise of Air Cooled Multi Split type Outdoor units, and a variety of indoor units connected by Common Refrigerant piping and Power and Control Cabling.

The appropriate Indoor units are detailed below, however the Units offered shall be as per the Bill of Quantities. The outdoor unit configuration may be modified by the Bidder giving the same tonnage as specified.

10.2 SPECIFICATION OF Variable Refrigerant Volume System (VRV):

GENERAL:

The system selected is a modular system, with number of indoors connected to centrally located outdoor units, as per detail designing given in the tender. The outdoor units for all the system shall be air cooled type and mounted on terrace of the building. Indoor units in various areas shall be as per enclosed drawings/ Bill of Quantities.

All the VRV air conditioners shall be fully factory assembled, wired, internally piped & tested. The outdoor unit shall be pre-charged with first charge of R410a refrigerant. Additional charge shall be added as per refrigerant piping at site. All the units shall be suitable for operation with 415 V + 10%, 50 Hz + 3%, 3 Phase supply for outdoor units & 220 V + 10%, 50 Hz + 3%, 1 Phase supply for indoor units.

The VRV system shall provide stable, trouble free & safe operation, with flexibility of operating desired indoor units. The outdoor units must be capable of delivering exact capacity proportional to the number of indoor units switched on & the heat load in the air conditioned area. The proportional operation shall be achieved by varying speed of the compressor in the outdoor units.

The operation of the VRV system shall be through independent wired remote controllers (no wireless controller to be used) as specified. The entire system shall be controlled by a system controller and shall be integrated through BACNET protocol with an intelligent building management system. The system controller shall be able to control start / stop on time schedule and also provide common fault from the system. The BMS shall be optional and will be provided by others.

10.3 Outdoor Units:

Outdoors units of the VRV system shall be compact air cooled type.

All the compressors of the outdoor units must be scroll inverter type. Each module of outdoor unit must have separate inverter compressor, suitable to operate at heat load proportional to indoor requirement.

“Anti-Corrosive” treatment (Blue Fins) for Al fins of Condenser Coils is mandatory. The treatment should be suitable for areas of high pollution and salt laden air.

The outdoor units must be suitable for up to 150 m refrigerant piping between outdoor unit & the farthest indoor units, total piping of 300 m for all the indoor units. Allowable level difference between outdoor unit & indoor units shall be 50 m in case of outdoor unit on top & 40 m in case of outdoor unit at bottom. Allowable level difference between various indoor units connected to one outdoor unit shall be up to 15 m.

Back up operation, in case of failure of one of the compressors of outdoor unit, for single module outdoor units or failure of one of the modules in case of multiple module outdoor units shall be possible. The VRV outdoor unit shall always be supplying at least 33% of back up operation, of the full load capacity.

The outdoor unit shall employ system of equal run time for all the compressors, inverter or on / off type, within each outdoor unit – Single Module or Multi Module.

The outdoor units shall be suitable to operate within an ambient temperature range of – 5 Deg C to 43 Deg C, in cooling mode.

Air cooled condenser shall have Axial Flow, upward throw fan, directly coupled to fan motors with minimum IP 55 protection. The outdoor unit condenser fan shall be able to develop external static pressure up to 6 mm of H₂O.

The entire operation of outdoor units shall be through independent remotes of indoor units. No separate Start/ Stop function shall be required.

Starter for the Outdoor Unit compressor shall be “Direct on Line” type. Inverter compressor of the unit shall start first & at the minimum frequency, to reduce the inrush current during starting.

Refrigerant control in the outdoor unit shall be through Electronic Expansion Valve. Complete refrigerant circuit, oil balancing/ equalizing circuit shall be factory assembled & tested.

Noise level of outdoor units shall not exceed 63 dB (A) at a distance of 1.5 m from the unit.

Outdoor units shall be complete with following safety devices:

- High pressure switch
- Fan driver overload protector
- Over current relay
- Inverter Overload Protector
- Fusible Plug

Monitoring from BMS

Necessary relays and contacts shall be provided for monitoring the status of the outdoor units from the building management system. The outdoor units shall provide necessary volt free contacts for this purpose. Status shall include start / stop/ run and trip.

Unit shall be supplied with

- Connection Pipes
- Clamps
- Necessary relays for hard wired points to BMS for providing ON/OFF status and trip alarm

Units shall be available in following configuration 5 HP, 8 HP to 48 HP, within increments of 2 HP

10.4 Specifications for Indoor Units:

10.4.1 Indoor units:

The indoor unit shall be selected for maintaining the required temperature and noise criteria as specified under Basis of Design.

10.4.2 Ceiling Mounted duct type units:

These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise. The cold air supplied by these units will be supplied to the area to be air conditioned, through duct system specified in the tender.

Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.

The unit casing shall be Galvanized Steel Plate.

Unit must be insulated with sound absorbing thermal insulation material, Glass Fiber.

The noise level of unit at the highest operating level shall be selected to meet the noise criteria specified for each area.

The unit must be able to develop external static pressure of 25mm (250Pa) at the specified air quantities – to match the specified supply air ducting, grills and extract grills plus 5Pa.

Unit must have Thermal Fuse for fan motor protection, in case of motor heating.

Each indoor unit shall have factory installed as standard equipment, maintenance free long-life filter and resin net with mold resistant.

The unit will be connected in series to a suitable outdoor unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities. The entire system shall be controlled by a system controller and shall be integrated through BACNET protocol with an intelligent building management system. The system controller shall be able to control start / stop on time schedule and also provide common fault from the system. The BMS will be provided by others.

The unit shall be supplied with following from the factory

- Paper pattern for installation
- Drain hose/ Clamp metal/ Insulation for fitting/ Sealing pads/ Clamps/ Screws.
- Long life replacement filter

The unit must be available in following sizes –

8HP, 10HP, 12HP, 14HP, 16HP, 18HP, 20HP, 22HP, 24HP, 26HP, 28HP, 30HP, 32HP, 34HP, 36HP, 38HP, 40HP, 42HP, 44HP, 46HP, 48HP, 50HP, 52HP, 54HP, 56HP, 58HP, 60HP

10.4.3 4 WAY Cassette Units / Split units

The 4 way cassette units should be of **Refrigerant 410**, with maintenance friendly features like the optional auto elevation grille it becomes easy to access filters for cleaning even on the highest ceilings. Independently controlled vanes allow individualized control in all directions around the 4-way ceiling cassette. The Split / Cassette Units should be with Scroll compressor, air cooled condenser, with internal refrigerant piping.

The Split / Cassette unit should be installed in the insulated cabinet with decorative panel consisting of cooling coil, blower with motor, filter and insulated Drain pan.

The air cooled condenser with fan duly mounted on a steel common frame, and to be installed in the wall opening with suitable angle iron / channel frame to be provided by the contractor.

Compressor shall be scroll serviceable type and shall have dual pressure stat and operating oil charge. The motor shall be suction gas cooled and shall be sealed against dirt and moisture. The motor shall be suitable for 415 +/- 10 Volts or 230 +/-10 Volts 50 Hz AC Supply and speed of the motor shall not exceed 1660 rpm.

10.4.4 Outdoor Air Processing Unit:

- For fresh air treatment an outdoor inline fans shall be provided. Size will be as per BOQ.
- The indoor processing unit shall be connected to VRV outdoor units of the specified capacities.
- Where required drain pumps shall be provided.
- The unit must include as standard equipment, maintenance free long-life filter, resin net with mold resistant.

10.5 Specification for Controls System for VRV air conditioning system:

10.5.1 Wired Remote Controller:

Wired remote controller shall be supplied as specified in the "Bill of Quantities"

The controller must have large crystal display screen, which displays complete operating status.

The digital display must allow setting of temperature with 1 Deg C interval.

Remote shall be able to individually program by timer the respective times for operation start and stop for a period of 1 week.

Remote shall have 24 hrs. Clock function.

Programming can be enabled or disabled. Provide scheduling of start / stop and temperature limit – 5 settings per day.

Remote must be equipped with thermostat sensor in the remote controller that will make possible more comfortable room temperature control

The remote shall be able to monitor room temperature & preset temperature by microcomputer & can select cool/ heat operation mode automatically.

The remote must constantly monitor malfunctions in the system & must be equipped with a “self-diagnosis function” that let know by a message immediately when a malfunction occurs.

It shall be possible to wire the remote up to 100 RMT.

10.5.3 Wireless Remote Controller:

- Wireless remote controller shall be supplied as specified in the “Bill of Quantities”
- The same operation modes & settings as with wired remote controllers must be possible.
- Compact light receiving unit to be mounted into wall or ceiling shall be included.

10.5.4 Intelligent Control system:

Intelligent control system controller shall be supplied as specified in the “Bill of Quantities”.

The System supplied must integrate with the VRV system.

The VRV system supplied must be provided with a control system, from the supplier of VRV equipments. The required hard ware must be selected, suitable for up to minimum 30 indoor units.

Complete operation & monitoring of VRV air conditioning system shall be possible through the control system.

Following functions shall be possible

Control shall be capable of following

- Controlling 30 indoor units
- Zone control
- Malfunction code display
- All the functions available with wired remote controller
- It should be possible to wire the remote to 1000m
- Scheduling of indoor units, 24 hrs. Clock & programming.
- Remote start / stop of indoor units
- Graphical report
- Energy saving function
- Mal function report.
- Monitor and report from remote side.
- Interface for using BAC net or Lon works at Client’s option.
- Colour LCD touch panel icon display
- Multi language (English, French, Italian, German, Spanish & Chinese)
- Yearly schedule
- P.P.D. (Power Proportional Distribution function)
- History of 500 actions
- Simple Interlock Function
- Fire Alarm System interface

Following major functions shall be provided:

Monitoring	Air conditioning status monitoring Indoor unit error monitoring Indoor air inlet temperature monitoring Filter choke sign monitoring
Control, Operation & Setting	Start/ Stop control Temperature adjustment mode setting Remote control setting Temperature setting Filter sign reset
Display	Air conditioner operation setting & status Set temperature Indoor unit error Indoor air inlet temperature Filter sign
Measurement	Accurate operation time Number of switching times Power consumption with KWH meter Room temperature Outdoor temperature
Alarm	Fire Alarm interface

Necessary data cabling and connections shall be provided for remote monitoring and control of the complete VRV System.

- Remote monitoring of the complete HVAC system shall be possible.
- System shall be capable to take external signal like Security/ Fire for forced shut off.
- Required hardware shall be suitable for operation between -10 Deg C to 50 Dg C & humidity range, of 0% to 98%, without condensation.

11.0 PAC Unit for IT Data centre

BASIS OF DESIGN – PAC UNIT

- Type of Unit : Bottom Discharge DX type Close Control
- Precision air conditioner with variable speed compressor and evaporator fan motor.
- Capacity of Units and quantity : Minimum 4.3 TR / 15.1 Kw cooling capacity.
- Return air to Close Control Units : 24 Deg C +/-1 Deg C and 50% +/- 5% RH
- Sensible Heat Ratio : >0.90
- Design ambient temperature : 40 Deg C
- External Static Pressure : 20 Pa
- Condenser to confirm satisfactory performance up to 45 Deg C of ambient temperature.
- Compressor Technology : With Variable speed compressor
- Evaporator Fan Technology : With Variable speed fan-motor
- Condenser Fan motor : With Fan speed controller
- Expansion valve : With Electronic Expansion valve
- Refrigerant : R410A / R134 A

11.1 DIRECT EXPANSION TYPE CLOSE CONTROL PRECISION PACKAGED UNITS

General

Modular construction Close Control Precision air conditioning unit suitable for operation on R-410a refrigerant with Top discharge arrangement consisting of inlet filter, direct drive Backward curved Plug

fans with Electronically communicated Motors, Scroll Compressor, Direct Expansion Cooling Coil, Multistage Heater banks & Variable Capacity Electrode type Humidifier to maintain humidity inside the space, condensate drain pan of stainless steel construction, Microprocessor panel, programmable control complete with LCD display. The unit shall be suitable for operation on 415 V, 50 Hz, AC supply.

The proposed precision unit should be equipped with Variable speed evaporator fan-motor and variable speed compressor and with precise controlling Electronic expansion valve with Microprocessor controller.

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 Sandwich panels with glass wool internal insulation (fire insulation class: 0). 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

Units shall have one/two plug fans with High efficiency, external rotor electronically commutated (EC) motor with integrated electronics, True soft start characteristics (inrush current lower than operating current), Backward curve, corrosion resistant aluminum fan wheel, Maintenance free design and construction. The fan section shall be designed for higher air flow. The fan shall be protected over temperature of motor, electronics, locked rotor protection, short circuit of motor output. Fans are IP54, Protection class F. Only EBM/equivalent make approved.

Fan should vary the speed based on the return air temperature sensors and accordingly the fans should regulate the airflow based on the requirement. Fan speed should not be locked in the controller.

Air Filtration

The filter cells are made of MERV8 following ASHRAE 52.2 (45% by ASHRAE 52.1) or G4 following EN779, located within the cabinet, and accessible from the front of the unit.

Refrigerant

All units equipped with direct expansion circuit are suitable for R410A refrigerant only. Other refrigerant viz. R22/ R407c are not acceptable.

Lowest TEWI (Total Equivalent Warming Impact) – R410A is less than 14% compare to R407C and hence units should be with R410 a ref. gas only.

Low specific volume, lower pipe size - R410A has a better thermal exchange properties.

This results in overall performance gains in terms of system efficiency. The greater density of the vapor in R410A permits higher system velocities, reduces pressure drop losses and Allows smaller diameter tubing to be used.

Evaporator Coil

The inclined evaporator coil is manufactured from copper tubes with 7.2 mm, mechanically bonded to hydrophilic painted Al fins, with a stainless steel condensate drain pan. The large face area/low velocity coil allows precise control of temperature and humidity during cooling and dehumidification, and is designed to optimize fluid velocity and minimize pressure drop.

Split coil configurations are not acceptable.

Refrigeration Circuit

Two independent refrigeration circuits, incorporating a high efficiency, fully hermetic Scroll compressor with crankcase heater, safety valve, filter drier, moisture indicating sight glass and Electronic Expansion Valve.

Each compressor is equipped with pre-set high and low pressure switches for protection against high condensing and low evaporating temperatures. The low pressure switch features an automatic reset (with an adjustable delay for winter start-up).

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.

The refrigerant circuit comprises:

- Liquid receiver
- Electronically-controlled Expansion valve
- Solenoid valve for shutting off the refrigerant liquid
- Refrigerant liquid flow indicator
- Solid cartridge Freon filter
- Safety valve
- High pressure safety pressure switch with manual reset
- Low pressure switch with automatic reset
- Shut-off valves for external connections
- Copper refrigerant pipes with anti-condensation insulation on the suction line
- Pipe taps on suction and delivery side and charging valve on liquid side.

Each Compressor to have its own independent Evaporator and Condenser.

Expansion device: Electronic Expansion Valve (EEV)

The unit shall 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 45 deg C db and at low ambient of up to 0 deg C db temperatures. Condenser shall be in copper tube & aluminum fins construction.

The condenser fan/s shall be of propeller type with max 1000 RPM variable voltage electric motor complete with IP-54 protection with only EBM make. Motor shall be speed controlled to ensure a stable operation for varying ambient; by a factory fitted direct acting head pressure activated steeples 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. Each Circuit to have its independent set of condenser coil and Fans is separate casing.

Electric Strip heaters

Each packaged unit shall be provided with multistage electric heaters with heating elements constructed from a non-oxidable 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. De- Humidification via split coil configuration is not acceptable.

Water Sensor

The system shall be provided with relevant water detection kit 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 in case of wet floor.

Microprocessor Control System

Logic Circuitry:

A microprocessor shall continuously monitor operation of each room. Air-conditioning unit shall 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.

Microprocessor to control the following functions:

- Room temperature
- Humidity
- Speed of the delivery fans
- Timing of compressors with automatic rotation
- Alarm signal on two levels
- Controlled automatic reset of high and low pressure alarms

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 in case 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.

12.0 Refrigerant Piping:

Piping shall be refrigerant grade hard copper piping as required. Pipe jointing shall be done using special fittings. Refnet joints supplied by VRV manufacturer shall be provided where required. Piping shall be suitable for the high pressure of R410a and piping thickness shall be increased accordingly.

Piping jointing shall be of the brazed type. The piping shall be tested at 38.5 kg/ cm²

The indoor and outdoor units shall be connected with refrigerant piping. All piping connections for the units should be performed inside the unit. The refrigerant piping should be insulated with Armaflex insulation as specified under insulation Brazing shall be carried out to the requirements of relevant code of practice using silver soldered brazing rods. Compression fittings will not be accepted on refrigerant pipe work. After installation of the complete piping the same shall be tested with nitrogen at 38.5 Kg/ cm².

After successfully pressure testing the pipe work the same shall be vacuumed to 7mm Hg and vacuum shall be maintained for 4 hours, vacuuming shall be achieved using a vacuum pump. Use of compressor for vacuuming shall not be permitted. Vacuum shall then be broken with R-410a gas to atmospheric pressure. The pipe shall once again be vacuumed to 7mm Hg pressure. This exercise shall be carried out twice before the Engineer-in-Charge's representative before charging the refrigerant in the circuit.

All connections of Refrigerant Piping shall be in high grade Copper of Refrigeration quality of "Mandev" make/ equal.

13.0 DRAIN PIPING:

Drain piping shall be PVC with necessary fittings and accessories. 25mm diameter pipe shall be used for single unit and 40mm diameter pipe for 2 units and 50mm for 3 units installation. The drain piping shall be with P traps and shall be terminated up to the nearest drain.

14.0 Inline Fans

Inline fan shall be direct-driven, three or four blade type, mounted on a steel mounting plate with orifice ring.

- a. Mounting Plate shall be of steel construction, square with streamlined venturi inlet (reversed for supply applications) coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 16 to 18 gauge sheet steel depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.
- b. Fan Blades shall be constructed of aluminium or steel. Fan hub shall be of welded steel construction with blades bolted to the hub. Fan blades and hub assembly shall be statically and dynamically balanced at the manufacturer's works.
- c. Shaft shall be of steel, accurately ground and shall be of ample size for the load transmitted and shall not pass through first critical speed through the full range of specified fan speeds.

- d. Motor shall be standard (easily replaceable) permanent split capacitor or shaded pole for small sizes, totally enclosed With prelubricated sleeve or ball bearings, designed for quiet operation with a maximum speed. Motors for larger fans shall be suitable for $415 \pm 10\%$ volts, 50 cycles 3 phase power supply, and for smaller fans shall be suitable for $220 \pm 10\%$ volts. 50 cycles single phase power supply. Motors shall be suitable for horizontal or vertical service as mentioned in Schedule of Quantities.

PROPELLER FANS

Propeller fans shall be direct driven, three or four blade type mounted on a steel mounting plate with orifice ring.

Mounting plate shall be of steel construction, square with streamlined venturi inlet coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge steel sheet depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

Fan blades shall be constructed of aluminum or glass reinforced polypropylene. Fan hub shall be of heavy welded steel construction with blades bolted to the hub fan blades and assembly shall be statically and dynamically balanced.

Shaft shall be of steel accurately ground and shall not pass through first critical speed through entire range of specified fan speed.

Motor shall be standard permanent split capacitor of shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for a quiet operation with a maximum speed of 1000 RPM for fans 60 cm dia or larger and 1440 RPM for fans 45 cm dia. and smaller. Motors for larger fans shall be suitable for $415 \pm 6\%$ volts. 50 cycle 3-phase power supply and for smaller fans shall be suitable for $220 \pm 6\%$ volts, 50 cycles single-phase power supply. Motors shall be suitable for horizontal or vertical service as indicated in drawings and Schedule of Quantities.

Propeller fans shall be provided with following accessories: -

Wire guard and bird-screen

Gravity louvers at outlet

Regulator for controlling fan speed for single-phase fan motor.

Single-phase preventers for 3 phase fans.

Wiring between regulator and fan motor including termination at both ends.

5. PERFORMANCE DATA

All fans shall be selected for the lowest operating noise level. Capacity rating, power consumption with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of installation.

6. TESTING

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings, power consumption shall be computed from measurements of incoming voltage and incoming current.

SECTION – 5:- FAN SECTIONS – SPECIFICATIONS

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of ventilation fan sections conforming to these specifications and in accordance with the requirement of drawings and 'Schedule of Quantities'.

2. TYPE

Ventilation fan sections shall be complete with Centrifugal Fans, belt driven fans complete with motor drive and housing with weatherproof cowl.

3. UNIT CONSTRUCTION

3.1 Housing

The housing shall be fabricated out of 16 gauge steel sheet and shall have flange to be connected to duct. The discharge cowl shall be hinged along one edge for easy access to motor and drive, for inspection and maintenance. The entire assembly shall be weatherproof and provided with 18 gauge galvanized steel mesh bird screen of 6 mm size on all discharge cowls around the outlet areas.

3.2 Fan

Fan shall be forward / backward inclined wheel type designed for maximum efficiency, minimum turbulence and quiet operation. Fan shall be statically and dynamically balanced.

3.3 Motor

Motors shall be suitable for $415 \pm 10\%$ volts, 50 CPS, 3 Phase AC supply totally enclosed fan cooled motor provided with class 'F' insulation. Motor shall be designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be through belts.

3.4 Back draft Damper

Where called for in schedule of quantities the ventilation fan section shall be provided with a rattle free back draft damper to prevent air from re-entering the fan when fan is not in operation, thus sealing completely in closed position. Damper shall be chatter-proof under all conditions.

4. VIBRATION ISOLATION

The motor and fan assembly shall be isolated from base through Dunlop/Resistoflex vibration isolators.

5. PERFORMANCE DATA

All fans shall be selected for the lowest operating noise level. Capacity rating, power consumption with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of installation.

6. TESTING

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings, power consumption shall be computed from measurements of incoming voltage and incoming current.

SECTION 6:- AXIAL FLOW FANS – SPECIFICATIONS

1. SCOPE

This section covers the technical requirements for manufacture, testing at works, delivery at site, testing after installation, commissioning of axial flow fan equipments for ventilation and exhaust system. Their location shall be as given in 'Schedule of Quantities' and drawings.

The fans shall be complete with all the accessories required for proper installation and performance consisting mainly of the following: -

- (a) Suction and discharge side flanges and counter flanges suitably drilled, complete with bolts & nuts, direct driving electric motor, suspension hangers (for ceiling hung fans only) for vibration isolation (rubber in shear type). Any structural steel and hardware required for assembly, installation, supporting of fan or accessories. 2 mm thick flexible connectors, fire resistant type at suction and discharge end, Foundation bolts and vibration isolators (in case of floor mounting only). Gravity louvers

2. APPLICABLE SPECIFICATIONS STANDARDS AND CODES.

Documents listed below should be read along with the technical data given in the 'Schedule of Quantities' and shall be applicable to the material, manufacture, testing and installation of axial flow fans and accessories.

- (a) I.S.S.: 3588 – 1986; specifications for electric axial flow fans.
- (b) ANSI/ASHRAE: standard 51
- (c) ANSI/AMCA: standard 210 for preparing performance curves, charts and testing of fans
- (d) IS-2312 – Propeller type A.C ventilation fans
- (e) BS – 848 – Methods of performance test for fans

3. DESIGN & MANUFACTURING

Fan and Components

- 3.1 The fan shall be designed to handle the quantity of air against the static pressure and at conditions indicated in the technical data. The fan shall have optimum efficiency at operating conditions and shall have performance characteristics to match the approved performance curves.
- 3.2 The unit shall be factory built to the highest standards to ensure rigidity, maximum mechanical and electrical reliability, quite, stable and vibration free operation at the prescribed conditions of flow, static and speed.
- 3.3 The casing shall be fabricated from heavy gauge sheet steel with suction and discharge ends flanged and complete with counter flanges, G.I. nuts and bolts. The flanges and counter flanges shall be matched and drilled suitably to receive flexible PVC connections. An inspection door with handle and neoprene gaskets shall be provided. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts.

Impeller & Blades

The impeller shall be cast aluminum; aerofoil type with well-balanced blades made from cast aluminum alloy or cast steel construction.

3.4 Drive

The fan hub and blades shall be directly mounted on the shaft of a totally enclosed motor, rotor of fan motor shall be well balanced. The motor shall be TEFC, squirrel cage, IP 55 0– class F and suitable for $415 \pm 10\%$ V, 50 HZ 3 phase AC power supply. The motor shall be dual speed wherever called for in 'Schedule of Quantities'. The maximum motor speed shall be limited to 1450 RPM. Motor conduit box shall be mounted on exterior of fan casing and lead wires from motor to conduit box shall be protected from air stream by enclosing in a flexible metal conduit.

4. TECHNICAL SPECIFICATIONS

- 4.1.1 The firm shall submit the technical data and performance characteristics with operating points duly marked for approval prior to fabrication. The supplier shall supply the test certificates of all the fans.

5. GENERAL REQUIREMENTS

- 5.1 Static, dynamic balancing and vibration: the individual fan impeller, blades, motor shall be statically and dynamically balanced independently. After assembly the entire fan motor unit shall not give rise to any vibrations. The balancing shall be as per ISO: 1940 GR 6.3.
- 5.2 **NOISE LEVEL:** The tendered shall indicate the noise level generated by the fan/motor unit in terms of decibel units to be measured at 3M from the unit. This shall fall in line with best engineering standard.

6. PAINTING

All fans and their accessories shall be painted with two coats of suitable enamel paint after one coat of Red Oxide primer.

7. PACKING

The fans shall be dispatched in packed condition to avoid damage during transportation to site. Transit insurance for the fans shall be included in this offer.

8. INSPECTION & TESTING

All fans shall be subjected to inspection and testing requirements as noted. The contactor shall be responsible for providing all inspection facilities and for conducting all Tests at works. Test certificates for all fans shall be submitted, some fans at the discretion of Client may be tested at the factory in his presence.

The performance of the fan motor unit shall be tested by operating at design conditions. The following parameters will be tested vis-à-vis the approved performance curves

- Airflow capacity
- Static head developed
- BHP requirement
- Vibration and noise level

HEPA FILTER & HEPA FILTER MODULE**DESCRIPTION**

It shall be Single Skin 18G CRCA Powder coated Housings complete with Aluminium powder coated perforated grill (thickness 1.6 mm). The housing is suitable for Hepa Filter having size 2'x2'x1' or as required in boq. The Housing is complete with Measurement Ports (DOP & Pressure Drop). Volume Control Damper shall be provided. S.S. Hardware for filter mounting and zinc plated hardware for back cover and Volume Control Damper shall be provided. Offered Housings are suitable for fixing Flange/cassette/box type Hepa Filters

1. D.O.P. tested point to point scanned **HEPA FILTERS** having following technical specifications :-

- | | |
|---------------------|--|
| a) Frame | - Aluminium. |
| b) Type | - Flange/cassette Type. |
| c) Media | - Micro Fibre Glass (Imported). |
| d) Sealing of media | - By means of epoxy. |
| e) Efficiency | - $\geq 99.97\%$ down to 0.3 micron particle size. |
| f) I.P.D. | - < 25 mm WG |
| g) F.P.D. | - 50 mm WG |
| h) Separators | - Aluminium |

The contractor may use mini pleat HEPA filters in lieu of deep pleat filters.

15 HEPA filter housing specification

Sr.No	Description	Specification
1	Type of HEPA filter housing	Ceiling mounted, suitable for bottom filter loading
2	Provision for duct connection	Top connection/side connection
3	MOC	G I powder coated
4	Thickness	1.6 mm
5	Housing surface finishing from inside	G I powder coated
6	Filter fixing arrangement	Loading from bottom side Pressure plates - One (top) shall fixed and other (bottom) will lose and tightens with clites and bolts
7	Pressure plate size	25 mm x 5 mm
8	Pressure plate MOC	SS 304
9	Grill MOC	SS 304 Capsule perforated with 75% perforation
10	DOP test and on line pressure measurement	Vendor shall provide the port with nipple for DOP test and online pressure measurement
11	External volume control damper and MOC	Volume control damper at housing inlet, bevel gear type arrangement for damper operation from clean room side with sleeve. For MOC and specification of volume control damper pl ref

		specification of "Volume control damper"
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16 Return air riser

Sr.No	Description	Specification
1	Riser details	In built in the panel.
2	Return air riser grill	Push fit type /magnetic catcher type, Capsule Shape perforated sheet 16/18 Gauge thick within built G-4 filter
4	MOC of return air grill	SS 304
5	Return air grill location	300 mm above the Finished floor
6	Damper	Inbuilt in the riser
7	Damper specification	Inbuilt in the riser in powder coated aluminium MOC and operation from clean room side through grill/ after removal of grill. specification of volume control damper refer specification of "Volume control damper"

MOTORIZED COMBINED SMOKE & FIRE DAMPERS – SPRING RETURN

All supply and return air ducts at AHU room crossings (or ducts as applicable) and at all floor crossings shall be provided with approved make fire and smoke dampers of at least 90 minutes fire rating certified by CBRI ROORKEE as per UL 555:1973

Fire damper blades & outer frame shall be formed of 1.6 mm galvanized sheet steel. The damper blade shall be provided on both ends using chrome-plated spindles in self-lubricated bronze bushes. Stop seals will be provided on top and bottom of the damper housing made of 16 g galvanized sheet steel. For preventing smoke leakage side seals will be provided.

In normal position damper blade shall be held in open position with the help of a 24 V operated electric actuators thereby providing maximum air passage without creating any noise or chatter.

The damper shall be actuated through electric actuator. The actuator shall be energized with the help of a signal from smoke detector installed in AHU room/R.A. duct/damper. The A/C Contractor shall also provide smoke detector. The fire damper shall also close due to Temp. rise in S.A. ducts thru the electric temp. sensor factory set at 165 Deg. F micro switches with bake lite base will be provided to stop fan motor and give open & close signal at remote panel in case of motorized actuator.

Each dampers in case of motorized smoke-cum-fire damper shall have its own panel which will incorporate necessary circuit required to step down voltage available from power supply to shown status of the damper (open or close), to allow remote testing of damper & indication in event of damper closure due to signal from smoke sensor/temp. sensor & reset button. Additional terminal will be provided to have signal (sound beep or visual) in central control room.

Damper actuator shall be spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored.

Spring return action of the actuator shall be an in-built mechanism and shall not be mounted externally.

The damper shall be installed in accordance with the installation method recommended by the manufacturer.

10 PAINTING

All grills and diffusers shall be powder coated in color as approved by Engineer-in-Charge before installation.

All ducts immediately behind the grills/diffusers etc. Are to be given two coats of black paint in Matt finish.

11 TESTING

After completion, all duct system shall be tested for air leakage.

The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final balance of air quantity through each outlet shall be submitted to the engineer-in-charge for approval. Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5% in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time.

12. DOCUMENTATION TO MEASUREMENTS

For each drawing, all supply of ductwork must be accompanied by computer-generated detailed bill of material indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct areas by gauge and duct size range as applicable.

Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

13. TESTING

After duct installation, a part of duct section (approximately 5% of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA-“HVAC Air Duct Leakage Test Manual: (First Edition).

20.0 SAFETY CODES - SPECIFICATIONS

1. SCOPE

The scope of this sub-section is the minimum safety requirements to be observed during manufacture and erection of the HVAC system as specified herein in addition to the safety norms generally followed:-

2. I.S. STANDARDS

The safety code for mechanical refrigeration IS: 660 and safety code for air conditioning IS: 659 shall be observed.

3. SAFETY REQUIREMENTS

Some of the important safety requirements are as under but not limited to the same:-

- a) There shall be maintained in a readily accessible place, first aid appliances including adequate supply of sterilized dressings and cotton wool.
- b) The injured person shall be taken to a public hospital without loss of time.
- c) Suitable and strong scaffolds shall be provided for workmen for all works that cannot be safely done from ground.

- d) No portable single ladder shall be over 8 meters in length. The width between side rails shall not be less than 30 cm (clear) and the distance between two adjacent rings shall not be more than 30 cms, when a ladder is used, an extra mazdoor shall be engaged for holding the ladder.
- e) The excavated material shall not be placed within 1.5 meters of the edge of the trench or half of the depth of trenches whichever is more. All trenches and excavations shall be provided with necessary fencing and lighting.
- f) Every opening in the floor of a building or in a working platform to be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be one meter.
- g) No. Floor, roof or other part of the structure shall be so overloaded with debris or material as to render it unsafe.
- h) Workers employed on mixing and handling materials such as asphalt, cement mortar or concrete & lime mortar shall be provided with protective footwear and rubber hand gloves.

Those engaged in welding works shall be provided with protective eye shields and glove.

No paint containing lead or lead products to be used except in the form of paste or readymade paint.

Suitable facemasks shall be supplied for use of workers when the paint is applied in the form of spray or surface having lead paint dry rubbed and scraped.

Overalls shall be supplied by the Contractor to the painter and adequate facilities shall be provided to enable the working painter to wash during cessation of the work.

The ropes used in hoisting or lowering material or as a means of suspension, shall be of adequate quality and adequate strength and free from defects.

All site personnel shall wear safety helmets whenever they are in the construction/erection areas.

22.4 RECTANGULAR DUCT**TRAVERSE REPORT**

PROJECT _____ SYSTEM _____

LOCATION / ZONE _____ ACTUAL AIR TEMP. _____ DUCT S.P _____

DUCT	REQUIRED	ACTUAL
SIZE _____	FPM _____	FPM _____
SQ.FT. _____	CFM _____	CFM _____

POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13
1													
2													
3													
4													
5													
6													
7													
8													
VELOCITY SUBTOTALS													

PROJECT _____

SYSTEM _____

OUTLET MANUFACTURER _____

TEST APPARATUS

[illegible]

TEST DATE _____ **READINGS BY** _____

Note : Please Furnish above report for all grills/diffusers with S.No. marked on respective drawings

24.4 TRAINING OF CLIENT'S PERSONNEL

1. The Vendor/Contractor shall train the Client's engineering personnel in the shops, where the equipments will be manufactured and or in their collaborator's works and where possible, in any other plant where equipments manufactured by the Vendor/Contractor or his collaborator is under installation or test to enable those personnel to become familiar with the equipments being furnished by the Vendor/Contractor, either at his works or at his Sub-Vendor's/Sub-Contractor's works or at site.
2. The period of training shall be adequate and mutually agreed upon by the Client and the Vendor/Contractor.
3. The training shall be so oriented as to make the Client's personnel proficient in operating the equipments.
4. The Client's personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing and replacement procedures to be adopted for the equipments offered.
5. The Vendor/Contractor shall train the Client's/Purchaser's personnel in carrying out minor repairs, if need arises, during the operation of the equipments.
6. The charges for training the Client's/Purchaser's personnel, if any, be included in the price for supply of erection, testing and commissioning.

25.0 TECHNICAL INFORMATION REQUIRED WITH BID

Technical Data Shall be furnished as follows along with manufacturers Capacity charts, Catalogues and Selection Data		
1.	FAN (CENTRIFUGAL) FOR TOILET EXHAUST	
1.1.1	Manufacturer And Model No.	
1.1.2	Fan Discharge Position	
1.1.3	Double or Single Inlet	
1.1.4	Fan Impeller DIA (INCH)	
1.1.5	Forward/Backward Curved	
1.1.6	CFM	
1.1.7	Fan Speed (BHP)	
1.1.8	Motor (HP) And Speeds	
1.1.9	Static Pressure (INCH WG)	
1.1.10	Balance (Static And Dynamic)	
1.1.11	Performance Curves	
2	FAN (PROPELLER)	
2.1.1	Manufacturer And Model No.	
2.1.2	Blade Dia (INCH)	
2.1.3	CFM	
2.1.4	Fan Speed	
2.1.5	Motor (HP)	
2.1.6	Static Pressure (INCH WG)	
2.1.7	Accessories	

a)	Speed Regulator	
b)	Gravity Louvers	
c)	Bird Screen	
d)	Wire Guard	
3	FILTERS (FOR AIR HANDLING UNITS)	
3.1	Type and Material	
3.2	Gross Filter Area (SQFT)	
3.3	Velocity Through Filter (F.P.S.)	
3.4	Pressure Drop Through Filter When New (INCHWG)	
3.5	Efficiency	
4.0	INSULATION	
4.1	Manufacturer and Type	
4.2	Material	
4.3	K Value Density at 10 Deg C Mean Temp.	
4.4	Thickness	
4.5	AHU Room Insulation	
4.6	Under deck Insulation	
5.0	DUCT LINING	
5.1	Manufacturer and Type	
5.2	Material	
5.3	K Value density at 10 Deg C Mean Temp.	
5.4	Thickness	
6.0	INLINE FANS	
6.1	Manufacturer	
6.2	Type	
6.3	Capacity (CFM)	
6.4	Fan dia	
6.5	Fan make	
6.6	Fan Type	
6.7	Motor make	
6.8	Overall dimensions	
6.9	Motor Electrical characteristics	
6.10	RPM	
6.11	Operating Weight	
6.12	Noise Level	
6.13	Type of Drive	
7.0	CONTROLS	
7.1	THERMOSTAT (EACH TYP	
7.1.1	Quantity	
7.1.2	Make & Type	
7.1.3	Model No.	
7.1.4	Range and Differential	
7.1.5	Voltage Requirement	
7.1.6	Pipe insulation	
7.2	MODULATING MOTOR	
7.2.1	Quantity	

7.2.2	Make & Type	
7.2.3	Model No.	
7.3	MODULATING VALVES	
7.3.1	Quantity	
7.3.2	Make & Type	
7.3.3	Size	
7.3.4	Capacity	
7.4	OTHER CONTROLS	
7.4.1	Quantity	
7.4.2	Make & Type	
7.4.3	Model No.	
8.0	GRILLS	
8.1	Make	
8.2	Material	
8.3	Gauge	
8.4	Grills	
8.5	VCDs	
8.6	Fire Dampers	
9.0	ELECTRIC MOTORS	
9.1	Name of Manufacturer	
9.2	Type of Motor & Frame Size	
9.3	Rated Output (KW)	
9.4	Range or Working Voltage	
9.5	NO of Phases & Phase Connections	
9.6	Nominal Frequency	
9.7	Rated Speed (RPM)	
9.8	Rated Current (AMPS)	
9.9	Class of Insulation	
9.10	Temp. Rise With Ambient Air AT 40 DEG C	
9.11	Efficiency & Power Factor At	
	100%	
	75%	
	50%	
	25%	
10.0	PIPING	
10.1	PIPES & FITTINGS	
10.1.1	Manufacturer	
10.1.2	Class	
10.1.3	MS OR GI	
10.1.4	ISI Makes	
10.2	VALVES	
	Make & Material	Test Pressure
		Standard (IS/BS)
10.2.1	Gate Valve	
10.2.2	Globe Valve	
10.2.3	Check Valve	
10.2.4	Balancing Valve	
10.2.5	Butterfly Valve	

10.2.6	Pot Strainers	
10.2.7	'Y' Strainers	
10.2.8	Ball Valve and w/o Strainers	
10.2.9	Pot Strainers	
Note:	Contractors shall submit manufacturers test certificates of all equipments and material with delivery of respective lot	

26.0 LIST OF BUREAU OF INDIAN STANDARD CODES

IS 1239 (Part– I) 1979	Mild Steel Tube
IS 1239 (Part – I) 1982	Mild Steel Tubular and Other Wrought Steel Pipe Fittings
IS 4736 – 1986 (Reaffirmed)	Hot Dip Zinc Coatings of Steel Tubes
IS 823-1964	Code of Procedure For Manual Metal Arc Welding of Mild Steel
IS 780-1984	Service Valves For Water Works Purpose
IS 778-1980	Copper Alloy Gate, Globe and Check Valves For Water Works Purpose
IS 1536-1976	Flanges Configuration
IS 5312 (Part –I) 1984	Swing Check Type Reflux Non Return Valves For Water Works
IS 2379-1963	Color Code For Identification of Pipelines
IS 554-1975	Dimension For Pipe Thread Where Pressure Tight Joints Are Required On Threads
IS 655-1963 (Reaffirmed 1991)	Metal Air Ducts
IS 277-1992	Galvanized Steel Sheet For Fencing
IS 4064 Part II-1978	Specific Requirements For Direct Switches of Individual Motors
IS 3854-1969	Switches For Domestic & Similar Purpose
IS 732 (Part III-1902)	Inspection and Testing of Installation
IS 659 – 1964 (Reaffirmed 1991)	Air Conditioning Safety Code
IS 660 – 1963 (Reaffirmed 1991)	Mechanical Refrigeration (Safety Code)
IS 4894 – 1991	Test Code For Centrifugal Fan
IS 3103 – 1975 Reaffirmed 1994	Code of Practice For Industrial Ventilation
IS 7240 – 1981	Application & Finishing of Thermal Insulation Material
IS 325	Specifications For Three Phase Erection Motor
IS 3142 – 1993	V Grooved Pulley
BS-EN-779 – 1993	Particulate Air Filters For General Ventilation
IS 702 – 1988	Industrial Bitumen
IS 8183 – 1993	Bonded Mineral Wool
IS 2494 – 1993	V Belts For Industrial Purposes
IS 2062 – 1992	General Purpose Steel

ASHRAE Hand Books	American society of heating, refrigeration and air conditioning books - Applications 1999 - Fundamentals 1997 - System and equipments 1996 - Indoor air quality 62 – 1999
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27.0 SYSTEM TESTING ADJUSTMENT AND BALANCING

1. SCOPE

- a) Testing, adjusting and balancing of heating, ventilating and air-conditioning systems at site.
- b) Testing, adjusting and balancing of HVAC Hydronic system at site.
- c) Testing, adjusting and balancing of exhaust system at site.

Comply with current editions of all applicable practices, codes, methods of standards prepared by technical societies and associations including:

ASHRAE: 1999 HVAC Application

SMACNA: Manual for the Balancing and Adjustment for air distribution System

2. PERFORMANCE

- a) Verify design conformity.
- b) Establish fluid flow rates, volumes and operating pressures.
- c) Take electrical power readings for each motor.
- d) Establish operating sound and vibration levels.
- e) Adjust and balance to design parameters
- f) Record and report results as per formats specified.

3. DEFINITIONS

Test: To determine quantitative performance of equipments.

Adjust: To regulate for specified fluid flow rates and air patterns at terminal Equipments (e.g. reduce fan speed, throttling etc.)

Balance: To proportion within distribution system (sub mains, branches and Terminals) in accordance with design quantities.

4. TESTING, ADJUSTING AND BALANCING (TAB) PRECEDURES

The following procedures shall be directly following in TAB of the total system.

Before commencement of each one of the TAB procedure explained hereunder, the contractor shall intimate the Project Manager about his ready to conduct the TAB procedures in the format given in these specifications.

5. DESCRIPTION OF SYSTEM AND REQUIREMENT

Adjust and balance the following system to provide most energy efficient operation compatible with selected operating conditions.

- All supply, return and outside air systems.
- All exhaust air systems
- All chilled water systems.
- All cooling tower (condenser) water systems.
- Emergency purge systems

6. AIR SYSTEMS

a) Air Handlers Performance

The TAB procedure shall establish the right selection and performance of the AHUs with the following results.

- Inlet air Dry and Wet bulb temperatures.
- Outlet air Dry and Wet bulb temperatures.
- Air leaving dew point temperature
- Sensible heat Pickup
- Latent heat Pickup
- Sensible hat factor

b) Air distribution

Both supply and return air distribution for each AHU and for areas served by the AHU shall be determined and adjusted as necessary to provide design air quantities. It shall cover balancing of air through main and branch ducts utilizing telescoping probes of Electronic Rotating Vane Anemometers and Accubalance for grilles and diffusers.

c) The Preparatory work

To conduct the above test, following preparatory works are required to be carried out including the availability of approved for construction shop drawings and submittals.

All outside air intake return air and exhaust air dampers are in proper position.

All system volume dampers and fire dampers are in full open position.

All access doors are installed & are airtight.

Grilles are installed & dampers are fully open.

Provision and accessibility of usage of TAB instruments for transverse measurements are available.

All windows, doors are in position.

Duct system is of proper construction and is equipped with turning vanes and joints are sealed.

7. HYDRONIC SYSTEM BALANCING

The Hydronic system shall involve the checking and balancing of all water pumps. Piping network (main & branches), the heat exchange equipments like cooling and heating coils, condensers and chillers and cooling towers in order to provide design water flows.

The essential preparation work, must be done by the HVAC contractor prior to actual testing, adjusting and balancing of HVAC system and ensure following:

Availability of co-ordinate drawings and approved submittals and system sketch with design water flows specified thereon.

Hydronic system is free of leaks, is hydrostatically tested and is thoroughly cleaned, flushed and refilled.

Hydronic system is vented.

The contractor shall confirm completion of the basic procedures and prepare checklists for readiness of system balance.

Check pumps operation for proper rotation and motor current drawn etc.

Confirm that provisions for TAB measurements (Temperature, pressure and flow measurements) have been made.

Open all shut-off valves and automatic control valves to provide full flow through coils. Set all balancing valves in the preset position, if these values are known. If not, shut all riser balancing valves except the one intended to be balanced first.

Balancing work for both Chilled Water System and Condenser Water System shall be carried out in a professional manner and test reports in the specified format shall be prepared and presented to the Consultant / Project manager for approval.

8. **READINESS FOR COMMENCEMENT OF TAB**

Prior to commencement of any test, the readiness to do so should be recorded as per the prescribed checklist.

9. **TAB INSTRUMENTS**

1. Air measuring Instruments

- a) For measuring DB and WB temperature, RH and dew point, microprocessor based TSI USA make VelociCalc Plus Meter, Model 8386, or equivalent shall be used. This instrument shall be capable of calculating the sensible, latent total heat flows, sensible heat factor and give printouts at site and have data logging/downloading facility.
- b) For measuring Air velocity, DB temperature and Air volume, TSI USA make VelociCalc meter model 8345 or equivalent shall be used. It shall be able to provide instant print out of recorded Air Volume readings.
- c) Pitot tube.
- d) Electronic Rotary Vane Anemometer TSI make or equivalent.
- e) Accubalance Flow Measuring Hood TSI make or equivalent.

[All above instruments shall have NIST testification (US Institute of Science and Technology) Calibration Certificate]

2. Hydronic Measuring Instruments

For measurement of water flow differential pressure and temperature, CBI measuring instrument Tour & Anderson AB Sweden or equivalent shall be used. The instrument shall have a built-in microcomputer capable of giving readings for pressure differential flow rate and temperature.

3. Rotation Measuring Instrument

Electronic Digital Tachometer

4. Temperature & RH Measuring Instrument

TSI VelociCalc model 8386 and VelociCalc model 8345 or equivalent.

5. Electrical Measuring Devices

Clamp on Volt ammeter

Continuity Meter

6. Vibration and Noise Levels

Vibration and alignment field measurements shall be taken for each circulating water pump, water chilling unit, air handling unit and fan driven by a motor over 10 HP. Readings shall include shaft alignment, equipments vibration, bearing housing vibration, and other test as directed by the Project

Manager.

Sound level readings shall be taken at ten (10) locations in the building as selected by the Project Manager. The readings shall be taken on an Octave Band Analyzer in a manner acceptable to him. The contractor shall submit test equipments data and reporting forms for review. In order to reduce the ambient noise level the readings shall be taken at night. All tests shall be performed in the presence of Consultant / Project Manager.

CHAPTER K**TECHNICAL SPECIFICATIONS FOR LIFTS****TECHNICAL DATA SHEET****Speed Proposed: 1m/sec for passenger lift & 0.5 m/sec for service lift, Car height:2.2m****Passenger Lift**

Sl. No.	Details	No. of Stops/ Floors	Travel Distance (m)	Lift Well Size (in mm)	Car Inside Size (in mm)	Quantity	Capacity	Speed (m/sec)
1.	G+2	3	12	2500 (W) x 1900 (D)	2000 (W) x 1100 (D)	1	13 Persons	1

(SERVICE Lift):

Sl. No.	Details	No. of Stops/ Floors	Travel Distance (m)	Lift Well Size (in mm)	Car Inside Size (in mm)	Quantity	Capacity	Speed (m/sec)
1.	G+2	3	12	2300 (W) x 2100 (D)	1400 (W) x 1800 (D)	1	1000kg	0.5

TECHNICAL SPECIFICATIONS

1. Sizes:
For all lifts: Lift well size, Car size, Car opening as per Technical Data Sheet
2. Drive: Variable voltage variable frequency drive
3. Material:
 - a. Car walls shall be made up of stainless steel (minimum 1 mm thick) with Moon rock / Etched pattern/ Honey Comb finish and car ceiling shall be made of stainless steel with 'Hairline' finish.
 - b. Floor: 2mm thick anti skid PVC tiles flooring for all Lifts (PASSENGER & SERVICE).
4. Ventilation:
Suitable no. of fans with steel grills shall be provided inside the car. Separate inverters of suitable capacity with maintenance free batteries shall be provided in each machine room. The same inverter shall feed the lighting & alarm bells of the lifts also which are housed in this machine room.
5. Lighting:

Each car shall have a minimum of 4 Numbers LED fittings for lighting suitable to provide 200 lux in the car.

6. Car Position Indicator:

Digital car position indicator shall be provided inside the car at a height of at least 2000 mm from floor level.

7. Car Operating Panel: Car operating panel shall have the following:

- i. Key operated switch marked to indicate 'attendant' / automatic operation.
- ii. Micro stroke push buttons for each floor.
- iii. Emergency stop push button.
- iv. Emergency alarm push button.
- v. Up / Down direction push buttons.
- vi. Non-Stop push button.
- vii. Overload warning audio visual indicator.
- viii. Suitable press & speak intercom for communication from the car to respective machine room and control room at ground floor.
- ix. Door open and door close push buttons.
- x. Suitable emergency light with maintenance free battery with suitable battery charger.
- xi. Telephone outlet: One plug in socket in lift car with necessary cable pair in trailing cable and the terminal outlet provided in machine room.

8. Lift instructions:

Steel plate containing following instructions shall be provided inside each lift car:

- i. Lift number ____
- ii. Capacity ____ Kg, ____ persons.
- iii. No smoking.
- iv. Operate push buttons/ switches correctly.
- v. Do not lean against the lift door.
- vi. Watch before stepping out.
- vii. Do not panic in the event of break down. Press alarm button & follow instruction of the authorized staff.

Steel plate containing following instructions shall be provided / outside each lift car, on all floors:

- i. Lift number ____
- ii. Capacity ____ Kg, ____ persons.
- iii. Please stand in 'Q'.
- iv. Smoking not permitted inside the lift car.
- v. Passenger travel at their own risk.
- vi. Please keep the lift neat and clean.
- vii. Do not force open the landing door.
- viii. Watch before you step into and out of the lift car.
- ix. Heavy article/ luggage not allowed. (only outside the passenger lifts)
- x. Avoid use of lift during fire.
- xi. Complaints if any may be sent Assistant Engineer (Electrical).

9. Car Door:

Horizontal sliding, power operated (AC/ DC gearless), stainless steel doors with Moon rock / Etched pattern/ Honey Comb finish, operation of door shall be automatic & car door shall have re-opening arrangement by electronic door detectors / Infrared curtain covering the entire width & height of the door and door pressure limiter as secondary door safety..

10. Landing door:

Stainless steel door with Moon rock / Etched pattern/ Honey Comb finish with centre opening/ side opening, power operated horizontal sliding doors (matching with the respective car door). The landing door and car door shall be mechanically connected so as to open or close simultaneously. The landing door shall have fire rating of ONE hour.

11. Sill Projection:

Necessary sill projection of M.S. shall be provided by the firm along with facia plate as required as per relevant code.

12. Control & indicators on landings:

- a. Two number Micro stroke push buttons (One with 'UP' arrowhead & other with 'DOWN' arrowhead) for all intermediate landings and Single Micro stroke push button (with 'UP' / 'DOWN' arrowhead) for terminal landings.
- b. Hall lantern to indicate the Up / Down direction of motion of lift at the time of car's arrival along with electronic chime, separate for each lift.
- c. Digital car position indicator at all landings separate for each lift.
- d. Alarm bell, separate for each lift, at ground floor landing with stainless steel cover and shall be fed from inverter.
- e. Fireman's switch (toggle switch) at ground floor landing with break glass cover, separate for each lift.

13. Motor:

Motor shall be squirrel cage induction motor with high starting torque, insulation class – 'F'.

14. Electrical protection:

Suitable protection to protect the machine against phase reversal and failure of any one phase shall be provided. Over current, under voltage, over voltage and earth leakage protection shall also be provided.

15. Electrical wiring and cabling:

All electrical wiring shall be with copper conductor wire with flame resisting, moisture proof insulation and will run in heavy gauge metal conduit/ G.I. casing. The trailing cable between the car and lift well will be multi core type, designed for lift services and will have flame resisting, moisture proof covering. Cables should be with ISI mark. All wiring and earthing etc. shall conform to IE Rules and Regulations.

16. Leveling accuracy:

Every lift car shall stop at landing (other than car switch control) with car sill fairly in level (+ 5 mm) with landing sill.

17. Counter weights:

All counter weight sections shall be carried in a structural steel frame and secured by at least two tie rods passing through holes in all the sections. The factor of safety of counter weight sections of wrought iron and steel shall not be less than five. All counter weights shall be of metal and shall travel between rigid guide rails. (Note: Manufacturer's test certificate will have to be supplied)

18. Terminal buffers:

Terminal buffers shall be installed as a means of stopping the car and counter weights beyond the limits of travel as per Lift Rules and shall be spring or oil buffers. Buffers in the pit shall be mounted on steel channel or on suitable concrete blocks.

19. Guide:

Steel 'Tee' section guide shall be provided for the car and counter weights. At least the guides for the car shall be machined.

20. Safety gear and over speed governor:

Every lift shall be provided with one or more safety devices, attached to the lift car. The safety devices shall be capable of stopping and sustaining the lift car with full rated load in the car at governor tripping speed. Each lift shall be equipped with an over-speed governor device which operates to apply the safety gear in the event of the speed of the lift car in the descending direction exceeding a predetermined limit.

21. Ropes:

Chain shall not be used for the suspension of a lift. Not less than three independent suspension ropes shall be used for car or counter weights of any lift. The minimum diameter of the ropes for cars & counter weights of passengers and goods lifts shall be 12mm. The factor of safety of suspension ropes shall not be less than 11. (Note: Manufacturer's Test Certificate will have to be supplied)

22. Automatic rescue device:

ARD shall be provided to move the car automatically (with the help of maintenance free battery) up /down to bring it to the nearest landing in case of failure of power supply.

23. Lift Announcement:

The lift shall be provided with floor announcement system with volume control.

24. Load weighing device:

Elevator shall be provided with load weighing device, overload indicator and announcement in the car as mentioned above. The car doors will not close in case the overloading.

25. Steel Ladder: A Steel ladder should be provided in the pit.

26. Vibration Isolation:

Vibration isolation arrangement shall be provided to prevent transmission of vibration to the building and structure.

27. General:

- a. Work shall be carried out as per CPWD specifications unless otherwise specified.
- b. All lift equipment and installation shall conform to the relevant IS Standards, as under:

Outline dimensions	IS 14665 (Part 1): 2000
Installation, operation and Maintenance	IS 14665 (Part 2): 2000
Safety rules	IS 14665 (Part 3): 2000
Components	IS 14665 (Part 4): 2000
Flexible cables	IS 4289 (Part 2): 2000

And list of IS codes for Lift installations applicable is given below:

1.	Code of Practice for installation, operation and Maintenance of electric passenger & goods lifts.	IS-1860
2.	Code of Practice for installation, operation and Maintenance of electric service lift.	IS-6620
3.	Specification for electric passenger & goods lifts	IS-4666
4.	Electric service lift.	IS-6383
5.	Online dimension for electric lifts	IS-3534
6.	Code of practice for installation and maintenance	IS-4591
7.	Specification for steel wire suspension ropes for lifts & hoists.	IS-2365
8.	Glossary of terms relating to wire ropes	IS-2363
9.	Specification for lifts cables	IS-4289
10.	Glossary of terms for electrical cables & conduits	IS-1591
11.	Specification for rubber insulated cables	IS-434/1
12.	Specification for varnished, cotton cloths & tape for electrical purpose	IS-3352
13.	Specification for lift door locking devices and contracts	IS-7759
14.	Specification for hot rolled and slit steel bars	IS-1173
15.	Method of loading rating of worm gear	IS-7443
16.	Code of practice for selection for selection of standard worn and helical gear box	IS-7403
17.	Isometrics screw threads	IS-4218
18.	Degree for protection provided by enclosure for low voltage switchgear and control gear	IS-2147
19.	Specification for HRC cartridge fuse links upto 650 volts.	IS-2208
20.	Code of practice for electrical wiring installation (system voltage not exceeding 650 volts).	IS-732
21.	Voltage & frequency for AC transmission & distribution system	IS-5850
22.	Specification for AC contractors voltage not exceeding 1000V	IS-2959
23.	Heavy duty air break switched & composite unit of air break switches & composite unit of air break switches and fuses for voltage not exceeding 1000 volts.	IS-4047
24.	General requirements for switch gear & controller for voltage	IS-4237

	not exceeding 1000 volts.	
25.	Specification for motor starter of voltage upto 650 V	IS-1822
26.	Nomenclature of floors & storeys	IS-2332
27.	Code of practice for sound insulation of non industrial building	IS-1950
28.	Code of practice for installation & maintenance of inducting motors	IS-906
29.	Specification for three phase induction motor.	IS-235
30.	Guide for testing three induction motor	IS-4029
31.	Specification for degree of protection provided by enclosure for rotating electrical machinery	IS-4691
32.	Designation of method of cooling for rotating electrical machines.	IS-6362
33.	Classification of insulating materials for electrical machinery and	IS-1271
34.	apparatus in relation to their thermal stability in service.	
35.	Code of practice for earthing.	IS-3043
36.	Electrical installation fire safety of building	IS-1646
37.	Code of practice for the protection of buildings and allied structures against lightning	IS-2309
38.	Specification for hoist way door locks	IS-7754
39.	Rules for the design, installation, testing and operation of the lifts, escalator and moving parts.	IS-1735
40.	Electrical Traction Lift.	IS-14665

- c. Suitable scaffolding in the hoist way, cutting work and all minor civil works, if any, required shall be done by the firm without any extra cost.
- d. All steel items in machine room and hoist way shall be provided by the firm without any extra cost. However, lifting arrangement in the lift machine room shall be provided by MOHFW/HLL.
- e. After handing over of the site to the firm, all the landing door openings shall be suitably protected by the firm to avoid any miss happening.
- f. All exposed metal parts will be painted with good quality anticorrosive paint after erection and before commissioning of the lift.

CHAPTER L

TECHNICAL SPECIFICATIONS FOR BUILDING MANAGEMENT SYSTEM (BMS)

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings, as in attached Input/Output Summary and as described herein. Drawings are diagrammatic only.
- B. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Client.
- C. Client shall be the named license holder of all software associated with any and all incremental work on the project(s).

1.2 SYSTEM DESCRIPTION

- A. The entire Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via Bacnet/Sedona communication protocols to a Network Area Controller (NAC) / Router.
- B. The entire Integrated Control and Monitor Management System (IBMS) shall be comprise of a network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility (when specified) and communicating via the Internet to a host computer in a remote location. The IBMS shall communicate to third party systems such as Chillers, Boilers, Air-Handling Systems, Energy metering systems, Lighting Management System & other energy management systems, Fire-Life safety systems and other building management related devices with open, interoperable communication capabilities.
- C. The IBMS framework shall utilize JAVA based automation products and services with built-in Internet connectivity to a broad range of distribution partners in the building automation, energy services, power/utility, and industrial sectors. The Framework shall bring together the computerization of control applications under the umbrella of single integrated system architecture. The suite of component software applications shall support true plug-and-play, multi-vendor interoperability, resulting in lower automation and information infrastructure costs. The Network Area Controllers (NAC's) shall run a JAVA Virtual Machine (JVM) platform and use a common set of tools for accessing and integrating multiple protocols.
- D. The Building Management System (BMS) shall be comprised of Network Area Controller or Controllers (NAC) / Routers. The NAC / Router shall connect to the local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to Bacnet/Sedona and/or BACnet Direct Digital Controllers (DDC) and other open protocol systems/devices.
- E. Following software packages shall be loaded into the system as minimum standard :-
 - a. Complete system operational software
 - b. Site specific data manipulation software
 - c. Active graphics software
 - d. Energy management system software
 - e. Alarm indication software

- g. Data Visualization Package
- h. Internet Enabled Remote Monitoring Package.

1.3 SUBMITTAL

- A. Copies of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package. BMS contractors supplying products and systems, as part of their packages shall provide catalog data sheets, wiring diagrams and point lists to other contractors for proper coordination of work.
- B. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol. BMS contractors shall provide these diagrams for their portions of work; the Systems Integrator shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN).
- C. Submittal shall also include a complete point list of all points to be connected to the BMS.
- D. Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. BMS contractors shall provide as-built for their portions of work. The BMS contractor shall be responsible for as-built pertaining to overall BMS architecture and network diagrams. All as-built drawings shall also be installed into the BMS server in a dedicated directory.

1.4 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:

FMCS	Facility Management and Control System
BMS	Building Management System
NAC	Network Area Controller
DDC	Direct Digital Controller
IBC	Interoperable BACnet Controller
GUI	Graphical User Interface
WBI	Web Browser Interface
PMI	Power Measurement Interface
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement

1.5 DIVISION OF WORK

- A. The BMS contractor shall be responsible for all controllers (DDC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.
- B. The BMS contractor shall also be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of

all graphical screens, Web browser pages, setup of schedules, logs and alarms, Sedona/Bacnet network over IP management and connection of the NAC to the local or wide area network.

1.6 AGENCY AND CODE APPROVALS

- A. All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
1. UL-916; Energy Management Systems
 2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "signal Equipment"
 3. CE
 4. FCC, Part 15, Class A Computing Devices.
 5. RoHS Compliant

1.7 SOFTWARE LICENSE AGREEMENT

- A. The CLIENT shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Engineer-in-Charge as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.
- B. The CLIENT shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, CLIENT shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, BMS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the Client. The Client shall determine which organizations to be named in the SI organization ID ("orgid") of all software licenses. Client shall be free to direct the modification of the "orgid" in any software license, regardless of supplier.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.9 JOB CONDITIONS

- A. Cooperation with Other Contractors: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

PART 2 MATERIALS

2.1 GENERAL

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein. All systems and software within BMS shall be Year 2000 compliant and shall be supported by compliance documentation from the manufacturer.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, LonWorks technology, MODBUS, OPC, Sedona-Sox Network and other open and proprietary communication protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards, BACnet and Sedona-Sox Network to assure interoperability between all system components is required. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet/ Sedona-Sox Network devices shall be via Ethernet (BACnet/Sedona over Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.
- C. All components and controllers supplied under this Division shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a host to pass data shall not be acceptable.
- D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network. Systems employing a “flat” single tiered architecture shall not be acceptable.
 - i. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - ii. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

PART 3

3.1 NETWORKS

- A. The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.
- B. Local area network minimum physical and media access requirements:
 - 1. Ethernet; IEEE standard 802.3

2. Cable; 100 Base-T, UTP-8 wire, category 5
3. Minimum throughput; 100 Mbps.

3.2 NETWORK ACCESS

A. Remote Access.

For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The CLIENT shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

3.3 NETWORK AREA CONTROLLER (NAC) / ROUTER

- A. The BMS contractor shall supply one or more Network Area Controllers (NAC) / Router as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided in IO Summary.
- B. The Network Area Controller (NAC) / Router shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC / Router. It shall be capable of executing application control programs to provide:
 1. Calendar functions
 2. Scheduling
 3. Trending
 4. Alarm monitoring and routing
 5. Time synchronization
 6. Integration of LonWorks controller data and BACnet controller data
 7. Network Management functions for all LonWorks based devices
- C. The Network Area Controller must provide the following hardware features as a minimum:
 1. One Ethernet Port – 10/100 Mbps
 2. One RS-232 port
 3. One LonWorks Interface Port – 78KB FTT-10A
 4. One RS-485 ports
 5. Battery Backup
 6. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 7. The NAC / Router must be capable of operation over a temperature range of 32 to 122°F
 8. The NAC / Router must be capable of withstanding storage temperatures of between 0 and 158°F
 9. The NAC / Router must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

- D. The NAC / Router shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC / Router shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
- E. The NAC / Router shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.
- F. Event Alarm Notification and actions
 - 1. The NAC / Router shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - 2. The NAC / Router shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
 - 3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - a. To alarm
 - b. Return to normal
 - c. To fault
 - 4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: Electricals, HVAC, Fire, etc.
 - 5. Provide timed (schedule) routing of alarms by class, object, group, or node.
 - 6. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- G. Control equipment and network failures shall be treated as alarms and annunciated.
- H. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1. Screen message text
 - 2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 - 3. Pagers via paging services that initiate a page on receipt of email message
 - 4. Graphic with flashing alarm object(s)
 - 5. Printed message, routed directly to a dedicated alarm printer
- I. The following shall be recorded by the NAC / Router for each alarm (at a minimum):
 - 1. Time and date
 - 2. Location (building, floor, zone, office number, etc.)
 - 3. Equipment (air handler #, accessway, etc.)
 - 4. Acknowledge time, date, and user who issued acknowledgement.
 - 5. Number of occurrences since last acknowledgement.

- J. Alarm actions may be initiated by user defined programmable objects created for that purpose.
 - K. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
 - L. A log of all alarms shall be maintained by the NAC / Router and/or a server (if configured in the system) and shall be available for review by the user.
 - M. Provide a “query” feature to allow review of specific alarms by user defined parameters.
 - N. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
 - O. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
- 3.4 Data Collection and Storage
- A. The NAC / Router shall have the ability to collect data for any property of any object and store this data for future use.
 - B. The data collection shall be performed by log objects, resident in the NAC / Router that shall have, at a minimum, the following configurable properties:
 - 1. Designating the log as interval or deviation.
 - 2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 - 3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 - 4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 - 5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
 - C. All log data shall be stored in a relational database in the NAC / Router and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.
 - D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
 - E. All log data shall be available to the user in the following data formats:
 - 1. HTML
 - 2. XML
 - 3. Plain Text
 - 4. Comma or tab separated values
 - F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
 - G. The NAC / Router shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC / Router on the network. Provide the ability to configure the following archiving properties, at a minimum:
 - 1. Archive on time of day

2. Archive on user-defined number of data stores in the log (buffer size)
3. Archive when log has reached it's user-defined capacity of data stores
4. Provide ability to clear logs once archived

3.5 AUDIT LOG

- A. Provide and maintain an Audit Log that tracks all activities performed on the NAC / Router. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC / Router), to another NAC / Router on the network, or to a server. For each log entry, provide the following data:
1. Time and date
 2. User ID
 3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

3.6 DATABASE BACKUP AND STORAGE

- A. The NAC / Router shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
- B. Copies of the current database and, at the most recently saved database shall be stored in the NAC / Router. The age of the most recently saved database is dependent on the user-defined database save interval.
- C. The NAC / Router database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

3.7 DIRECT DIGITAL CONTROLLERS (DDC)

IP Based Building Automation Controllers, Sedona Framework

The Controller should have the ability to have true open source standards, using IP Based Ethernet connectivity. These include Modbus Server and Client at TCP and RS485 level, and also the BMS leading protocol BACnet, supporting both Client and Server at the TCP/IP and mstp levels.

Controller should have Sedona Framework, which is an open source development framework , should provide a complete software platform for developing, deploying, integrating, and managing pervasive device applications at the lowest level. The Sedona Framework distributes decision making control and manageability to any device and brings intelligence and connectivity to the network edge, and back.

DDC controller should be an open system that allows products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. DDC Controls, to embrace the conversion of IT, Infrastructure, internet, intranets, and to adopt the open source implementation of an Ethernet based DDC Framework. It is required that Manufacturers that embrace the Sedona open source standard, do so, in a way that ensures that programs (Objects and Kits) can be deployed across all manufacturers platforms, without changes, and different engineering tools having to be deployed, to achieve the same result.

DDC Features available as standard at the IP embedded Controller level shall incorporate the following:

- Utilizes the industry standard Niagara AX Workbench tool, with no need for special licenses
- Can also be programmed with 2 other independent tools from the Sedona Ecosystem Community
- Ability to store onboard 80 Million history records
- Built in SQL Lite Database and Management Tool

- Ethernet Client/Server Peer to Peer
- Built-in html5 Graphics, multi lingual display to Smartphone or browser
- Email alarms
- Built in BACnet Server and Client, Onboard IP and mstp (up to 31 external devices) levels
- Built in Modbus Server and Client, at the TCP and RS485 (up to 31 external devices) levels
- Web Services, for REST interfaces, and push data to cloud data services
- Web based, using Open Web Server and built-in SQL Lite Server, and, PHP5 and html5.
- No Browser Plugins are allowed, this includes proprietary plugins, Flash and JAVA
- Two 32 bit Processors, one for the main engine and one for the I/O and BACnet mstp port
- 12 bit A to D inputs, with math oversampling to achieve 16 bit.
- 12 bit A to D outputs
- On board, 16 Mbyte Nor Flash, 64 Mbyte SDRAM, and Micro SD Card (up to 16GB)
- On-board Logging with graphical and tabular format, synchronized to the Niagara Framework
- Supports Modbus, BACnet and Sedona, concurrently
- Ability to read Modbus Meters and count pulses on every UI input at 20Hz.
- Totalizer points would support Math resolution of 15 digits, or 999,999,999,999,999
- On board RTC
- Optimization for Heating and Cooling
- Psychometrics Calculations
- Degree Days Calculations
- Ability to write and compile custom programs, and utilize in other manufacturers controls.
- Minimum of 20 point I/O controller

Other Capabilities/Features required as below:

Language: This is a general purpose component oriented programming language very similar to Java or C#. The Sedona language is used to write custom functionality.

Sedona Virtual Machine: The Sedona virtual machine is a small interpreter written in ANSI C and designed for portability. It allows code written in the Sedona programming language to be written once, but run on any Sedona device. The VM itself is designed to be highly portable to new microprocessors and operating systems.

Java Support: The Sedona compiler also generates standard Java byte code, which allows the Sedona code to run on the Java VM, too.

Component Oriented Programming: Sedona enables a style of programming where prebuilt components are assembled into applications. Components can act as services or be explicitly linked together to create data and control flow. This model is especially suited to graphical programming tools.

Networking: Several protocols are bundled with Sedona to provision, program, and communicate with Sedona-enabled devices over various network topologies. The Controllers can remotely add, remove, and modify the components in the application, in real-time

Open Source Ecosystem

The Ethernet port should give connection to IP networks and it should utilize the Sedona-SOX protocol or TCOM for communication with the Niagara AX Framework®. It should seamlessly integrate with an associated JACE®(Network controller) to provide management functions such as site-wide control strategies, histories, schedules and alarming.

The RS485 port, when used in conjunction with the controller operating in IP mode, can read and control other Modbus devices, such as VSD's and Power Meters. In the IP mode, the Controller concurrently, supports BACnet IP, SOX, Modbus and IP and Modbus Slave.

3.8 GRAPHICAL USER INTERFACE SOFTWARE

A. Operating System:

1. The GUI shall run on Microsoft Windows Server .

- B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

- C. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
3. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - b. Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.
5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

- D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

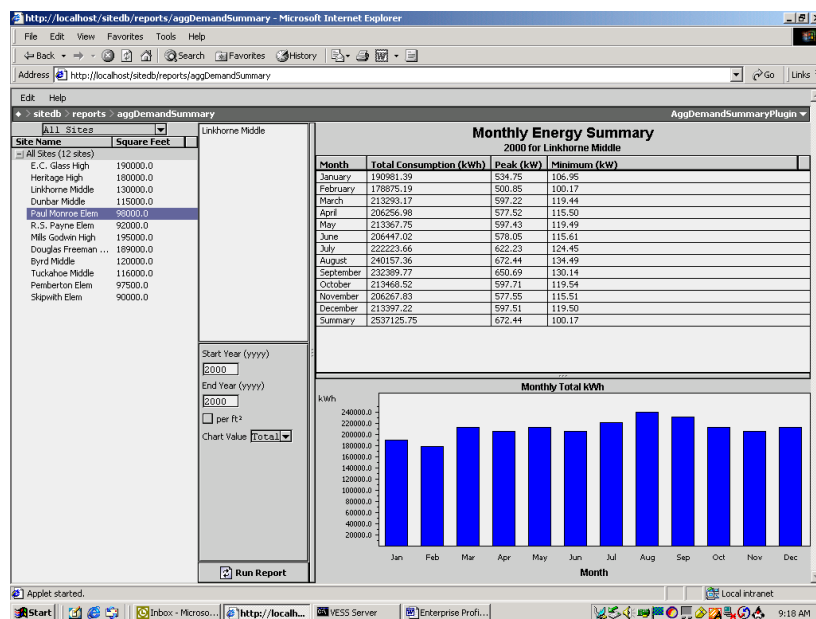
- a. Create, delete or modify control strategies.
- b. Add/delete objects to the system.
- c. Tune control loops through the adjustment of control loop parameters.
- d. Enable or disable control strategies.

- e. Generate hard copy records or control strategies on a printer.
 - f. Select points to be alarmable and define the alarm state.
 - g. Select points to be trended over a period of time and initiate the recording of values automatically.
- E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- F. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- G. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- H. Programming software shall be same as GUI. The Same GUI can be used to configure the DDCs & NAC.
- I. Alarm Console
- 1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
 - 2. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and unacknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

SPECIAL ENERGY MANAGEMENT REPORTING AND PROFILING APPLICATIONS

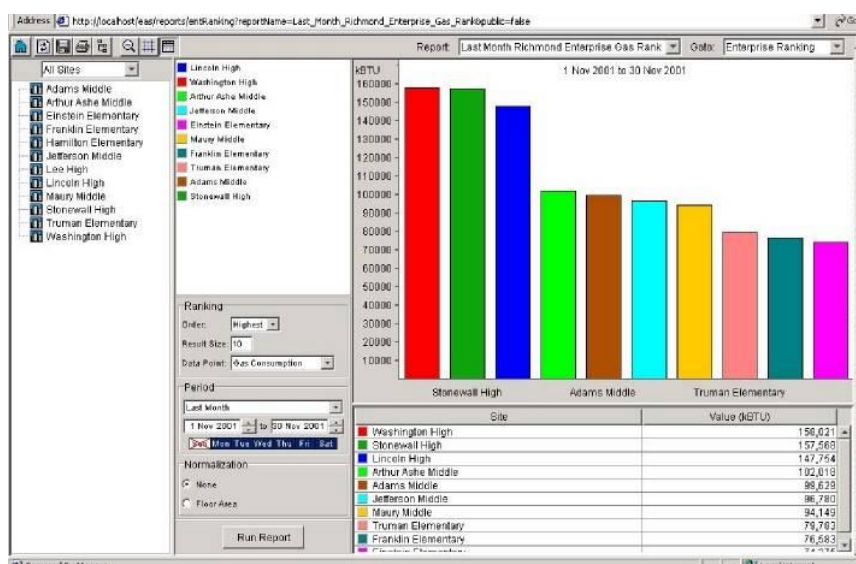
These reports are defined below.

1. **Aggregate Demand Summary** - This report aggregates (totalizes) multiple points (meters) and shows the peak, minimum, average, and total consumption as well as computes load factor. By reducing peak consumption and leveling the total load, volatility is reduced and energy customers can make significant improvements in their energy procurement. This report will help identify favorable aggregation combinations and unattractive peaks. Once the user selects this report, they define parameters such as sites, meters, time period, and commodity. The following screen shot is an example of Aggregate Demand Summary.



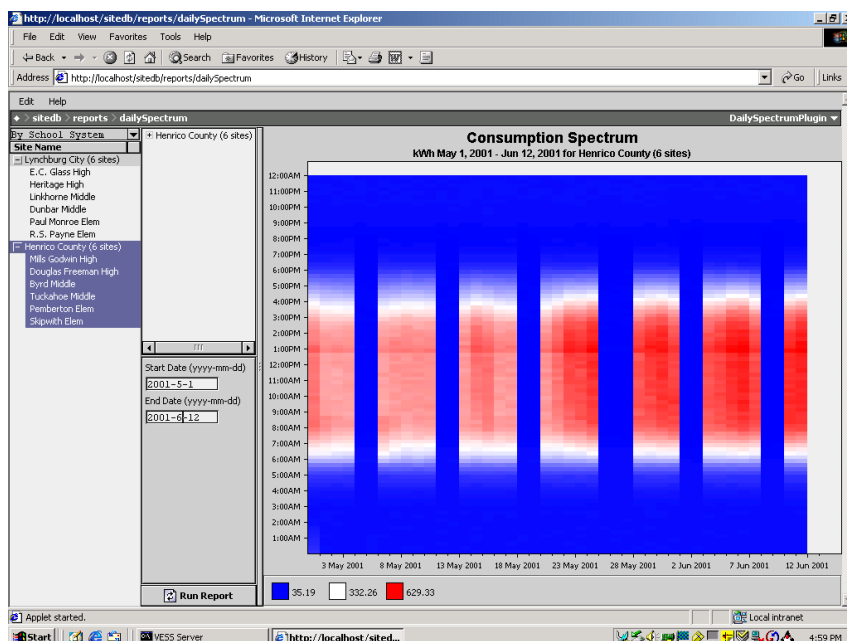
2. **Summary Ranking Reports** - By selecting this report, the user can identify the 10 worst or 10 best sites in the database. Once the report type has been selected, parameters to define before the report can be generated will include the following:

- Measurement unit – KW, therms, CCF gallons, PSI, etc. The database will search for all values matching the request.
- Compare an entire facility or normalize by square foot
- Time periods to compare
- Highest values or lowest values – Will be able to view either the best or worst 10 points matching the defined parameters
- Cost or consumption in future revisions

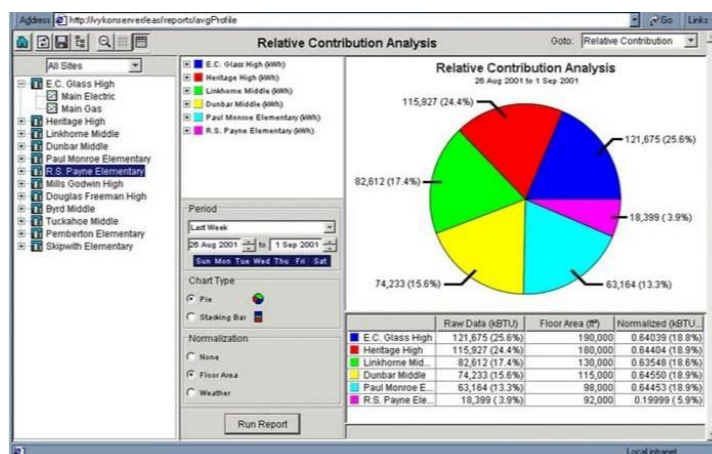


3. **Spectrum Summary Report** – A quick view of any point or aggregated point with color coding identifying the reasonableness of the data value. The chart can report on up to one year of data, with the ability to zoom to a higher definition. As data values approach and/or exceed historical ranges, the color on the graph will change to identify such. If all data values are within historical ranges, the user can move on to other functions. In the following screen shot, the Spectrum Summary Report is

reporting on total electricity for an aggregated point, which consists of 6 schools. The reporting period is six weeks, with the blue identifying low loads overnight and on weekends. The fourth weekend in the report was a three day weekend which is identified by a larger blue gap. A user can also see rising consumption (red) as temperatures rise going into the summer season. When the user clicks on an area of the graph, the data value along with time stamp will appear. The colors and associated data value ranges are user definable. The following screen shot is an example of the Spectrum Summary Report.

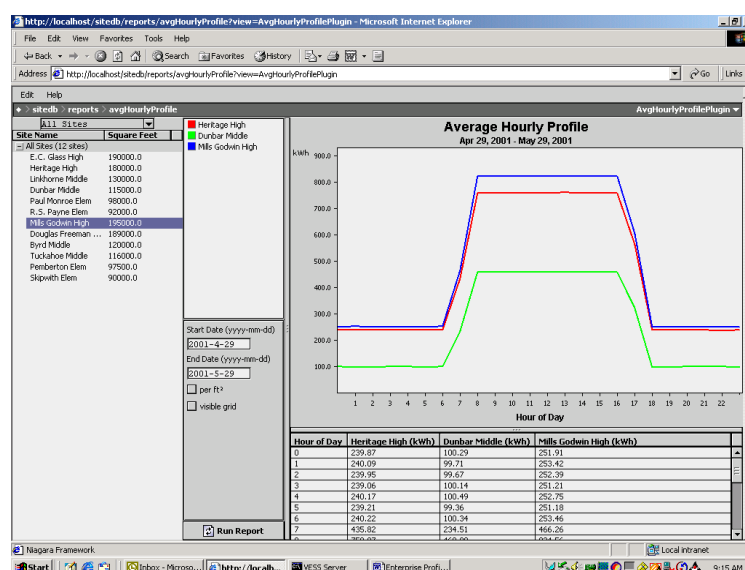


4. **Equipment Operation Reports** - Users will have the ability to analyze digital points and identify run times. Comparisons between sites or points can be made and run times can be graphed. For example, comparing lighting or HVAC run hours in a group of stores or comparing HVAC run hours in June for Store 1 versus Store 2. Data will be displayed in time and percentage.
5. **Relative Contribution Report** – This pie chart report will give users the ability to identify how individual points contribute to a total from a point group. The user would select a group of points, calculate the aggregate consumption of the group, and report on the individual contribution of each. Data will be displayed both graphically in a pie chart as well as in tabular format. Users could identify that HVAC is 48% of the building load; lighting is 42%, or Building 1 accounts for 14% of the total enterprise load and Building 2 contributes 19%. This report will allow users to identify inefficiencies and help perform budgeting.

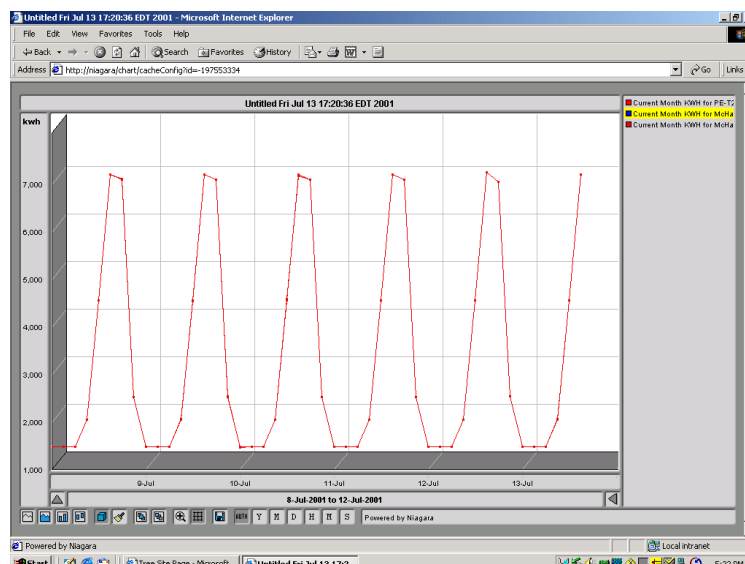


6. **Average Profile** – The report will allow the user to average the load for a single load across time periods and give the average load, and/or aggregate multiple meters (loads) and view the average aggregated load. This report will be very beneficial when negotiating with energy service providers because it includes the load profile and consumption totals. With the ability to filter by time periods, measurement units, points or point groups, weekdays, and weekends, load profiles with associated data will allow the user to procure exactly the amount of energy required. This reduces risk for the energy provider and therefore reduces cost for the end-user.

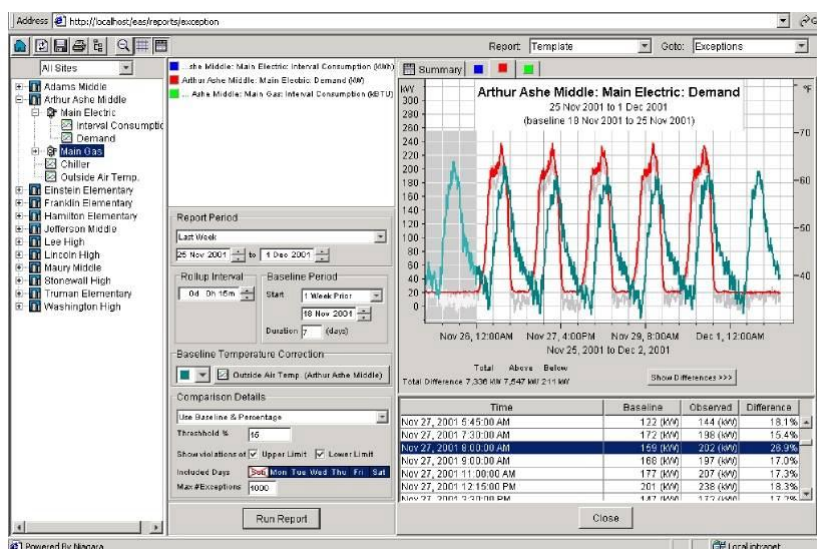
The user will be able to manipulate between 1-minute intervals and hourly intervals. In addition, users will be able to choose between auto scale and manual scale. For example, if the minimum value is 100KW and the maximum is 500 kW, the user can have the chart automatically scale between those values or they can select any range to scale the 400kW range. When printing charts, this may be useful. This will be useful for sophisticated users who need a higher resolution of data. The following screen shot is an example of the Average Profile Report.



7. **Point Trending** – This report will allow the user to choose a single or multiple points and trend the values over a specified time period. Either analog or digital points can be trended and multiple variables can be selected to be report. For a visual representation of several point values, the user will view all points on the left Y-axis. If the user would like to perform a statistical analysis identifying correlation coefficient and standard deviation between variables, they will have the ability to select a single point for each Y-axis. If a point group has been created, it would be presented as a single point value. The same auto scale/manual scale feature discussed in Average Profile Report is available in Point Trending. The following screen shot is an example of the Point Trending Report.



8. **Exception Report** – This report will identify all data values for the specified period that does not fall in a user-defined range. Although the range will be user definable, the benchmark or baseline to be compared against will be historical data. Users can get to this report by selecting it among the library of report templates, or can automatically be taken here from the Average Profile Report or Point Trending Report by clicking on an “Exception” button once a profile is being viewed.



3.9 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Google Chrome. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical

User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

D. The Web browser client shall support at a minimum, the following functions:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
7. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - i) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - ii) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - a. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - b. View logs and charts
 - c. View and acknowledge alarms
 - d. Setup and execute SQL queries on log and archive information
8. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
9. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

1.2 SERVER FUNCTIONS AND HARDWARE

- A. A central server shall be provided. The server shall support all Network Area Controllers (NAC) / Router connected to the customer's network whether local or remote.

- B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.
- C. It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.
- D. The server shall provide the following functions, at a minimum:
1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
 2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC / Router in the network, local or remote.
 3. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC) / Routers.
 4. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
 5. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.
 6. The server shall provide demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
 7. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers / Routers. Systems not employing this prioritization shall not be accepted.
 8. Each Network Area Controller / Router supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
 9. The server shall provide central alarm management for all Network Area Controllers / Routers supported by the server. Alarm management shall include:
 - i) Routing of alarms to display, printer, email and pagers
 - ii) View and acknowledge alarms
 - iii) Query alarm logs based on user-defined parameters
 10. The server shall provide central management of log data for all Network Area Controllers / Routers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
 - i) Viewing and printing log data
 - ii) Exporting log data to other software applications
 - iii) Query log data based on user-defined parameters
- E. Server Hardware Requirements: The server hardware platform shall have the following minimum requirements:

Operator Work Station and OS

1. Client workstation with Intel i5 processor with minimum 320Gb HDD, 4 GB RAM, 19" TFT Monitor, DVD Writer, two serial(one for mouse and one for Serial data acquisition RS converter) and one parallel port (for Printer), multimedia speakers,infrared mouse;
2. Work station shall be preloaded with requisite MS Windows Licensed software compatible with the BMS platform as well as with anti-virus software. Workstation PC shall not have USB port. Workstation PC shall be loaded with client software if required.
3. Server with xeon dual core processor 2.13 GHz, 500Gb SATA HDD, 4 GB RAM, RAID 1 built in, 3.5 simple swap DVD ROM , OS & firewall software loaded with lifetime license. Server PC shall not have USB port. Server software shall be loaded on server.
4. The Servers and Operator work stations required for the system shall have latest hardware configuration; the minimum configuration requirements for servers and clients are mentioned in the Bill of Materials provided elsewhere in this tender.

Servers and Clients shall be loaded with vendor's latest version BA System Monitoring and control Software along with its compatible Operating Systems Software with antivirus package.

1.3 SYSTEM PROGRAMMING

- A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.
- B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display.
- C. Programming Methods
 1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
 2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
 3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
 4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.

5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

1.4 OBJECT LIBRARIES

- A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
- B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
- C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.
- D. All control objects shall conform to the control objects specified in the BACnet specification.
- E. The library shall include applications or objects for the following functions, at a minimum:
 1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
 2. Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
 3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals
 4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
 5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
 6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce

the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

1. Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
2. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
3. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.
4. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.
5. PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
6. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
7. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
8. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
9. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to

issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

10. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
11. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.
12. For BACnet devices, provide the following objects at a minimum:
 - a. Analog In
 - b. Analog Out
 - c. Analog Value
 - d. Binary
 - e. Binary In
 - f. Binary Out
 - g. Binary Value
 - h. Multi-State In
 - i. Multi-State Out
 - j. Multi-State Value
 - k. Schedule Export
 - l. Calendar Export
 - m. Trend Export
 - n. Device
13. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
14. For BACnet devices, provide the following support at a minimum
 - a. Segmentation
 - b. Segmented Request
 - c. Segmented Response
 - d. Application Services
 - e. Read Property
 - f. Read Property Multiple
 - g. Write Property
 - h. Write Property Multiple
 - i. Confirmed Event Notification
 - j. Unconfirmed Event Notification
 - k. Acknowledge Alarm
 - l. Get Alarm Summary
 - m. Who-has

- n. I-have
- o. Who-is
- p. I-am
- q. Subscribe COV
- r. Confirmed COV notification
- s. Unconfirmed COV notification
- t. Media Types
- u. Ethernet
- v. BACnet IP Annex J
- w. MSTP
- x. BACnet Broadcast Management Device (BBMD) function
- y. Routing

1.5 DDE DEVICE INTEGRATION

- A. The Network Area Controller / Router shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.
- B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the BMS. Objects provided shall include at a minimum:
 - 1. DDE Generic AI Object
 - 2. DDE Generic AO Object
 - 3. DDE Generic BO Object
 - 4. DDE Generic BI Object

1.6 MODBUS SYSTEM INTEGRATION

- A. The Network Area Controller / Router and the DDC controller shall support the integration of device data from Modbus RTU, Ascii, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.
- B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the BMS. Objects provided shall include at a minimum:
 - 1. Read/Write Modbus AI Registers
 - 2. Read/Write Modbus AO Registers
 - 3. Read/Write Modbus BI Registers
 - 4. Read/Write Modbus BO Registers
- C. All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.
- D. The BMS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning

1.7 OPC SYSTEM INTEGRATION

- A. The Network Area Controller / Router shall act as an OPC client and shall support the integration of device data from OPC servers. The connection to the OPC server shall be Ethernet

IP as required by the device. The OPC client shall support third party OPC servers compatible with the Data Access 1.0 and 2.0 specifications.

- B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the OPC system data into the BMS. Objects provided shall include at a minimum:
1. Read/Write OPC AI Object
 2. Read/Write OPC AO Object
 3. Read/Write OPC BI Object
 4. Read/Write OPC BO Object
 5. Read/Write OPC Date/Time Input Object
 6. Read/Write OPC Date/Time Output Object
 7. Read/Write OPC String Input Object
 8. Read/Write OPC String Output Object
- C. All scheduling, alarming, logging and global supervisory control functions, of the OPC system devices, shall be performed by the Network Area Controller / Router.
- D. The BMS supplier shall provide an OPC client communications driver. The equipment system vendor that provided the equipment utilizing OPC shall provide documentation of the system's OPC server interface and shall provide factory support at no charge during system commissioning.

OTHER CONTROL SYSTEM HARDWARE

FIELD DEVICES

7.1 ELECTRIC AND ELECTRONIC CONTROLS RELATED EQUIPMENT

General Requirements

All controls shall be capable of operating in ambient conditions varying between 0-55 deg. C and 90% R.H. non-condensing.

All Control devices shall have a 20 mm conduit knockout. Alternatively, they shall be supplied with adaptors for 20 mm conduit.

Ancillary Items

When items of equipment are installed in the situations listed below, the BAS contractor shall include the following ancillary items :

(i) Weather Protection

All devices required to be weatherproofed are detailed in the Schedule of Quantities. IP ratings for the equipment is mentioned in the respective section.

(ii) Pipework Immersion

Corrosion resisting pockets of a length suitable for the complete active length of the device, screwed ½" (13 mm) or ¾" (20 mm) NPT suitable for the temperature, pressure and medium.

(iii) **Duct Mounting (Metal or Builders Work)**

Mounting flanges, clamping bushes, couplings, locknuts, gaskets, brackets, sealing glands and any special fittings necessitated by the device.

Additional features

- (i) **Concealed Adjustment** : All two position switching devices shall have concealed adjustment unless detailed otherwise in the Schedule of Quantities
- (ii) **Operating Voltage** : All two position switching devices shall operate on 230 v a.c and all accessible live parts shall be shrouded. An earth terminal shall be provided.

7.2 TEMPERATURE SENSOR

Temperature sensors for space, pipes and ducts, shall be of the Resistance Temperature detector (RTD) type or thermistor. These shall be two wire type and shall conform to the following specifications :

- 1) Immersion sensors shall be high accuracy type with a high resistance versus temperature change. The accuracy shall be atleast ± 0.33 degrees F and sensitivity of atleast 2 ohm/F.
- 2) Immersion sensors shall be provided with separate stainless steel thermo well. These shall be manufactured from bar stock with hydrostatic pressure rating of atleast 10 kgf/cm².
- 3) The connection to the pipe shall be screwed ¾ inch NPT (M). An aluminum sleeve shall be provided to ensure proper heat transfer from the well to the sensor. Terminations to be provided on the head. Flying leads shall not be acceptable.
- 4) The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections.
- 5) Duct temperature sensors shall be with rigid stem and of averaging type. These shall be suitable for duct installation.
- 6) Outdoor air temperature sensor shall be provided with a sun shield.
- 7) The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

The temperature sensors may be any of the following types:

- 1) PT 100, PT 1000, PT 3000
- 2) NI 100, NI 1000
- 3) Balco 500.
- 4) Thermistor

7.3 HUMIDITY SENSOR

Space and duct humidity sensors shall be of capacitance type with an effective sensing range of 10% to 90% RH. Accuracy shall be + 3% or better. Duct mounted humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with a housing. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

7.4 PRESSURE TRANSMITTER FOR WATER

Pressure transmitters shall be piezo-electric type or diaphragm type. (Bourdon Tube type shall not be acceptable). Output shall be 4-20mA or 0-10V DC and the range as specified in the data sheet depending on the line pressure. Power supply shall be either 24 V AC, 24 V DC or 230 V AC. Connection shall be as per manufacturer's standards. The pressure detector shall be capable of withstanding a hydraulic test pressure of twice the working pressure. The set point shall fall within 40%-70% of the sensing range and detector shall have sensitivity such that change of 1.5% from the stabilized condition shall cause modulation of the corrective element. The sensor must be pressure compensated for a medium temperature of -10° C to 60° C with ambient ranging between 0° C to 55° C.

7.6 DIFFERENTIAL PRESSURE SWITCH FOR PIPE WORK

These shall be used to measure pressure differential across suction and discharge of pumps. The range shall be as specified in the data sheet. Switch shall be ON with increase in differential. Housing for these shall be weather proof with IP 55 protection. The pressure switch shall be capable of withstanding a hydraulic test pressure of 1.5 times the working pressure. The set point shall fall in 40-70% of the scale range and shall have differentials adjustable over 10%-30% of the scale range. The switches shall be provided with site adjustable scale and with 2 NO/NC contacts.

7.7 DIFFERENTIAL PRESSURE SWITCH FOR AIR SYSTEMS

These shall be diaphragm operated. Switches shall be supplied with air connections permitting their use as static or differential pressure switches.

The switch shall be of differential pressure type complete with connecting tube and metal bends for connections to the duct. The housing shall be IP 54 rated. The pressure switches shall be available in minimum of 3 ranges suitable for applications like Air flow proving, dirty filter, etc. The set point shall be concealed type. The contact shall be SPDT type with 230 VAC, 1 A rating.

The switch shall be supplied suitable for wall mounting on ducts in any plane. It should be mounted in such a way that the condensation flow out of the sensing tips. Proper adaptor shall be provided for the cables.

The set point shall fall within 40%-70% of the scale range and it has differentials adjustable over 10%-30% of the scale range.

The switches shall be provided with site adjustable scale and with 2 NO/NC contacts.

7.10 WATER FLOW SWITCH

These shall be paddle type and suitable for the type of liquid flowing in the line. Output shall be 2NO/2NC potential free.

7.11 LEVEL SWITCH

The level switches shall have to meet the following requirement :

Type	:	Float Type/Capacitance type/Conductivity type
Mounting	:	To suit application.
Connection	:	Flanged ANSI 150 lbs RF Carbon steel
Float material	:	316 SS
Stem Material	:	316 SS
Output	:	2 NO, 2 NC potential free
Switch Enclosure	:	IP 55

7.12 CO2 Sensor

CO2 sensor to monitor indoor air quality and replace stale CO2 laden air with a fresh- in draft, whenever CO2 exceeds a certain level. The CO2 sensor shall evaluate the CO2 concentration on the AHU room and the outside air. The output signal shall be proportional to the CO2 content of the ambient air. It shall be a microprocessor based unit consisting of a selective photo acoustic CO2 sensor. The sensor shall be wall or ceiling mounted type.

The CO2 sensor shall evaluate the CO2 concentration. The output signal shall be proportional to the CO2 content of the ambient air. It shall be a micro processor based unit consisting of a selective photo acoustic CO2 sensor. The sensor shall be wall or ceiling mounted type. The sensor shall be self calibrating and shall also come with an out door enclosure for mounting.

These shall work on 24VAC or 24VDC supply with the output being standard type i.e. 4-20 mA, 0- 10 Volts etc.

Output signal : 4 mA to 20 mA or 0 to 10VDC

Operating Temperature Range : -5 to 45 deg C

Operating Humidity Range : 0 to 85% non condensing

Air Flow Range : 0 to 2000ppm

Mount : Wall or ceiling Mount

1.8 **PORTABLE OPERATORS TERMINAL (POT)**

They shall permit the project operating staff to:

- Display point values
- Display parameters
- Change time schedule elements
- List and acknowledge alarms
- Monitor points in the system
- Command points (manual overrides) of points
- Override input points (put inputs in test)
- Read and check variables on the network
- Password protected
- Node configuration for Fan Coil, Rooftop Unit TCUs etc
- Liquid Crystal Display
- Minimum 4x20 character
- Permanent mount or portable connection.

ENCLOSURES FOR CONTROLLERS AND ELECTRICAL PANELS

All the controllers shall be housed in Lockable Vandal proof boxes which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for tropical climatic conditions.

The panel shall be metal enclosed 14 SWG CRCA sheet steel cubicle with gaskets between all adjacent units and beneath all covers to render the joints dust proof. All doors and covers shall be hinged and latched and shall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag grounded off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and secured with the frame and holes in the panels correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with nuts. Self threading screws shall not be used in the construction of control panels. Knockout holes of approved size and number shall be provided in the panels in conformity with the location of incoming and outgoing conduits/cables. Lamps shall be provided to support the weight of the cables. The dimension of the boxes shall depend on the requirement with the colour decided in consultation with the Engineer-in-Charge.

Note: All panel enclosures used in plant room spaces and external to building shall be suitable for outdoor application (IP 54 protection) and UL listed.

CONDUITS AND WIRING

Prior to laying and fixing of conduits, the contractor shall carefully examine the drawings indicating the layout, satisfy himself about the sufficiency of number and sizes of conduits, sizes and location of conduits and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of Engineer-in-Charge. Any modifications suggested by the Contractor shall be got approved by the Engineer-in-Charge before the actual laying of conduits is commenced.

CONDUITS / TRUNKER

Conduits and accessories shall conform to relevant Indian Standards. PVC conduits of required dia shall be used as called for in the schedule of quantities. Joints between conduits and accessories shall be securely made, with help of adhesive.

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

CONNECTIONS

All jointing methods shall be subject to the approval of the Engineer-in-Charge. Separate conduits shall run for all power wiring.

The threads and sockets shall be free from grease and oil. Connections between conduit and controller metal boxes shall be by means of brass hexagon smooth bore bush, fixed inside the box and connected through a coupler to the conduit. The joints in conduits shall be smooth to avoid damage to insulation of conductors while pulling them through the conduits.

BENDS IN CONDUIT

Where necessary, bends or diversions may be achieved by means of bends and/or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with a finished wall surface. No bends shall have radius less than 2-1/2 times the outside diameter of the conduit.

SIGNAL CABLING & COMMUNICATION CABLING

The signal cable shall be of the following specifications :

- | | | | |
|----|---------------------|---|--|
| a. | Wire | : | Annealed Tinned Copper |
| b. | Size | : | 1.5 sq. mm, 7 strands |
| c. | No. of conductors | : | Two (One pair) |
| d. | Shielding | : | Overall beld foil Aluminium polyester shield. |
| e. | Jacket | : | Chrome PVC |
| f. | Nominal DCR | : | 17.6 ohm/km for conductor
57.0 ohm/km for shield |
| g. | Nominal OD | : | 8.5 mm |
| h. | Nominal capacitance | : | 130 pF/m between conductors
at 1 KHz 180 pF/m between one
conductor and other
conductors connected to shield. |
| i. | Colour | : | Black and Red |

COMMUNICATION CABLE

The communication cable shall be of the following specifications :

- | | | | |
|----|-------------------|---|---|
| a. | Wire | : | Annealed Tinned Copper |
| b. | Size | : | Minimum 24 AWG stranded |
| c. | No. of conductors | : | One pair (2 conductor) |
| d. | Shielding | : | Overall beld foil Aluminium polyester shield. |
| e. | Jacket | : | Chrome PVC |

- f. Nominal DCR : 78.7 ohm/km for conductor, 55.8 ohm/km for shield
- g. Nominal OD : 5.64 mm
- h. Nominal capacitance : 131 pF/m between conductors at 1 KHz 243 pF/m between one conductor and other conductors connected to shield.
- i. Colour : Black and Red, Black and White)

Project name	IPC, Ghaziabad	BMS I/O SUMMARY FOR AHU 01			
S.No.	Description	Analog		Digital	
		AI	AO	DI	DO
I	<u>AHU SIDE - for AHU 01</u>				
	-				
A	<u>FILTERS</u>				
1	Pre Filter			1	
2	Fine Filter			1	
3	HEPA Filter	1			
B	<u>COILS</u>				
	<u>AHU Side</u>				
1a	DX Coil Run /Trip Status			2	
1b	DX Coil Cmd				1
1c	Heater Bank On Off Cmd				3
1d	Heater Bank On Off Status			3	
C	<u>BLOWER</u>				
1	VFD auto/manual status			1	
2	VFD Run status			1	
3	VFD start/stop command				1
4	VFD Trip Status			1	
5	VFD Speed Control		1		
D	<u>AIR TEMPERATURE</u>				
1	<u>RA Temp and RH Transmitter</u>	2			
E	<u>AIR FLOW SENSOR</u>				
1	Air velocity sensor	1			
F	<u>Duct Smoke Detector</u>				
II	<u>ROOM NAME</u>				
1	COOLING				
	Temperature Transmitter	1			
	RH Transmitter	1			

	Pressure Transmitter	1			
2	STERILITY LAB				
	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter	1			
3	AIR LOCK +++ Next to Sterility Room				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter	1			
4	AIR LOCK ++ (IN STERILITY AREA)				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter	1			
5	AIR LOCK + (IN STERILITY AREA)				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter	1			
	Sub Total	13	1	10	5
	Spare 10%	1	0	1	1
	TOTAL	14	1	11	6

Project name	IPC	BMS I/O SUMMARY FOR AHU 2			
S.No.	Description	Analog		Digital	
		AI	AO	DI	DO
I	<u>AHU SIDE - for AHU 02</u>				
	-				
A	<u>FILTERS</u>				
1	Pre Filter			1	
2	Fine Filter			1	
3	HEPA Filter	1			
B	<u>COILS</u>				
	<u>AHU Side</u>				
1a	DX Coil Run /Trip Status			2	
1b	DX Coil Cmd				1
1c	Heater Bank On Off Cmd				3
1d	Heater Bank On Off Status			3	

C	<u>BLOWER</u>				
1	VFD auto/manual status			1	
2	VFD Run status			1	
3	VFD start/stop command				1
4	VFD Trip Status			1	
5	VFD Speed Control		1		
D	<u>AIR TEMPERATURE</u>				
1	<u>RA Temp and RH Transmitter</u>	2			
E	<u>AIR FLOW SENSOR</u>				
	-				
1	Air velocity sensor	1			
F	<u>Duct Smoke Detector</u>			1	
II	<u>ROOM NAME</u>				
1	BACTERIAL ENDOTOXIN				
	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter	1			
2	MICROBIAL IDENTIFICATION				
	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter	1			
3	AIRLOCK ++ (IN MICROBIAL IDENTIFICATION AREA)				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter	1			
4	MLT / TMC	1			
	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter				
	Sub Total	14	1	11	5
	Spare 10%	1	0	1	1
	TOTAL	15	1	12	6

Project name	IPC		BMS I/O SUMMARY FOR AHU 03			
-						
S.No.	Description	Analog		Digital		
		AI	AO	DI	DO	
I	AHU SIDE - - for AHU 03					

A	<u>FILTERS</u>				
1	Pre Filter			1	
2	Fine Filter			1	
3	HEPA Filter	1			
B	<u>COILS</u>				
	<u>AHU Side</u>				
1a	DX Coil Run /Trip Status			2	
1b	DX Coil Cmd				1
1c	Heater Bank On Off Cmd				3
1d	Heater Bank On Off Status			3	
C	<u>BLOWER</u>				
1	VFD auto/manual status			1	
2	VFD Run status			1	
3	VFD start/stop command				1
4	VFD Trip Status			1	
5	VFD Speed Control		1		
D	<u>AIR TEMPERATURE</u>				
1	<u>RA Temp and RH Transmitter</u>	2			
E	<u>AIR FLOW SENSOR</u>				
	-				
1	Air velocity sensor	1			
F	<u>Duct Smoke Detector</u>				
II	<u>ROOM NAME</u>				
1	INCUBATION				
	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter	1			
2	MEDIA PREPERATION				
	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter	1			
3	WASHING				
	Temperature Transmitter	1			
	RH Transmitter				
	Pressure Transmitter				
4	WASHING AREA				
	Temperature Transmitter	1			
	RH Transmitter				
	Pressure Transmitter				
5	DECONTAMINATION + BIO WASTE				

	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter	1			
6	CLEAN CORRIDOR				
	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter	1			
7	SECONDARY GOWNING				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter				
8	REFERENCE CULTURE				
	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter	1			
9	A/L EXIT				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter	1			
10	DIRTY LINEN				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter				
11	COLD ROOM				
	Temperature Transmitter	1			
	RH Transmitter	1			
	Pressure Transmitter	1			
12	AIR LOCK (NEXT TO CHANGE ROOM)				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter	1			
13	CHANGE ROOM				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter	1			
14	AIR LOCK AT THE ENTRY				
	Temperature Transmitter				
	RH Transmitter				
	Pressure Transmitter	1			
	Sub Total	28	1	10	5
	Spare 10%	3	0	1	1

	TOTAL	31	1	11	6
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1.9 SUMMARY OF WORK

- A. Provide LonWorks/BACnet based products that communicate on multiple channels to meet the functional specifications as indicated on the Drawings and the dedicated product functional specifications and profiles specified in other sections.
- B. Provide LonTalk/BACnet routers as required to combine different communication channels onto a central field bus or as required to segment groups of Intelligent Devices and/or Control Units.
- C. The BAS Contractor shall utilize Performance Calculations to simulate all network traffic in advance to minimize field troubleshooting prior to installation of network control devices. Additional routers and/or repeaters shall be installed by the contractor to maintain acceptable network traffic.
- D. The BAS Contractor shall utilize a LonWorks/BACnet protocol analyzer tool to monitor network traffic on all installed control channels for a minimum of 24 hours per channel after final installation. The BAS contractor shall reconfigure nodes and/or install additional routers as necessary to maintain traffic to less than 50% of channel bandwidth capacity.
- E. Provide Intelligent Devices (ID's), Programmable Control Units (PCU's), and Terminal Device Control Units (TDCU's) as herein specified, as needed to perform functions indicated in the input output summaries and sequences of operation, and/or indicated on the HVAC drawings.
- F. Provide wire, raceway systems, 24 DC and/or 24 AC power supplies and final connections to nodes provided by this contract and the following Control Units to meet or exceed all pertinent and applicable codes.
- G. The BAS Contractor shall provide all controls, sequences of operation, and systems monitoring as required by these specifications and by the drawings. Provide all required devices, sensors, hardware, software, wiring, controllers, etc.

1.10 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION.

- A. Control Valves and calibrated by factory certified technicians qualified for this work.
- B. Reference Standards
 1. Control system components shall be new and in conformance with either of the following applicable standards for products specified:
 - i. ANSI/EIA 709.1 (LonTalk Protocol)
 - ii. LonMark Certified (Version 3.1 Guidelines)
 - iii. UL 916 (Energy Management Equipment)
 - iv. BACnet (Building Automation Control Network)
- C. Products
 - a. Utilize standard components for all assemblies. Custom hardware, operating system, and utility software are not acceptable.
 - b. All products (PCU's, TDCU's and ID's) shall contain Lon Works/BACnet networking elements to allow ease of integration of devices from multiple vendors.

- c. All materials, equipment and software shall be standard components, regularly manufactured for this and other systems and custom designed for this project. All systems and components shall be thoroughly tested.

1.11 SUBMITTALS

- A. **General:** Submit the following according to conditions of Contract and Division 15 sections. In addition, provide the following:

1. Product data on all components used to meet the requirements of the specifications such as enclosures, network transceivers, XIF documentation, configuration parameter options, mounting details, power supplies, etc.
2. Software documentation regarding the proposed PC operating system third party utilities and application programs, and the proposed application program for the Control Units.
3. Mechanical system served by the HVAC Control System. Indicate and Tag each input/output served by each Control Unit or Intelligent Device.
4. Submit 3 sets of submittals for review within 3 weeks of contract award.

- B. **Shop Drawings**

1. The controls contractor shall submit AutoCAD generated schematic drawings for the entire control system for review and approval before work shall begin. Included in the submittal drawings shall be a one-page diagram depicting the complete system architecture complete with a communications riser. Drawings shall include point-to-point wiring diagrams and must show all temperature controls, start- stop arrangement for each piece of equipment, equipment interlocks, wiring terminal numbers and any special connection information required for properly controlling the mechanical equipment. The submittal shall include a bill of material reference list as well as equipment sequences of operation.
2. The submittals shall include manufacturer's catalog data describing each item of control equipment or component provided and installed for the project.

1.12 OPERATION AND MAINTENANCE MANUALS

1. Include the following documentation:
 - a. Maintenance Instructions: Document all maintenance and repair/ replacement procedures. Provide ordering number for each system component, and source of supply. Provide a list of recommended spare parts needed to minimize downtime.
 - b. Documentation of network variables, network node configurations, priority interrupts, node binding, addressing structure, etc.

1.13 INSTRUCTION OF CLIENT OPERATING PERSONNEL

- A. All training shall be by the HVAC Controls Contractor and shall utilize specified manuals, as-built documentation, and the on-line help utility.
- B. Operator training shall include 2 initial eight-hour sessions or, if the Client desires this time may be allotted differently. The initial operator training program shall be to establish a basic understanding of Windows based software, functions, commands, mouse, etc. The training shall encompass as a minimum:
 1. Troubleshooting of input devices, i.e., bad sensors.

2. Sequence of operation review.
3. Sign on - sign off.
4. Selection of all displays and reports.
5. Commanding of points, keyboard and mouse mode.
6. Modifying English text.
7. Use of all dialogue boxes and menus.
8. System initialization.
9. GUI Software.
10. Lon Maker /BACnet Network Management Software.

1.14 ACCEPTANCE PROCEDURE

- A. Upon completion of the installation, Contractor shall start-up the system and perform all necessary calibration and testing to ensure proper operation of the project control systems.
- B. Schedule a hardware demonstration and system acceptance test in the presence of the Contracting Officer and/or the Engineer. The acceptance testing is defined as demonstrating the sequence of operation as indicated in the drawings. The hardware demonstration is specified in this Section. The Contractor shall perform all tests prior to scheduling the acceptance test and hardware demonstration to insure the overall system is ready for inspection and observations.

1.15 OWNERSHIP OF PROPRIETARY MATERIAL

- A. The Client shall retain all rights to software for this project.
- B. The Client shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Client as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of Trade secrets contained within such software. All project developed software and documentation shall become the property of the Client. These include, but are not limited to:
 1. Project graphic images
 2. Record drawings
 3. Project network database
 4. Project-specific application programming code
 5. All documentation.

1.16 WARRANTY

- A. The HVAC Control System shall be free from defects in workmanship and material under normal use and service. If within twelve (12) months from the date of substantial completion, the installed equipment is found to be defective in operation, workmanship or materials, the building systems contractor shall replace, repair or adjust the defect at no cost.
- B. The warranty shall extend to material that is supplied and installed by the Contractor. Material supplied but not installed by the Contractor shall be covered per the above to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation.
- C. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.

1.17 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Do not install electronic hardware in the project until non-condensing environmental conditions have been established. Products installed in violation of this request will be replaced at no additional cost to the project.
- B. Coordinate storage requirements for factory mounted terminal control units on air terminal devices, air handling units or other packaged control equipment. Do not store control units on site in non-conditioned areas.
- C. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

PART 2 – PRODUCTS**2.1 NETWORKS**

- A. The system architecture shall as a minimum support the following levels.
 - 1. Support's 9.6, 38.4, 76.8kbps/ 78kbyte FTT 10 channels for operating nodes.
 - 2. 10/100 MB high speed bus to tie together multiple 78kbyte FTT 10 channels.
 - 3. IP (via network interface card, or a LTA card & Lon to IP adaptor).
 - 4. Modem to FTT10 for remote sites.
 - 5. Access to a system workstation over the IP via Ethernet/standard web browser.
- B. Local area network minimum physical and media access requirements:
 - 1. Ethernet; IEEE standard 802.3.
 - 2. Cable; 10 Base-T, UTP-8 wire, category 5.
 - 3. Minimum throughput; 10 Mbps with the ability to increase to 100 Mbps.

2.2 PROGRAMMABLE NODES (Applicable only for Lonworks controller)**A. GENERAL REQUIREMENTS.**

- 1. LPNs shall be equipped with a 3120 Neuron® with co-processor or 3150 Neuron® microprocessor controller, (flash or EEPROM) memory for general data processing, power supply, network transceivers.
- 2. Operating system software, custom operating sequence software and application programs shall be stored in programmable, non-volatile memory.
- 3. A LPN shall operate totally stand-alone and independent of a central computer for all specified control applications. Software shall include a complete operating system (OS), communications handler, point processing, standard control algorithms, and specific control sequences.
- 4. LPN's shall be a modular design with a separate wiring base. The base shall be din-rail mounted and provide terminal strips to allow field wiring to take place without the controller hardware being present. The controller hardware shall "plug-in" to the wiring base. The controller hardware shall be able to be removed without removing wires or terminal strips.
- 5. LPN's shall include a battery or capacitor backed hardware calendar/clock device.

6. The LPN Lon Works® network interface shall be a Type 1 transceiver. A communication connection shall be provided for attaching POT to node for downloading and troubleshooting applications.
7. The LPN shall provide for a RS232 PC connection.
8. The LPN shall provide for a RS232 modem connection.
9. The LPN shall provide for a connection to a local digital display unit.
10. LPNs shall include:
 - i) Network service pin.
 - ii) Power On indicator light.
 - iii) Network communication indicator light.

B. INPUT/OUTPUT REQUIREMENTS

1. Binary Input (BI) Types Supported by the DDC/LPN: The BI function shall accept on-off, open-close, or other change of state (two state data) indications.
2. Analog inputs shall include 0-10 Vdc, 0-20 mA, 4-20 mA, and 1,800 ohm (25 ° C) or 10,000 ohm (25 ° C) thermistor. Resolution of the Analog to Digital converter shall be a minimum of 10 bits.
3. DDC/LPNs shall include universal inputs that support either of the above describe inputs.
4. The DDC/LPN shall accommodate both binary and true analog outputs, 0-10Vdc. The resolution of the digital to analog converter shall be a minimum of 8 bits.
5. Binary outputs shall be capable of handling maintained as well as pulsed outputs for momentary or magnetic latching circuits.
6. The DDC/LPN shall accommodate expansion input/output units.
7. Enclosure shall be NEMA 1.
8. The DDC/LPN shall include all hardware and software required for communications with other nodes, PCs, and the OW over the Lon Works LANs.
9. Programming shall provide for the control of network data traffic through the use of send on delta and time adjustable control of network broadcasts or polls.

2.3 LON WORKS® APPLICATION SPECIFIC NODES (LASN) (Applicable for Lonworks only)

A. General characteristics of LASN

1. The processor shall be a 3120 or 3150 Neuron.
2. LonMark certified and must comply with the following LONMARK® interoperability profile guidelines:
 - (i) Variable Air Volume (VAV) boxes - Profile 8502

- (ii) Fan Coil Units - Profile 8501
- (iii) Unit Ventilators - Profile 8505
- (iv) Heat Pumps - Profile 8503
- 3. Non-programmable, configurable application.
- 4. Shall provide software configuration tool, as specified under system software.
- 5. Data broadcasting to the network or data polling shall be controlled by the application to preclude data storms on the network.
- 6. Controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog and digital outputs shall be industry standard signals such as 0-10Vdc and floating point control allowing for interface to industry standard field devices.
- 7. After a power failure the LASN must run the control application using the current set points and configuration. Reverting to default or factory set points is not acceptable.

B. ROOM SENSORS

1. Room temperature sensors are to be provided with a cover to prevent accidental damage.
2. Terminal unit temperature sensors shall all be of the thermistor (NTC) type with a minimum of 100 ohm/ degrees F resistance change versus temperature change within a range of 60 to 90F to ensure good resolution and accuracy. Thermistor shall produce 3000 ohm at 77 degrees F for calibration.
3. Sensor shall be supplied with a vertical base for mounting on a standard single gang junction box supplied by the SI contractor.
4. Temperature sensor cover plate shall be vandal proof, flush mounted with hex head hardware. Alternatively standard room temperatures with 0-10V/ 4- 20 mA output shall also be acceptable.

2.4 DIGITAL DISPLAY UNIT (DDU) – Liquid Crystal Display or Workstation

A. GENERAL REQUIREMENTS.

1. The DDU shall permit the project operating staff to:
 - (i) Display point values
 - (ii) Display parameters
 - (iii) Change time schedule elements
 - (iv) List and acknowledge alarms
 - (v) Monitor points in the system
 - (vi) Command points (manual overrides) of points
 - (vii) Override input points (put inputs in test)
 - (viii) Read and check LonWorks /BACnet variables on the network
 - (ix) Password protected
 - (x) Node configuration for Fan Coil and Rooftop Unit TCUs
2. DDU with the following components:
 - (i) Liquid Crystal Display
 - (ii) Minimum 4x20 character
 - (iii) Pushbuttons for scrolling display and enter

- (iv) Permanent mount or portable connection.

2.5 LON/BACnet ROUTERS, REPEATERS AND TRANSCEIVERS

A. GENERAL

1. Equip each router with a network transceiver on each network port.
2. The network router shall be designed to route messages from a segment, sub-net, or domain in full duplex communication mode.
3. Routers shall utilize LonTalk®/BACnet protocol transport, network, session layers to transparently route messages bound for a node address in another sub-net or domain.
4. Routers and repeaters shall be fully programmable and permit a systems integrator to define message traffic, destination, and other network management functions utilizing LonWorks® /BACnet software tool.
5. The routers and repeaters shall be capable of DIN rail or panel mounting and be equipped with status LED lights for Network traffic and power.
6. Provide a minimum of two Neuron 3120 or 3150 processors or 32 bit Hi performance processor for use as the network router communication controller.

B. ETHERNET IP ROUTER

1. Equip each router with an Ethernet IP communication on one side and a Lon Talk® /BACnet transceiver Type.
2. The network router shall be designed to route messages from a segment, sub-net, or domain in full duplex communication mode.
3. On Ethernet IP side, the router shall utilize Ethernet IP protocol transport to route messages.
4. On the LonTalk®/BACnet side, the routers shall utilize LonTalk®/BACnet protocol transport, network, session layers to transparently route messages bound for a node address in another sub-net or domain.
5. Routers shall be fully programmable and permit a systems integrator to define message traffic, destination, and other network management functions utilizing LonWorks® /BACnet software tool.
6. The routers shall be capable of DIN rail or panel mounting and be equipped with status LED lights for Network traffic and power.

C. TRANSCEIVERS

1. Type 1 network transceiver, free topology, twisted pair: Provide a transformer isolated, twisted pair transceiver capable of mounting directly on a printed circuit board. The transceiver shall meet the following specifications:
 - i. Meets LonMark™/BACnet Interoperability Association Standards.
 - ii. Differential Manchester encoded signaling for polarity insensitive network
 - iii. Wiring.
 - iv. Transformer isolated for common mode rejection.
 - v. 78 kbs network bit rate up to distances of 2000 meters.
 - vi. Free topology supports star, home run, multidrop and loop wiring.
 - vii. Topologies.
 - viii. Complies with FCC and VDE requirements.
 - ix. UL recognized component.
2. Type 2 Network Transceiver, Twisted Pair: Provide a transformer isolated twisted pair transceiver capable of mounting directly on a printed circuit board. The transceiver shall meet the following specifications:

- i. Meets LonWorks®/BACnet interoperability standards.
- ii. Differential Manchester encoded signaling for polarity insensitive network wiring.
- iii. Transformer isolation for common mode rejection.
- iv. 1.25Mbps network bit rate up to distances of 1000 meters.
- v. FCC and VDE Level B requirements compliance.
- vi. UL recognized component.

2.6 SOFTWARE

A. COMMAND & OPERATING SOFTWARE

1. As a minimum, the menu driven command and operating software shall permit the operator to perform the following tasks with a minimum knowledge of the HVAC Control System provided and basic computing skills.
 - i) Configure the network.
 - ii) Create control sequences.
 - iii) Graphical interface to systems.
2. Provide additional third party software to permit the operator to manage hard drive files such as access, delete, copy, modify, etc. The package shall be object oriented and permit the user to manage directories upon boot-up. The file management software shall organize directories and sub-directories using files, file folder objects.
3. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
4. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
5. System Diagnostics. The system shall automatically monitor the operation of all HVAC control workstations, printers, modems, network connections, and nodes. The failure of these devices shall be annunciated to the operator.
6. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer. Data shall be able to transferable to other software packages so as to create custom reports.
7. Web Browser Access: The DDC/GUI system shall provide total integration of the facility infrastructure systems with user access to all system data, either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet.

B. GRAPHICAL OBJECT-ORIENTED PROGRAMMING SOFTWARE

1. The system shall include a graphical object-oriented programming function which shall be used to create all control sequences utilized in LonWorks®/BACnet programmable nodes. The graphical object-oriented programming function shall provide programming elements to be connected together to create a logic diagram. The graphical object-oriented programming function shall include elements for mathematical, logical, timing, set point, display and input/output functions to create logic diagrams that represent sequences of operation for LPNs/DDC.
2. Program elements shall be able to be combined into a custom template that can then be used as a standard function.
3. Program checkout and debug tools shall include display of real-time and/or simulated system variables and inter-object data on the programming screens. The user shall be able to assign fixed or variable values to inputs during the dynamic debugging of the control sequence.
4. The graphical programming tools shall provide the ability to print I/O lists, lists of standard network variables and lists of all parameters to be viewed by the HMI.
5. The programming software shall reside on each POT and OW server for programming and/or configuring each model of LPN/DDC on the project. The applications shall be downloaded and executed at the appropriate nodes. The software shall allow for updated applications via the network from the OW.
6. DDC programs are to be provided to meet the control strategies as called for in the sequence of operation sections of these specifications. Each LPN shall have available a full library of DDC algorithms, intrinsic control operators, arithmetic, trigonometric, logic, Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and relational operators for implementation of control sequences. 2-Position, Floating, Standard I/O and Counter Inputs, Time Based Data, Curve Fit Function, Psychometric Functions, Integration.
7. All DDC set points, gains, and time constants associated with DDC programs shall be available to the operator for display and modification via the POT, DDU or OW interface.

C. Library of Applications:

A library of control, application, and graphic objects shall be provided to enable the creation of applications and user interface screens. Provide the capability to cut & paste objects and libraries into applications for a node/system. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together, using a built-in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface display shall not be acceptable.

- D. Provide integral trend-logging presentation in the programming screen.
- E. Print capability, with page break reference tags to allow down to 8 ½" x 11" size paper
- F. Off-line simulations (step function, continuous run function, simulation of external inputs)
- G. Dynamic presentation of logic in on-line state (all intermediate values)
- H. Text to logic screens

- I. Memory monitoring
- J. Power cycle restart function
- K. Run-time capability
- L. Calculator objects, (basic stuff), including if-then-else, log, ln, exp, and trig functions.
- M. Recognize standard network variable type data (nvi) and create network variables to put on the network (nvo)
- N. Programming Objects
- O. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects, regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification.
 - 1. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
 - 2. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system (step function and run mode, integral trend logging).
 - 3. The system shall support object duplication within the Client's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.
- P. Object Libraries
 - 1. A standard library of object function blocks shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
 - 2. The function blocks in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
 - 3. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
 - 4. Application Specific Node Configuration software Tools: Provide application specific node configuration software tools that will permit the individual LASN to be configured and commissioned with appropriate parameters. This software will reside on the POT. Functionality shall include:
 - 5. Recognize all Standard Configuration Parameters (SCPTs)
 - 6. Provide capability for setting all Standard Configuration Parameters (SCPTs)
 - 7. Translation capability for user defined configuration parameters

8. Monitoring capability for nvo's from the nodes
9. Ability to set the values for nvi's to the nodes

Q. Network Management

1. Windows network management software tool shall be used to assign domain, subnet, and node addresses to nodes; configure all routers and repeaters; define network data connections between LonWorks®/BACnet device network variables, known as "binding;" and record binding data into node addressing tables, and create a database of all addressing and binding information for all nodes on the network.
2. Network management shall include the following services: browse all network variables on nodes; Attach, Detach, Manage, Add, Remove, and Replace nodes; plus transmission error off-line, on-line reporting.
3. The network management database shall be resident in the operator workstation server, ensuring that anyone with proper user name/password authorization has access to the network management database at all times.
4. The software shall have Client/server capability to allow multiple users ability to manipulate the database simultaneously.

R. Human-Machine Interface - Operator Workstation Software

1. The HMI shall be client/server architecture to allow multiple client access to an Ethernet connected server. The workstation shall operate also as a stand-alone workstation/server.
2. The software shall enable an operator to interact with various devices including recorders, input/output (I/O) systems, transmitters, and other field devices.
3. It shall provide the following functions:
 - i. Calendar.
 - ii. Scheduling.
 - iii. Trending.
 - iv. Alarm monitoring and routing.
 - v. Time synchronization.
 - vi. Time zone handling
 - vii. Integration of LonWorks®/BACnet controller data
 - viii. Object linking and embedding for process control (OPC) for connectivity to third part OPC compliant software/devices.
 - ix. Color graphic display
 - x. On-line plots
 - xi. Use Microsoft NT security
 - xii. System documentation generation
 - xiii. Dynamic data exchange (DDE)
 - xiv. Dispatch of a single time schedule to all programmable nodes
4. **System Configuration.** At a minimum, the HMI shall permit the operator to perform the following tasks, with proper password access:
 - i. Create, delete, upload, or modify control strategies.
 - ii. Add/delete objects to the system.
 - iii. Tune control loops through the adjustment of control loop parameters.
 - iv. Enable or disable systems
 - v. Generate text file reports to a networked printer.
 - vi. Select points to be alarm able and define the alarm state.

- vii. Configure alarms to be sent to Microsoft windows mail client
- viii. Select points to be trended over a period of time and initiate the recording of values automatically.
- ix. Provide different levels of security to every object in the HMI database
- x. Modify and create users with passwords and access levels and also be able to use currently logged on users and passwords

5. Event Alarm Notification and Actions

- i. The HMI software shall provide alarm recognition, storage, routine management, and analysis.
- ii. The HMI software shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
- iii. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
 - a) To alarm.
 - b) Return to normal.
 - c) To fault.
- iv. Provide for the creation of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
- v. Provide timed (schedule) routing of alarms by class, object, group, or node.
- vi. Provide alarm generation from “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- vii. Control equipment and network failures shall be treated as alarms and annunciate.
- viii. Alarms shall be annunciating in any of the following manners as defined by the user:
 - a) Screen message text.
 - b) Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - i. Day of week.
 - ii. Time of day.
 - iii. Recipient.
 - c) Pagers via paging services that initiate a page on receipt of email message.
 - i. Auto answer (at OWS) and auto dial (from node)
 - ii. Graphic with flashing alarm object(s).
 - iii. Printed message, routed directly to a dedicated alarm printer.
 - iv. Audio messages.
 - v. The following shall be recorded by the OWS HMI software for each alarm (at a minimum):
 - a. Time and date.
 - b. Location (building, floor, zone, office number, etc.).
 - Equipment (air handler #, access way, etc.).
- ix. Acknowledge time, date, and user who issued acknowledgement. Number of occurrences

- x. Alarm actions may be initiated by user defined programmable objects created for that purpose.
- xi. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- xii. A log of all alarms shall be maintained by the OWS HMI and shall be available for review by the user.
- xiii. Attach a graphic screen, text notes, and/or plant status report, to each alarm, as defined by user.
- xiv. Repeat/nuisance alarms must have feature to be disabled, and a feature for monitoring disabled alarms.
- xv. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. An alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and unacknowledged alarms.
- xvi. The dedicated alarm window shall provide user selectable colors for each different priority of alarm.

6. Data Collection and Storage Requirements

- i. The OWS HMI shall have the ability to collect data for any property of any object and store this data for future use.
- ii. The data collection shall be performed by objects, resident in the node, and if desired OWS, shall have, at a minimum, the following configurable properties:
 - a. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 - b. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 - c. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 - d. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
 - e. All log data shall be stored in a database in the OWS HIM and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
 - f. Systems that cannot provide log data in HTML formats at a minimum shall not be acceptable.
 - g. The OW shall have the ability to archive its log data either locally (to itself), or remotely to a OWS server. Provide the ability to configure the following archiving properties, at a minimum:
 - i. Archive on time of day.

- ii. Archive on user-defined number of data stores in the log (buffer size).
- iii. Archive when log has reached its user-defined capacity of data stores.
- iv. Provide ability to clear logs once archived.

7. Audit Log

Provide and maintain an Audit Log that tracks all activities performed on the OWS HMI. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally to OWS HMI or to a server. For each log entry, provide the following data:

- a. Time and date.
- b. User ID.
- c. Change or activity: i.e., change set point, add or delete objects, commands, etc.

8. Database Backup And Storage

- a. The OW shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
- b. Shall have the ability to automatically complete full or partial backups; and have the ability to full or partial restore. Partial is defined as only items that have changed in the database.
- c. Copies of the current database and, at the most recently saved database shall be stored in the OW. The age of the most recently saved database is dependent on the user-defined database save interval.

9. Graphical Real-Time Displays.

The HMI, shall at a minimum, support the following graphical features and functions:

- i. Graphic screens shall be developed using any drawing package capable of generating and importing a GIF, BMP, DWG, DXF, or JPG file format. In addition to, or in lieu of a graphic background, the HMI shall support the use of scanned pictures.
- ii. Graphic screens shall contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML, or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
- iii. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
- iv. Commands to start and stop binary objects shall be done by clicking the selected object and selecting the appropriate command from the pop-up menu. Data entry may be typed or mouse entered.
- v. Adjustments to analog objects, such as set points, shall be done by clicking the selected object and entering value or using a graphical slider to adjust the value.
- vi. The OWS shall be able to support multiple graphic objects at the same time. If tiled, then each graphical object shall be fully scalable or aspect locked.
- vii. Trend Displays (variable versus time) - A trend display shall show the values of points plotted versus time similar to a strip chart recorder. Eight tags shall be trended per trend. The HMI software shall provide real-time and historical trending (for data which had been logged). This may be achieved by either color graphic page display or an Microsoft excel based display.
- viii. Real-Time Trends - shall contain real-time data without consuming hard disk space.
- ix. Historical Trends Logs - A historical trend log display presents data stored on the computer's hard disk.
- x. X-Y Plots (variable versus variable) - An x-y plot shall dynamically represent the real-time or historical relationship one variable plotted against another variable.

- xi.** Automatic Generation - All trends and plots shall be self-generated and not require any programming by the user.
- xii.** The HMI software shall provide dialog boxes and menu picks for configuring trends and plots.
- xiii.** Any analog or binary data may be trended or plotted.
- xiv.** The software shall store pre-configured presentation of trends to facilitate operator call-up of trend log displays. It shall be possible to call up a trend log with pre-assigned data.

10. Graphics Builder - The HMI software shall provide a graphics builder.

- i.** Display Documentation - The graphics builder shall provide show, simulate, review, and document animation functions to allow the user to identify, diagnose, change, and document animation points on each display.
- ii.** A library of vendor-supplied objects will be included. These objects, widgets, and symbols must be continuously scalable. These items shall be editable by the user.
- iii.** A library of animated graphic objects shall be included.
- iv.** Animation - The Graphics Builder will animate process graphics with real-time data from field devices.
- v.** Multi-State Color Animation shall be provided to change a graphic object's color from a palette of colors.
- vi.** Alarm Color - Color animation for normal, alarm, and alarm acknowledged states for both analog and binary point tags shall be provided. The user shall define the foreground and background colors for each state.
- vii.** Alarm Blink – Objects and text data shall blink based on alarm state and acknowledged state.
- viii.** Text and Numeric Animation - The software shall display the numeric value of an analog point, text of a text point, and the descriptors of a binary point. Display Linking - The software shall provide a display linking function. Clicking the object associated with the link changes the display to a new user-defined display.
- ix.** Pick able / Non-Pick able - The software shall enable active points to be selected with the mouse and accessed. It shall be possible to make a point non-pick able: the dynamic information shall be displayed, but the operator will not be able to access a detail display, change the value, etc. based on security settings of the software.
- x.** Ability to open external executable files from button click
- xi.** Ability to open HTML web pages from button click
- xii.** Ability to view Microsoft Excel files from button click

11. On-Line Help. Provide a context sensitive help system to assist the operator in operation and editing of the system. Help screens shall be available for all applications and shall provide the relevant data for that particular screen.

12. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data.

- a.** System security shall be selectable for each operator.
- b.** The system administrator shall have the ability to set passwords and security levels for all other operators.
- c.** Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object.
- d.** Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected.
- e.** All system security data shall be stored in an encrypted format.
- f.** Each object in the HMI database must be able to have a security policy applied to it.

- g. System Diagnostics. The system shall automatically monitor the operation of network connections and controllers. The failure of any device shall be annunciate to the operator.
- h. DDE Server - The HMI software shall be able to communicate and exchange data with any Third Party DDE compliant application.

MICROSOFT REPORT GENERATION – The HMI software shall be able to seamlessly interact with Microsoft Office Products, including Excel, with no additional programming.

CHAPTER M

TECHNICAL SPECIFICATIONS FOR FIRE FIGHTING

A. FIRE FIGHTING WORKS:

FIRE PROTECTIONS

1. SCOPE OF WORK

The scope of work covers the supply, installation, testing & commissioning of Fire Fighting Wet Riser Hydrant system proposed for the Building. It will be the responsibility of the Contractor to get all approval and completion certificate from the Local Fire Department without which the work will not be taken over by the Client. Fee payable to the local bodies for such activities shall also be borne by the Client on production of receipts for money paid and the all other expenses barring the fee will be borne by the contractor.

2. TENDER DRAWINGS

For guidance of the bidder, drawings as listed in Annexure are enclosed with these tender documents. These drawings are broadly indicative of the work to be carried out. The contractor on award of work will furnish detailed stage-wise working drawings as required in advance for approval of Engineer and get the same approved by Local Fire Authority/other statutory bodies. No claim whatsoever shall be admissible on account of changes that may be introduced by the Engineer/ Local Fire Authority.

3. SHOP DRAWINGS

The contractor shall prepare and furnish all shop drawings in quadruplicate at no extra cost for approval by the Engineer before commencing fabrication/ manufacture of the equipment. Such shop drawings shall be based on the Architectural drawings and requirements laid down in the specifications and as per site conditions. The manufacture of equipment shall be commenced only after the shop drawings are approved in writing by the Engineer. Such drawings shall be co-ordinate with all disciplines of work.

4. COMPLETION AS BUILT DRAWINGS

On completion of the work and before issuance of certificate of virtual completion, the contractor shall submit to the Engineer. General layout drawings, drawn at approved scale indicating layout of pump house piping and its accessories "As installed". These drawings shall in particular give the following:

- a. General layout of pump house
- b. Panels and other equipment location and sizes etc.
- c. Complete schematic as installed.
- d. Location of Hydrants, Earth pipes, route of earthing conductors etc.
- e. Route of all cables and pipes run along with detail sizes and mode of installation.

5. DOCUMENTS

The contractor shall submit to the Engineer, the following documents on completion of the work and before issuance of virtual completion.

- i. Warranty for equipment installed.
- ii. Test certificates
- iii. History sheets of the equipments
- iv. Catalogues

- v. Operation and maintenance manuals
- vi. List of recommended spares and consumables
- vii. Reconciliation statement
- viii. All approvals and sanctions

6. SANCTION/ APPROVALS FROM STATUTORY AUTHORITIES/ LOCAL FIRE AUTHORITY

The contractor shall be fully responsible and shall carry out following activities:-

- a. Submission of working drawing
- b. Obtaining the approval of drawings
- c. Arranging inspection of site by officials of the Authority
- d. Obtaining the final no objection/ completion certificate after submitting required documents.
- e. Any other statutory approvals required.

7. MANUFACTURING

The responsibility for ensuring the manufacture of the equipment as per the specifications shall be solely that of the contractor. The contractor shall be responsible for selection of materials as per agreed specifications.

8. MAKE OF MATERIALS

Only approved make of material shall be used. The contractor shall get the samples of all the items approved from the consultant or project incharge engineer before commencing the supply.

9. MANUFACTURER INSTRUCTION

Any specific instruction furnished by manufacture covering the points not mentioned in technical specifications of the tender shall be brought to the notice of project incharge engineer in writing for further instructions in this regard at the time of tendering.

10. MATERIAL TESTING

The project incharge engineer shall have full power to get any material of work to be tested by an independent agency at contractor's expense in order to prove the soundness and adequacy.

11. INSPECTION AND TESTING

- a. All equipment shall be inspected and tested as per an agreed Quality Assurance Plan before the same is packed and dispatched from the contractor's works. The contractor shall carry out tests as specified/ directed by engineer.
- b. Contractor shall perform all such tests as may be necessary to meet requirements of Local Authorities, Municipal or other statutory laws/ bye-laws in force. No extra shall be paid for these.
- c. The project incharge engineer may, at his sole discretion, carry out inspection at different stages during manufacturing and final testing after manufacturing.
- d. Approvals or passing of any inspection by the engineer or his authorized representative shall not, however, prejudice the right of the engineer to reject the plan if it does not comply with the specification when erected or give complete satisfaction in service.

12. TRAINING OF DEPARTMENT PERSONNEL

- a. The contractor shall train the Client's personnel to become proficient in operating the equipment installed. Training shall be done before the expiry of the defects liability period (one year after completion & handing over).
- b. The period of training shall be adequate and mutually agreed upon by the engineer and contractor.

- c. The Client's personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing, minor repairs and replacement.
- d. Nothing extra shall be paid to the contractor for training Client's personnel.

13. PERFORMANCE GUARANTEE

At the close of the work and before issue of final certificate of virtual completion by the engineer, the contractor shall furnish written guarantee indemnifying the Client against defective materials and workmanship for a period of one year after completion and handing over. The contractor shall hold himself fully responsible for reinstallation or replace free of cost to the Client.

- a. Any defective material or equipment supplied by the contractor.
- b. Any material or equipment supplied by the Client which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

B. PIPING FOR WET RISER SYSTEM

1. SCOPE

This section covers the details of requirement of piping used in wet riser system, including the associated auxiliary equipment.

2. GENERAL

The wet riser system shall remain pressurized at all times during operation, and as such the piping work shall be carried out to withstand the same.

3. PIPES AND FITTINGS

Pipes for Wet Riser system shall be of black steel conforming to IS: 1239 (Heavy Class)
Fittings for black steel pipes shall be malleable iron suitable for welding or tapered screwed threads.

4. JOINTING

Joint for black steel pipes and fittings shall be metal to screw grid up to 50 mm dia and above 65 mm dia welded joints. A small amount of red lead may be used for lubrication and rust prevention in threaded joints. Hold tight will be use for threaded pipes joint.

All the welding shall be radiographic ally tested. Joints between MS pipes, valves and other appurtenances, pumps etc. shall be made with M.S. flanges with appropriate number of bolts. Flanged joints shall be made with 3mm thick insertion rubber gasket.

5. DIA OF FLANGE AND HOLE CONFORMING IS:

Size of pipe	80 mm	100 mm	150 mm	200 mm	300 mm
Dia of flange	200 mm	220 mm	285 mm	340 mm	445 mm
Dia of bolt	16 mm	16 mm	16 mm	16 mm	16 mm
No. of hole	4 mm	4 mm	8 mm	8 mm	12 mm

6. PIPE PROTECTION

- a. All pipes above ground and in exposed locations shall be painted with one coat of red oxide 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 hot bitumen, wrapped with bituminous pypkote or Hessian cloth and finished with one coat of hot bitumen paint.
- c. Pipe passing through structural members will be provided with M.S. pipes.

7. PIPE SUPPORTS

All pipes shall be adequately supported from ceiling or walls from existing inserts by structural clamps fabricated from M.S. structurals e.g. rods, channels, angles and flats. All clamps shall be painted with one coat of red lead and two coats of black enamel paint. Where inserts are not provided the contractor shall provide anchor fasteners.

Pipe Support Spacing	Horizontal	Vertical
Pipe up to 50 mm	2 Mtr.	3 Mtr.
Pipe 65 – 100 mm	1.75 Mtr.	3 Mtr.
Pipe above 100 mm	1.50 Mtr.	3 Mtr.

8. ORIFICE FLANGES

Contractor shall provide orifice flanges fabricated from 6 mm thick stainless steel plates on the branch lines feeding different zones/ floors so as to allow required flow of water at 3.5 Kg/ sq.cm. Pressure. The contractor shall furnish design for these orifice flanges.

9. AIR VESSEL AND AIR RELEASE VALVE

Air vessel on top of each wet riser piping shall be installed before execution for approval fabricated out of at least 8 mm thick steel to withstand the pressure, with dished ends and supporting legs. This shall be of 250 mm dia and 1 m high. This shall be completed with necessary flange connection to the wet riser piping and air release valve with necessary piping to meet the functional requirement of the system. The air vessel shall be of continuous welded construction and painted with red Colour. This shall be tested for twice the working pressure.

10. VALVES, GAUGES AND ORIFICE PLATES

Butter-fly or Sluice valves above 50 mm shall be of cast iron body and bronze/ gunmetal seat. They shall conform to type PN 1.6 of IS: 13095,780, valves up to 65mm shall be of gunmetal construction. Valve wheels shall be of right hand type and have an arrowhead engraved or cast thereon the direction for turning open and closing.

Non-return valves shall be of cast iron body and bronze/ gunmetal seat. They shall be swing conform to Class 1 of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

Pressure gauge of suitable range shall be installed on the discharge side of each pump vacuum gauge shall be provided on suction side for pumps with negative suction. The dial size shall be 250 mm. The gauges shall have brass cocks.

Orifice plates shall be of 6mm thick stainless steel to reduce pressure on individual hydrants to operating pressure of 3.5-kg/ sq.cm. Design of the same shall be given by the contractor as per location and pressure condition of each hydrant.

11. EXTERNAL YARD HYDRANTS

External yard hydrants shall be of 'Stand Post' type conforming to IS: 908 and comprise stand post for single or double(as per specified in boq) outlet, duck foot bend, flange riser and single headed brass/ gunmetal or (as per specified in boq)valve conforming type A of IS: 5290.

The stand post column shall be of cast iron, cast in one piece, conforming to grade 20 of IS: 210 or M.S. pipe. The internal diameter at the top shall be at least 80 mm.

The outlet shall be angled towards ground, with instantaneous spring lock type gunmetal female coupling of 63 mm dia. For connecting to hose pipe.

12. INTERNAL HYDRANTS

The internal hydrant outlet shall comprise double-headed double outlet or as per B.O.Q. gunmetal or SS landing valve' conforming to type A of IS: 5290. Separate valves one on each of the two heads shall form part of the landing valve construction.

A brass cap with chain is provided on one head of the outlet which will have an instantaneous pattern female coupling for connection to the hose pipe. The landing valve shall be fitted to a tee connection on the wet riser at the landing.

13. FIRST AID HOSE REEL EQUIPMENT

First aid hose reel equipment shall comprise reel hose guide fixing bracket, hose tubing globe valve, stopcock and nozzle. This shall conform to IS: 884. The hose tubing shall conform to IS: 1532.

The hose tubing shall be 20 mm dia and 36 m long. The gunmetal / brass nozzle and globe valve shall be of 25 mm size.

The fixing brackets shall be of swinging type. Operating instructions shall be engraved on the assembly.

14. HOSE PIPES, BRANCH PIPES AND NOZZLES

Hose pipes:- Hose pipes shall be rubber lined woven jacketed 63 mm in diameter and 15 m long. They shall conform to controlled percolation type comply with IS:8423 or type A (reinforced rubber lined) of IS: 636 . The hose shall be sufficiently flexible and capable of being rolled.

Each run of hose pipe shall be complete with necessary coupling at the ends of match with the landing valve or with another run of hose pipe or with Branch pipe.

The coupling shall be of instantaneous spring lock type.

Branch pipe: - Branch pipe shall be of copper, gunmetal or aluminum alloy 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

Nozzle: - The nozzle shall be of copper or gunmetal, 20 mm in internal diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with the nozzle spanner.

End couplings, branch pipes, and nozzles shall conform to IS: 903. Each hydrant point will be provided with two hoses of 15 m each and one gunmetal branch pipe.

15. HOSE CABINET

The hose cabinet to accommodate the hosepipes, branch pipe nozzle and the hydrant outlets shall be fabricated from 1.5 mm thick sheet steel. In case of internal hydrants, this shall accommodate the hose reel equipment also. This shall have lockable, center opening glazed doors.

The scope of work includes provision of masonry or steel frame structure, as specified for installation. The hose cabinet shall be painted red stove enameled.

16. FIRE BRIGADE INLET CONNECTIONS/ DRAW OFF CONNECTION

One set of 2/4 ways collector head Fire Brigade connection shall be provided at under ground tank, sprinkler system and individual wet risers as specified.

The inlet to the wet riser sprinkler header shall be with 150 mm dia butterfly or sluice valve and non-return valve. The scope shall include necessary reducers, tees bends and special fittings as required.

It should be provided with M.S. enclosure fabricated from 1.5 mm thick M.S. sheet, front glass locking arrangement supported on M.S. structural members, painting with two coats of postal red enamel.

C. ELECTRIC DRIVE, HORIZONTAL FIRE PUMPS

1. SCOPE OF WORK

- a. Work under this section shall consist of furnishing all labour, materials, equipments and appliance necessary and required to completely install electrically operated pumps as required by the drawings and specified hereinafter or given in the schedule of quantities.
- b. Without restricting to the generality of the foregoing, the pumps and ancillary and accessories.
 - i. Electrically operated pumps with motors, base plates and accessories.
 - ii. Alarm system with all accessories wiring and connections.
 - iii. Pressure gauges with isolation valves and piping bleed and block valves.
 - iv. M.S. pipes, valves, suction strainers, delivery headers and accessories.
 - v. Foundations, vibration eliminator pads and foundation bolts.

2. QUALITY CONTROL

- a. These shall comply with the IS codes as specified.

3. SUBMISSIONS

- a. Product Manuals
- b. Hydraulic Details

4. STORAGE

- a. These shall be stored as delivered in original packing.

D. FIRE MAIN PUMP AND JOCKEY PUMPS

1. PUMPING SETS

- a. Pumping sets shall be multi stage horizontal split casing centrifugal Pump having single outlet with cast iron body and bronze dynamically balanced impellers. Connecting shaft shall be stainless steel with bronze sleeve and grease- lubricated bearings.
- b. Pumps shall be connected to the drive by means of spacer type love joy couplings, which shall be individually balanced.
- c. The coupling joining the prime movers with the pump shall be provided with a sheet metal guard.
- d. Pumps shall be provided with approved type of mechanical seals.
- e. 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.
- f. The pump shall meet the requirements of the Tariff Advisory Committee and N.B.C.and N.F.P.A. and the unit shall be design proven in fire protection services.

2. ELECTRIC DRIVE

- a. Electrically driven pumps shall be provided with totally enclosed fan ventilated induction motors. For fire pumps the motors should be rated not to draw starting current more than 3 times normal running current.

- b. Motors for fire protection pumps shall be at least 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.
- c. Motors shall be wound for class F insulation and winding shall be vacuum impregnated with heat and moisture resistant varnish glass fiber insulated.
- d. Motors for fire pumps shall meet all requirements and specifications of the Tariff Advisory Committee. and N.B.C. and N.F.P.A.
- e. Motors shall be suitable for 415 volts, 3 phase 50 cycles a/c supply and shall be designed for 38 deg. C ambient temperature. Motors shall conform to I.S. 325.
- f. Motors shall be designed for two-start system
- g. Motors shall be capable of handling the required starting torque of the pumps.
- h. Contractor shall provide inbuilt heating arrangements for the motors for main pumps to ensure that motor windings shall remain dry.
- i. Speed of the motors shall be compatible with the speed of the pump.

3. AIR VESSEL

- a. Provide one air vessel fabricated from 10 mm M.S. plate with dished ends and suitable supporting legs. 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.
- b. The fire pumps shall operate on drop of pressure in the mains as given 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.

4. VIBRATION ELIMINATORS

- a. Provide on all suction and delivery lines 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 connector shall be as per manufacturer's details.

5. INSTALLATION

- a. 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.
- b. Pumps and motors shall be truly aligned by suitable instruments.
- c. All pumps 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.
- d. Manufacturer's instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.
- e. 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 Engineer-in-Charge or their authorized representative for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost to the Clients.
- f. Each pump shall be provided with a 150 mm dia pressure, isolation cock and connecting piping, bleed and block valve.

- g. Provide vibration eliminating pad and connectors for each pump.

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.

E. DIESEL DRIVE, HORIZONTAL FIRE PUMPS

1. SCOPE OF WORK

- a. Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install diesel driven pumps as required by the drawings, specified hereinafter or given in the schedule of quantities.
- b. Without restricting to the generality of the foregoing, the pumps and ancillary equipment shall include the following:
 - i. Diesel driven pumps with motors, base plates and accessories.
 - ii. Alarm system with all accessories, wiring and connections.
 - iii. Pressure gauges with isolation valves and piping bleed and block valves.
 - iv. M.S. pipes, valves, suction strainers, delivery headers and accessories.
 - v. Foundations, vibration eliminator pads and foundation bolts.

2. QUALITY CONTROL

- a. These shall comply with the IS codes as specified.

3. SUBMISSIONS

- a. Product Manuals
- b. Hydraulic Details

4. STORAGE

- a. These shall be stored as delivered in original packing.

F. DIESEL ENGINE PUMPS

1. PUMPING SETS

- a. Pumping sets shall be multi stage horizontal split casing centrifugal pump having single outlet with cast iron body and bronze dynamically balanced impellers. Connecting shaft shall be stainless steel with bronze sleeve and grease-lubricated bearings.
- b. Pumps shall be connected to the drive by means of spacer type love joy couplings, which shall be individually balanced dynamically and statically.
- c. The coupling joining the prime movers with the pump shall be provided with a sheet metal guard.
- d. Pumps shall be provided with approved type of mechanical seals.
- e. 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.
- f. The pump shall meet the requirements of the Tariff Advisory Committee and the unit shall be design proven in fire protection services.


2. DIESEL ENGINE

- a. Diesel engine shall be of 6 cylinders with individual head assemblies. The engine shall be water-cooled and shall include heat exchanger and connecting piping, strainer, isolating and pressure reducing valves, bye-pass line complete in all respects.
- b. Engineer shall be direct injection type with low noise and exhaust emission levels.
- c. The speed of the engine shall match the pump speed for direct drive.
- d. The engine shall be capable of being started without the use of wicks, cartridge heater, plugs or either at engine room temperature of 7 deg. C and shall take full load within 15 seconds from the receipt of the signal to start.
- e. The Engine shall efficiently operate at 38 deg. C ambient temperature at 50 m above mean sea level.
- f. Noise level of the engine shall not exceed 105 DBA (free field sound pressure) at 3 m distance.
- g. The engine shall be self starting type up to 4 deg. C and shall be provided with one 24 V heavy duty DC battery, starter, cut-out, battery leads complete in all respects. One additional spare battery shall be provided. The battery shall have a capacity of 180 to 200 ampere hours and 640 amps cold cranking amperage.
- h. Provided a battery recharger of 10 to 15 amperes capacity with trickle and booster charging facility and regulator.
- i. Annunciation panel shall be suitable for working on 24 volts D.C. Arrangement for starting shall be automatic on receiving the signal but shutting off shall be manual.
- j. The engine shall be provided with an oil bath or dry type air cleaner as per manufacturer's design.
- k. Engine shall be suitable for running on high speed diesel oil.
- l. The system shall be provided with a control panel with push button starting arrangement also and wired to operate the engine on a differential pressure gauge.
- m. The entire system shall be mounted on a common structural base plate with ant vibration mountings and flexible connections on the suction and delivery piping.
- n. Provide one fully mounted and supported day oil tank fabricated from 5mm thick M.S. sheet electrically welded with a capacity of 8 hours working load but not less than 600 lit. Provide level indicating gauge glass on the day oil tank and low fuel indication of the control panel.
- o. Provide one exhaust pipe with suitable muffler (residential type) to discharge the engine gases to outside open air as per site conditions.
- p. Provide all accessories fittings and fixtures necessary and required for a complete operating engine set.
- q. Contractor shall indicate special requirements, if any, for the ventilation of the pump room.

3. OPERATING CONDITIONS FOR FIRE & SPRINKLER PUMPS

Cut in

Cut out

Operating pressure		
Jockey pump	9.0 Kg/ sq.cm	7.0 Kg/sq.cm
Fire Electrical Pump 1	6.5 Kg/ sq.cm	automatically
Fire Electrical Pump 2	5.5 Kg/ sq.cm	automatically
Diesel Engine driven pump 3	4.50 Kg/ sq.cm	manual

Note: - The diesel pump shall start automatically, on fall of pressure in the pipe line, in the absence of electric supply, but the stopping shall be manual.

1. Jockey pump shall start and stop through pressure switch automatically.
2. Jockey pump shall stop when main pump starts.
3. Main pump shall start automatically on fall of pressure but stopping shall be manual.

4. VIBRATION ELIMINATORS

- a. Provide on all suction and delivery lines 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 connector shall be as per manufacturer's details.

5. INSTALLATION

- a. 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.
- b. Pumps and motors shall be truly aligned by suitable instruments.
- c. All pump connections shall be standard flanged type with appropriate number of bolts. In case of nonstandard flanges companion flanges shall be provided with the pumps.
- d. Manufacturer's instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.
- e. 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 Engineer-in-Charge or their authorized representative of inspection of equipment during manufacturing and also to witness various tests at the manufacturers works without any cost to the Clients.
- f. Each pump shall be provided with a 150 mm dia pressure gauge, isolation cock and connecting piping, bleed and block valve.
- g. Provide vibration eliminating pad and connectors for each pump.

G. POWER AND CONTROL PANEL AND OTHER CONTROL COMPONENTS

1. SCOPE

This section covers the detailed requirements of the power and the control panel for the wet riser system, and also for the various control components in the system.

2. **POWER AND CONTROL PANEL CONSTRUCTIONAL REQUIREMENTS**

- a. **GENERAL FEATURES:-** The power and control panel shall be totally enclosed dust and vermin proof free standing floor mounted cubicle type, fabricated out of sheet steel not less than 2 mm thick. Where necessary, additional stiffening shall be provided by angle iron framework. General construction shall be of compartmentalization and sectionalisation such as mains incomer, electric fire pump, diesel fire pump, pressurization such as mains incomer, electric fire pump, diesel fire pump, Jockey pump and control, so that there is no mix up of power and control wiring and connections in the same sections as far as possible. The panel shall be front operated type with all connections accessible from the front. Front doors shall be hinged type. Back doors shall be hinged type or removable type for inspection. The door hinges shall be of concealed type, the doors shall be provided with quick fixing doors knobs with indication. The general arrangement of the panel shall be got approved before fabrication. The cubical construction shall be to IP 21 as per IS: 2147, painted with approved make and shade stove enamel paint, aluminum identification plate for each compartment danger plate surrounding of bus bar and live contact parts, wiring diagram etc. red, white or black enamel coated aluminum plate to be fixed on visible location.
- b. **CABLE ENTRIES AND GLAND PLATES:-**All cable entries shall be through double compression plates which are removable and stationarised. Necessary compression type glands shall also be provided. Where heavy cables are brought in and terminated, suitable clamps shall be incorporated to relieve the stress on the glands due to the weight of the cable. Cable entries may be from top or bottom depending on the equipment layout and cable scheme as approved.
- c. **BUS BAR AND CONNECTIONS:-**The bus bars shall be air insulated and of aluminum of high conductivity electrolytic quality (grade E 91 E to IS 5082) and of adequate cross section. Current density shall not exceed 1.6 sq.mm per amps. sq.cm. All connections to individual, circuits from the bus bars shall preferably be with solid connections. The bus bar and the connections shall be suitable covered with PVC sleeves or in an approved manner. Bus bars shall be suitably support using non hygroscopic insulated supports such that they may stand 50 KA RMS symmetrical current for one second. High tensile bolts and spring washers shall be provided at bus bar joints with red, yellow paint and neutral with black color paint.
- d. **EARTHING ARRANGEMENT: -** GI strip 25 mm x 5mm shall be run at the rear of the board, bonding all the sections suitably. 2 nos. earth terminals shall be provided at the ends of the GI strip for connection to earth system. Earth terminals shall be with a flexible loop and the hardware shall be of GI or passivated and plate iron.
- e. **TERMINAL BLOCKS AND SMALL WIRING: -**Terminal blocks shall be of heavy duty type and generally not less than 15 Amps 250 V grade up to 100 V, and 600 V grade for the rest of the functions. They shall be easily accessible for maintenance. All control wiring inside the panel shall be with PVC insulated copper conductor of 2.5 sq.mm size and 600 V grade conforming to IS: 694. Suitable color coding may be adopted. Wiring harness shall be neatly formed and run preferably function wise, and as far as possible segregated voltage wise. Identification ferrules shall be used at both ends of the wires.

3. **INSTRUMENTS AND LAMPS:**

All indication lamps and instruments shall be flush mounted type in front of the panel. The voltmeter and ammeter shall be of size 10 mm conforming to clause 1.5 of 1248 for accuracy.

Current transformers shall be provided with ammeters, wherever necessary.

Indicating lamps to indicate the availability of electric supply shall be provided at the incoming section. Necessary indicating lamps for alarm indications and battery charging shall be provided in the respective sections.

All indicating lamps and voltmeter shall be protected with HRC cartridge type fuses.

- a. Labels:- All internal components shall be provided with suitable identification labels. Aluminum sheet engraved labels shall be fixed at the panel for all switches, instruments, push buttons, indicating lamps, danger plate etc.
- b. Painting: - The entire panel shall be given a primer coat of red after degreasing and phosphating treatment and 2 coat of powder/ stove enameled paint of approved shade before assembly of various items.

4. EQUIPMENT REQUIREMENTS

- a. General: - The power and control panel shall comprise individual section for the various equipments of the system and controls, in a combined cubical type design. Where particularly specified, totally independent panels for each equipment shall be provided in cubical design and the main equipment panel and the individual panels in such a case shall incorporate isolation arrangement of appropriate capacity. All MCCBs shall be to AC 23 duty to IS: 2516.
- b. Incomer section: - The incoming section shall comprise
 - i. Moulded case circuit breaker with Electronic release, ammeter, voltmeter, selector switch set of phase indication lamps.
 - ii. Aluminum bus bars
 - iii. TP & N outgoing Moulded case circuit breaker with Electronic release for electric fire pump
 - iv. TP & N outgoing Moulded case circuit breaker with Electronic release for Jockey pump.
 - v. TP & N outgoing Moulded case circuit breaker with Electronic release for battery charger unit control.
 - vi. TP & N outgoing Moulded case circuit breaker with Electronic release (spares)

Note: - Terminal blocks, inter-connections, labels etc. as necessary.

5. ELECTRIC FIRE PUMP SECTION: -

This section shall incorporate the following facilities.

- i. TP & N Moulded case circuit breaker
- ii. Control system components and equipment such as relays, contractors, and timers etc. for automatic operation.
- iii. Starter unit, current transformer and ammeter
- iv. Indication lamps, their fuses, terminal block, push button, control and selector switches etc. as required.
- v. Pump lock out devices due to faults or abnormalities as specified.
- vi. Visual/ audio alarms, indications and communications facility as specified.
- vii. Necessary inter connection control and power cable work, cable glands, lugs and internal wiring and connections.

6. ENGINE SECTION: -

The engine section shall incorporate the following facilities.

- i. Control system components and equipment such as relays, contractors, and timers etc. for automatic operation.
- ii. Instruments, indicator lamps, fuses, terminal blocks, push buttons, control and selector switches etc. as are required.
- iii. Engine shut down and block out devices due to faults or abnormalities as specified.
- iv. Visual/ audio alarm indication and enunciator facility as specified.
- v. Inter- connection control and power cable work, cable glands, lugs, all internal wiring and connection etc.

7. AUXILIARY PUMP SECTION: -

Each of the auxiliary pump section for priming pump shall incorporate the following:

- i. TP&N Moulded case circuit breaker
- ii. Control system components such as relays, timers, contractors etc. as are necessary for functional requirements.
- iii. Starter unit, current transformer and ammeter
- iv. Indication lamps, fuses, terminal blocks, push buttons selector, switch etc. as required.
- v. Inter-connections, power and control cable work, cable plants lugs, internal wiring and connections.
- vi. Low water level alarm for terrace tank, where provided.

8. CONTROL SECTION: -

This section shall incorporate the following:

- i. Control components integrating the various sections, so as to satisfy the functional requirements.
- ii. Battery charger unit with boost/ float charge facility with voltmeter, capable of independently charging 1 set of battery at a time.
- iii. Visual/ audio alarms not covered in individual sections.
- iv. Lamps healthy test facility.
- v. Instruments, indicating lamps, push buttons, fuse terminal blocks etc. as are required.
- vi. Test facility to stimulate operation of hydrants.

9. OTHER CONTROL COMPONENTS**1.1. Pressure Switches:**

Pressure switches shall be provided for switching on and off the jockey pump at present pressures and also for switching of the fire pump at preset pressure. Being the main component for initiating the signal for the operation of the pumps, the pressure switches shall be totally reliable, sturdy in construction and of long life. The pressure settings shall be adjustable.

1.2. Low water level indication and switch:

To prevent the dry running of the fire pumps due emptying of the static tank, water level indication and switch shall be provided. This shall trip the electric motor or stop the diesel engine, as the case may be when the water level goes below a present level. This shall also furnish a distinct low water level audiovisual alarm. This should indicate the level of water at different stags is the power and control panel.

1.3. Power Supply for Controls:

In order ensure that the control systems remains operational at all times, the control system shall be designed for 24V DC operation, fed from 24 V wet battery. This shall be independent of the starting battery for the engine i.e., battery shall remain trickle charged at the times from the common battery, charges at the control section.

10. MAINTENANCE MANUAL

- a. On completion of the entire work and successful commissioning, contractor shall hand over four copies of maintenance manuals of all equipment installed by him.
- b. Maintenance manuals shall include information relating to make, model Number, year of manufacture for all electrical and mechanical equipment with names of local suppliers or manufacturers' agents.

11. MEASUREMENTS

- a. Pumping sets, air vessel, switchboard cubicle, pressure switch, fire alarm shall be measured by number and shall include all items necessary and required and given in the specifications.
- b. Earthing shall be measured as a lump sum item.
- c. Earthing tape will be linear measurement.
- d. Cabling shall be measured per linear meter from switchboard to each motor and shall include all items necessary and required and given in the specifications.

H. INSTALLATION AND TESTING

1. SCOPE

This section covers the requirements of installation of the various components of the wet riser system.

A survey of the site of the work shall be made by the contractor before preparation of the detailed drawings for submission to the department for approval. The installation shall be carrier out strictly in accordance with the approved drawing.

The scope of installation work shall include the following, where or not expressly mentioned in the schedule or work.

- i. Cement concrete (1:2:4 mix) foundation for all pump sets
- ii. Vibration isolation arrangement for all pump sets
- iii. Filling up the hole in flooring with cement concrete, after laying the wet riser pipes
- iv. Necessary supports and clamps for wet riser pump room
- v. Necessary supports and camps for wet riser plumbing the building
- vi. Supporting bracket/ frame work for the fuel oil tank of the engine

- vii. Excavation of the earth, consolidation and refilling after laying of wet riser piping in ground.
- viii. Provision of necessary brick base or intermediate support as required in approved manner in case of soils which are not strong enough to support the pipes, thereby likely to cause different settlement.
- ix. Necessary anchor block of ample dimensions in 1:2:4 cement concrete at all bends, tee connections, foot of the wet riser, and other places as required to stand the pressure thrust in pipes.
- x. Necessary masonry work/ steel work for supporting hose cabinets near external (yard) hydrants.
- xi. Valve chambers of approved design with external (yard) hydrant.
- xii. Ground level hydrants of approved design, where specified.
- xiii. Cutting and making good the damages for the installation work of the riser system
- xiv. All the required control piping, exhaust piping from engine to outside, oil piping for fuel oil and lubricating oil for the engine, drain piping from the pumps to the drain point in the pump room, overflow piping from priming tank to the sump. The piping work shall include all necessary fittings, valve and accessories for effective functional requirements.
- xv. Inter-connecting cable work with controls, control panel, batteries etc. including battery leads.
- xvi. Orifice plates at individual hydrants as required.

Where provision of MS pipe shall below ground become inescapable, it shall be protected from soil corrosion by two coats of bitumen painting and wrapped with bituminous Hessian cloth and finish with hot bitumen paint.

Each MS pipe shall be subjected to hydraulic pressure test before installation, in presence of the Engineer or his authorized representative.

External (yard) hydrants shall be located at least 2m away from the face of the buildings but not more than 15m and be accessible.

Where external hydrants below ground level are specifically indicated in tender specifications, there shall be enclosed in masonry trenches of size 75sqcm and 8cm above ground level. The hydrant shall be within 8cm from the top of the enclosure.

Necessary facility for draining the rise pipe shall be provided at ground floor level with 50mm size sluice valve.

Internal hydrant at each floor shall be located at about 1m above floor level.

Valve chambers shall be of 1sqm in size, with cover.

2. HOSES AND HOSE CABINET

All hoses shall be numbered and a record submitted with completion plan. The number and length shall be easily recognizable on each hose pipe.

External hose boxes shall be installed such that the hose is not exposed to sun rays.

3. PAINTING

Painting of the entire wet riser piping over the ground shall be done with anticorrosive primer and 2 coats of approved paint. The color shall be red to shade No. 536 of IS: 5, Paint shall conform to IS:2932.

The pumps and engine shall be painted after installation with a coat of approved paint to similar shade as per original supply.

4. TESTING OF THE SYSTEM

After laying and jointing, the entire piping shall be tested to hydrostatic test pressure. The pipes shall be slowly charged with water so that the air is expelled from the pipes. The pipes shall be allowed to stand full of water for a period of not less than 24 hours and then tested under pressure. The test pressure shall be 12 kg/cm². The test pressure shall be applied by means of manually operated test pump or by a power driven test pump to be provided by the contractor. In either case precautions shall be taken to ensure that the required test pressure is not exceeded.

The open end of the piping shall be temporarily closed for testing.

Test shall be conducted on each pump set after completion of the installation with respect of delivery head, flow and B.H.P. The test shall be carried out by the contractor at his own cost.

All leaks and defects in different joints, noticed during the testing and before commissioning shall satisfaction of engineer.

Testing of fittings/ equipments shall be carried out either at site or at works in the presence of a representative of the engineer. Test certificates shall also be furnished by the contractor.

The automatic operation of the system for the various functional requirements and alarms as laid down in his specification shall be satisfactory carried out on pressure of the engineer.

5. APPROVAL BY LOCAL BODIES

It shall be the responsibility of the contractor to obtain the approval of drawings and to get the installation inspected and approved by the concerned authorities as may be necessary as per local by laws, any fee payable to the local bodies for such activities shall also be borne by the Client on production of receipts for money paid and the other expenses will be borne by the contractor.

6. PIPE WORK ASSOCIATED WITH DIESEL ENGINE

Pipe works for fuel system, lube oil system and exhaust system shall be complete with all required supports, clamps, hangers etc. for a complete work.

Fuel feed is by gravity and the fuel tank shall be located at least 60cm above the fuel injection pump.

Fuel pipe of copper shall not be soldered but brazed or welded.

No valves or cocks shall be provided in the fuel feed line to engine from the fuel tank.

Precautions shall be taken to prevent any air locks in any part of the fuel system. No air relief cock shall be permitted and where inescapable, screwed plugs shall be provided for the purpose.

The installation of the fuel supply system shall be such that a completely primed condition is maintained, free from air lock.

Filters shall be provided in fuel oil and lube oil circuits allocations that are easily accessible for maintenance.

7. **WET RISER PIPE WORK**

The suction line for each pump shall be independent.

No sluice valve shall be provided in situation line, where the pump is located above the water level in the sump foot valve and strainer shall however be provided.

Butterfly or Sluice valve shall be provided in situation line, where the pump is located below the water level in the sump, strainer at the suction end shall be provided.

Each external (yard) hydrant shall be controlled by a Butterfly or sluice valve at ground level.

Butterfly or Sluice valves shall be kept in open position and the scope of work includes provision of necessary leather strap and pad lock so as to prevent unauthorized closing of valve.

The installation work includes provision of all clamps, supports, anchors etc.

Spacing between vertical supports shall not exceed 1.5m and horizontally at 2m up to 50mm and 1.5m for higher diameters. Clamps shall be provided on either side of the tee joints for internal hydrants. Necessary anchors/ thrust pads shall be provided as approved at locations of bends, tees etc. as required within the scope of work.

Under ground pipes of the wet riser system shall be laid 1m below ground level and at least 2m away from the face of the buildings. The run of piping shall be preferably along roads and footpaths and shall not be under buildings. Where specifically indicated to cross buildings, these shall be laid in masonry trenches with removable covers. With cut off valves at the entry and exit points.

I. **STANDARDS AND CODES**

1. IS 1648 Code of practice for fire safety of building (general) fire fighting equipment and maintenance.
2. IS 3844 Code of practice for installation of internal fire hydrant in multistory buildings
3. IS 2217 Recommendations for providing first aid and firefighting arrangement in public buildings.
4. IS 2190 Code of practice for selection, installation and maintenance of portable first aid fire appliances.
5. Part IV, firefighting National building code
6. IS 5290 External fire hydrants
7. IS 5290 Internal landing valves
8. IS 904 2 & 3 way suction collecting heads
9. IS 884 First aid hose reel

10. IS 5132 High pressure rubber pipe
11. IS 1537 C.I. Double flanged pipes
12. IS 1538 C.I. Double flanged fittings
13. IS 780 C.I. Sluice valves and gunmetal valves
14. IS 6234 Specifications for Water type (stored pressure) fire extinguisher.
15. IS 2873/2171 Specifications for fire extinguisher of Carbon-di-oxide & Dry powder type.

CHAPTER N

TECHNICAL SPECIFICATIONS FOR CLOSED CIRCUIT TELEVISION SYSTEM, PA SYSTEM, RODENT REPELLANT SYSTEM, WATER LEAK DETECTION SYSTEM, DOOR INTERLOCKING AND ACCESS CONTROL SYSTEM

1. GENERAL

All equipment and materials used shall be standard components, regularly manufactured, regularly utilized in the manufacturer's system.

All systems and components shall have been thoroughly tested and proven in actual use.

2. INDOOR CCTV DOME CAMERA SYSTEM (COLOUR)

The COLOR CCD camera shall meet or succeed the following design and performance specifications:

- a. The CCD camera shall be a 1/3" interline transfer imager meeting CCIR signal format specifications.
- b. The camera shall have factory fitted 3mm lens.
- c. The camera shall be 2:1 interlace, with AC line lock, which is adjustable via remote control.
- d. The image sensor shall have a total pixel array of 811(H) x 508(V) with an effective pixel array of 768(H) x 494(V).
- e. The camera shall provide a resolution of 520 TV lines.
- f. The camera shall provide for automatic electronic iris and a shutter speed range of 1/60 to 1/30,000.
- g. The camera/lens package shall provide for a sensitivity of 1.0lux at F1.4, signal level of 20 IRE, gain high.
- h. The camera shall have a signal to noise ratio of >46dB.
- i. The camera shall have a factory fitted dome housing, which should compliment with the interiors of the building.
- j. The camera shall have PT mechanism and allow panning of 360° C degree and tilting 120 ° C (degree).

2.1. DIGITAL VIDEO RECORDER

- a. The digital recorder shall be 16 channel/8 channel (with built-in multiplexer) hard disk digital recorder. The digital recorder shall have the capability to record 5 recording resolutions, Fine/ Normal / Basic/ Economy/ Network. The digital recorder shall have the capability to set the following resolutions for the recordings:
- b. 704x576/ch, 704x288/ch, 352x288/ch
- c. The digital recorder shall have 16 Video Input terminals (BNC x 16), 1 Video main monitor Output (BNCx1), 1 Monitor 2 output (BNCx1), S-Video output and 1 VGA monitor.
- d. The digital recorder shall have a one-touch operation for Play, Stop, Record and Still. The digital recorder shall have high-speed digital fast-forward and review.
- e. The recorder shall have 4 audio inputs and 1 audio output (RCA x 4 in, RCA x 1out).
- f. The digital recorder shall have a built-in CD-R/RW drive for backing up data to CD-R/RW and a built-in USB terminal for backing up data to a USB memory.

- g. The digital recorder shall have a built-in LAN terminal (100Base-TX/ 10Base-T) for remote viewing by running the utility software (included in the product package) on a specified network.
- h. The digital recorder shall have motion sensor for each of 16 channels.
- i. The sensitivity level can be set to a value between 1 and 9. The lower is the value, the higher is the sensitivity.

The digital recorder shall offer the following search modes:

- EVENT SEARCH
- TIMELINE SEARCH
- T/D SEARCH
- BOOKMARK SEARCH

The digital recorder shall have SSP(RS485) communication for the controller operation and the camera operation.

The digital recorder shall have switching between PAL and NTSC video systems.

The digital recorder shall be no larger than 432 x 98 x 349 mm (W x H x D) and weigh approximately 7.5 Kg (with two HDD units).

The digital recorder shall be CE listed, ISO9001, and ISO14001 certified.

Minimum Performance Specifications

Hard disk capacity	Max HDD capacity (technically) per bay: 540 GB
Compression Method	MPEG4 (video)
Signal format	PAL / NTSC colour signal standard (switchable)
Video Input	16 (BNC x 16)
Main Monitor output	1 (BNC x 1)
Monitor 2 output	1 (BNC x 1)
S-video output	1
VGA output	1(VGA X 1)
Audio input	4 (BNC x 4)
Audio output	1 (BNC x 1)
USB terminal	For Compact Flash reader (Front Panel)
LAN terminal	100BASE-TX / 10BASE-T (RJ-45)
Menu Language	English / French / German / Spanish/ Italian/ Russian/ Chinese/ Polish/ Czech/ Swedish/ Rumanian/ Bulgarian/ Serbian/ Japanese
Picture Resolution	NTSC: 704 x 480, 704 x 240, 352 x 240 PAL: 704 x 576, 704 x 288, 352 x 288
Picture Quality	5 levels (Fine/ Normal/ Basic/ Economy/ Network)
Screen display	1-screen display / 4-screen display / 9-screen display / 16-screen display
Number of cameras	16
Playback	Playback/ still/ search/ Cue/ Review/ Frame advance/ Slow
Backup to USB2.0 memory & CD-RW	JPEG & AVI
Search Mode	
Event Search	Search by event
Timeline Search	Search by calender
Time / Date Search	Search by time and date
BOOKMARK Search	Search by bookmark

Control Signal	
RS-485	Push Lock x 4 terminals
Telemetry control protocol	SSP, PELCO-D, KALATEL, VICON, SENSORMATIC, ELMO
Alarm in	16 inputs
Alarm out	4 outputs
Remote control	IR remote control can control up to 99 units.
Electrical	
Power Source	Input:100V to 127V AC, 4A or 200V to 240V AC, 2A
Power consumption	Max. 90W (HDDx2 and CD-RW)
Operating conditions	Temperature: 5°C to 40°C, [41°F to 104°F], Humidity: 80% or less
Physical	
Dimensions (W x H x D)	432 x 98 x 349 mm (17.0 x 3.9 x 13.7 inch)
Weight	7.5kg (264.6 oz) with two HDD units + built-in CD-RW)

2.2.32" COLOR MONITOR

- The 32" COLOR monitor shall be comprised of a high resolution CRT, and solid state electronics housed in a rugged metal case.
- The 32" COLOR monitor shall meet or exceed the following design and performance specifications:
 - The monitor shall provide a 32" picture display, 90 degrees deflection.
 - The monitor shall meet CCIR standards.
 - The monitor shall feature a display with integral implosion protection.
 - The monitor shall provide a minimum of 1000 TV lines resolution at the centre and 800 TV lines at corners.
 - The monitor shall feature automatic degaussing circuitry and fast warm up period.
 - The monitor shall operate on 230 VAC, 50Hz. Input power and use a maximum of 48 watts.
 - The monitor shall provide horizontal within 15% and vertical linearity within 10%.
 - The monitor shall accept 0.5 to 2.0 V p-p composite video.
 - The monitor shall use internally derived synchronization.
 - The monitor shall feature brightness, vertical hold, horizontal hold, contrast and power ON/OFF controls on the front panel.
 - The monitor shall provide a video gain of 30 dB.
 - The monitor shall provide a terminating slide switch and two BNC connectors, one looping, on the rear.
 - The monitor shall be provided with a 6', 3 wire grounded AC power cord.
 - The monitor shall be constructed of a black matte, textured coat finished steel cabinet with black plastic faceplate.
 - The monitor shall have an operating temperature range of 50 deg. F to 131 deg. F and an operating humidity range of 10% to 95% relative, non-condensing.
 - The monitor shall be rack mountable in a standard EIA rack

2.3.SPEAKER CUM HOOTER

- a. A moveable jumper provided should have a choice for high (98 db A) or low (94 db A) outputs.
- b. Speaker cum hooter will be dual transformer speaker capable of operating at 25 and 70.7 Vrms and will have a frequency range of 400 to 4000Hz.
- c. The synchronized speaker should be supplied with "ALERT" (wall orientation) as the standard marking. It should be for indoor and outdoor installation.

3. PUBLIC ADDRESS SYSTEM CUM VOICE EVACUATION SYSTEM

- a. The public address system with microphone and amplifier of adequate capacity with 2 Nos. manual selector switches for selecting between: (a) alarm or public address system (b) Alert tones or Evacuation tones to all the channels.
- b. The amplifier shall work on A.C. or 24 VDC power supply separate from that of the fire alarm panel. Master control for adjustment of volumes shall be provided. The amplifier unit shall have complete protection against over loads, short circuits and wrong battery polarity. The amplifier shall have hum and noise level better than 60db.
- c. Speakers with line impedance transformers (at speaker end) shall be connected to amplifier. This will be integrated with panel and shall be capable of announcing pre-recorded messages.
- d. A Message Unit shall be provided having up to 30 seconds of pre-recorded emergency messaging.
- e. The message contained in the message unit shall be recordable in the field.
- f. The Public address system shall be provided with a separate full battery back-up and suitable chart.

4. Ultrasonic Rodent Repeller

- (i) Fully digital Ultrasound output verification USB reporting safety compliance as per International radiation protection association guidelines. Third party integration –software monitoring and reporting.
- (ii) System will be used in Data center area.(Room area, ceiling ,false flooring needs to be consider)
- (iii) System should include required transducers, controllers, brackets ,cables and all the required components to make the system complete and fully functional.
- (iv) One third octave airborne ultrasound band frequencies emitted from transducer can be recorded and documented in the form of report there by ensuring human safety as per IRPA Guidelines Geneva.
- (v) Document and verify ultrasound output from transducers whereby you can record individual frequency peaks along with corresponding sound pressure levels.
- (vi) Seamless Integration with Maser CRMS V2 Proprietary software that enables real time monitoring and reporting system health in PDF Format.
- (vii) Networkable on RS-485 with support for hardwired their party BMS Integration via Modbus and potential free NO-NC Contacts.

5. WATER LEAK DETECTION SYSTEM

5.1. Introduction

A system for early detection of water leaks at particular locations in any water-dependent appliance and apparatus used in buildings such as homes, townhouses, apartments, mobile homes, and offices. A central control apparatus electrically interconnected with a plurality of circuits which enable water leaks to be accurately detected in a diversity of devices including air conditioners, compressor coils, hot water appliances, and pipes, and for communicating the severity of the water-related problem. A

plurality of water sensors are incorporated into specially designed probes of the preferred embodiment wherein water leaks may be accurately and reliably detected in a diversity of water-dependent appliances and devices. The product shall be designed and should be easily installed and to be inherently devoid of any safety hazards. The total area under protection shall be divided into multiple zones. When there is a potential leak detected, the product shall be able to locate the zone(s) in which the leak has occurred with the corresponding zone name.

5.2. Technology

Water leak detection system should be microcontroller-based system, which consists of 4 zones for water leak detection and 5 output relay contacts and one output for hooter.

The operation of the entire system can be monitored via the 80 characters (4X20) LCD mounted in the front face of the panel. All the inputs shall be given to the system via the versatile membrane keypad. All the indications can be viewed in the LED provided in the front face of the system. All the status can be viewed remotely using standard Modbus protocol via RS485 medium.

In the existing conventional water leak detection system, the sensing signals are 12V / 24V DC supply. When the DC excitation is used, the sensor cable, when comes in contact with water, chemical reaction takes place due to electrolysis between the two bare conductors of the sensor cable. As the result, negatively charged particles start deposited in the positive conductor of the sensor cable, which leads to corrosion & rusting in the sensor cable. The sensitivity of the cable will be drastically reduced because of deposited particles.

The signals for sensing the water leaks are 12V, 50Hz AC supply. Since alternate current is used the direction of flow of current is altered 50 times a second. This will not allow the particles to deposit in the bare conductor, as the change in direction is dynamic and fast. As a result, there is no chance of corrosion & rusting in the sensor cable.

Supply Voltage – 12V AC

Frequency 50Hz

Output – 5 Relay contact ,1 Hooter Output

Communication Protocol – Modbus

6. Door Interlocking System

6.1. System Description

The door interlocking system is used to control the entry of personnel to a secure area such as a clean room, where dust or small particles may be a problem. The principle is generally well understood. In its simplest form, the door interlocking is composed of 2 to n doors that are electrically interlocked in such a way that the all doors cannot be opened simultaneously. The door interlocks are used in a variety of situations but in essence they are there to control the unwanted passage from one area to another.

Door Inter Locking System achieves in prevention of process area contamination by

- Preventing simultaneous access of doors/Rooms.
- Ensures that when one door for a room is OPEN then all other doors in that particular room are closed.
- Programmable delay between each door openings to maintain required pressure.
- In Emergency an override key is available on a push button module for opening the door.

6.2. EM Lock - A magnetic lock is a simple locking device that consists of an electromagnet and armature plate. By attaching the electromagnet to the door frame and the armature plate to the door, a current passing through the electromagnet attracts the armature plate holding the door shut. The magnetic lock relies upon some of the basic concepts of electromagnetism. Essentially it consists of an electromagnet attracting a conductor with a force sufficiently large enough to prevent the door from being opened.

6.3. Controller

- Advanced Micro controller based system.
- It supports up to 2 –n doors. (As per application 2 Door system-2no of doors, 3 Door system-3 no of doors, 4 door system-4no of doors)
- Emergency Station is provided to unlock all doors in emergency.
- Inbuilt sensor Magnetic Lock to read door feed back.
- Relay status indication with high intensity LED
- Door status indication with GO, WAIT message display
- Provided long life LEDs.
- Supports Access control module interface.
- Supports Fire alarm module interface.

6.4. Push Button

- The SS push button is used to open the door, when the button is pressed it sends a request to the controller to release the door.
- The Push Button module is provided with locked, unlocked message status display.
- Shall have emergency button as well.

7. Access Control System

7.1. System Description

- The objective shall be to provide restricted entry/exit in the entire premises. The person who is authorized to enter the particular area shall not be allowed to intervene in any other areas thus restricting unauthorized personnel entry & exit thru critical areas and facilitate effective people management.
- The Reader proposed shall be Prox /I class Readers.

7.2. Reader Specifications : -

Proxpoint Readers - , can connect thru wiegand interface to controllers. 2 to 3 inches read range. LED, BEEP configurable, small & sleek design

Features

- Features a beeper and multicolor LED which can be host-and/or locally controlled.
- Enables various beeper and LED configurations, depending on individual site requirements.
- Can read HID cards with formats from 26 to 140 Bits.
- Designed for mounting directly onto metal with no change in read range performance.
- Available with either Wiegand or Clock-and-Data (magnetic stripe data) output.
- Compatible with all standard access control systems.

7.3. Controller Specifications –

- Four Door (8 Reader) Access Control Panel with Built-in 5 Amps Supply, with display, on board TCP/IP, compatible with Access Control software. Can connect to all the readers which gives weigand or Clock & Data output. 30000 users, 55000 transactions.
- Two Door (4 Reader) Access Control Panel with Built in 2 Amps Supply, on board TCP/IP, remote up gradation of firmware, compatible with Access Control software. Can connect to all readers which gives wiegand or Clock & Data outputs. 30000 users & 55000 transactions.
 - Access to authorized personnel Powered by HID
 - Imperative for areas like Manufacturing facilities, Pharmaceutical companies
 - Support of Proximity/I class card reader
 - Support of MS Access/MS SQL/Oracle Database
 - Online monitoring and control through PC

7.4. Biometric Reader

Fingerprint attendance recorder with inbuilt controller with Proximity (EM) reader, 1900 Templates, keypad, LCD, TCP/IP, aluminium dye cast body, membrane keypad. Connects to exit reader / switch and to the door lock. Compatible with software for Attendance, Access Control software can be attached. For multi locations or for employee base of more than 400 to 500, one can with Oracle or SQL. It can store 15000 users and 60000 transactions; REQUIRES 12VDC, 2A POWER SUPPLY

- **Electro magnetic Lock :-**
Supply Installation of Electromagnetic lock having holding force of 600 LBS.
 - Operating Voltage – 12V/24V DC
 - CE Approved
 - Force 600 LBS
 - Built in magnetic contact
 - Required suitable mounting bracket
- **Proximity /I class thick cards**
Clampshell type thick card. Cannot be printed on directly. Sticker of ID can be fixed on it.
- **Access Control Software**
Access Control , Attendance Software supports 250 employees at single location.

CHAPTER O

SPECIFICATIONS FOR LAN DATA NETWORKING / CABLING

1. Introduction

- (a) This Document defines the minimum technical and functional parameters to be met by the Structured Cabling System in order to meet the communication requirements.
- (b) This document describes the installation, termination and testing of the structured cabling system for various applications such as Voice, Data and Multi-media services. The Installers shall adhere to all requirements of this specification document and ensure that all of their employees assigned to perform any installation tasks are made fully aware of their obligations under this document except where explicitly varied or excluded in supporting documentation for this site.
- (c) All HLL / IPC site specific documents will be issued with a unique Project ID that shall be used to identify the project on all correspondence and as built documentation.
- (d) This section shall be used as the reference for any person that is required to recommend, scope, design, install, terminate, test or certify any structured cabling system within any HLL / IPC Site.
- (e) This document shall be read in conjunction with any Site Specific Specifications. Site Specific Specification details will take precedence over details in this document
- (f) This document does not cover other media types such as wireless.
- (g) This document shall be accompanied by a detailed design document that shall provide the scope of requirement for an individual environment.
- (h) For the complete description of HLL / IPC Structured Cabling System Standards, refer to the body of this document.

2. TELEPHONE SYSTEM AND LAN WIRING

(a) Enhanced Category 5 UTP specifications

- i. The UTP shall be 4-pair, with 24 SWG solid or standard copper conductors.
- ii. The UTP-based cabling system shall have a 160 MHz channel bandwidth over a maximum distance of 100m (328 ft) and a channel power sum attenuation-to-crosstalk ratio (PSACR) of 9.6 dB@ 100 MHz using an interconnect or BIX cross connect configuration.
- iii. The UTP-based cabling system shall use matched components from a single manufacturer, certified to deliver system performance over the lifetime of the application that the cabling system was originally designed to support.
- iv. All component used in the UTP-based cabling system shall be warranted for a period of 25 years from date of installation against defects in materials and workmanship.
- v. The UTP-based cabling system shall comply with the following standards:
Enhanced Category 5 – TIA/EIA Addendum
Category 5 – ANSI/TIA/EIA-568, TIA/EIA TSB67
Class D – CENELEC EN50173
Class D – ISO/IEC 11801

(b) UTP Outlets

- i. The outlet UTP connection module and its optional cover shall be available in the following colours: grey, almond, white, black, orange, red, yellow, green, blue, purple and brown.
- ii. The outlet UTP connection module shall be Power Sum rated, with a power Sum NEXT performance equal to or better than ANSI/TIA/EIA-568 Category 5 pair-to-pair NEXT performance specifications, and shall have a PS5 marking to indicate compliance.
- iii. The eight-position outlet UTP connection module shall accommodate six-position modular plug cords without damage to either the cord or the module.
- iv. It shall be possible to inspect and/or re-terminate the UTP cable at the outlet through front access at the face plate.
- v. The faceplate housing the outlet UTP connection modules shall have aperture plugs to cover any unused openings in the faceplate.
- vi. The faceplate housing the outlet UTP connection module in wall mounted single and dual-gang electrical boxes, utility poles and modular furniture (cubical) access points using manufacturer – supplied faceplates and/or adapters, equipped with front, side or angled-entry options for modular cords.

(c) UTP System Testing

- i. There are two primary field test parameters for an UTP-based end-to-end cabling system. These are continuity/wire mapping and a visual inspection, both to be performed by the vendor.
- ii. Continuity/wire mapping is used to verify consistency pair-to-pin terminations at each end of a given cable. It also checks for faulty connections in the run. For each of the eight conductors in the cable, continuity/wire mapping indicates:
 - Continuity of the channel to the remote end.
 - Shorts between any two or more conductors.
 - Crossed pairs.
 - Reversed pairs.
 - Split pairs.
 - Any other mis-wiring.

(d) TELEPHONE TAG BLACK (TTB / IDF)

CAT-5e (enhanced) unshielded twisted pair cable in MS conduit shall be used to have modern structured cabling network for telephone system, to have latest facilities for Internet and also data cabling. All the telephone Jack must terminated on RJ-11 jacks and installed onto a dual Jack faceplate. Telephone RJ-11 Jacks must be terminated with a **BLACK** Connector/Jack.

For LAN CAT 6 UTP cables shall be used for interconnecting the RJ 45 outlets to Intermediate Switch (Hub) or directly to IT room, if the running length limit permits. These Intermediate switch shall be installed in a rack/cabinet and located in electrical room of the respective floors. Fibre Optic cable or CAT-6 UTP cable shall be used for backbone to interconnect the Intermediate switch to IT room's Server rack, as per the design requirement of the specialised Vendor. All the Data Jack must terminated on an 8 wire, 8-position Jack. Each RJ-45 Data Connection will be terminated with a **BLUE** Data Jack

Only conduit routing & wiring shall be provided by the Electrical contractor and the configuration & wiring shall be done by the Vendor for the IT Networking.

EPABX system, with latest technology will be provided by a separate Vendor to provide Voice Mail & Call Accounting by costing of all calls made by telephones.

Note: The EPABX of the existing building shall be used for the proposed building. The contractor shall integrate the network of the proposed building into the EPABX system available in the existing building. Necessary racks and interconnection ancillaries as required shall be in the scope of the present contract.

A small cabinet for Low current services shall be provided at the false ceiling level at entrance to locate all the terminal points like Tel.Tag block, tap-off box for MATV etc., for interconnecting all the low current outlets (jacks) provided. Each tel. outlet shall be provided a separate wire from the room tag block.

Similarly one CAT-5e wire from the floor TTB/IDF shall be provided for each Tel. Outlet proposed.

A Multi pair box as per BOQ Tel. Cable shall be laid from the Service gate to the Telephone switch room MDF for Direct lines from the Service provider. Some of the lines shall be bypassed to EPABX and shall be directly provided to Top management's office & Telephone operators for direct communication to outside. Rest of the lines shall be routed through EPABX for the use of patrons & staff through extensions. The following area/desk shall have direct access to outside Tel. lines:

- a) Telephone Operator's room
- b) Telephone Switch room
- c) Security room
- d) Fire officer room

3. MATV SYSTEM

(a) Co-Axial Cables

The co-axial cable shall be of wideband type with operation upto 860MHz capability, with PE dielectric and PVC jacket.

The cable shall meet or exceed the following specifications:

	RG-6	RG-11
IS Standard IS:14131	5CA4	7CA4
Centre Copper Conductor Dia	1.02mm	1.63mm
Dielectric Dia	4.57mm	7.11mm
Dielectric Material	Cellular PE	Cellular PE
Outer Dia	7.0mm	10.03mm
Bending Radius	>75mm	>115mm
Impedance	75 Ohms	75 Ohms
Return Loss	>23 dB	>23 dB
Attenuation at 20°C	Max dB/100Mtr	Max dB/100Mtr

5 MHz	1.9	1.25
45 MHz	5.25	3.5
300 MHz	11.65	7.38
450 MHz	14.45	9.02
550 MHz	16.1	9.97
860 MHz	20.1	12.52

Construction of Laboratory Building for Indian Pharmacopoeia Commission at Raj Nagar, Ghaziabad, Uttar Pradesh

List of Approved Makes of Materials

1. List of Approved Makes- CIVIL & Plumbing Services

S.No	Details of equipment/ material	Make/manufacturer
1.	Adhesive for Door Work	Fevicol/Vamicol/Dunlop
2.	Air Release Valve	Azud/ API/ Bermad/ BIR/ Kirloskar / Venus / Zoloto
3.	Aluminium Accessories and Hardware	Classic/Argent/Oxford /Newlite /Crown /EBCO /Earl Bihari
4.	Aluminium Cladding Sheets	Aludecor / Armstrong / Alucobond / Alupan / Alstone
5.	Aluminium Die-Cast handles & two point locking kit	Giesse / Securistyle / Alu – alpha
6.	Aluminium Extrusion	Hindalco / Jindal / Indal/ Mahavir
7.	Aluminium Fabricator	To be approved by the Engineer-in-Charge
8.	Anchor Fastner	Hilti / Faischer /Bosch
9.	Anti – Termite Treatment	It should be done by permanent members of IPCA as approved by Engineer-in-Charge.
10.	Automatic variable temperature control / fixed temperature control faucets	Jaquar / AOS-Robo-U-Tec/ Parry / Angash / Euronics
11.	Back up rod	Supreme Industry or equivalent
12.	Ball Cock	Sant / L&T/Audco/ Gpa
13.	Ball valves with floats	Zoloto / Leader / Sant / Jayco /GPA /Audco /AIP
14.	Batch Mix Concrete (BMC) / Ready Mix Concrete (RMC)	The contractor to install his own computerized batching plant of suitable capacity and arrange for Transit Mixers, pumps etc. as per approval of Engineer – In- Charge. Or The RMC shall be procured from the source as approved by Engineer – in Charge.
15.	Brass stop & Bib Cock	Zoloto / Sant / Jaquar
16.	Butterfly valves	Zoloto/Audco / AIP /Sant/ KSB
17.	C. I Fitting	Electrosteel/ Kesoram/ Neco/ RIF
18.	C.I Sluice Valve & Non Return Valve	Kirloskar / IVC/ Leader /Zoloto/ Audco/ Sant/ AIP
19.	C.I Valves (Full way, Check and Globe Valves)	Leader / Kirloskar / SKF / Zolto / Sant / Upadhyay / Castle / Kartar
20.	C.I. Manhole Covers	Neco/R.I.F./B.C./Hepco/SKF/Kajeco
21.	C.P. Fittings Mixer / Pillar taps/ C.P brass angle valve/ Valves Washers, C.P. brass accessories	Parko /Jaquar /Marc/ Sanitaryware (ARK) Parry/ Orient/ Kohler
22.	C.P. Waste, Spreaders, Urinal	Jaquar/Parko/ Parryware
23.	Carpet Flooring & Skirting (Floatax)	Forbo/ Polyflor/ Tarket
24.	Cement	ACC / Ultra tech / JK Cement / Jaypee-Rewa / Ambuja / Lafarge / Bangur/ Shree
25.	Cement: White	Birla White / JK
26.	Central Control	Rain Bird, USA/Toro/Nelson,

27.	Centrifugal Pump	Crompton /Kirloskar/ KSB/
28.	Centrifugally C.I Rainwater Intel fitting , Bronze gratings	Sages Metals, GMGR, Electro Steel , Kesoram, Neco , Neer
29.	Centrifugally cast C.I Rainwater fitting / Bronze gratings etc.	Sages Metals/ GMGR/ Electro Steel / Kesoram Neco / Neer
30.	Centrifugally casted C.I. Pipes	NECO / HEPSCO /HIF/ SKF /Kapilash
31.	Ceramic tiles	Somany / Kajaria /Nitco/ Orient-Bell
32.	Ceramic tiles Adhesive	Cico / Pidilite / BalEndura / Sika
33.	Chlorinator	Thermax Ltd/ Watcon, Ion exchange/ Sigma DH Combine Inc./ Siemens/ Techcon/ Jesco / Prominent Heidelberg
34.	Chlorine Dosing System	Toshcon / Chloromax
35.	Clean Room Wall Pannels with/ without return air risers, Doors/ windows etc.	CLESTRA/ NICOMAC / HEMAIR / GMP / EPACK
36.	Clear Glass / Clear Float Glass / Toughened Glass	Modi / Saint Gobain (SG) / Asahi India Safety Glass Ltd /
37.	Cockroach Trap	Chilly/ Player/ Camry
38.	Compressed Chequered tiles	Somany / Kajaria / Nitco
39.	Concrete Additive	Sika /CICO/Pidilite / Fosroc / Fairmate / MC Bauchemie
40.	Copper Fittings (Capillary)	Yorkshire Imperial, U.K./ Rajco Metal Works Mumbai / IBP Conex Ltd.
41.	Copper Pipes	Rajco Metal works, Mumbai / IBP Conex Ltd.
42.	CPVC Pipes & Fittings	Flowguard/ Astral/ Ashrivad
43.	Curtain Rod/Drapery Rod	Vista work / Mac Decor
44.	Dash Fasteners	Hilti / Faischer /Bosch
45.	Disc Filter	Azud, Spain/ Amaid / Arkal,
46.	Door closer / Floor spring	Doorking / Everite / Hardwyn/ Master
47.	Door Locks	Godrej / Harrison / Link
48.	Door Seal – Woolpile Weather Strip	Anand Reddiplex/ Enviroseal
49.	Doors & Windows Fixtures / Fitting.	Everite / Classic/ Crown / Earl Bihari
50.	Drainage Pumps	Grundfos/ KSB/Salmson/Kirloskar/ DP Holland
51.	Ductile Iron Fittings (IS:9523)	Electrosteel/Kesoram/Tisco/Jindal
52.	Ductile Iron Pipes (IS:8329)	Electrosteel/Kesoram/Tisco/Jindal
53.	E.P.D.M Gaskets	Anand Reddiplex / Enviro Seals
54.	Epoxy Floor	Fosroc/ BASF/ Cico/ Sika Pidilite
55.	Epoxy SLF Flooring	Sika/ /BASF / Pidilite
56.	Extruded Polystyrene Board	Styrofoam by DOW Chemicals / Insuboard by Supreme Industries
57.	False Ceiling - Calcium Silicate Boards & Tiles	India Gypsum/ Armstrong / Aerolite / Hilux / Saint Gobain (Gyproc)
58.	False Ceiling - Metal	Armstrong / Unimet or equivalent
59.	False Ceiling - Mineral fibre	Armstrong / Decosonic / AMF/ Saint Gobain (Gyproc)
60.	Filtration Plant / Softening Plant	Bikon water / Ion exchange /Thermax/ Pentair/ Eureka Forbes/Fontus
61.	Fire rated Doors & Frames	Navair / Shakti-Hormann / Promat / Godrej
62.	Fire Rated Glass	Asahi India Safety Glass Ltd./ Modi/ Saint Gobin
63.	Fire Retardant Paint	Viper FRS 881, Nullifire, Burger

64.	Fire Seal	Sealz, Alstroflam, Abacus
65.	Fire: Door Closures, Mortice Dead locks	Becker Fire Solution, Inersoll Rand LCN Series, Dorma TH Series.
66.	Fire: D-Type Pull Handles	Becker Fire Solution, Dorma, Hardwin
67.	Fire: Hinges	Becker Fire Solution, Inersoll Rand, Dorma.
68.	Fire: Panic Exit Devices	Becker Fire Solution, Inersoll Rand LCN Series, Dorma PHA Series/ D-line
69.	Fire: Tower Bolts	Suzu, Nulite, Dorset
70.	Flush Door Shutters	Duro / Greenlam / Century
71.	Flush Valves	Gem/ Jaquar / Marc
72.	Forged Steel Fittings & Flanges (For Welded joints)	Rohini /Kanwal/ Vijay Cycle & Steel (VS)
73.	G.I. Fittings	R/Unik/Zoloto/K.S./Sun/Swastik
74.	G.I. Pipes	Jindal / Tata / Prakash Surya / SAIL / Swastik
75.	Geyser	Spherehot / Racold / Usha Lexus /Bajaj
76.	Glass : Mirror	Modiguard / Atul / Saint Gobain/ Asahi India Safety / Modi Float
77.	Glass for Aluminum Doors/ Windows/ Structural Glazing	Modiguard / Saint Gobain / Pilkington/ Asahi India Safety Glass Ltd.
78.	Glass Wool / Insulation Boards	Rockwool / UP Twiga / Lioyd Insulation
79.	Grab bars and Disabled Hardware	Dorma / D-line
80.	Gunmetal Valves / C.P brass angle valve	Zoloto / Leader / Kilburn / Sant / Kartar/ AIP/ Audco
81.	Gypsum Board & Gypsum False Ceiling	Boral Gypsum / India Gypsum / Laffarge / Saint Gobain (Gyproc)
82.	Hand Drier	Kopal / Utech Systems / Euronics Automat
83.	HDPE Pipes / Moulded Fittings	Emco /Polyefins/Pioneer Plyfab/ Jain
84.	HDPE Solution tank	Watcon / Ion Exchange / Water Supply Specialist Pvt. Ltd.
85.	Heat Resistant Terrace Tiles	Thermatek or equivalent
86.	Horizontal Centrifugal / Monoblock Pumps	Kirloskar / DP Holland / Wilo /Ground fos/ CR Pumps/Ebara/Wilo
87.	Hydro-pneumatic System	HBDGM/ Grundfoss / Salmson / Nocchi / Kirloskar/ DP Holland / Wilo
88.	Inbuilt Drip Line	Azud/ Rainbrid-USA/ Netafim
89.	Insulation of Hot water pipes	Vidoflex insulation / Superior insulation Kaiflex – Kaimann/Armoflex/Thermafex
90.	Laminates	Century/Greenlam/Formica/Sunmica/ Merrino
91.	Liquid Level Controllers / Indicators	Advance Auto / Sridhan International / Minilec / Radar / Femac / Switzer / 21 st Century
92.	Liquid Soap Dispenser	Euronics/Utec/Kopal
93.	M.S. Pipe	Jindal / Prakash – Surya /TATA
94.	Mainline Isolation Valve	Sant /Leader/Zoloto,
95.	MS Saddle with G.I. Riser	Harvel/Alprene/Rain Bird, USA
96.	Night Latch	Godrej /Harrison / Link
97.	Non Return Valve	Sant/ Leader/ Zoloto / AIP / Kirloskar/ IVC/ Leader/ Audco
98.	OT: Anti-bacterial paint	Sikka by Liquid Plastic/ Viesmann/ SSK/ TRILUX
99.	OT: Conductive Tile Flooring: ESD-Control Tile Flooring	Tarkett/ Gerflor/ Armstrong/ Forbe/ Trilux

100.	P.R.S. Dials	Rain Bird, USA/ Toro, USA/ Nelson,
101.	P.T.M.T. Fitting	Prince India / Symet
102.	R.C.C Pipes	Indian Hume Pipe / Pragati Concrete Udyog / ISI Marked Pipes/Daya/KK / JSP
103.	Paints - Cement Based	Snowcem Plus/, Berger (Durocem Extra)/ Nerolac (Super Acrylic)/ TATA Cem
104.	Paints - Epoxy paint	Nerolac / Cico / Sika / BASF / Berger / Pidilite
105.	Paints - Oil Bound Distemper / Acrylic Washable Distemper	Asian (Tractor)/ Burger (Bison)/ Nerolac (Super Acrylic)
106.	Paints - Other Paints / Primer	ICI Dulux/ Asian/ Berger/ Nerolac
107.	Paints - Plastic Emulsion Paint	ICI Dulux/ Asian/ Berger/ Nerolac
108.	Paints - Synthetic Enamel Paints	ICI Dulux (Gloss), Berger (Luxol Gold), Asian (Apcolite), Goodlas Nerolac (Full gloss hard drying)
109.	Paints - Texture paint	Berger / Spectrum / Unilite Heritage /Asian
110.	Paver blocks (All Types)	KK Manholes / Uni Stone Products (India) Pvt. Ltd/ Hindustan Tiles
111.	PE-AL-PE Pipe and Accessories	Kitec/ Jindal/ Kissan/Vista
112.	Pipe coat material (pipe protection)	RPG Raychem/Pypkote/Makphalt/Lwl
113.	Plastic seat cover of W.C	Commander/Hindware / Parryware
114.	Plywood/Block board/Ply board	Duro/ Greenply/ Century/ Kitply/ Greenply / National / Anchor
115.	Polycarbonate Sheets	Galina/ GE Plastic / Vergola / Skyarch/ Polytechno/ FlexyTuff
116.	Poly-sulphide Sealant	Pidilite / Fosroc / Cico / Sika
117.	Pop up Connecting Assembly	Rain Bird/Dura/Lasco,
118.	Pop up Spray Head	Rain Bird/Toro, USA/Nelson,
119.	Powder Coating Material pure Polyester	Jotun / Berger / Goodlass Nerolac
120.	PP-R Pipes (PN – 16)	Amitex Polymers Pvt. Ltd. / Prince/ Supreme
121.	Pre-coated Galvanised Steel Sheet	Tata BlueScope / Llyod Insulations India Ltd / S.R.Metals
122.	Pre-Laminated Particle Board	Novapan /Century /Green Ply
123.	Pressure Relief Valve	Omega/ Sant/Leader/ Zolato / Upadhyay / Audco
124.	Pumps	DP Holland / Wilo/ Grundfoss
125.	PVC continuous fillet for periphery packing of glazings / Structural/ Glazing	Roop / Anand / Forex Plastic/ Nagalia/Trading Company
126.	PVC Doors	Sintex/ Polyex/ Rajshri
127.	PVC Flooring	Tarkett Floors / LG Floors / Gerflor / Premier Vinyl flooring / Regent / Armstrong
128.	PVC flushing cistern	Commander / Parryware / Hindware
129.	PVC Pipes & fitting SWR Soil, Waste & Vent Pipes and fittings, Type B PVC Casing & Screen Pipes	Prince / Supreme / Finolex
130.	PVC Water Stops	Prince /Supreme/ Finolex
131.	Polyethylene Storage Tank	Sintex / Polycon/ Fusion
132.	R.O. Water Purifier Unit	Eureka Forbes/ Kent/ Zero B/ Dr. RO
133.	Reinforcement Steel	SAIL/RINL/TATA Steel Ltd./ Jindal Steel & Power Ltd./ JSW Steel Ltd.
134.	RQRC Hydrant	Harvel/Alprene/Rain Bird, USA
135.	RQRC Key	Harvel/ Aqua/ Drip& Drip

136.	Sensor Operated Auto Flushing System Urinals	Jaquar / AOS-Robo/U-tec/Angash/Euronics
137.	SFRC / RCC Manhole Covers/ Perfect RCC Grating	KK Manholes /SK Precast Concrete/ Advent concretevision / Daya concrete
138.	Silicon sealants /Weather Sealant / Structural Glazing Sealant	GE- Silicon / Pidilite / Forsoc / Cico /Dow Corning / Sika/
139.	Sluice valve / NRV	Kirloskar/IVC/Kilburn /Zoloto/Castle/ Leader / L&T/Audco
140.	Solenoid valve	Rain Bird, USA/Toro/Nelson,
141.	SS Gratings, Soap Dish Towel Rail etc.	Camry/Glacier/Gem
142.	Stainless Steel	Salem Steel or as approved by EIC
143.	Stainless Steel bolts, Washers & Nuts	Kundan / Puja / Atul
144.	Stainless Steel Clamps	Hilti /Intellotech Konzept
145.	Stainless steel CP Grating	Chilly / Camry
146.	Stainless Steel D-handles	D-line / Giesse /Dorma
147.	Stainless Steel Friction Stay	Earl Bihari / Securistyle / EBCO
148.	Stainless Steel Pressure Plate Screws	Kundan/ Puja/ Atul
149.	Stainless Steel Screw for Fabrication and fixing of Windows	Kundan / Puja / Atul
150.	Stainless Steel Sink	Hindware / Neelkanth / Nirali
151.	Stone ware pipes & Gully Traps	Perfect / SKF/ R.K/ Hind / Anand /Burn
152.	Submersible Drainage pump	Jyoti / Crompton/ Kirloskar/ KSB /Grundfos/ Mather & Platt / JS/Wilo/ITT
153.	Sunken Portion Treatment	Choksey / Sika / Cico, MC Bouchemie / MC Bouchemie / BASF
154.	Super plasticizer	CICO, Roffes Construction Chemicals, Pidilite Industries
155.	Tiles: Ceramic tiles	Somany / Kajaria / Nitco / Orient-Bell / Spartek/ HR Johnson
156.	Tiles: Glass Mosaic Tiles	Mridul / Bisazza/ Italias
157.	Tiles: Glazed tiles	Somany / Kajaria /Nitco/ Orient-Bell
158.	Tiles: Vitrified Tiles (Double / Multy Charged)/ Germ free	Kajaria / Nitco /RAK /Hindware/ Orient-Bell
159.	UPVC Pipes & fittings	Finolex / Prince / Supreme / AKG / Kasta / Vector / Astral
160.	Valve Box	Rain Bird, USA/Carson Brook, USA/Dura,
161.	Veneered Particle Board	Duro / Greenply / Century / Novapan / Action Tesa
162.	VFD Pump	Jyoti / Crompton/ Kirloskar/ KSB/ Grundfos/ Mather & Platt
163.	Vibration Eliminator Resisto-flex Pads & Connections	Relay Corpn./ Kanwal
164.	Vitreous China/ Sanitary ware	Hindware / Parryware / Cera
165.	Water Cooler	Blue Star/ Voltas/ Usha/ Godrej
166.	Water Meter	Capstan / Kranti/ Anand/ Kant
167.	Water Proofing treatment Agencies	To be approved by the Engineer-in-Charge
168.	Water Proofing Materials	BASF/ Fosroc / Sika / CICO
169.	Water supply pumps	KSB/ Grunfos/ Kirloskar/ Crompton/ Mather & Platt
170.	White Glazed Fire Clay Sink	Hindware / Parryware / Cera
171.	Wooden Laminated Flooring	Nitco /Euro / Pergo

2. <u>SOLAR SYSTEMS</u>		
S. No.	Details of equipment/ material	Make/ Manufacturer
a.	Solar PV system	Tata BP Solar / EPL India Limited / Solahart (India), ARYAV/EMVEE
b.	Solar Hot water system	Tata BP Solar / EPL India Limited / Solahart (India), / Edwards (Australia)/ WBS Innovations/ Inter solar
3. <u>FIRE ALARM SYSTEM:</u>		
Note: All fire alarm components/ Panels shall be UL listed & confirm to NFPA standard.		
S. No.	Details of equipment/ material	Make/ Manufacturer
1.	Intelligent Addressable Fire Alarm System	Zicom, FirePro, Honeywell, Siemens, Schneider, Bosch, Notifier, GE Edwards, Tyco
2.	Intelligent Addressable Fire Alarm Detectors, Hooters, Manual Call Point UL Listed, Talkback	Zicom, FirePro, Honeywell, Siemens, Schneider, Bosch, Notifier, GE Edwards, Tyco
3.	Data Cables	Molex/ Awaya/ Delton/ Hua-wei
4.	Switches	Clipsal/ Crabtree/ Legrand/ Hua-wei/ Havells
5.	Cable TV Cables	Skytone/ Bonton/ Finolex/ Delton/ Hua-wei
6.	Termination Control Cable	Dowell's/ Elemex/ Wago/ Phoenix
7.	Cable Tray/Raceway	Pilco/ Slotco/ Needo/MEM
8.	Control Cable	RR Cable/ Bonton/ Havells/ Polycab/ Finolex/ Harsh
9.	Photo Chromatic Switch	Bajaj/ Wipro/ Phillips/ L&T
10.	Splitter Box	Shyam Antenna/ CAT vision or equivalent
11.	Panic Button	Eureka Forbes/ Fire Pro or equivalent
12.	Intelligent Addressable Response Indicator	Morlay/ Seimens Finder/ Notifier/ GE Edwards/ Honeywell
13.	Fibre Optic	Belden/ Simone/ Sydstemax
14.	Change Over Switch	HPL/ L&T or equivalent
15.	Luminaires	Philips/ Surya / Bajaj/ Pierlite
16.	Mica Tape Cable	Bonton, Skytone, Radox, FRTEK

4. LIFTS:

S. No.	Details of equipment / material	Make/ Manufacturer
1	Lifts	OTIS/ Kone / Mitsubishi/ Schindler/ Johnson Lifts Pvt. Ltd.

5. LV Package/PA System/CCTV

S. No.	Details of equipment/ material	Make/ Manufacturer
1.	PA Speaker	Bosch/ Ahuja/ Evacpro/ Ateis/Bose
2.	Amplifier	Bosch/ Ahuja/ Evacpro/ Ateis/Bose
3.	CD Player	Bosch/ Ahuja/ Evacpro/ Ateis/Bose
4.	RG 6, RG 11/Wire	Belden/ Skytone/ Bonton/ Finolex
5.	CAT 6 /CAT 5 Wire/Accessories -Jack panel , Face Plate	Huwavei/ Belden / Panduit/ Ststemax / Simone
6.	Ethernet / Switch / Router	Huwavei / Avaya / Alcatel / Cisco
7.	Speaker	Belden / Canare / Extron / Leoni
8.	CCTV Camera/ DVR/ Central Monitoring Software , Other Items	Honeywell / Pelco / Vicon / Bosch/ GE/ Axis/ Sony

6. <u>DRINKING WATER PUMPING SYSTEMS ETC.</u>		
S. No.	Details of equipment/ material	Make
1.	Raw water pump set/ Treated water pump set/ Drainage pump set	Grundfos/ WILO/ Ebara/ Kirloskar/ ITT/ ArmStrong/ Mather & Platt
2.	Sodium hypochlorite dosing system	Asia LMI/ Grundfos/ Seiko/ E - Dose
3.	Chain pulley block	Indef, Ardee, J.K. Morris
4.	RO System	Kent/Dr RO/Eureka Forbes/ ZeroB
7. <u>HVAC</u>		
S. No.	Details of equipment/ material	Make/ Manufacturer
1.	Accoustic Lining for ducts/AHU Rooms	UP Twiga/Owens Corning/Kimcco
2.	Adhesives	Fevicol/Superlon or equivalent
3.	Air Distribution/Ducting GI Sheets	Sail / Tata / Jindal
4.	Axial Flow Fans	Kruger/Waves / Humidin/ Brightflow/ Systemair/ Airflow
5.	Cable Lugs/Thimbles/Glands	Dowell/Combat/Raychem/Jainsons
6.	Cable Tray	Pilco/slotco/rizzo/MEM/SMC
7.	Centrifugal Fans for Fan Sections	Kruger/Nicotra/COMEFRI/ Bright flow/ Humidin
8.	Control Cables	Universal/Finolex/Polycab/Havells
9.	Dash Fasteners	HILTI / Fischer / Cannon / Wurth
10.	Duct/Pipe Supports	EASYFLEX/Resistoflex/Diamond
11.	DX Type Air Handling Units	Edgetech/Waves/Zeco/Fedder's Lloyd
12.	Extended Polystyrene (EPS) for underdeck Insulation	Styrene Packing/ Perfect Pack /Beardshell or equivalent
13.	Extruded Aluminium Grills/Diffusers	Air Track Concept/ Caryaire / Airflow/Ravistar/Rusk
14.	Extruded Aluminium Sections	Mahavir / Jindal/ Hindalco/ Indal
15.	Factory Fabricated Duct & Flanges	Rolastar / Zeco / Dynamic/Eco-duct
16.	Fan Sections	Edgetech/Humidin / Waves/ Systemair
17.	Filters(Prefilters,Fine filter & Hepa Filter)	Thermadyne/Camfil/Freudenberg filtration technology/AMERICAN AIR FILTER
18.	Fire / Smoke Dampers	Air Track Concept/ Caryaire / Trox/ Systemaire/ Ravistar/Air flow
19.	Fire Damper Actuator	Belimo/Danfoss/Siemens/Trox/Honeywell
20.	Flexible Connection (N.U Matic Cloth) (Fire & Fungal Proof & Lint free)	Archana Chemicals/Airflow/Pyroguard
21.	Header/ Separator/ Refrigerant pipes	Daikin/ Mitsubishi Heavy/ Samsung/Trane or equivalent
22.	HEPA Filter Modules	Allied concepts/Ravistar/FFT/Camfil or equivalent
23.	Inline Fans/Propeller Fans	Caryaire / Kanalfakt / Krugger/ Systemair/Airflow
24.	Insulation -Fibre Glass	UP Twiga / Owens Corning/ Styrene Packaging
25.	Duct Insulation - XLPE	Trocellene /Supreme or equivalent
26.	Paints	Shalimar/Asian/Burger/Nerolac
27.	Power Cables	Universal/Finolex/Poly Cab//Havells

28.	Pre Insulated Ducting	UP Twiga / Owens Corning/Kimcco
29.	PVC Drain Pipe	Polypack/ Supreme or equivalent
30.	Red Oxide/Zinc Chromate Primer	ICI/Berger or equivalent
31.	Refnet joints	Daikin/ Mitsubishi Electric / Samsung/Trane or equivalent
32.	Remote Controller (individual/ centralized)	Daikin/ Mitsubishi Electric / Samsung/Trane
33.	Starters/ change over switch/ push buttons/ Rotary switches/ 1-phase preventor/ Soft starter	Siemens / Larsen & Turbo / Merlinegerin/ ABB/ Schneider/C&S Electric/Havells
34.	VRV/VRF Outdoors/Indoor Units	Mitsubishi Electric/Daikin/ Samsung/ Trane/ Toshiba
35.	Air Curtain	ALMONARD / THERMADYNE OR Equivalent

8. FIRE FIGHTING WORKS

S. No.	Details of equipment/ material	Make/ Manufacturer
1.	Diesel engine driven pump	Kirloskar/ Ashok Leyland / Mather & Platt / Wilo
2.	Air Break Contactors	Seimens / L&T / ABB/Schneider/GE
3.	Air Release Valve	Rb / Tbs /Cimbrio/ Zoloto
4.	Alarm valve & Hydraulic (Alarm motor with coupling)	HD fire protect/ Mather&Platt or Equivalent
5.	Alternator	Stamford/ Lorey Somer/ kirloskar/ toyo denki/ AVK
6.	Ammeter, Voltmeter, PF, kW, Hz, meter ,Energy Meter,Multimeter	AE/ Enercon/Conserve
7.	Ball Valve	Rb / Zoloto / Leader / Danfoss / Sant /Rapid / Castel/ Emerald /Audco
8.	Battery	Exide/ Amco/ Amaraja/ Statcon
9.	Butt welded fitting (UL/EN Listed)	V.S.Forge /True Forge / DRP-M
10.	Butterfly valves / C.I. Double flanged sluice Valves & check valves	Audco / Zoloto / Safex/ Intervolve/ Leader/ Sant/ Kirloskar / Advance
11.	Cable lugs and glands	Comet/Dowell/Lotus/Jainson/Baliga/ Stripwel/Havells
12.	Cables	Universal / CCI /Gloster/ Elektron/ Polycab/ Finolex/Havells
13.	Control / Potential / Current Transformer	Gillbert & Maxwell/ AE/ Kappa/Meher/L&T/Areva
14.	Deluge valve	Eversafe / HD / Tyco
15.	ELCB	MG/MDS Legrand – Lexic/ L&T Hager/ Siemens
16.	Electrical Motors	Kirloskar / Seimens / Crompton / Wilo / Mather & Platt/ABB
17.	Epoxy Paint	ICI / Berger/Asian/Nerolac
18.	Fire Aid / Fire Hose Reels, GM short branch pipe, 2/3/4 FB inlet/draw off connection/Hose pipe	Ceasefire / Newage / Safex/ Minimax/ Usha fire/Omex
19.	Fire Buckets	Safex / Minimax/Peter Autokit
20.	Fire Extinguisher	Safex , Minimax , Peterautokit , Omex Padmini Fire. Ceasefire, Newage/Exflame
21.	Fire Man's Axe	Ceasefire / Newage / Safex/Minimax/Exflame

22.	Flow switch	Potter / System sensors/ Rapid flow/Danfoss/Viking/Exflame
23.	Foot Valve (Cast iron/ Gunmetal)	Kirloskar/ Neta/ Leader/ Zoloto
24.	Forged steel fitting	V.S.Forge/True Forge / DRP-M
25.	Forged Steel Fittings & Flanges (For Welded joints)	Rohini / Kanwal or Equivalent
26.	GI / MS Pipes	Tata / Jindal / SAIL
27.	Gunmetal Branch Pipe	Newage / Ushafire / Winco / Kailash
28.	Gunmetal Valves (fullway Check and Globe Valves)	Audco / Zoloto / Sant
29.	Hydrant Valves	Newage / Minimax / Safex/ Ceasefire/Exflame/Omex
30.	Non-Return Valve – Swing	Intervalve /Audco/ Zoloto/ Sant/Veeson/AIP
31.	Nozzle	Newage , Winco , Ushafire , Kailash
32.	Over Load Relays	GE / L&T / Siemens/ABB/Siemens/Areva
33.	Pipe coat material (pipe protection)	Pypcoat / Makphalt / Safex
34.	Pipe Hangers/ Clamps/Supports	Chilly/ GMGR /CAMRY/Hilti
35.	Power/auxiliary Contactors	MG/ Siemens/ ABB/GE/L&T
36.	Pressure guage	Feibig / Emerald / Waaree/H Guru
37.	Pressure Switch	Danfoss / Indfoss / Switzer
38.	Push Buttons, Indicating lamps LED	MG/ Larsen&Toubro/ Schneider/Rank/BCH
39.	RRL Hose	Newage /Ushafire / Padmini Fire/ Ceasefire/ Safeguard /Superex /Omex/Exflame/Minimax
40.	Single Phase Preventer	L&T , Minilac, Grinnel, Tyco, Yiking, Eversafe
41.	Sluice Valves	Kirloskar / Audco /Unik / Leader/ Zoloto/ Sant
42.	Solenoid valve, Spray nozzle	Eversafe / HD / Tyco
43.	Sprinkler (ICV)	HD /Fireasfe / Reliable / Wormald/ Padmini Fire
44.	Sprinkler Heads	Grinnel / Tyco / Viking / Eversafe/ Reliable/ HD/ Fireasfe / Padmini Fire/Newage/Omex
45.	Steel flexible extension	Eversafe / Safex or equivalent
46.	Suction “Y” Type Strainer	Kirloskar / Leader / Zoloto/ Sant
47.	Vibration Eliminator	Resistoflex / D waren / Kanwal
48.	Weld Electrodes	Advani/ ESAB/ L&T/Victor
49.	Hose Box	Newage/ Minimax/Exflame/Omex
50.	Hose Reel Drum	Newage/Minimax/Exflame

9. **EPABX & TELEPHONE SYSTEMS**

S. No.	Details of equipment/ material	Make/ Manufacturer
1.	EPABX	Alcatel , Matrix, Avaya , CISCO , Siemens , Nortel
2.	Digital/ANALOG PHONES/Handsets	Beetel , Panasonic , Siemens , Alcatel
3.	VOICE BOX – RJII	Krone , TVS , Finolex
4.	MDF/IDF	Krone, TVS , Finolex
5.	Data/ Telephone cable (2 PAIR , 4 PAIR CABLE, 10 PAIR , 20 PAIR , 50 PAIR , 100 PAIR CABLES)	Delton , Finolex , RR Cable

10. **DATA NETWORKING**

S. No.	Details of equipment/ material	Make/ Manufacturer
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1.	Active Components – Core and Edge switch	CISCO , Enterasys , Juniper
2.	Passive Components – Horizontal and vertical cabling	AMP , Systimax , Nexans , Panduit
3.	Enclosures – Distribution rack and server rack	APW , Netrack
4.	Server	IBM , Dell , HP

11. Electrical Works

S.No	Description	Make/manufacturer
1.	11 KV Panel/11KV VCB	L&T, GE,ABB , Areva , Schneider , Siemens,CG
2.	11KV, 433 V OLTC oil type transformer	GE , ABB, Siemens, Areva, kirloskar, CG. schneider
3.	A/C outlet 32 Amps with MCB	Hensel/ North West/ Crabtree
4.	A/C Outlets	North West/ MDS-Legrand/ Crabtree
5.	ACB (TP,4P) with variable microprocessor based releases (O/C, S/C & E/F) compatible with PLC	L&T (u-power), Siemens (Sentron), Schneider (Nw Masterpact), GE (entelliguard), ABB (emax).
6.	APFC Panels	L&T, Siemens (Siepan), GE, Schneider, ABB
7.	APFC-Relay	L&T, GE, Siemens, Schneider,ABB
8.	ATS	L&T, Mitsubishi, Schneider, GE, Socomec
9.	Auxiliary relays compatible with PLC etc.	Siemens, L&T, GE,ABB, Areva
10.	Batteries	Hitachi, Global, Yuasa, Exide, Amco, SF, Microtek, Amaraja
11.	Battery charger	Amaraja, Sabnife, Statcon
12.	Battery Charger-cum-DCDB	Amaraja, Volstat, Caldine, Expo-Fyn, BCH, HBL
13.	Brass compression gland (Heavy duty)	Commex, Gripwell ,Dowell or equivalent
14.	Bus bar	Jindal/ Hindalco /Indal or equivalent
15.	Bus trunking , rising mains, end feed unit, top-off box(plug-in type)	L&T, ABB, Siemens, Schneider , GE, C&S
16.	Cable lugs & gland	Dowel, Jhonson, Gripwell, Comex, Hex, Comet
17.	Capacitors with harmonic filters	Epcos, L&T, GE , Siemens (Siepan), Schneider, ABB
18.	Ceiling fans	Crompton, Usha, Orient, Bajaj, Havells, GE, Khaitan, Alstom
19.	LED Light Fixtures&Lamps/CFL Light Fixture & Lamps	SYSKA,Philips, Crompton, Wipro, GE, Osram, Bajaj,Surya
20.	Coaxial wires	Finolex, Delton, Skytone, Anchor, L&T, Beldon,
21.	Colour Monitor	Samsung , LG,Sony
22.	Contactors	ABB, L&T, Schneider, GE,Siemens
23.	Control Cables	Polycab, Nicco, Ecko, UIL, Elektron,KEI ,
24.	Control fuse base with HRC fuse / HRC Fuse	L&T, GE, Siemens, ABB, Alstom
25.	Copper control cable (FRLS)	Havell's, RR Cables, Harsh,Polycab
26.	Crimping lugs/thimbles	Dowells, Hex, Commet
27.	CT/PT's	Meher, CGL, Kappa, Maxwell, Areva, L&T, AE, Jyoti,
28.	CT's (Cast resin)	L&T, AE, Kappa, Pragati, Gilbert
29.	Cubical type Synchronizing & capacitor control panel (Bolted / Folded fabrication)	L&T, ABB, Schneider, GE,Siemens (Siepan), GE
30.	Cubicle type fuse unit	Siemens, L&T, ABB, Schneider ,GE

31.	Data Outlets	SYSTEMAX, amp, clipsal
32.	MCBs , RCCB & DBs	Legrand, Schneider, Siemens, GE, ABB, L&T (Hager)
33.	DG Set- Alternator	Stamford, Lorey Somer, kirloskar, toyo denki, avk
34.	DG sets package	Jakson Engineers, TIL,Caterpillar, Sterling generators ltd., Perkins, Kirloskar
35.	Diesel engine	Cummins, Mitsubishi, Perkins, Kirloskar,Volvo,Catterpillar
36.	Digital lighting control system	Aura dimming, relux controls, lightolier control, effectron, Philips, Schneider.
37.	Digital Numerical Relays	L&T, ABB , Siemens, Schneider , GE,Areva
38.	DWC HDPE Pipe	DURA-LINE , REX , CARLON, EMTELLE
39.	Energy / Digital meters	Enercon, L&T, Rishabh, Secure, Trinity, Schneider Electric, Havells, HPL, GE, Siemens, ABB, Konzerv
40.	Exhaust fan	Usha, Crompton, Havells, GE, Bajaj, Alstom
41.	Feeder pillars, Meter cubicle Panels, Floor panels for upto 400A i/c switchgear	ABB, L&T, GE,Siemens, Schneider
42.	Fiber Optic Cable	Sterlite Industries, Finolex
43.	Fire extinguisher	Ceasefire, Exflame, Minimax, Life Guard, Safex, Peter Autokit
44.	FRLS - PVC/Aluminum / copper 1.1 KV grade /cables & wires	Havells,Polycab , Finolex, RR
45.	G.I./Cu. Strip & earthing material)	Bharati, Indiana, Slotco
46.	H.T. Cables	Cable corporation of India, Universal, KEI, Havells, Nicco, Polycab, Finolex, Rallison, Gloster
47.	Hand gloves & rubber mat	Premier polyfim Ltd, Polyelectrosafe, Challenger, Electromat, Safe Hold
48.	Indicating Lamp(LED)	BCH/ L&T/ Rank/ MG
49.	Indicating lamps	AE, Kaycee, Vaishnav, L&T, Siemens, Emco
50.	Industrial socket outlets	GE, ABB, Hager, Legrand
51.	Insulators	Jaya Shree, Modern, IEC, WSI.
52.	Intelligent detectors & hooters & accessories	Notifire, Honeywell, Johnson Control, Schneider, edwards
53.	Intelligent fire alarm panel	Notifire, Honeywell, Johnson Control, Schneider, edwards
54.	Inverter	Microtek , Luminous , Su-Kam,Eton
55.	Isolators	Siemens, L&T, ABB,GE
56.	Jointing kit	Reychem, Xicon, Birla 3M
57.	Light fittings	Philips, Wipro, Bajaj, Havells, Keslec, Pierlite, Crompton, GE, Osram ,Surya
58.	Lightning arrestor	Indelec, Gersom, Helitta, MDS, Hager, Duval Messin, L&P Electro, LPI
59.	LT cables (XLPE,PVC)	Cable Corporation Of India, Universal, Havells Nicco, Polycab, Finolex, Rallison, Gloster, Elektron,KEI
60.	LT panels	ABB, L&T, GE, Siemens, Schneider
61.	MCCB with variable Microprocessor based (O/C, S/C, E/F) / Thermo magnetic releases	L&T D-sine , Siemens(3VL) , Merlin Gerin (NSX compact) , GE(Record), ABB-T Max

62.	Measuring instruments (Digital/analog type)	L&T, Ducati, Conzerv, HPL, Siemens
63.	Modular switches, socket outlets and wiring accessories with moulded cover plate	Anchor (ave), MK (wraparound) , Siemens, legrand (mosiac), L&T, clipsal (neo`c` metro), Havells (piccadilly)
64.	MS Conduit	BEC, AKG, Steel Craft
65.	MS Conduit accessories	Rama, Novel, BEC, AKG, steel craft
66.	Multi-function Meter	L&T, ABB , Siemens, Schneider, Ducati,
67.	Overload relay single phase preventer	ABB, L&T, GE, Siemens, Areva
68.	Panel accessories	L&T, Rishab, Siemens, BCH
69.	Street Light including Poles & Light Fixtures	Bajaj, Transrail ,Power control corp, National tubing co, sancube, Hilite
70.	Power capacitor with batter than 14% harmonic filter at 525 V (long life mixed Dielectric)	L&T(Meher) , EPCOS (Siemens), DUCAT, GE, Schneider, ABB
71.	Programmable timer (self-powered electronic digital)/Astronomer	L&T, Siemens, Hager, MDS, Legrand
72.	Protective relays (Microprocessor based compatible with PC & PLC)	Siemens, L&T, ABB, GE, Areva
73.	Push button, indicating lamps (led type)	Siemens, L&T, ABB, Schneider , C&S
74.	PVC conduit	Precision, Avonplast, Clipsal, Harsh, Polypack, BEC, AKG
75.	PVC conduit Accessories	Precision, Avonplast, Clipsal, Harsh, Polypack, BEC, AKG.
76.	Race ways/ Cable Trays/ Floor trunking / wall channels	MEM, Legrand, Needo, Rico Steel, Pilco, Slotco
77.	Relay and Control Panel	Siemens , L&T, GE, Schneider, ABB
78.	Relays- Auxiliary / Numerical /Bi metal relay	L&T, GE, ABB, Alstom, Siemens, Areva.
79.	Sandwiched bus-duct	Siemens, ABB, GE, Schneider, L&T, C&S
80.	Selector switch	Salzer, Kaycee, Siemens, HPL, L&T, BCH
81.	Starters	Siemens, L&T, GE, ABB, Schneider , Areva
82.	Surge diverter	Tercel, ABB, Siemens, Emerson, Hager, Phoenix, Legrand
83.	Tap-off, Splitter box	Zinwell, Novatron, Catvision
84.	Telephone tag block	Krone, Tvs, R&M, Phoenix, Wago
85.	Terminal strip	Connect well, Phoenix, WAGO
86.	Termination Kits	Raychem, Birla, 3M
87.	Trivector - Meter (Digital type) only for SEB supply.	L&T, Secure, Enercon, Siemens,
88.	UPS	Emerson , A.P.C ,Socomec, GE, Mistubishi, Eaton
89.	Voltmeter and ammeter	AE, Meco, Universal, Rishab, Yokins
90.	11 KV RMU	ABB, Crompton & Greaves, Schneider Electric, L&T

12. SEWAGE / EFFLUENT TREATMENT PLANT

S.No	Description	Make/manufacturer
1.	Pump Sets i/c Water transfer and sludge disposal/transfer pump	Grundfos/ WILO/ Ebara/ Kirloskar

2.	Chemical dosing system	Asia LMI/ Seiko/ E - Dose
3.	Filter Press/ Plate	Pharmatec/ Sachin
4.	Air Blowers	Beta/ Everest/ TMVT
5.	UV Systems	Alpha UV, Creative UV, AM Ozonic

13. BUILDING MANAGEMENT SYSTEM

S. No.	Details of equipment/ material	Make/ Manufacturer
1.	2-way Motorized Valve	Johnson/ Sontay Siemens /Honeywell
2.	Air ,Water Pressure Sensors	Johnson / Sontay/ Greystone/ Siemens/ Honeywell
3.	Air DP switches	Johnson /Sontay/ Greystone / Siemens /Honeywell
4.	CO2 Sensor	Honeywell / Siemens / Sontay
5.	Colour Printer	Cannon / Epson/ Hewlett Packard
6.	Colour Monitor	Dell(Ultra Sharp) / HP(Pavillion) / ASUS /Samsung(Sync Master) / LG (Flatron)
7.	Communication Cables / Signal Cable/ Control Cables	Finolex / Elektron / Delton / Fusion Polymers / Polycab / Excel / Varsha/ Teleflex/ Finecore
8.	Current Relay	Veris / Seto / Mamac/Omron / ABB
9.	Damper Actuator	Johnson/ Siemens
10.	DDC Controllers	Johnson/ Cylon/ Siemens/ Honeywell
11.	DP Switch – Air/ Water	Honeywell / Sontay / Siemens
12.	Duct, Room Temperature/ RH Sensors /Humidity Sensor	Johnson / Sontay / Greystone/ Siemens/ Honeywell/ Alerton
13.	Duct Static Pressure Sensor / Temperature Sensor	Honeywell / Alerton / Siemens
14.	Flame Proof Level Switch / Level Transmitter	Veksler / Filpro / Sontay / Techtrol
15.	Flow Meter	Schenitech / Honeywell / Kampstrup
16.	Immersion Temperature Sensor	Honeywell / Alerton / Siemens/ Johnson / Sontay / Greystone
17.	Interfaces , Gateways , Network Controllers	Johnson/ Cylon/ Siemens/ Honeywell
18.	LAN cables for BMS Network	Belden / D-Link / Avaya
19.	Level Switches	Kele /Veksler /Fluitech /Minilec /Honeywell
20.	Operation Workstation Hardware Software	IBM / HP/ Dell/ Johnson/ Cylon/ Siemens/ Honeywell
21.	Outside Air Temperature Sensor / Outside Temperature & RH sensor	Honeywell / Alerton / Siemens / Johnson / Sontay / Greystone
22.	Personal Computer	HP / DELL / LENOVO / TOSHIBA
23.	PH Sensor / TDS Sensor	Honeywell / Hach / Greisinger
24.	Pressure Transmitter – Water	Honeywell / Alerton / Siemens
25.	Room Humidity Sensor	Honeywell / Alerton / Siemens
26.	Room Temperature Sensor	Honeywell / Alerton / Siemens
27.	Room Thermostat for FCU	Johnson / Siemens/ Anchor/ Honeywell
28.	Standalone 16 bit DDCs	Honeywell-WEBS / Alerton / Spyder / Siemens (PX

		SERIES)
29.	Variable Frequency Drive	Johnson / Siemens /Emerson /Honeywell / ABB
30.	Voltage / Current / Power Factor Transducer	SETO / ABB / L&T / Enercon / SETCO
31.	Water DP Switches	Sontay / Kele
32.	Water Flow Switch	Honeywell / Alerton / Siemens
33.	Water Level Switch	Veksler / Filpro / Sontay
34.	Web Based BMS Software with unlimited user license	Siemens(Design Insight) / Honeywell-WEBs / Alerton
35.	Web Based Router / Network Area Controller	Honeywell-WEBs / Alerton / Siemens
14. <u>ACS/RODENT REPELLANT SYSTEM/WATER LEAK DETECTION SYSTEM/DOOR INTERLOCKING SYSTEM</u>		
S. No.	Details of equipment/ material	Make/ Manufacturer
1.	Access Control System	Honeywell/ Samsung or equivalent
2.	Rodent Repellant System	Maser / RSCAT/ STAR ELECTRONICS or Equivalent
3.	Water Leak Detection Syste	C Systems / Sontay / Greystone or Equivalent
4.	Door Interlocking System	NRH/ Eltech/Avon or Equivalent
5.	Fire Suppression System	UTC/ TYCO / 3M or Equivalent

Note:-

1. The contractor will use one of the approved makes as approved by the Consultant / Engineer - in-charge.
2. In case of different quality / pattern of same make, the pattern/ quality shall be approved by the Consultant / Engineer – in – charge.
3. All the items included in the list or otherwise to be used in the work should conform to CPWD and relevant BIS specifications / relevant codes, as applicable.
4. If any item is missing in the above list, its make will be decided by the Engineer –in-charge/ Consultant.
5. If any major equipment is using a small component of make other than that given as a standard component with the equipment, the same shall be accepted.
6. Similar Makes for the same items may be used for all the subheads.