

# **GALGOTIAS UNIVERSITY ENG. & ADMIN BLOCK**

## **TENDER DOCUMENT FOR PLUMBING AND FIRE FIGHTING WORKS**

**Date: 04.02.2024**

### **:CLIENT:**

**Smt. SHAKUNTLA EDUCATIONAL & WELFARE SOCIETY  
GALGOTIAS UNIVERSITY**

PLOT NO. 2, YAMUNA EXPY, SECTOR 17A,  
GREATER NOIDA, UTTAR PRADESH -203201, INDIA

### **:PROJECT MANAGER:**

**CBRE South Asia Pvt. Ltd | PJM Group - India**  
6<sup>th</sup> & 7<sup>th</sup> Floor | DLF Square Building | Jacaranda Marg  
DLF Phase II | Gurgaon 122002, India

### **: ARCHITECT:**

**ARCOP ASSOCIATES PVT. LTD.**

E-106, GREATER KAILASH ENCLAVE-I  
NEW DELHI, INDIA

### **: MEP SERVICES CONSULTANTS:**

**SUNIL NAYYAR CONSULTING ENGINEERS LLP**

206, 206A, 2nd Floor, Time Centre,  
DLF Golf Course Road, Sector-54, Gurgaon-122 002

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**SECTION: 1**  
**NOTICE INVITING TENDER**

## NOTICE INVITING TENDER

Tender is invited by The Registrar, M/s **SMT SHAKUNTLA EDUCATIONAL & WELFARE SOCIETY, Galgotias University, PLOT 02, YAMUNA EXPY, SECTOR 17A, GREATER NOIDA, UTTAR PRADESH** for **PLUMBING & FIRE FIGHTING Works**, for New Admin & Engg. Block, Greater Noida, Uttar Pradesh.

Bidders to download the Tender Documents and submit the duly filled Tender documents in all respect to [projects.pq@galgotiasuniversity.edu.in](mailto:projects.pq@galgotiasuniversity.edu.in) on OR before the date mentioned in the newspaper notification. Please send Pre-Bid queries by email only.

**Following Tender Documents are to be submitted by the bidders:**

Sl. No	Description	Duly Signed & Stamped
A	Notice Inviting Tender (NIT) & Form of Tender	1 Original (NIT with duly filled-in Form of Tender & Appendix)
B	GCC, SCC & Formats of No Claim Certificate, Articles of Agreement, Indemnity Bond, RBG & Performance Bank Guarantee	1 Original
C	Bill Of Quantities	1 Original
D	Power of Attorney authorizing the signatory of Tender & Contract	1 Original
E	Proposed Methodology of Work	1 Original
F	Proposed Schedule of Work	1 Original
G	List of Plant & Machinery along with Schedule of Deployment at site	1 Original
H	Proposed Site Organization Chart along with Manpower Deployment Schedule	1 Original
I	Details of works in Hand	1 Original
J	Litigation History	1 Original
K	Project Quality Plan	1 Original
L	Environment, Health, and Safety Plan	1 Original

***Bidders shall put his stamp and signatures on every page of the Tender including every Tender drawing at the lower right-hand corner.***

**All the rates mentioned in the tender shall be inclusive of transportation, loading & unloading, government statutory requirement charges, etc., and shall remain firm till completion of work. No escalation of the prices shall be allowed for any reasons whatsoever. GST and Labour Cess shall be mentioned separately.**

Bidders are advised to submit the Tenders strictly based on the conditions of contract and specifications contained in the Tender documents and are advised not to stipulate any deviations. Deviations may, however, be stipulated in case of unavoidable circumstances. Exceptions and deviations, which Bidder may desire to stipulate, shall be listed separately. The PMC, client & the Architect reserve the right to reject any such deviations or evaluate the Tender containing deviations having financial implication, by adding the cost for such deviations as may be determined by the PMC or the client or the Architect.

We intend to adhere to a very strict timeline in administering this Tender.

***Proposals received beyond the mentioned time and date will not be considered.***

Incomplete responses shall be liable to be disqualified at GALGOTIAS UNIVERSITY's sole discretion.

***This Notice Inviting Tender shall form part of the contract.***

For,

**SMT SAKUNTALA EDUCATIONAL & WELFARE SOCIETY  
Galgotias University**

**Authorized Signatory**

**SECTION: 2**  
**FORM OF TENDER**

**FORM OF TENDER**

To,  
**SMT SAKUNTLA EDUCATIONAL & WELFARE SOCIETY**  
**Galgotias University**  
PLOT 02, YAMUNA EXPY,  
SECTOR 17A, GREATER  
NOIDA, UTTAR PRADESH,  
INDIA-203201

Dear Sir,

Having examined the conditions of contract, specifications, Tender drawings and Bill of quantities relating to the works specified in the Tender hereinafter set out and having examined the site of the works specified and having acquired the requisite information relating thereto as affecting the tender, I/We hereby offer to execute the works specified, within the time specified & at the rates mentioned in the attached bill of quantities and in accordance, in all respect, with the specifications, designs, drawings and instructions in writing referred to the GCC, SCC, Technical Specifications & (Tender drawings) of the said Tender.

Should this tender be accepted, I/We hereby agree to abide by and fulfil the terms and provision of the said conditions of Contract as per Tender document to so far as they may be applicable or in default thereof to forfeit and pay to **Galgotias University**, the amount as per the said conditions.

I/We have deposited Earnest Money Deposit (If applicable) in the form of Bank Guarantee in favour of **Galgotias University** as specified in Appendix to Form of Tender. Should I/We fail to execute the contract when called upon to do so, I/We do hereby agree that this sum shall be forfeited by **Galgotias University**.

All information and documents as required to be submitted as per Tender Document are enclosed. Our banker(s) (Name & complete address):

The names of partners of our firm are:

- 1.
- 2.

Name of the partner of the firm authorized to sign OR

Name of person having Power of Attorney to sign the Tender & Contract (Certified true copy of the Power of Attorney shall be attached)

Yours faithfully,

Signatures of Tenderer Stamp Name & Address

- i. Witness 1 (Signatures, Name & Address):
- ii. Witness 2 (Signatures, Name & Address):

**SECTION: 3**  
**PRE-QUALIFICATION (attached separately)**



## **SECTION: 4**

# **GENERAL CONTRACT CONDITIONS**

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**Schedule II  
Contract Agreement**

**General Conditions of Contract (GCC)**

**1. DEFINITIONS & INTERPRETATIONS**

## 1.1. Definitions

The following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

- (a) "**Acceptance Defects Notice**" has the meaning given to it in Clause 11.3.(c).
- (b) "**Affiliate**" means any entity which directly or indirectly:
  - (i) owns or Controls such entity;
  - (ii) is owned or Controlled by such entity;
  - (iii) is under common ownership or Control with such entity.
- (c) "**Affected Party**" has the meaning given to it in Clause 31.1.
- (d) "**Applicable Law**" means, with respect to any Governmental Authority, national, regional or local law, directive, statute, rule, regulation, ordinance, treat, order, decree, judgment, decision, determination, interpretation, certificate, injunction, registration, license, permits, authorization, guideline, approval, consent or requirement of/by such Governmental Authority, as construed from time to time by any Governmental Authority.
- (e) "**Application for Change Proposal**" has the meaning given to it in Clause 22.4(a).
- (f) "**Approved List**" has the meaning given to it in Clause 16.2.
- (g) "**Architect**" means the person/entity appointed as the architect for the Project by the Client and as notified by the Client to the Contractor pursuant to Clause 13.1.
- (h) "**Bid**" has the meaning given to it in the Instructions to Bidders.
- (i) "**Bidding Documents**" means the Notice Inviting Bids ("**NIB**"), Tender Drawings, Instructions to Bidders ("**ITB**"), Drawings, Technical Specifications, Bid Forms, Technical Bid, Price Bid, Contract and General Conditions of Contract ("**GCC**").
- (j) "**Change**" has the meaning given to it in Clause 22.1.
- (k) "**Change in Law**" has the meaning given to it in Clause 32.1.
- (l) "**Change Order**" has the meaning given to it in Clause 22.3(e).
- (m) "**Change Proposal**" has the meaning given to it in Clause 22.3(a).
- (n) "**CIBIL**" means Credit Information Bureau (India) Limited.
- (o) "**Codes and Standards**" means the codes and standards as more fully detailed in the Technical Specifications, in relation to the design, specification, construction, fabrication and inspection of the New admin. & Engg. Block.
- (p) "**Commencement Date**" has the meaning given to it in Clause 7.1.
- (q) "**Completion**" has the meaning given to it in Clause 11.1(a).
- (r) "**Completion Certificate**" has the meaning given to it in Clause 11.1(b).
- (s) "**Completion Date**" has the meaning given to it in Clause 7.2(a).

- (t) "**Contract**" means (i) the Contract Agreement; (ii) GCC; (iii) Technical Specifications; and (iv) any other documents listed in the Contract Agreement.
- (u) "**Contractor**" means Who has been awarded the Work.
- (v) "**Contract Agreement**" means the agreement to be executed on [ ] between the Contractor and the Client in the form set out in **Schedule II** for undertaking and completing Works with respect to the Project including all annexures and schedules, as the same may be amended, supplemented or modified from time to time by mutual written agreement. **[input the date of execution of the Contract.]**
- (w) "**Contract Price**" has the meaning given to it in Clause 23.1.
- (x) "**Contract Schedule**" has the meaning given to it in Clause 5.22(b).
- (y) "**Contractor's Equipment**" means all appliances, things or equipment of whatsoever nature required for the execution and completion of the Works and the remedying of any defects therein.
- (z) "**Contractor's Personnel**" means the Contractor's Representative, Works Manager and each individual and collectively the Contractor's employees, labour (skilled, semi-skilled and unskilled) Sub-Contractors, and their respective employees, contractors (of the Sub-Contractors), officers, licensees, invitees, agents and representatives, who are provided and/or utilized by Contractor for the execution of the Works and any other personnel notified to the Client by the Contractor as the Contractor's Personnel.
- (aa) "**Contractor's Representative**" means the person identified in Clause 5.23.(a), or the replacement of such Person who is nominated and approved in accordance with the procedure provided in Clause 5.23.(d).
- (bb) "**Control**" means (and related terms shall refer accordingly to), with respect to any person, (i) the possession, directly or indirectly, of the power to direct or cause the direction of the management and policies of such person whether through the ownership of voting securities, by agreement or otherwise or the power to elect more than one-half of the directors of such person; or (ii) the possession, directly or indirectly, of a voting interest of more than 50% (fifty percent); or (iii) the power to veto decisions of such person, whether through ownership of voting securities, by contract, or otherwise;
- (cc) "**Defects Notice**" has the meaning given to it in Clause 11.1(c).
- (dd) "**Defect Liability Period**" has the meaning given to it in Clause 21.2.
- (ee) "**Dispute**" has the meaning given to it in Clause 35.2.
- (ff) "**Documents**" means the data in the form of text, worksheets, Drawings (including as-built drawings) designs, specifications, plans or reports in print or electronic form and complying with the requirements of the Technical Specifications, to be submitted by the Contractor, in relation to the Works required for developing the New admin. & Engg. Block, including but not limited to engineering data, ELECTRICAL AND ELV and construction drawings, documents required to satisfy all regulatory approvals and other such descriptive material as specified under the Technical Specifications.
- (gg) "**Drawings**" means the drawings for the New admin. & Engg. Block including for the ELECTRICAL AND ELV and structural Works required to build the New admin. & Engg. Block and as referred to in the Technical Specifications and any modification to such drawings as approved by the Client, Architect and Project Manager and such other drawings as may, from time to time be provided by the Client to the Contractor.
- (hh) "**Environmental Standards**" means Applicable Law, codes, rules and regulations relating to: (a) pollution, contamination, clean-up, protection and reclamation of the environment; (b) health or safety, including, without limitation, the exposure of employees or other persons to any Hazardous Materials; (c) the release or threatened release of any Hazardous Materials; (d) the management of any Hazardous Materials, including, without limitation, the manufacture, generation, formulation, processing, labelling, distribution, introduction into commerce, registration, use, treatment, handling, storage, disposal of materials, the discharge of chemicals, gases

or other substances or materials into the environment, the presence of such materials, chemicals, gases or other substances in or around the New admin. & Engg. Block, transportation, reuse, recycling or reclamation of any Hazardous Materials; and (e) any governmental approval issued by a Governmental Authority with respect to the foregoing.

- (ii) **"Final Acceptance Certificate"** has the meaning given to it in Clause 11.3.(b).
- (jj) **"Final Completion"** has the meaning given to it in Clause 11.3.(a).
- (kk) **"Force Majeure Event"** has the meaning given to it in Clause 31.1.
- (ll) **"Governmental Authority"** means any Indian national, regional, state, municipal or local government, and any division, ministry, department, agency or other emanation of any of the same, including any judicial body, commission, board, branch or similar authority of such government and anybody empowered to grant, withdraw or determine the terms and conditions of any applicable permit and the organs of the Government of India or as the case may be, the Government of the Indian State where the Site is located.
- (mm) **"Hazardous Materials"** means (i) any element, compound, substance, preparation, chemical, physio-chemical properties or biological derivative, radiation, noise, vibration, material or combination thereof which by reason of its composition or characteristics is defined in Applicable Law as a hazardous material, or (ii) any other material which any Government Instrumentality determines from time to time is harmful, toxic, or dangerous, or otherwise ineligible for handling, storage or disposal by unregulated means or is liable to cause harm to human beings, other living creatures, plant, micro-organism, property or the environment.
- (nn) **"Indemnified Party"** has the meaning given to it in Clause 28.3.
- (oo) **"Indemnifying Party"** has the meaning given to it in Clause 28.3.
- (pp) **"Information"** has the meaning given to it in Clause 29.1.
- (qq) **"Intellectual Property"** means any licenses, permissions or agreements from licensors of any materials, goods, processes, methods and systems incorporated or to be incorporated in the New admin. & Engg. Block, proprietary information, patents, trademark rights, technology, utility model, registered design, know-how, trade secrets, data bases, industrial processes, source codes, copyrights (including rights in computer software) and any other intellectual or industrial property rights (whether registered or unregistered) subsisting or recognised under the Applicable Law or laws of any other applicable jurisdiction.
- (rr) **"Invoice"** has the meaning given to it in Clause 24.4(a).
- (ss) **"Instructions to Bidders (ITB)"** means the instructions to bidders issued by the Client or Project manager as part of the Bidding Documents in relation to the Works to be completed by the Contractor dated 07th December 22 bearing no. RMH-ELECTRICAL AND ELV-001.
- (tt) **"KMP"** means the key managerial personnel as defined under the Companies Act, 2013.
- (uu) **"Latent Defect"** has the meaning given to it in Clause 21.12.(a).
- (vv) **"Letter of Award (LOA)"** means the formal acceptance in writing by the Client by way of registered letter or by email notifying the Contractor that its bid has been accepted.
- (ww) **"Losses"** has the meaning given to it in Clause 28.1.
- (xx) **"Materials"** means and includes all the materials required for undertaking the Works including ELECTRICAL AND ELV works and activities required for developing the Project and building the New admin. & Engg. Block.
- (yy) **"Miscellaneous Invoice"** has the meaning given to it in Clause 24.4.(j).



- (zz) "**Notice Inviting Bids (NIB)**" means the notice inviting bids issued by the Client as part of the Bidding Documents in relation to the Works to be completed by the Contractor dated 7th December 22 bearing no. RMH-ELECTRICAL AND ELV-001.
- (aaa) "**Notice of Completion**" has the meaning given to it in Clause 11.1.(a)(iv).
- (bbb) "**Notice of Final Completion**" has the meaning given to it in Clause 11.3.(ix).
- (ccc) "**Notice of Provisional Acceptance**" has the meaning given to it in Clause 11.2.(a).
- (ddd) "**Occupancy Certificate**" means the final occupancy certificate for the New admin. & Engg. Block issued by Governmental Authority certifying the New admin. & Engg. Block can be occupied and used for its intended purpose.
- (eee) "**Pending Agreement Change Order**" has the meaning given to it in Clause 22.3.(i).
- (fff) "**Performance Bank Guarantee**" has the meaning given to it in Clause 3.1.
- (ggg) "**Performance Parameters**" has the meaning given to it in Clause 9.
- (hhh) "**Price Bid**" has the meaning given to it in the Instructions to Bidders.
- (iii) "**Prohibited Payment**" has the meaning given to it in Clause 36.9(a).
- (jjj) "**Project**" means the development, construction and operation of the New admin. & Engg. Block by the Contractor, located at the Site.
- (kkk) "**Project Manager**" has the meaning given to it in the Instructions to Bidders.
- (lll) "**Provisional Acceptance**" has the meaning given to it in Clause 11.2(a).
- (mmm) "**Provisional Acceptance Certificate**" has the meaning given to it in Clause 11.2(b).
- (nnn) "**Provisional Defects Notice**" has the meaning given to it in Clause 11.2.(c).
- (ooo) "**Prudent Industry Practices**" means the practices, methods, techniques and standards, as they may be modified from time to time, which are generally followed in the ELECTRICAL AND ELV Works industry; including those expected from a reasonably skilled, prudent and experience person engaged in Works for completion of buildings and performing works and services and providing and supplying equipment and materials as required to be performed or supplied by the Contractor, Sub-Contractors, their employees and other third party agents of the Contractor under the Contract.
- (ppp) "**Public Official**" has the meaning given to it in Clause 36.9.(b).
- (qqq) "**Purpose**" has the meaning given to it in Clause 29.2.
- (rrr) "**Quality Assurance Programme**" has the meaning given to it in Clause 8.2 and means the quality assurance programme as approved by the Client and as set out in the Technical Specifications.
- (sss) "**Quality Engineer**" has the meaning given to it in Clause 5.35(d)(i).
- (ttt) "**RBI**" means the Reserve Bank of India.
- (uuu) "**Request for Change Proposal**" has the meaning given to it in Clause 22.3(a).
- (vvv) "**Safety Officer**" has the meaning given to it in Clause 5.35(d)(ii).

- (www) "**Serial Defect**" has the meaning given to it in Clause 21.13(a).
- (xxx) "**Site**" means all parcels of land on which the New admin. & Engg. Block has to be built and developed as shown in **Schedule XVII**.
- (yyy) "**New admin. & Engg. Block**" means the New admin. & Engg. Block to be built on the Site based on the designs and drawings provided by the Architect and other specifications as provided for and detailed under the Technical Specifications, which shall without limitation, include.
- (zzz) "**Sub-Contractor**" means any person, including vendor of the Contractor to whom execution of any part of the Works is contracted by the Contractors and includes their successors or permitted assignees.
- (aaaa) "**Successful Bidder**" has the meaning given to it in the Instructions to Bidders.
- (bbbb) "**Take Over**" means the handing over of the New admin. & Engg. Block by the Contractor to the Client, pursuant to Clause 11.4, pursuant to the issuance of a Take Over Certificate.
- (cccc) "**Take Over Certificate**" means the certificate issued by the Client pursuant to Clause 11.4.
- (dddd) "**Taxes**" include all taxes, duties, cesses, imposts, fees, levies (including without limitation, all central, state and local government taxes, octroi, excise duties, customs duties, sales tax, countervailing duties, value added tax, works contract tax, service tax, building and construction workers cess and withholding taxes on income) imposed under any Applicable Law (whether within India or outside India) in connection with the Works, the Project, the Parties or performance by the Contractor/Sub-Contractor of its obligations and responsibilities under the Contract.
- (eeee) "**Technical Bid**" has the meaning given to it in the Instructions to Bidders.
- (ffff) "**Technical Specifications**" means the technical specifications attached to the Contract.
- (gggg) "**Work Product**" has the meaning given to it in Clause 30.1.
- (hhhh) "**Works**" means the works and services as set out in the Technical Specifications laid down into the Contract, to be executed by the Contractor in relation to the New admin. & Engg. Block and the Project, in accordance with the terms of the Contract. Works shall also include works to be executed by the Contractor under the Contract, which are contracted by the Contractor to the Sub-Contractor(s).
- (iiii) "**Works Manager**" has the meaning given to it in Clause 5.23(h).

## 1.2. Interpretation

- (a) Reference to the singular shall include reference to the plural and vice-versa and a reference to any gender shall include a reference to the other genders, except where the context otherwise requires.
- (b) The headings and marginal notes in the Contract are included for ease of reference, and shall not affect the meaning or the interpretation of the Contract.
- (c) The Schedules and Technical Specifications to and of the Contract form an integral part of the Contract and will be of full force and effect as though they were expressly set out in the body of the Contract.
- (d) Unless the context otherwise requires, a reference to any Article, Clause, recital and Schedule shall be to an Article, Clause, recital and Schedule of the Contract respectively.

- (e) Reference to any law or regulation having force of law includes a reference to that law or regulation, as from time to time, amended, modified, supplemented, extended or re-enacted.
- (f) Reference to time shall, except where the context otherwise requires, be construed as a reference to Indian Standard Time. Any reference to calendar shall be construed as reference to the Gregorian calendar.
- (g) The words "include" or "including" shall be deemed to be followed by "without limitation" or "but not limited to" whether or not they are followed by such phrases.
- (h) In case of any discrepancy between words and figures, the words shall prevail over the figures.
- (i) The provisions of all the documents comprising the Contract and the Documents shall be interpreted harmoniously and only if the provisions of the said agreements and documents cannot be interpreted harmoniously with each other on account of inconsistencies or ambiguities then, unless expressly stated otherwise in the Contract Agreement, the priority of the documents shall be in accordance with the following sequence; (i) the Contract; (ii) GCC (iii) Technical Specifications; and (iv) any other documents listed in the Contract.
- (j) Whenever provision is made for the giving of notice, approval or consent by any Person, unless otherwise specified, such notice, approval or consent shall be in writing and the words "notify" and "approve" shall be construed accordingly.
- (k) Provisions including the word "agree", "agreed", "agreement" require the agreement to be recorded in writing.
- (l) The terms "written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record.
- (m) When any timeframe in terms of number of days is prescribed in the Contract, the same shall be reckoned exclusively of the first and inclusively of the last day, except for a payment obligation, in which case, in the event the last day does not fall on a business day, then the last day shall be the next succeeding business day.
- (n) The rule of construction, if any, that a contract should be interpreted against the Party responsible for the drafting and preparation thereof, shall not apply.
- (o) Reference to any agreement, deed, document, instrument, or the like shall mean a reference to the same as may have been duly amended, modified or replaced. For the avoidance of doubt, it is clarified that a document shall be construed as amended, modified or replaced only if such amendment, modification or replacement is executed in compliance with the provisions of such document(s).
- (p) The word "cost" shall be deemed to be all-inclusive also including overhead costs and all taxes under Applicable Law whether on or off the Site.
- (q) Wherever provision is made for the giving or issue of any notice, consent, approval, certificate or determination by any person, unless otherwise specified such notice, consent, approval, certificate or determination shall be in writing and the words "notify", "certify" or "determine" shall be construed accordingly.
- (r) Any reference to any Applicable Law shall include such law/provision as is from time to time modified or re-enacted or consolidated.
- (s) Terms defined in the Schedules, Annexure and Appendices unless contradictory shall have the same meaning throughout the Contract.

- (t) Review and comment by the Client or its personnel, with respect to any of such documents or other information shall not relieve or release the Contractor from any of its duties, obligations or liabilities provided for under the terms of the Contract.

## 2. SCOPE OF WORK

- 2.1. The Contractor shall execute all the Works as set out in **(attached separately as BOQ)**, including all activities required or appropriate to design, fabricate, manufacture, procure and deliver all supplies and Materials required for undertaking the Works for the New admin. & Engg. Block. The Contractor shall carry out and complete the Works in entirety which includes, the supply of all equipment, Materials, plant and machinery, tools, transportation, scaffolding, labour and everything else necessary for the proper execution and successful completion of the Works. The Works shall be undertaken and completed in such a manner that the New admin. & Engg. Block is fit for the purposes.
- 2.2. The Contractor shall be solely responsible for all means, methods, techniques, sequences, procedures and safety measures programmes in connection with execution of Works.
- 2.3. The Contractor shall be fully responsible and liable for everything and all matters in connection with or arising out of or being a result or consequence of it carrying out or omitting to carry out any part of the Works. The Contractor is bound to carry out any items of Works necessary for the completion of the New admin. & Engg. Block even though such items of work may not be expressly described in the Bidding Documents.
- 2.4. The Contractor shall execute the Works consistent with the requirements set forth in the Contract. The Contractor agrees to execute the Works and do all other things required/considered prudent to so do, in relation thereto, in accordance with the parameters set forth in this Clause 2. The Contractor shall be solely responsible for all means, methods, techniques, sequences, procedures and safety programmes in connection with the undertaking the Works under the provisions of the Contract. Without limiting the generality of the foregoing, the Contractor shall execute the Works:
  - (a) in a continuous manner;
  - (b) in a proper workmanlike and careful manner and in its entirety, in compliance with Applicable Law and the Codes and Standards, by using methods and Contractor's Equipment which are acceptable as per Prudent Industry Practice;
  - (c) with safety, dependability, efficiency and economy, in each case, using qualified, competent and where necessary, licensed Contractor's Personnel, so as to successfully achieve the Performance Parameters;
  - (d) by ensuring that all Works are performed in accordance with the design and instructions provided by the Client;
  - (e) in accordance with the Quality Assurance Programme; and
  - (f) with properly equipped facilities and non-Hazardous Materials, except as otherwise specified in the Contract.
- 2.5. The Contractor shall also execute all such Works and/or supply all such items and Materials that:
  - (a) can be reasonably inferred from the Contract as being required for attaining Final Completion and Take Over, and which are/is needed for the safe, trouble free and normal operation;
  - (b) can be reasonably inferred in accordance with Prudent Industry Practice, that the provision or causing the provision of such Works and/or supply of such items and materials, was contemplated as part of the Contract;
  - (c) is/are necessary to enable the Contractor to fulfill its obligations under the Contract and comply with the warranties set out in the Contract;

- (d) is/are necessary to satisfy the provisions of the Technical Specifications; or
- (e) although not stated in the Contract, are necessary for stability or for the completion, or safe and proper operation, of the Works;

in each case, as if such Works and/or Materials were expressly mentioned in the Contract and the same shall be considered a part of the Works and shall be executed/supplied by the Contractor, without any additional cost to the Client.

- 2.6. In the absence of any standard specification in relation to any part of the Works, the Parties shall discuss and mutually agree upon such technical matters pertaining to the Works. In the event the Parties cannot reach a mutual agreement within a period of [15 (fifteen)] days from the date of commencement of such discussions, then the instructions/directions of the Client or Project Manager regarding such technical matters shall be carried out by the Contractor under the Contract.
- 2.7. Except as otherwise expressly provided in the Contract, the Contractor agrees and acknowledges that it shall perform all its obligations and responsibilities under the Contract, at its own risk, cost and expense.
- 2.8. As part of the scope of obligations under the Contract, the Contractor shall procure and pay for, in its own name, as an independent contractor and not as an agent of the Client, all items, materials and services necessary in connection with the execution of the Works and all other obligations under the Contract.
- 2.9. The Client reserves the right to increase or decrease the scope of the Works on any or all items or to change the nature of the Works involved in any or all items or to completely delete any item(s) of the Works under the Contract. The Contractor shall not be entitled to claim for loss of anticipated profits, for mobilization of additional resources, or for any other such reason on account of such instructions. In the event that the Client elects in writing to add an item to scope of the Works or to delete an item from its scope, the Client shall be entitled to increase/reduce (as the case may be) an appropriate amount from the Contract Price.

### **3. CONTRACTOR'S PERFORMANCE BANK GUARANTEE**

- 3.1. The Contractor shall, at its cost, within [15 (fifteen)] days from the issuance of the Letter of Award and on or before the execution of the Contract Agreement, submit to the Client an unconditional and irrevocable bank guarantee from a reputable bank acceptable to the Client for an amount of INR [ ] amounting to 5% (five percent) of the Contract Price in the form as set out in **Schedule I ("Performance Bank Guarantee")**. The Performance Bank Guarantee shall be valid up to the expiry of the Defect Liability Period and shall have a claim period of 3 (three) months from the date of its expiry.
- 3.2. If requested by the Client, the Contractor undertakes to extend the validity period of the Performance Bank Guarantee or to issue a further Performance Bank Guarantee in the event that the duration of the Contract is for any reason extended beyond such validity date.
- 3.3. Notwithstanding anything contained to the contrary in the Contract and/or the Bidding Documents, no payments due to the Contractor from the Client under the Contract shall be payable by the Client to the Contractor until the Performance Bank Guarantee has been delivered to and approved by the Client.
- 3.4. Without prejudice to the rights to the Client under Applicable Law or otherwise, the Contractor acknowledges and agrees that the Client shall have the right to invoke the Performance Bank Guarantee in the event of:
  - (a) failure of the Contractor to commence and/or complete the Works to the Client's satisfaction within the time period specified in Clause 7;
  - (b) any breach of the Contract by the Contractor which breach has not been remedied within 30 (thirty) days of notice from the Client; or
  - (c) to recover any amount that may become due to the Client from the Contractor.

#### **4. ELECTRICAL AND ELV Works OF THE NEW ADMIN. & ENGG. BLOCK**

##### **4.1. Setting Out**

- (a) The Contractor shall execute all Works in relation to the ELECTRICAL AND ELV works of the New admin. & Engg. Block in accordance with the requirements of the Technical Specifications and to the satisfaction of the Client and the Project Manager. The Contractor shall set-out the Works in accordance with the procedures set out under the Technical Specifications or provided to it by the Client and/or the Project Manager.
- (b) The Contractor shall be responsible for undertaking the Works. If, at any time during the ELECTRICAL AND ELV works of the New admin. & Engg. Block, the Contractor becomes aware of any error, the Contractor shall promptly and in any event, no later than 15 (fifteen) days from the detection of such error, notify the Client and thereafter at its own expense, immediately rectify such error, to the reasonable satisfaction of the Client.
- (c) The Contractor shall be responsible for the true and proper setting out of the Works in relation to instructions given by the Client/Project Manager/Architect in writing and for the correctness, subject as above mentioned, of ELECTRICAL AND ELV Works and for the provision of all necessary instruments, appliances and labour in connection therewith. If, at all any error shall appear or arise in the Works of any part of the Works, the Contractor, on being required to do so by the Client and/or the Project Manager, shall, at its own cost, rectify such error to the satisfaction of the Client. The checking of any defect in the Works by the Client/Project Manager/Architect shall not in any way relieve the Contractor of its responsibility for the correctness thereof and the Contractor shall carefully protect and preserve all bench marks, sight-rails, pegs and other things used in the Works.

##### **4.2. Contractor's Supervision**

The Contractor shall, during the ELECTRICAL AND ELV Works of the New admin. & Engg. Block, provide all necessary superintendence and ensure that the appropriate Contractor's Personnel are at all times present at the Site, to provide such full-time superintendence. In relation to the supervision during the Works to be undertaken at the Site, the Contractor shall deploy only such Contractor's Personnel at the Site, who are skilled and experienced in their respective fields and supervisory staff who are competent to adequately supervise the said Works.

##### **4.3. Inspection**

- (a) The Contractor shall provide to the Client and the Project Manager, access to any place on the Site where the New admin. & Engg. Block is being developed, in order to inspect the progress of the Works.
- (b) The Contractor shall give the Client and the Project Manager's personnel full opportunity to carry out the activities set forth in this Clause 4.3, including providing access, facilities, permissions and safety equipment. Provided that, no such activity shall relieve the Contractor from any obligation or responsibility under the Contract.

#### **5. CONTRACTOR'S OBLIGATIONS**

##### **5.1. Contractor's general responsibilities**

- (a) The Contractor shall execute the Works in accordance with the terms of the Contract, Applicable Law and Prudent Industry Practices. The Contractor shall be liable and responsible for provision of labour and materials for undertaking the Works required to for the New admin. & Engg. Block in accordance with the Contract.
- (b) The Contractor shall take full responsibility for the adequacy, stability and safety of all the Works on the Site.

- (c) The Contractor shall keep the Client informed of the progress of the Works at regular intervals as required by the Client.
- (d) The Contractor shall keep the Client informed of any and all requirements and claims under any Applicable Laws and keep informed the Client of compliance thereunder.
- (e) The Contractor shall be responsible for obtaining all information required for the performance of its obligations under the Contract.
- (f) The Contractor has clarified and carefully examined all the documents, information and such other matters as may be necessary or desirable for performing its obligations under the Contract, to its entire satisfaction. The Contractor shall not, except as expressly provided in the Contract, be entitled to any extension of time or to any adjustment of the Contract Price, on grounds of misinterpretation or misunderstanding of any such matter.
- (g) The Client shall not be responsible for any error, inaccuracy or omission of any kind in the Bidding Documents and shall not be deemed to have given any representation of accuracy or completeness of any data or information. Any data or information received by the Contractor, from the Client and/or Project Manager or otherwise, shall not relieve the Contractor from its responsibility for undertaking the Works.
- (h) The Contractor has, prior to the execution of the Contract obtained all information and taken into consideration the restrictions imposed to coordinate its activities for the Works with the other contractors required for completion of the Project.
- (i) The Contractor represents that it is fully informed of all general and local conditions near the Site and other factors that may have an effect on the compliance of its obligations under the Contract. The Contractor cannot claim an extension of time or an increase in the Contract Price as a result of such local conditions or factors.
- (j) The Contractor represents and confirms that it has entered into the Contract Agreement on the basis of its proper examination of the Site by its checking or carrying out its own investigations as may be required, including the suitability and availability of the access routes thereto and that it is aware about the conditions of the Site and its surroundings and has satisfied itself as to all technical, commercial, social and general conditions of and all circumstances affecting the Site. The Contractor represents and confirms that by signing the Contract, the Contractor accepts total responsibility for having foreseen all difficulties and costs of successfully completing the Works and that the effect of all contingencies have been considered by the Contractor prior to entering into the Contract Agreement and that the Contractor shall not be entitled to extension of time or an increase in the Contract Price on account of the same.
- (k) The Contractor acknowledges that any failure to verify and interpret any data and information in relation to the Site and/or the New admin. & Engg. Block shall not relieve it of its responsibility for properly estimating the difficulty or cost of successfully performing its obligations under the Contract.

## 5.2. **Water and power for carrying out the Works**

Water and electricity for carrying out the Works shall be arranged by the Contractor at its own risk and costs. The Contractor shall, so far as is reasonably practicable, having regard to local conditions provide on the Site at its own cost, water for the use of the Contractor's Personnel, staff, and work people at the Site.

## 5.3. **Temporary works and arrangements**

The Contractor shall furnish to the Client full particulars, Drawings, etc., of all temporary works necessary for the completion of the Works and shall allow sufficient time for the Client to consider the same. The Client reserves the right to alter/ comment on the Contractor's proposals if it considers that modifications should be made. The Contractor shall be solely responsible for the stability and safety of all temporary Works and unfinished Works.



**5.4. Demolition and clearance**

The Contractor shall be responsible for undertaking the Works, clearance from the Site of all scrub, debris, rubbish, etc. that shall be carted to an area not objected to by any Governmental Authorities. However, no trees shall be removed without the prior permission of the Client and without obtaining prior approvals as may be required under the Applicable Law.

**5.5. Storage, cleaning and de-watering**

- (a) The Contractor shall at all the times during performance of the Works keep the Site clean and free from all debris and unwanted Materials as per instructions of the Client/ PM.
- (b) Storage of Materials shall be in organized manner and in proper compartments. Storage on suspended floors shall not be permitted unless specifically approved in writing by the Client for specific Materials in specific locations. The Client shall be furnished with load details, if requested, before seeking approval for storage.
- (c) Regular cleaning operations shall be undertaken to remove all dust, debris, waste materials, etc. and disposal of the same. A cleaning schedule shall be maintained by the Contractor to the satisfaction of the Client.
- (d) The Contractor shall make its own arrangements for storage of Materials, which cannot be accommodated at the Site. The 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 the Site. Stores elsewhere shall not be eligible for being considered as "Delivered at Site".
- (e) The Contractor understands that the Site is free from pollutants at the time of access to the Site and commencement of Works. The Contractor shall comply with all applicable environmental laws and regulations and shall ensure that the Works are undertaken in compliance with such Applicable Laws.
- (f) The 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. The Contractor shall make proper arrangements for drainage prior to use of water.

**5.6. Vehicular movements and temporary roads**

- (a) The Contractor shall not make temporary roads until approval from the Client is received in writing. Site access and circulation roads are to be on the lines agreed to with the Client.
- (b) No vehicle other than those specifically allowed by the Client shall be permitted on the Site.
- (c) All the vehicles and Materials coming in to the Site should be checked for explosive materials by using metal detectors and under vehicle scanner.

**5.7. Care and use of existing facilities and services**

- (a) During the completion of the Works, the Contractor shall take all precautions and exercise full care, at its cost, to ensure that no damage is caused to the existing water supply, sewerage, power or telecommunication lines or any other services or works. The Contractor shall provide and erect before undertaking the Works, substantial barricades, guardrails, and warning signs. The Contractor shall furnish, place and maintain adequate warning lights, signals, etc., as required by Client. However, such substantial barricades, guardrails, and warning signs shall not relieve the Contractor of its responsibilities, obligations and liabilities for safety and timely completion of Works.
- (b) If any service lines have to be shifted / diverted, it shall be done so with the explicit permission of the Client.



**5.8. Co-ordination of builders work required for services**

- (a) The Contractor shall co-ordinate the requirements for holes, fixings and builders work, for internal and external services installations in accordance with the requirements of the relevant Drawings, which shall be made available to the Contractor by the Client.
- (b) All holes, chases, etc., shall be left in the building work as it proceeds and cut-out subsequently, except in so far as may be necessary due to subsequent authorized instructions. The Contractor shall therefore obtain necessary builders work details in such order and in such time so as to enable them to be checked and approved by the Client and/or the Project Manager not less than 2 (two) weeks before the actual works are planned to take place.

**5.9. Contract**

The Contractor shall within [ ] days of the issuance of the Letter of Award enter into and execute the Contract Agreement with the Client, in the form annexed as **Schedule II** with such modification as may be necessary. The cost of stamp duties and similar charges (if any) incurred with respect to entry into the Contract Agreement shall be borne by the Contractor.

**5.10. Inspection of Site**

- (a) The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied itself as to the form and nature of the Works. The Contractor shall not rely only on the information provided by the Client.
- (b) The Contractor shall not remove/shift any existing services passing through the Site above or below ground deemed to be a hindrance towards the completion of the Works without the prior written consent of the Client.

**5.11. Works to be to the satisfaction of the Client**

Unless it is legally or physically impossible, the Contractor shall undertake the Works in strict accordance with the Contract to the satisfaction of the Client and shall comply with and adhere strictly to the instructions and directions from the Client and/or the Project Manager.

**5.12. Drawings and Documents**

**(a) General**

The Drawings and Documents prepared for the Project shall be treated as confidential documents and must not be copied or loaned or shared with any other party without the express permission of the Client. In the event of termination of the Contract, the Contractor shall forthwith return to the Client, all Drawings and Documents prepared for the Project and all copies thereof in the possession or under the control of the Contractor. The Contractor agrees that the provisions of the Contract pertaining to confidentiality shall survive termination/completion of the Works under the Contract.

**(b) Drawings**

- (i) The Drawings furnished by the Architect, if any, as part of the Bidding Documents, are for bidding purposes only and are intended as a guide to the Contractor and give general layout of buildings and structures and general positions of utilities, services and equipment only and in measuring from these Drawings and preparing Bid the Contractor must make due and proper allowance for all necessary diversions from the straight line, rises or falls as may be required for the proper execution of the Works.
- (ii) The set of Drawings which are part of the Bidding Documents is only representative of the type and general nature of Works and not the quantum of Works involved. Additional Drawings shall be issued at the relevant stage for actual execution of Works.

- (iii) Detail Drawings in all cases shall be worked in preference to those of a more general nature and figured dimensions where indicated shall be followed in preference to scaled dimensions.

(c) **Good for Construction Drawings**

- (i) The Architect/Client/or the Project Manager shall issue free of charge [3 (three) sets] of ELECTRICAL AND ELV Drawings, approved for undertaking the Works, to the Contractor. Additional copies as and when required shall be supplied by the Architect or Project Manager and costs shall be reimbursed by the Contractor.
- (ii) The Client and/or Project Manager may from time to time during the course of the Contract issue the Contractor with revised Drawings and the Contractor shall ensure that all superseded Drawings are removed from Site and stored in a lockable cabinet as directed by the Client and/or Project Manager and replaced by revised Drawings.
- (iii) The Contractor shall ensure that a complete up to date register of Drawings is maintained at Site. All Drawings shall be properly filed and indexed for ready reference.
- (iv) The Contractor shall ensure that only the valid up to date Drawings is used for fabrication, setting-out, ELECTRICAL AND ELV etc.

5.13. **Discrepancies**

The Contractor shall bring to the notice of the Client any discrepancies within or between Drawings and/or the other Documents prior to commencement of Works and shall not proceed with Works until the Client/Architect/PM gives clarifications and instructions to proceed.

5.14. **As-built drawings**

The Contractor shall commence preparation of the 'as-built drawings' from the onset of the Contract, in order that all minor amendments and discrepancies are incorporated. To ensure that this requirement is complied with, the Client shall check the Drawings on its request as the Works proceed. [4 (four)] sets of as-built drawings and one soft copy on a CD shall be submitted by the Contractor to the Client within 2 (two) weeks from date of issue of the Final Acceptance Certificate.

5.15. **Programme**

- (a) The Contractor shall include in its Bid a preliminary contract schedule. Upon issuance of the Letter of Award and before commencement of the Works, the Contractor shall prepare a detailed and comprehensive contract schedule for review and approval by Client/PM.
- (b) The schedule shall show the date on which each part of the Works is to begin and date when such part of the Works is scheduled to be finished along with the relevant milestones under ("**Contract Schedule**"). The Contractor shall ensure that it complies with the Contract Schedule and shall co-ordinate performance of the Works with the Client, Project Manager and the Architect in order to maintain the Contract Schedule.
- (c) The Contractor shall also submit weekly/monthly progress reports indicating progress of Works giving scheduled and actual percentage completion, causes for delays if any etc. as well as other reasonable reports and photographs as the Client and/or Project Manager may require from time to time.
- (d) The submission to and approval by the Client and/or Project Manager of such schedules or the furnishing of such particulars shall not relieve the Contractor of any of its duties or responsibilities under the Contract.
- (e) The Contractor acknowledges and confirms that the development of the New admin. & Engg. Block is a time bound project. The Contractor shall strictly adhere to the milestones as per the Contract Schedule.

Any delay in delivering the Project, completing the Works and meeting the milestones will result in substantial losses to the Client.

- (f) Subject to Clause 10 (Liquidated Damages) for any delays by the Contractor in achieving the any milestone as per the Contract Schedule, the Client will withhold an amount from the Invoice maximum up to 5% (Five percent) of the Contract Price until the Contractor meets the subsequent milestone as per the Contract Schedule. On successfully achieving the subsequent milestone, the withheld amount will be paid to the Contractor in the next Invoice. If the Contractor fails to achieve the subsequent milestone, an additional 5% (five per cent) of Contract Price shall be withheld. The entire withheld amount shall be accounted in the Contract Price.
- (g) The Contractor will submit schedule of Material delivery and shall obtain approval from the Client/PM before delivering any Material to the Site.
- (h) Provision of time will be made by the Contractor for other agencies and contractors to carry out their part of the Works and such lapse of time will be considered by the Contractor in the Contract Schedule. No compensation will be paid to the Contractor for idle labour and Materials due to work of other contractors.

#### 5.16. **Contractor's Representative and Works Manager**

##### **Contractor's Representative**

- (a) The Contractor has appointed [ ], s/o [ ] and r/o [ ], as the Contractor's representative for the purpose of the Contract ("**Contractor's Representative**"). The Contractor shall within [7 (seven) days] from the date of issuance of Letter of Award, notify the Client, of the duties and authorities of the Contractor's Representative.
- (b) The Contractor's Representative shall represent and act for the Contractor, at all times during the term of the Contract and shall provide to the Client all the Contractor's notices, instructions, information and all other communications under the Contract.
- (c) All notices, instructions, information and all other communications provided by the Client to the Contractor under the Contract, shall be provided to the Contractor's Representative or, in its absence, its authorized deputy, except as otherwise provided.
- (d) The Contractor shall not revoke the appointment of the Contractor's Representative without the Client's prior written consent, which shall not be unreasonably withheld. If the Contractor proposes to appoint another person as its representative, then it shall provide a [14 (fourteen) days] notice to the Client requesting it to approve such appointment. In this regard, the Contractor shall submit the curriculum vitae of such representative along with its request. The Contractor shall ensure that the person proposed to act as its representative shall be fluent in the local language of India and the English language. If the Client does not object to the appointment of such representative within [14 (fourteen) days] of receipt of the request provided by the Client, the representative shall be deemed to have been approved by the Client as the Contractor's Representative. If the Client objects to the appointment of the representative within [14 (fourteen) days] of receipt of the request provided by the Contractor, giving the reason thereof, then the Contractor shall propose a replacement within 14 (fourteen) days of such objection. The provisions of this Clause 5.23(d) shall apply *mutatis mutandis* to such replacement. If the Client consents thereto, the Contractor shall appoint any other person as the Contractor's Representative, pursuant to the procedure set out in this Clause 5.23.(d).
- (e) The Contractor's Representative may, subject to the approval of the Client, which shall not be unreasonably withheld, at any time, delegate to any person any of the powers, functions and authorities vested in it. Any such delegation may be revoked by the Contractor's Representative at any time, but shall be subject to a prior notice to the Client, signed by the Contractor's Representative. Such notice

shall specify the powers, functions and authorities thereby revoked. No such delegation or revocation shall take effect unless a copy of written authorization of such delegation or revocation, as the case may be, has been delivered to the Client.

(f) Any act or exercise by any person of powers, functions and authorities so delegated to such person in accordance with Clause 5.23(e) shall be deemed to be an act or exercise by the Contractor's Representative and the Contractor shall be fully responsible for the same.

(g) The Contractor's Representative, persons to whom powers, functions and authorities have been delegated pursuant to Clause 5.23(e), and the Works manager shall be fluent in the English language and either proficient in the national language of India.

(h) **Works Manager**

The Contractor's Representative shall, [7 (seven) days] before Site mobilization, appoint a suitable person to manage the execution of the Works, who shall be present at the Site, during normal working hours prescribed under Applicable Law ("**Works Manager**"). Provided that, if at any point of time the Works Manager is not present at the Site, a suitable person shall be appointed by the Contractor's Representative to act as its deputy, who shall then be present at the Site in the absence of the Works Manager.

(i) **Removal of Contractor's Personnel from Site**

The Contractor's Personnel shall be reasonably qualified, skilled and experienced in their respective trades or occupations. The Client may, during the term of the Contract, by notice to the Contractor, object to the retention of any of the Contractor's Personnel and require the Contractor to remove (or cause to be removed) any person comprising the Contractor's Personnel, who,

- (i) has behaved inappropriately;
- (ii) carries out duties incompetently or negligently;
- (iii) persists in any misconduct or lack of care;
- (iv) fails to conform with any of the provisions of the Contract;
- (v) has committed a serious breach of the Site regulations provided by the Client;
- (vi) persists in any conduct which is prejudicial to the safety, health or the protection of the environment; or
- (vii) is otherwise not suitable.

The Client shall provide evidence of the same to the Contractor, whereupon the Contractor shall remove such person from the Site and promptly appoint (or cause to be appointed) a suitable replacement in accordance with Clause 5.23(d).

#### 5.17. **Contractor's Employees**

The Contractor shall provide and employ on the Site in connection with the execution of the Works:

- (a) only such technical assistants as are skilled and experienced in their respective fields and such sub-agents, foremen and leading hands as are competent to give proper supervision to the Works they are required to supervise;
- (b) such skilled, semi-skilled and unskilled labour as is necessary for the proper and timely execution of the Works; and

- (c) professionals for safety for undertaking the Works to the satisfaction of the Client.

**5.18. Watching and Lighting**

The Contractor shall in connection with the Works provide and maintain at its own cost all workplace lighting, guards, fencing and watching when and where necessary for the completion of the Works, or for the safety and convenience of the public or others. The care and the safety of the Materials and Works shall be sole responsibility of the Contractor. The constructed barricade on the Site shall be maintained by the Contractor. If such barricade is damaged, the same shall be replaced/rectified immediately without any additional cost to the Client. Adequate fire protection measures should be in place on site to attend to any mishap on the site. Adequate personnel shall be deployed by the Contractor within the Site to control the movement of Material and personnel.

**5.19. Care of Works**

From the commencement of the Works until the date stated in the Final Acceptance Certificate, the Contractor shall take full responsibility for the care of the Works and the loss or damage thereto.

**5.20. Damage to persons and property**

The Contractor shall indemnify the Client against any and all losses and claims in respect of injuries or damage to any persons or material or physical damage to any property whatsoever which may arise out of or in consequence of the execution of the Works and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect of or in relation thereto.

**5.21. Giving of notices and payment of fees**

The Contractor shall give all notices and pay all taxes, octroi, fees required to be given or paid by any national or state statute, ordinance or other Applicable Law, or any regulation, or bye law or any local or other duly constituted Governmental Authority in relation to the execution and completion of the Works and by the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the Works.

**5.22. Compliance with statutes, regulations, etc.**

- (a) The Contractor shall conform in all respects with the provisions of Applicable Law which may be applicable to the Works and shall keep the Client indemnified against all penalties and liability of every kind for breach of any such Applicable Law.
- (b) The Contractor shall comply with all rules, regulations, and laws including but not limited to labour laws, laws relating to medical and safety of workmen for labour directly or indirectly engaged by the Contractor, its representative, and Sub-Contractor. The Contractor shall register itself wherever and whomsoever required in this connection at local and state level. The Contractor shall indemnify the Client from every expense incurred by the Client under this Clause. The Client is authorized to call at any point of time to its registered office/offices for inspection or copy of such documents as it considers necessary for ensuring statutory compliances to the above by the Contractor.
- (c) In particular, the Contractor shall ensure strict compliance with the provisions of the Employee State Insurance Act, 1948, Employee Provident Fund and Miscellaneous Provisions Act, 1952, Factories Act, 1948, Workman's Compensation Act, 1948, Payment of Wages Act, 1946, Minimum Wages Act, 1948, Employees Liability Act, 1938, Industrial Dispute Act, 1947, Maternity Benefit Act, 1961, and Contract Labour (Regulation and Abolition) Act, 1970. Copies of the records and registers maintained under the Applicable Laws shall be provided to the Client at the end of each month. The salaries to all workmen shall be paid in the presence of the Client and/or Project Manager. The Contractor shall procure and maintain the necessary licenses under the Contract Labour (Regulation and Abolition) Act, 1970 after assisting the Client in procuring the registration there under. The Contractor shall also obtain various

licenses/ permits/ clearance/ approvals/ consents as appropriate from the various Governmental Authorities and other statutory authorities in respect of Works to be undertaken by it.

- (d) The Contractor shall ensure that the workmen operating the Contractor's Equipment for the execution of Works are licensed under Applicable Law, to the satisfaction of the Client.
- (e) The Contractor shall include in its rates all expenses necessary to meet its obligations for making contributions toward employee benefits funds (such as employees state insurance, provident fund, old age pension if any or any other benefits / compensation payable by the Contractor) etc., in compliance with all the statutory regulations and requirements. All records in this connection shall be properly maintained by the Contractor and produced for scrutiny by the concerned authorities and the Client and/or Project Manager whenever called for.
- (f) The Contractor acknowledges and agrees that none of the directors of the Contractor are on the RBI's defaulter list/caution list or the CIBIL's wilful defaulter list or is a defaulter or on non-cooperative list of any of the lenders and that no director of the Contractor is disqualified under Section 164 of the Companies Act, 2013. The Contractor further agrees and acknowledges that no person:
  - (i) who has been named in any list of defaulters circulated by the RBI or CIBIL; or
  - (ii) whose name appears in any caution list of any nature published by the RBI, CIBIL or any similar Governmental Authority; or
  - (iii) who has been named in the caution list/defaulters list/ specific approval list; or
  - (iv) who has been identified as a wilful defaulter/ non-cooperative by any bank or financial institution, as per the parameters determined by RBI, from time to time; or
  - (v) who is director in any company which has been identified as a wilful defaulter/defaulters / non-cooperative by the RBI, CIBIL or similar Governmental Authority or any bank or financial institution,

shall become a member of the Board or a KMP of the Contractor. If any such person is already a director on the Board or KMP of the Contractor, the Contractor shall intimate the Client and the Project Manager promptly and take expeditious and effective steps to remove such person from its Board and as KMP, and the Client shall have the right to take action as envisaged under the Applicable Law.

- (g) The Contractor acknowledges and agrees that no investigation by a Governmental Authority or any regulatory authority is pending against the Contractor, its sister concern, its chief executive officer or any of its directors/ managers/ employees, including but not limited to any charge sheet by an agency of the Governmental Authority, initiation of proceedings in the court of law or a conviction by the court of law for an offence committed by the Contractor or its sister concern or any of its directors/ managers/ employees. In case any investigation is pending against the Contractor or its sister concern or against its chief executive officer or any of its directors/ manager/ employees, the following details shall be furnished to the satisfaction of the Client:
  - (i) full details of such investigation;
  - (ii) name of the investigating agency;
  - (iii) charge/ office for which investigation has been launched;
  - (iv) name and designation of persons against whom the investigation has been launched;
  - (v) other relevant information.

- (h) The Contractor shall keep the Client informed of any and all claims under any Applicable Laws and keep informed the Client of compliance there under.

**5.23. Interference with traffic and adjoining properties**

All operations necessary for the completion of the Works shall, so far as compliance with the requirements of the Contract permits, be carried on so as not to interfere unnecessarily or improperly with the public convenience, or the access to use and occupation of public or private roads and footpaths, or to or of properties whether in the possession of the Client or of any other person. The Contractor shall save harmless and indemnify the Client in respect of all claims, proceedings, damages, cost, charges and expenses whatsoever arising out of, or in relation to, any such matters in so far as the Contractor is responsible therefore.

**5.24. Extraordinary traffic**

The Contractor shall use every reasonable means to prevent any of the highways or bridges communicating with or on the routes to the Site from being damaged or injured by any traffic of the Contractor or any of its Sub-Contractors and, in particular, shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic as will inevitably arise from the moving of material from and to the Site shall be limited, as far as reasonably, and so that no unnecessary damage or injury may be occasioned to such highways and bridges.

**5.25. Opportunities for other contractors**

The Contractor shall, in accordance afford all reasonable opportunities for carrying out the Works to any other contractors engaged by the Client and their workmen and to the workmen of the Client and of any other duly constituted authorities who may be employed in the execution on or near the Site of any Works not included in the Contract or of any contract which the Client may enter into in connection with or ancillary to the Works.

**5.26. Contractor to keep Site clear**

During the progress of the Works, the Contractor shall keep the Site free from unnecessary obstruction and shall store or dispose of any material and clear away and remove from the Site any wreckage, rubbish or Materials no longer required, on a daily basis. Regular cleaning operations on daily basis shall be undertaken by the Contractor to remove all dust, debris, waste materials etc., and disposal of the same to the nearby waste dumping yard. If Client and/or Project Manager notices the Contractor's inability/unwillingness to do the said job, the Client shall have the right to get the same cleaned by an external agency and debit the same to the Contractor's account.

**5.27. Clearance of Site on completion**

On the completion of the Works, the Contractor shall clear away and remove from the Site all surplus Materials, rubbish and debris and Site office and stores etc. of every kind, and leave the whole of the Site and Works clean and in a workmanlike condition to the satisfaction of the Client.

**5.28. Contractor's Personnel**

- (a) The Contractor shall within 7 days from the date of issuance of Letter of Award depute the Contractor's Personnel, at the Site so as to seek clarification with regard to the Works to be executed. Further, subject to details as provided in the Technical Specifications, the Contractor shall, in terms of this Clause 5.36, from the date of Letter of Award till Final Completion, engage sufficient and properly qualified Contractor's Personnel who are proficient in English language and skilled and experienced in their respective callings, to enable the Contractor to efficiently perform its obligations under the Contract. The Contractor shall ensure that the Contractor's Personnel include:



- (i) professional engineers licensed in accordance with the licensing requirements prescribed under Applicable Law to perform the Works pursuant to the Contract;
  - (ii) a team of engineers from various disciplines, adequate number of qualified and competent supervisory staff, craftsmen or other personnel, each of whom shall have extensive experience in executing works of a magnitude similar to the Works, shall have knowledge of the Applicable Laws; and
  - (iii) a team of sufficiently qualified and experienced welders which are required for the execution of the Works.
- (b) The Client shall have the right, but not the obligation, to approve any of the Contractor's Personnel. The Contractor shall, upon the request of the Client, provide the Client with the curriculum vitae of, and arrange interviews by the Client of, any or all of the Contractors Personnel. The Contractor shall not remove any of the Contractor's Personnel without the prior written consent of the Client, which shall not be unreasonably withheld.
- (c) The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Site. The Contractor shall be responsible for the recruitment, transportation, accommodation, catering and other welfare facilities of the Contractor's Personnel, and for all payments in connection therewith. Further, if specified in the Technical Specifications, the Contractor shall also provide all such facilities for the Client's personnel. The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with the relevant Governmental Authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance services are available, at all times, at the Site and at the respective accommodation of the Contractor's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics. The Contractor shall indemnify and hold harmless the Client from and against any claim, liability, assessment, damage, loss, penalty or fine stemming from any breach by the Contractor or any person for whom it is responsible, of this Clause 5.36.(c).
- (d) The Contractor shall, within [15 (fifteen) days] from the date of issuance of Letter of Award, appoint suitable and qualified persons, who shall be:
- (i) responsible to ensure quality of the Works undertaken for construction and development of the New admin. & Engg. Block and shall co-ordinate with the Client and the Project Manager for all matters in relation to the quality of the Works (the "**Quality Engineer**");
  - (ii) responsible for all matters in relation to the safety and protection against accidents at the Site and shall, at all times during the term of the Contract, ensure that the safety manual provided to the Contractor by the Client and the safety regulations at the Site provided under **Schedule VII** (Safety Regulations) are strictly adhered to (the "**Safety Officer**"). The Contractor shall, no later than [15 (fifteen) days] from the date of issuance of the Letter of Award, submit to the Client, the job safety analysis of the Safety Officer. The Safety Officer shall have the authority to issue instructions and take protective measures to prevent accidents and during the term of the Contract, the Contractor shall provide whatever is required by the Safety Officer to exercise such responsibility and authority. The Safety Officer shall:
    - (A) ensure that copies of the safety manuals provided by the Client pursuant to **Schedule VII**, are at all times available on the Site, along with Codes and Standards of practice in relation to the same, to be referred to and followed by the Contractor's Personnel;
    - (B) submit to the Client, as soon as practicable after the occurrence of an accident or dangerous occurrence, the details of such accident or dangerous occurrence, as the case may be; and



- (C) maintain all records and make reports concerning health, safety and welfare of persons, and damage to property, as may be reasonably required by the Client.

The Contractor shall indemnify and hold harmless the Client from and against any claim, liability, assessment, damage, loss, penalty or fine stemming from any breach by the Contractor or any person for whom it is responsible, of this Clause 5.36.(d).

- (e) The Safety Officer shall be present at the Site, during normal working hours, prescribed under Applicable Law, or a suitable person shall be appointed by the Contractor's Representative to act as its respective deputy, who shall be present at the Site in the absence of the Safety Officer.
- (f) The Contractor shall, at its own expense, provide, as and when required, the means of repatriation to all of the Contractor's Personnel and labour and personnel of the Sub-Contractor's to their respective home countries/states. Further, the Contractor shall also provide suitable temporary maintenance of all such persons, from the period commencing from the cessation of their employment with the Contractor, till the scheduled date of their respective departures. If the Contractor fails to comply with its obligations under this Clause 5.36.(f), the Client may provide the same, at the cost of the Contractor.
- (g) The Contractor shall ascertain the availability of labour (skilled and unskilled), personnel and Sub-contractors in the vicinity in which the Site is located and shall, to the extent possible, engage such labour (skilled and unskilled), personnel and Sub-contractors, as the Contractor's Personnel.
- (h) The Contractor shall ensure that the Contractor's Personnel are entitled to the prescribed number of holidays, as per Applicable Law and unless otherwise provided in the Contract, no Works shall be executed outside normal working hours and on holidays, prescribed under Applicable Law. Provided that, provisions of this Clause 5.36.(h) shall not apply to any Works which are customarily carried out by rotating or double-shifts.
- (i) The Contractor shall, and shall ensure that the Contractor's Personnel, in all dealings with the labor and personnel of its Sub-Contractors, pay due regard to all recognized festivals, official holidays, religious or other customs prevailing in the State of Uttar Pradesh, India and all Applicable Laws in this regard. Further, the Contractor shall ensure that the Contractor's Personnel act in a culturally sensitive manner at all times, giving due regard to the local community and cultures when on Site.
- (j) The Contractor shall at all times, during the term of the Contract, use its reasonable endeavors to prevent any unlawful, riotous or disorderly conduct or behavior by or amongst the Contractor's Personnel, the other Contractors and/or the labour, personnel and employees of the Sub-Contractors and to preserve peace and protection of persons and property on and near the Site and under no event shall the Client be responsible for the same. The Contractor shall promptly provide the Client, a notice in relation to any actual or anticipated labour dispute which may affect the execution of the Works. The said notice shall indicate the steps being taken by the Contractor to mitigate the effects of any actual or contemplated labour disputes.
- (k) The Contractor shall pay rates of wages to the Contractor's Personnel, as per rates prescribed under Applicable Law and observe conditions of labour in accordance with the Applicable Law. The Contractor shall, during the term of the Contract, withhold from wages and salaries of the Contractor's Personnel, sums required to be withheld as per the Applicable Law and pay the same promptly and directly, when due, to the respective Governmental Authority and upon request by the Client, in this regard, provide to the Client evidence of the payment of such withholding taxes as per the Applicable Law. In this regard, the Contractor shall comply with all accounting and reporting requirements under the Applicable Law and bear the cost of such compliance. In the event the Client becomes liable, under Applicable Law, due to any act or omission of the Contractor under this Clause 5.36.(k), the Client may make such payments and shall recover the same from the Contractor or deduct the amounts so paid from the Contract Price.

#### **5.29. Sanitation and drainage during the Works at the Site and labour camp**

- (a) The Contractor shall provide sanitation and drainage facilities on the Site and labour camp as required and stated under the Contract.
- (b) The Contractor shall strictly control the labour so that the Site is not polluted, made dirty or littered with debris, wastes or the likes.
- (c) Any person found creating mess or litter or pollution or illegally squatting on the Site shall be removed from the Site immediately at Contractor's cost.
- (d) The Contractor shall provide sanitation facilities at convenient locations on Site and labour camp to preserve the cleanliness of the Site. The effluent shall be directed as follows:
  - (i) waste water: Collection and pumping out and disposal off the Site in approved manner: and
  - (ii) septic tank provision - sludge to be collected and disposed of at intervals as directed.
- (e) The Contractor shall clear and deodorize the ground after their removal and meet all statutory requirements.

#### 5.30. **Worker's camp**

The Contractor shall make its own arrangements at its cost to provide accommodation for its staff and labour outside and away from the Site. No extra cost is payable to the Contractor on this account. The Contractor shall provide the following welfare arrangements in the labour camp area within [ ] km of the Site and as further detailed in the Technical Specification:

- (a) the Site activities include setting up a colony for the workers. Well laid out labour camp with all amenities (light, drinking water, cooking area with cooking facilities, wash areas, wash rooms for both male & female workers, crèche & learning area) shall be arranged at a suitable place;
- (b) labour camp shall be located away from Site premises;
- (c) access to the labour camp shall be provided;
- (d) maintain proper hygiene all times;
- (e) a warden to be appointed for labor camp and as single point responsibility;
- (f) drainage of sludge water /rain water shall be provided;
- (g) drinking water, bathing facilities and field washrooms should be provided at suitable places;
- (h) suitable arrangements for labour to purchase weekly provisions shall be made;
- (i) weekly off to the labour shall be ensured for rest;
- (j) food and transport (to & fro from Site to labour camp) facilities should be provided;
- (k) sufficient number of fire extinguishers should be provided;
- (l) an emergency assembly point should be provided;
- (m) security should be provided;
- (n) crèches/learning/play centre should be provided;

- (o) provision of pumps to drain out flood water from site/ labour camp;
- (p) electricity (with power back up) should be provided;
- (q) first aid facility, ambulance & along with doctor shall be provided;
- (r) labour camp monsoon precautions;
- (s) prevent contamination of drinking water;
- (t) collection and disposal of food waste & garbage regularly;
- (u) secure all loose [G. I. Sheets] to prevent from flying off in case of stormy and gusty wind;
- (v) standard earthing to partition with effective functioning of [ELCB's]
- (w) all temporary electric connections must be rooted through 30 mA cut off rating [ELCB];
- (x) all wires / cables are not laid on sharp edges or through a hole within the G. I. Sheet as to prevent damage to insulation. If, possible route through conduit pipes and support wire / cables by suitable hook;
- (y) no wooden material to be used for labor camp construction; and
- (z) all wire / cable joints are water and shock proof to prevent from shock.

**5.31. Alcoholic liquor or drugs**

Use of any alcoholic liquor, drugs, chewing of pan, gutka or smoking etc., is fully prohibited on the site. The Contractor shall not import, sell, give, barter or dispose any alcoholic liquor or drugs or cigarettes / beedies /etc. by its Sub-Contractors, agents or employees.

**5.32. Arms and ammunition**

The Contractor shall not give, barter or otherwise dispose of to any person or persons, any arms or ammunition of any kind or permit or suffer the same as aforesaid.

**5.33. Festivals and religious customs**

The Contractor shall in all dealings with labour in its employment have due regard to all recognized festivals, days of rest and religious or other customs. The Contractor shall intimate [7 (seven) days] in advance to the Client of any festival for any resource/ labour shortfall presumed with proper mitigation plan in place.

**5.34. Epidemics**

In the event of any outbreak of illness of an epidemic nature at Site and/or labour camp for the workmen engaged for the Works (directly or indirectly) the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Governmental Authority, or the local medical or sanitary authorities for the purpose of dealing with and overcoming the same under Applicable Law.

**5.35. Disorderly conduct, etc.**

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by any of its Sub-Contractors, employees or agents and for the preservation of peace and protection of persons and property in the neighborhood of the Works against the same.

**5.36. Safety Standards and Requirements**

The Contractor shall follow the rules and guidelines laid down in safety requirements as listed in **Schedule VII**. The cost so incurred by the Contractor in providing for safety standards and requirements as above shall be deemed to be included in the Contract Price and no extra amounts shall be payable to the Contractor on this account.

**5.37. Reports by the Contractor**

- (a) The Contractor shall file daily category-wise labour returns. The report shall indicate scheduled requirement against actual strength.
- (b) The Contractor shall prepare weekly reports of planned and actual progress of Works and subsequent week's scheduled Works. These will also include Material procurement status. These reports shall be submitted to Client and shall be reviewed in weekly co-ordination meeting.
- (c) The Contractor shall submit monthly report along with monthly bills. The reports shall include photographs taken from pre-determined locations which illustrate progress of the Works.
- (d) Further progress charts and schedules shall be prepared by the Contractor as directed by the Client and/or Project Manager.
- (e) The submission to and approval by the Client of such programmes/ reports or the furnishing of such particulars shall not relieve the Contractor of any of its responsibilities and liabilities under the Contract.

**5.38. Night or Sunday work**

Subject to Applicable Law and the terms of the Contract, the Contractor shall not perform any activity at the Site at night on any day or on Sundays except with the prior written consent of the Client and the Project Manager.

**5.39. Taxation**

The Contractor shall be responsible to pay personal and company taxes of its staff and its organization wherever applicable. The Contractor shall be responsible for deduction of tax at source while releasing payment to their staff, Sub-Contractors, workers, etc.

**5.40. NGT Guidelines**

The Contractor shall comply with all the provisions of National Green Tribunal (NGT) laws, rules, orders, notifications, and amendments made from time to time at his own cost, nothing extra shall be paid on this account. Any penalty, imposed by the NGT for construction of aforesaid building due to non-compliances shall be borne by the contractor itself. The item rates of BOQ are inclusive of all such cost to manage the activities as suggested by NGT. If site shutdown/ work held due to NGT/ Govt. orders then, the Contractor shall only be entitled to Extension of time and no claim shall be entertained on account of this by the owner on account of idle labour, staffs tools & plants, machineries etc.

**6. CLIENT'S OBLIGATIONS****6.1. Rights of Way and Facilities**

- (a) The Client shall provide and bear all costs and charges for special and/or temporary rights of way, which the Contractor may require, including those for access to the Site.
- (b) The Client shall provide clear, unhindered, freely accessible Site to the Contractor for execution of the Works.

- (c) The Client shall, in respect of the Works, provide adequate space for the storing of Contractor's Equipment (including equipment which is being procured by the Client under a separate contract) until the Completion Date.

## 6.2. Access to the Site

The Contractor and Contractor's Personnel shall be permitted access to the Site for the purposes of carrying out the Works. The Client, may at any time, remove or cause to be removed any of the Contractor's Materials, articles, things, personnel or labour without notice to the Contractor. This shall not, in any manner, prejudice or affect the Contractor's liabilities and obligations in respect of the Works and in particular the liability arising due to any damage to any person or Material at the Site.

## 7. TIME FOR COMMENCEMENT AND COMPLETION

### 7.1. Commencement of works

The Contractor shall commence the Works at the Site from the date of issuance of the Letter of Award ("**Commencement Date**"). The Contractor acknowledges that time is the essence of the Contract for commencement and completion of Works by the Completion Date.

### 7.2. Time for completion and extension of time

- (a) The Contractor agrees and undertakes to complete the Works in accordance with the terms of the Contract and the Bidding Documents within 6 months from the Commencement Date ("**Completion Date**") subject to Clause 7.2.(b) below.
- (b) In the event that the Contractor is delayed in performing the Works under the Contract solely as a result of:
  - (i) an event of Force Majeure; or
  - (ii) on account of Change in Law; or
  - (iii) breach by the Client of its material obligations herein,

then the Contractor shall issue a written notice to the Client and the Project Manager promptly upon occurrence of any of the events specified above indicating the reasons for the delay, the additional time required by the Contractor to complete the Works and the corrective action already undertaken or to be undertaken. The Client upon receipt of notice from the Contractor shall determine the time period for extension and whether such extension shall take place retrospectively or prospectively. Provided that, the Contractor shall be solely responsible for all costs and risks on account of such extension of time.

- (c) The Parties agree that any extension of time shall only be considered when work on the critical path of the program for the Works is affected. It shall be the duty of the Contractor at all times to use all reasonable endeavors to prevent any delay being caused by any of the events or circumstances mentioned in this Clause 7.2, to minimize any such delay as may be caused thereby, and to do all that may be reasonably required, to the satisfaction of the Client, to proceed with the Works.

### 7.3. Notice of Claim

- (a) Except where otherwise specifically provided in the Contract, the Contractor shall submit to the Client and the Project Manager a notice of a claim for an extension of the Completion Date, together with particulars of the event or circumstance justifying such extension, as soon as reasonably practicable, after the commencement of such event or circumstance. Such notice provided by the Contractor to the Client and Project Manager shall include:
  - (i) the material circumstances of the event including the cause or causes;

- (ii) the nature and extent of any delay;
  - (iii) the corrective action already undertaken or to be undertaken;
  - (iv) the period of any extension of time required for each component of the Works, so effected (as applicable); and
  - (v) a statement that it is a notice pursuant to this Clause 7.3.
- (b) The Contractor shall ensure that the particulars provided to the Client and Project Manager under this Clause 7.3 are kept up to date and shall continuously submit such further particulars as may be necessary or which may be requested by the Client, from time to time.

#### 7.4. **Minimize Delay**

The Contractor shall, at all times, use its reasonable endeavor's to minimize any delay in the performance of its obligations under the Contract.

#### 7.5. **Concurrent Delays**

If there are concurrent causes of delay and both delays would entitle the Contractor to an extension of time under this Clause 7.5., then, to the extent of that concurrency, the Contractor shall only be entitled to claim an extension of time for that cause of delay which would entitle it to the longer period of extension.

#### 7.6. **Rate of progress**

If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the Works is at any time, in the opinion of the Client and/or the Project Manager, too slow to ensure completion of the Works within the time period specified in Clause 7.2., the Client shall notify the Contractor in writing and the Contractor shall promptly take all steps as are necessary and the Client may approve to expedite progress so as to complete the Works or such section by the prescribed time or extended time. The Contractor shall not be entitled to any additional payment for taking such steps.

### 8. **MATERIALS AND WORKMANSHIP**

#### 8.1. **Quality of Materials and workmanship and tests**

All Materials and workmanship shall be as described in the Contract and in accordance with the Client's instructions and shall be subject from time to time to such tests as the Client may direct.

#### 8.2. **Quality Assurance Programme**

The Contractor before the start of Works shall submit for approval a quality assurance programme to the Client indicating measures that it proposes to implement to ensure that the quality of Works shall be in accordance with requirements laid down in the Contract ("**Quality Assurance Programme**"). The Client and/or Project Manager may add such additional quality assurance measures as it considers appropriate for ensuring quality compliance of the Works. The Contractor shall strictly adhere to this programme and any failure attributable to the Contractor shall attract the penal provisions laid down in the Contract.

#### 8.3. **Cost of samples/ Mock-ups / Tests**

- (a) All samples/mock-ups shall be supplied by the Contractor at its own cost if the supply thereof is clearly intended by or provided for in the Contract.
- (b) The Contractor shall provide samples for the approval of Client and shall provide alternative samples until the approval of the Client has been obtained. Samples approved by the Client shall be kept at Site under custody of the Contractor until completion of the Project.

- (c) The cost of conducting any test shall be borne by the Contractor if such test is clearly intended by or provided for in the Contract and in the cases only of a test under load or of a test to ascertain whether the design of any finished or partially finished work is appropriate for the purposes which it was intended to fulfill, is particularized in the Contract in sufficient detail to enable the Contractor to price or allow for the same in its tender.
- (d) The Contractor shall provide normal testing facilities at Site at its cost as directed by the Client and/or the Project Manager.

#### **8.4. Inspection of Works**

The Client and the Project Manager or any person authorized by them shall at all times have access to the Works and to all workshops and places where Works are being prepared or from where Materials, manufactured articles or machinery are being obtained for the Works and the Contractor shall afford every facility for and every assistance in or in obtaining the right to such access.

#### **8.5. List of approved brand and makes**

A list of approved brands and makes for Materials to be incorporated in the Works should be furnished by the bidder along with its tender. The Contractor shall submit samples of processed raw materials and Materials procured in conformity with Prudent Industry Practices for the approval of the Client and/or the Project Manager. Procurement of the Materials for the Works shall be after the approval of the Client and/or the Project Manager in writing.

#### **8.6. Basic Prices**

Basic price shall mean the cost of the Material per unit inclusive of all Taxes and duties, cost of transportation, loading, unloading, breakage, incidental charges, etc. All costs and expenses shall be deemed to be included in item rate quoted by the Contractor for that relevant item and shall not be entitled to claim any extra amounts on this basis. Goods and service tax, if applicable, in performance of the Works shall be calculated and shown separately in the Bidding Documents. The Contractor must provide break-up of all the tax components as applicable separately from the basic price.

#### **8.7. Removal of improper Materials**

The Client shall during the progress of the Works has power to order in writing from time to time:

- (a) the removal from the Site, within such time or times as may be specified in the order, of any Materials, which, in the opinion of the Client, are not in accordance with the Contract or otherwise not fit for use in respect of the Works;
- (b) the substitution of proper and suitable Materials and;
- (c) the proper re-execution of any Works which in respect of Materials or workmanship is not in accordance with the Contract.

#### **8.8. Default of Contractor in compliance**

In case of default on the part of the Contractor in carrying out such order, the Client shall be entitled to engage and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be recoverable from the Contractor by the Client or may be deducted by the Client from any monies due to or which may become due to the Contractor.

#### **8.9. Quality Control Tests**

The Contractor shall perform the relevant tests as required under the scope of Works. The cost of all such tests so performed shall be borne by the Contractor and no extra amounts shall be borne by the Client on this account. The details of the quality tests to be carried out shall be as set out in Technical Specifications or notified by the Client and/or Project Manager.

## **9. PERFORMANCE PARAMETERS**

### **9.1. Tests**

The tests shall be conducted by the Contractor in the presence of the Client and/or the Project Manager in accordance with the testing procedures set out in **Schedule VIII** to the Contract, so as to ensure the operation of the New admin. & Engg. Block as an integrated whole to establish the Performance Parameters.

### **9.2. Performance Tests**

The performance tests shall be conducted by the Contractor in the presence of the Client and/or the Project Manager in accordance with the performance testing procedures to the Contract, so as to ensure the operation of the New admin. & Engg. Block as an integrated whole to establish the Performance Parameters.

### **9.3. Attainment of Performance Parameters**

The Contractor guarantees that during the performance tests, the New admin. & Engg. Block and all parts thereof, shall attain the Performance Parameters, subject to and upon the conditions specified herein.

### **9.4. Consequences of Performance Parameters Not Being Met**

Subject to Clauses 9.1 and 9.2, if pursuant to conducting the tests and performance tests, the Performance Parameters are not met, either in whole or in part, the Contractor shall, at its cost and expense, make such changes, modifications and/or additions to the New admin. & Engg. Block, or any part thereof, as may be necessary to meet the Performance Parameters to the satisfaction of the Client. The Contractor shall notify the Client upon completion of the necessary changes, modifications and/or additions, carried out in accordance with this Clause 9.4, and shall request the Client to facilitate the repetition of the performance tests until the Performance Parameters have been met. If the Performance Parameters are not met, either in the whole or in part, even after 2 (two) such re-tests (after carrying out necessary changes, modifications, and/or additions), and the cap for the liquidated damages as provided in Clause 10.2. has been reached, then the Client may, at its sole discretion, exercise any one of the following options:

- (a) reject the New admin. & Engg. Block, and recover all the payments already made to the Contractor in terms of the Contract;
- (b) terminate the Contract and find a replacement contractor for undertaking the Works at the cost and risk of the Contract; or
- (c) accept the deficient Works and proportionately reduce the Contract Price to reflect the diminished value to the Client, and such reduction shall be determined by the Client. The Client shall deduct from the Contract Price, the amounts payable for the defects in New admin. & Engg. Block and the Contractor shall proceed in accordance with all other obligations under the Contract.

### **9.5. Liquidated Damages and Termination**

If the total amount of liquidated damages for shortfall in performance exceeds the amount of liquidated damages specified in Clause 10, the Client shall have the right to either:

- (a) reject the Works and recover all the payment already made to the Contractor in terms of the Contract;  
or



- (b) terminate the Contract pursuant to Clause 34 of the Contract.

## **10. LIQUIDATED DAMAGES**

### **10.1. Liquidated Damages for Shortfall in Performance of the Works**

The Contractor shall pay the liquidated damages as set forth in this Clause 10.1, if the New admin. & Engg. Block, or any part thereof, fails to meet:

### **10.2. Liquidated Damages for Delay**

- (a) If the Contractor fails to achieve completion of the Works on or before the expiry of the Completion Date, then the Contractor shall pay to the Client [1% (one percent)] of the Contract Price per week subject to maximum of [5% (five per cent)] of the total Contract Price as liquidated damages for every week or part thereof which shall elapse between the Final Completion and the date of issuance of the Final Acceptance Certificate. The Client may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies in its hands, due or which may become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from its obligation to complete the Works or from any other of its obligations and liabilities under the Contract.
- (b) The Contractor recognizes and acknowledges that the Client would suffer substantial losses and damage if there is a delay in the completion of the Works.
- (c) The payment of liquidated damages for delay under this Clause is in addition to, and without prejudice to, any other remedies that may be available to the Client under the Contract or Applicable Law.
- (d) Without prejudice to any other rights the Client may have, the Client shall have the right to reject the Works if the quality of the Works does not meet the Technical Specifications set out in **Schedule X** and the Contractor is unable to correct the deficiencies in Works within [5 (five) days] of being asked to by the Client.

### **10.3. Genuine Pre-estimate**

The Parties acknowledge that the damages, losses and costs incurred by the Client for delay in achieving completion of the Works by the Completion Date and for shortfall in performance are uncertain and difficult to determine with precision at the date of signing the Contract. The sums for liquidated damages for delay and liquidated damages for shortfall in performance as set out in this Clause 10.3 represent a reasonable, genuine and appropriate pre-estimate of the damages, losses and costs likely to be suffered by the Client if the delay or the shortfall in performance described in this Clause 10 occurs and are calculated as a best efforts attempt to quantify the Client's actual losses, costs and damages associated with such delay and shortfall in performance. The amounts due under this Clause 10.3, as liquidated damages, shall be payable by the Contractor, without any requirement of proof of the actual loss or damage caused by such delay and/or breach. The sums set out in this Clause 10 seek to limit the potential liability of the Contractor and constitute liquidated damages and not a penalty.

### **10.4. Contractor's Obligations**

The payment of liquidated damages by the Contractor in terms of Clause 10.3, does not in any way relieve the Contractor from any of its duties, obligations and responsibilities under the Contract and shall be without prejudice to any other rights available to the Client under the Contract.

### **10.5. Rights at Law**

If this Clause 10 (or any part hereof) is found for any reason to be void, invalid or otherwise in-operative so as to disentitle the Client from claiming liquidated damages, the Client is entitled to claim, damages in accordance with Applicable Law for the Contractor's delays or shortfall in performance of the Works for the New admin. & Engg. Block.

## 11. COMPLETION AND ACCEPTANCE OF WORKS

11.1. **Completion** The Works shall achieve completion, when each of the following has been completed to the Client's satisfaction ("**Completion**"):

- (i) the New admin. & Engg. Block is functional in accordance with the requirements of the Contract, and the tests have been successfully completed in accordance with Clause 9.1.;
- (ii) the Contractor has complied with all provisions of the Contract relating to the Works;
- (iii) the Contractor has performed all its obligations and provided to the Client all Documents, that are due on or prior to the Completion Date, in accordance with the terms of the Contract; and
- (iv) the Contractor has delivered to Client, the notice of completion: (a) certifying that all the conditions stated in this Clause 11.1 have been fully satisfied; and (b) accompanied by a report of results of the tests and the Works completed with sufficient detail to enable the Client to determine whether Completion has been achieved ("**Notice of Completion**"). Provided, however, that if Client subsequently raises an objection to such Notice of Completion in accordance with Clause 11.1.(c), such notice will not be deemed to be delivered until any such objection is satisfied.

- (a) Upon the Client and Project Manager being satisfied of completion with the Contractor set out in Clause 11.1.(a) above, they shall issue the completion certificate in a form and manner set out in **Schedule XI** ("**Completion Certificate**").
- (b) Within 30 (thirty) days of receipt of the Notice of Completion, the Client shall notify the Contractor, of deficiencies and defects, if any, in relation to satisfying the provisions of Clause 11.1.(a) ("**Defects Notice**"). The Contractor shall, promptly upon receipt of the Defects Notice, perform at the Contractor's sole cost and expense, corrective measures to remove such deficiencies and shall deliver to the Client, a new Notice of Completion when completion of the applicable Works has been completed.
- (c) Within 30 (thirty) days of receipt of the subsequent Notice of Completion, the Client shall notify the Contractor of additional or remaining deficiencies, if any, that must be corrected by Contractor as a condition to the Completion. Any Disputes regarding the existence or correction of any such alleged deficiencies shall be resolved pursuant to Clause 35 (Dispute Resolution).
- (d) For the avoidance of any doubt, it is clarified that the issuance of the Completion Certificate by the Client shall in no way relieve the Contractor of its other obligations under the terms and conditions of the Contract or give rise to any liabilities for the Client.

### 11.2. **Provisional Acceptance**

- (a) The New admin. & Engg. Block shall achieve provisional acceptance, when each of the following has been completed to Client's satisfaction ("**Provisional Acceptance**"):
  - (i) the Contractor has achieved Completion (Clause 11.1);
  - (ii) the Contractor has performed all its obligations under the Contract required to be performed;
  - (iii) the Contractor has successfully completed the tests required to ensure that the Works are reliable;
  - (iv) the Contractor has obtained the Occupancy Certificate for the New admin. & Engg. Block;

- (v) the Contractor has removed from the Site, all scaffolding, rubbish, etc., and has cleaned the Site off all debris;
- (vi) Client has received copies of all permits obtained by the Contractor required for the Works;
- (vii) the Contractor has submitted all Documents (including the as-built plans pursuant to Clause 5.19 and Clause 14, and all other items and deliverables required to be submitted by the Contractor under the Contract;
- (viii) the New admin. & Engg. Block is capable of being operated in accordance with Prudent Industry Practices;
- (ix) the New admin. & Engg. Block is capable of being operated in accordance with Applicable Laws;
- (x) the Client has received copies of all permits obtained by the Contractor pursuant to Clause 5.29.(c);
- (xi) all Works have been completed to the satisfaction of the Client; and
- (xii) no default pursuant to Clause 11.1.(c) exists.

The Contractor shall deliver to the Client, a notice of provisional acceptance, certifying that all the conditions set forth in this Clause 11.2.(a) have been fully satisfied, accompanied by a report of the Works completed with sufficient detail to enable the Client to determine whether Provisional Acceptance Certificate should be issued ("**Notice of Provisional Acceptance**").

- (b) Upon the Client and Project Manager being satisfied of completion with the Contractor set out in Clause 11.2.(a) above, they shall issue the provisional acceptance certificate in a form and manner set out in **Schedule XII ("Provisional Acceptance Certificate")**.
- (c) Within [30 (thirty) days] of receipt of the Notice of Provisional Acceptance, the Client and/or the Project Manager shall notify the Contractor, of deficiencies, if any, in relation to satisfying the provisions of Clause 11.2.(a) ("**Provisional Defects Notice**"). The Contractor shall promptly upon receipt of the Provisional Defects Notice, perform at Contractor's sole cost and expense, corrective measures to remove such deficiency and shall deliver to Client a new Notice of Provisional Acceptance when completion of the applicable Works has been completed. Within [30 (thirty) days] of receipt of the subsequent Notice of Provisional Acceptance, Client and/or Project Manager shall notify Contractor of additional or remaining deficiencies, if any, that must be corrected by Contractor as a condition to the issuance of the Provisional Acceptance Certificate. Any Disputes regarding the existence or correction of any such alleged deficiencies shall be resolved pursuant to Clause 35 (Dispute Resolution).
- (d) In the event the items stated under Clause 11.2(a)(v) have not been removed within [30 (thirty) days] of the issuance of the Provisional Acceptance Certificate, the Client may sell or otherwise dispose of the same. The Client shall be entitled to be paid the costs incurred in connection with, or attributable to, such sale or disposal and restoring the Site. Any balance of monies from the sale shall be paid to the Contractor.
- (e) The issuance of the Provisional Acceptance Certificate by the Client and/or Project Manager shall in no way relieve the Contractor of its other obligations under the terms and conditions of the Contract or give rise to any liabilities for the Client.

### 11.3. Final Acceptance Certificate and Final Completion

- (a) The New admin. & Engg. Block shall achieve final completion, when each of the following has been completed to Client's satisfaction and the Contractor has performed all other obligations under the

Contract, which are required to be performed prior to the issuance of the Final Acceptance Certificate ("**Final Completion**"):

- (i) the Contractor has achieved Provisional Acceptance;
  - (ii) the Contractor has executed Works to the sole satisfaction of the Client;
  - (iii) the Contractor has paid all liquidated damages, indemnity sums and other payments due from the Contractor under the Contract;
  - (iv) the Contractor has assigned to the Client or provided Client with all warranties or guarantees that Contractor has received from Sub-Contractors to the extent Contractor is obligated to do so pursuant to the Contract;
  - (v) all Contractor's Materials and other supplies, equipment, surplus, waste, huts, wreckage, debris, rubbish, and temporary facilities to which Client does not, and is not entitled to hold title, have been removed from the Site, and the Site have been restored in accordance with the terms of the Contract provided that, all activities in relation to clearing and disposal shall be conducted in accordance with all Applicable Laws;
  - (vi) all the Contractor's Personnel and the personnel of the Sub-Contractors and their personnel, have been removed from the Site;
  - (vii) all Sub-Contractors have been paid their dues by the Contractor and Contractor has delivered the final release and waiver of Liens and claims pursuant to the Contract and has delivered such other documents and certificates as Client has reasonably requested to ensure compliance with all Applicable Laws;
  - (viii) all activities required as per Applicable Law on account of the completion of the Works have been completed by the Contractor;
  - (ix) the Contractor has delivered to Client a notice of final completion: (a) certifying that all the conditions set forth in this Clause 11.3.(a) have been fully satisfied; and (b) accompanied by a report of the Works completed with sufficient detail to enable the Client to determine whether Final Completion has been achieved ("**Notice of Final Completion**"). Provided, however, that if the Client subsequently raises an objection to such notice in accordance with Clause 11.3(c), such Notice of Final Completion will not be deemed to be delivered until any such objection is satisfied.
- (b) Upon the Client and Project Manager being satisfied of completion with the Contractor set out in Clause 11.3.(a) above, they shall issue the final acceptance certificate in a form and manner set out in **Schedule XIII ("Final Acceptance Certificate")**.
- (c) Within [30 (thirty) days] after receipt of the Notice of Final Completion, the Client and/or the Project Manager shall notify the Contractor, of deficiencies, if any, in relation to satisfying the provisions of Clause 11.3.(a) ("**Acceptance Defects Notice**"). The Contractor shall promptly upon receipt of the Acceptance Defects Notice perform at Contractor's sole cost and expense, corrective measures to remove such deficiency and shall deliver to Client, a new Notice of Final Completion when completion of the applicable Works has been completed. Within [30 (thirty) days] of receipt of the subsequent Notice of Final Completion, Client and/or the Project Manager shall notify Contractor of additional or remaining deficiencies, if any, that must be corrected by Contractor as a condition to the Final Completion. Any Disputes regarding the existence or correction of any such alleged deficiencies shall be resolved pursuant to Clause 35 (Dispute Resolution).
- (d) Without prejudice to Clause 11.3.(a), additional conditions may be agreed to between the Client and the Contractor, as conditions for issuance of the Final Acceptance Certificate.

- (e) For the avoidance of any doubt, it is clarified that the issuance of the Final Acceptance Certificate by the Client shall in no way relieve the Contractor of its other obligations under the terms and conditions of the Contract or give rise to any liabilities for the Client.

#### 11.4. **Take Over**

- (a) Upon the issuance of the Final Acceptance Certificate, the Contractor shall handover to the Client and the Client shall take possession and control of the New admin. & Engg. Block ("**Take Over**") and shall issue to the Contractor, a take over certificate in a form and manner set out in "**Take Over Certificate**". Upon such Take Over, the Client shall, except as otherwise provided, be responsible for the risk of loss or damage to the New admin. & Engg. Block.
- (b) Prior to the possession and control of the New admin. & Engg. Block being handed to the Client in terms of this Clause 11.4, the Contractor shall be responsible and take care of the New admin. & Engg. Block/ Project in a manner consistent with Applicable Laws, Prudent Industry Practice and the other requirements set forth in the Contract. The transition of such possession and control of the New admin. & Engg. Block from Contractor to Client as set forth in this Clause 11.4 shall be accomplished in accordance with the procedures to be set forth in a transition plan to be submitted by Contractor (in a form acceptable to the Client) to the Client, for its approval, no later than [15 (fifteen) days prior] to the anticipated date of Final Completion.

### 12. **PROJECT MANAGER**

- 12.1. The Contractor acknowledges and agrees that the Client has appointed the Project Manager for the supervision and management of the Works to be undertaken by the Contractor and ensure completion of Works in the time period specified under Clause 7. The Contractor shall coordinate with the Project Manager while carrying out the Works. The Contractor acknowledges and agrees that any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by the Project Manager shall have the same effect as though the act had been an act of the Client. However:
  - (a) it shall not relieve the Contractor from any responsibility it has under the Contract, including responsibility for errors, omissions, discrepancies and non-compliances;
  - (b) any failure to disapprove any Works, Contractor's Equipment or Materials shall not constitute approval, and shall therefore not prejudice the right of the Client to reject the Works, Contractor's Equipment or Materials; and
  - (c) if the Contractor questions any determination or instruction of the Project Manager, the Contractor may refer the matter to the Client, who shall promptly confirm, reverse or vary the determination or instruction.
- 12.2. The Project Manager may issue to the Contractor instructions which may be necessary for the Contractor to perform its obligations under the Contract. Each instruction shall be given in writing and shall state the obligations to which it relates and the sub-clause (or other term of the Contract) in which the obligations are specified.
- 12.3. The Contractor shall comply with instructions from the Project Manager, or from the Client, including but not limited to:
  - (a) inspect and examine the Works before covering up and generate quality report;
  - (b) certification of bills in the manner satisfactory to the Client; and
  - (c) inspect and approve the mock-ups, quality of Materials and workmanship.

Notwithstanding any of the above, the Project Manager and the Architect shall, without prejudice, perform actions and deeds as also listed elsewhere in the Contract or in the agreement for appointment of the Project Manager by the Client.

- 12.4. The Project Manager shall be at liberty to object to and require the Contractor to remove forthwith from the Site engaged in the undertaking of Works any person provided by the Contractor who, in the opinion of the Project Manager, misconducts himself, or is incompetent or negligent in the proper performance of its duties, or whose presence on Site is otherwise considered by the Project Manager to be undesirable, and such person shall not be again allowed upon the Works without the consent of the Project Manager. Any person so removed from the Site for the performance of the Works shall be replaced as soon as possible.

### 13. ARCHITECT

- 13.1. The Client has appointed an architect for the purposes of designing the New admin. & Engg. Block ("**Architect**"). The Contractor shall co-operate and coordinate with the Architect and the Client to ensure that the Works are completed in accordance with the provisions of the design of the Architect as supplied to the Contractor as part of the Technical Specifications.
- 13.2. The Architect may shall depute a representative at the Site for performing the duties and obligations of the Architect specified herein and as set out in the agreement entered into between the Architect and the Client.
- 13.3. The Contractor acknowledges and confirms that the Architect or any representative of the Architect shall be entitled to inter alia the following items:
- (a) give instructions to the Contractor in matters pertaining to the design, Drawings and specifications and completion of the Works; and
  - (b) give notice to the Contractor of non-approval of any Works or Materials, and such Works shall be suspended or the use of such materials shall be discontinued until the decision of the Client, but such examination shall not in any way exonerate the Contractor from the obligation to remedy any defects which may be found to exist at any stage of the Works or after the same is completed.
- 13.4. The Contractor shall provide the Architect access to the Site to inspect the Works and provide every facility and assistance for inspecting the Works.

### 14. DOCUMENTS

#### 14.1. Documents Schedule

The Contractor shall, in accordance with the timelines specified in the Technical Specifications, provide to the Client a complete list of all Documents, which shall be utilized by the Contractor for the purpose of completion of the Works. The said list of Documents shall clearly indicate the Document number in accordance with the codes, title, revision number, and issue number in accordance with Prudent Industry Practice together with the date on which such Document has been issued. Further, Drawings in relation to the layout of the New admin. & Engg. Block shall clearly provide for the north direction and shall depict grid lines at the scale of [ ] meters which lines shall be submitted after a detailed survey carried out by the Contractor. The Contractor shall, if required by the Client, submit a revised schedule of the said Documents, till such time that all Works in relation to the fabrication of the New admin. & Engg. Block are completed by the Contractor. The Contractor shall, at its own cost, supply reduced size prints of all Documents, as and when required by the Client.

#### 14.2. Specification and Data Sheets

The Contractor shall, within the time specified in the Technical Specifications, submit to the Client, an updated list of all specifications and data sheets required for undertaking the Works. The said data sheets shall indicate the account number, title, revision number and date of issuance of such sheets, so that an updated summary of the latest specifications, is at all times available with the Client, for reference. The procedure for the submission

of revisions, if any to the said data sheets shall be as per the procedure set out for the revision of Documents pursuant to this Clause 14.2.

#### 14.3. **As-Built Plans**

- (a) The Contractor shall prepare and maintain an updated and complete set of as-built records of the New admin. & Engg. Block, identifying the precise as built locations, sizes and details of the Works executed. The Contractor shall ensure that all such records are maintained at the Site and shall be exclusively used for the purpose of the Contract.
- (b) The Contractor shall, in accordance with this Clause 14, submit to the Client, for its review and comments, (along with the other Documents), plans of the Works for the New admin. & Engg. Block, depicting all executed Works. If any errors are found in the as-built plans, such errors shall be corrected at the Contractor's cost and expense. Unless otherwise provided, as-built plans of the New admin. & Engg. Block and related documents submitted by the Contractor for review under this Clause 14.3.(b) shall be reviewed within 15 (fifteen) days from the date of submission to the Client. If the Client does not provide any comments on the Documents submitted by the Contractor within such 15 (fifteen) days review period then it would be deemed that the Client has no comments on the said as-built plans.
- (c) The Contractor shall submit 2 (two) copies of the as-built records to the Client. Further, upon completion of the ELECTRICAL AND ELV phase of the New admin. & Engg. Block, the Contractor shall complete the related plans in relation to the as-built stage (excluding all vendor drawings) and submit to the Client the following:
  - (i) [3 (three)] complete sets of all Documents on compact disc or other acceptable electromagnetic or electronic media, as may be required by the Client;
  - (ii) [5 (five)] complete sets of full size prints of the Documents;
  - (iii) [5 (five)] complete sets of data books specifying all details of the New admin. & Engg. Block in hard binders including certified prints and data for specialty materials to be provided under the Contract. All data books provided by the Contractor under this Clause shall be complete with index for tag numbers associated with the manufacture's data. Data books shall be bound in volumes, limited to a maximum of 3 (three) inches in thickness;
  - (iv) [3 (three)] sets of as-built data filled in computer data entry forms; and
  - (v) [3 (three)] copies of all the Documents information in the form of compact disc or other acceptable electromagnetic or electronic media, as may be required by the Client.
- (d) Provided that, in the event the Contractor designs the soft copies, it shall also provide a copy of that version along with its complete documentation. The Contractor shall, [15 (fifteen)] days prior to the issuance of the Final Acceptance Certificate, submit [5 (five)] sets of hard copy outputs of all the Documents to the Client.

#### 14.4. **Data**

- (a) The Contractor shall, in accordance with the timelines specified in the Technical Specifications provide such other structural drawings, instruction systems descriptions, Documents and Drawing indexes, computer control keys, computer programs, passwords and all other related data for the New admin. & Engg. Block containing the information necessary to enable the Client to use the New admin. & Engg. Block in accordance with Applicable Law.
- (b) The Contractor shall, in accordance with the timelines specified in the Technical Specifications provide the Client with data books, vendor prints, complete Drawing lists, descriptions of the New admin. & Engg. Block and other specific information on the New admin. & Engg. Block.

#### 14.5. **Review of Documents by the Client and/or the Project Manager**



- (a) The Contractor shall provide to the Client, free of cost, all Documents in accordance with the Technical Specifications and Applicable Law. All Documents submitted by the Contractor shall be written in English language. The Contractor shall prepare all the Documents, and shall also prepare any other documents that are necessary so as to instruct the Contractor's personnel with regard to the completion of the Works.
- (b) The review of Documents by the Client shall cover only general conformity of the Documents to the Technical Specifications, interfaces with the specification of the New admin. & Engg. Block provided under the Technical Specifications, external connections and of the dimensions which may affect the layout of the New admin. & Engg. Block.
- (c) This review by the Client may not indicate a thorough review of all dimensions, quantities and details of the New admin. & Engg. Block, any devices or items indicated or the accuracy of the information submitted. This review by the Client shall not be construed by the Contractor, as limiting any of its responsibilities and liabilities for mistakes and deviations from the requirements, specified under the Technical Specifications and the Contract. Any activity forming part of the Documents not particularly described in the Contract shall also be included in the obligations of the Contractor and the omission from the Documents of such activity necessary and obviously intended shall not relieve the Contractor from performing such activity. For the avoidance of doubt, it is clarified that Contractor shall await the expiry of the period specified in Clause 14.2 during which the Client is required to review the Documents, prior to commencing the related Works, and if the Contractor executes the related Works prior to the expiry of such period of the Documents, the same shall be at the sole risk and cost of the Contractor.

#### 14.6. **Mode of Submission**

- (a) Unless otherwise provided or agreed to by the Client, the Contractor shall, in accordance with the timelines specified in the Contract, submit to the Client, all Documents specified in the Contract, as being required to be submitted for the review by the Client, along with a notice as specified below.
- (b) The Documents to be submitted by the Contractor in accordance with this Clause 14.6 shall be submitted:
  - (i) in 2 (two) sets of soft copy using an internationally recognized web-based document viewing system, acceptable to the Client, linking the Client, the Contractor and the Sub-Contractors and [4 (four)] sets of hard copy;
  - (ii) along with a notice which shall state that the said Document is considered ready for both, (i) review by the Client in accordance with this Clause 14.2, and (ii) for use. The notice to be submitted by the Contractor shall also state that the said Document complies with the provisions of the Contract, or, if applicable, the extent to which it does not comply.
- (c) Without prejudice to the above, any Document, when issued to the Client, shall clearly evidence on such Document itself, the prior approval of the Contractor with respect to such Document. The Client may reject, without further review, any Document submitted by the Contractor, which in the opinion of the Client (i) has not been subjected to the Contractor's quality assurance system submitted pursuant to Clause 9.2; or (ii) contains an unusual amount of errors or (iii) is otherwise sub-standard.
- (d) Notwithstanding review by the Client of the Documents to be submitted by the Contractor pursuant to this Clause 14.2, the Contractor shall continue to be responsible for any errors, omissions or discrepancies therein. The Contractor shall bear any costs as a result of delay in providing such Documents or as a result of errors, omissions or discrepancies therein. The Contractor shall bear the cost of any alterations or remedial work necessary due to such errors, omissions or discrepancies for which the Contractor is responsible and shall modify the Documents accordingly. The performance of its obligations under this Clause 14.2 shall not relieve the Contractor of liability for delay in the completion of the Works under the Contract.
- (e) Unless otherwise provided in the Technical Specifications or the Contract, Documents submitted by the Contractor for review, shall be reviewed within 14 (fourteen) days from the date of submission of the



respective Document along with the notice specified in Clause 10.2(b), to the Client. If the Client fails to intimate the Contractor with regard to its decision on a Document, within the 14 (fourteen) day period specified in this Clause 14.2, then, such Document shall be deemed to have been reviewed by the Client. The Contractor shall, within 5 (five) days of intimation from the Client with regard to the review of the Documents, or a deemed review of such Document in accordance with this Clause 14.6., as the case may be, submit 6 (six) hard copies and 6 (six) soft copies in electronic form (in compact discs). Any Documents submitted by the Contractor, if in electronic form, shall be in a format acceptable to the Client.

#### 14.7. **Correction of Documents**

- (a) Without prejudice to Clause 14.3.(b), the Client may, at any time during the 15 (fifteen) day period specified in Clause 14.3, provide a notice to the Contractor that a Document has failed (to the extent stated) to comply with the provisions of the Contract. Upon receipt of a notice from the Client in terms of this Clause 14.7, the Contractor shall, at its own cost, promptly and in any case no later than 15 (fifteen) days from the receipt such notice, rectify the said Document and resubmit the same for the approval of the Client.
- (b) Unless otherwise provided, if any of the information submitted to the Client, in the Documents is substantially in variance with the Technical Specifications, which in the opinion of the Client is unacceptable, such Documents shall be returned to the Contractor marked "**Rejected**" and the Contractor shall re-submit the said Documents. For the avoidance of doubt, it is clarified that no extension of time shall be granted under this Clause 14.7 due to the Documents not being acceptable to the Client, in the first instance. In addition, the Client shall have the right to request the Contractor to make any change in the Documents that may be necessary to make the New admin. & Engg. Block conform to the Technical Specifications and the Contract, at the cost and expense of the Contractor.

#### 14.8. **Responsibility of Documents**

- (a) The Contractor hereby acknowledges that certain identified Documents forming part of the Technical Specifications have, as at the date hereof, been reviewed by the Client and the Contractor shall not, while executing the Works, depart from such Documents, unless consented to in advance by the Client. The Contractor shall be responsible for the accuracy of the Documents and any discrepancies, errors or omissions in the Documents and other particulars supplied by it, regardless of whether such Documents and particulars have been reviewed by the Client. If a Party becomes aware of an error or defect of a technical nature in a Document which was prepared for use, for the purpose of executing the Works, the Party shall promptly give notice to the other Party of such error or defect. If errors, omissions, ambiguities, inconsistencies, inadequacies or other defects are found in any Document provided by the Contractor, such Document, along with the Works corresponding to such Document, shall be corrected at the Contractor's cost and expense, notwithstanding the review by the Client of such Document. If the Documents have been previously reviewed by the Client, the Contractor shall not, during the completion of the Works, depart from the reviewed Documents, unless consented to in advance by Client. Review by the Client shall in no way relieve the Contractor of its obligations under the terms and conditions of the Contract or give rise to any liabilities for the Client.
- (b) The Contractor's obligation to complete the Works shall not be reduced or affected by review of any Documents or specifications by the Client.
- (c) Unless handed over by the Contractor to the Client, in accordance with the provisions of this Clause 14, the Documents shall, at all times, be in the care and custody of the Contractor.

#### 14.9. **Documents and Specifications for Works**

- (a) The Contractor shall, in accordance with the timelines specified in the Technical Specifications, submit to Client, for its review, in accordance with the procedure set out in Clause 14, details of the process package, layout Documents, detailed Documents, design specifications, detailed calculations and purchase specifications, etc., and any other information required by Client prior to issuing the same for

the purpose of construction and development of the New admin. & Engg. Block. Within 7 (seven) days of the review by the Client of the Documents to be submitted in terms of this Clause 14.9.(a), the Contractor shall submit to the Client, Document lists, indicating the date of availability of the latest copy of such Document with date of review by the Client of each such Document released for ELECTRICAL AND ELV purposes.

- (b) The Contractor shall ensure that all Documents submitted in terms of this Clause 14.9.(b) are made to a reasonable scale and are made in sufficient detail, as mutually agreed between the Parties, and in the event of any non-compliance with the same, necessary changes shall be made by the Contractor, at its own cost.
- (c) Unless the Contractor requests the Client for a specific deviation from the specifications in relation to the Documents submitted pursuant to this Clause 14.9. and the Client issues a written authority to deviate from the said specifications, the submission and correction, if any, of the Documents submitted pursuant to this Clause 14.9.(c), shall not relieve the Contractor of its responsibility to comply with the specifications specified in the Contract.
- (d) The Contractor shall ensure that all Documents to be submitted by it pursuant to this Clause 14 are submitted in accordance with the time lines specified in the Technical Specifications. For the avoidance of doubt, it is clarified that at no given point of time, will the Contractor rely on preliminary drawings for the purpose of construction and development of the New admin. & Engg. Block.
- (e) The Parties shall follow the following procedure in relation to the submission and subsequent review of the Documents submitted under this Clause 14:
  - (i) The Contractor shall submit to the Client, no later than the time specified in the Technical Specifications, copies of all preliminary Drawings and specifications in accordance with the requirements of the Technical Specifications;
  - (ii) The Client shall review the preliminary Drawings submitted in terms of Clause 14 and notify the Contractor, of any comments or suggestions by returning a marked-up print or copy of the said Drawings to the Contractor.
  - (iii) If the Client returns to the Contractor, marked-up Drawings or if the comments on Drawings and specifications are returned pursuant to Clause 14, the Contractor shall, promptly and in any event no later than 7 (seven) days from the receipt of the same, carry out the requisite corrections and obtain the Client's approval in relation to the said corrections, before issuing the same for the purpose of construction and development of the New admin. & Engg. Block.
  - (iv) The Contractor shall not modify any Documents submitted pursuant to this Clause 14 after the same have been reviewed by the Client. Provided that, if the Contractor is desirous of modifying any item issued for the purpose of construction and development of the New admin. & Engg. Block, as depicted on the Documents which have been submitted and reviewed in terms of this Clause 14, it shall submit to the Client the revised Documents and modified prints in relation to the same and follow the procedure set forth in this Clause.
- (f) The procedure stated in this Clause 14 shall apply *mutatis mutandis* to all applicable Documents submitted by the Contractor, during the construction and development of the New admin. & Engg. Block.

## **15. CONTRACTOR TO INFORM ITSELF FULLY**

### **15.1. Information**

- (a) The Contractor shall be responsible for obtaining all information required for the performance of its obligations under the Contract.

- (b) The Contractor has clarified and carefully examined all the Documents, design criteria, calculations, (if any) data, Technical Specifications and such other matters as may be necessary or desirable for performing its obligations under the Contract, to its entire satisfaction. The Contractor shall not, except as expressly provided in the Contract, be entitled to any extension of time or to any adjustment of the Contract Price, on grounds of misinterpretation or misunderstanding of any such matter.
- (c) The Client shall not be responsible for any error, inaccuracy or omission of any kind in the Technical Specifications as originally included in the Contract and shall not be deemed to have given any representation of accuracy or completeness of any data or information. Any data or information received by the Contractor, from the Client or otherwise, shall not relieve the Contractor from its responsibility of completion of the Works.
- (d) The Contractor has, prior to the execution of the Contract Agreement obtained all information and taken into consideration the restrictions imposed by the necessity to coordinate its activities for the New admin. & Engg. Block to be constructed and developed with the mutually agreed times.

## 15.2. Local Conditions

The Contractor represents that it is fully informed of all general and local conditions near the Site and other factors that may have an effect on the compliance of its obligations under the Contract. The Contractor cannot claim a Change under Clause 22 (Change in Contract Elements), an extension of time or an increase in the Contract Price as a result of such local conditions or factors.

## 15.3. Site and the New admin. & Engg. Block

- (a) The Contractor represents and confirms that it has entered into the Contract Agreement on the basis of its proper examination of the Site by its checking or carrying out its own investigations as may be required, including the suitability and availability of the access routes thereto and that it is aware about the conditions of the Site and its surroundings and has satisfied itself as to all technical, commercial, social and general conditions of and all circumstances affecting the Site, including the nature of the ground and sub-soil, Site surroundings, environmental aspects, the form and nature of the Site and the exact location and condition, as may be required. In this regard, the Contractor has obtained for itself all information, as may be necessary or desirable for the compliance of its obligations under the Contract, including all necessary information as to the risks, contingencies, climatic, hydrological, natural conditions and all other circumstances which may influence or affect the Contract Price and/or its obligations under the Contract. Further, the Contractor agrees that if during the term of the Contract, any portion of the Site is rendered unsafe, on account of any reason whatsoever (including unfavourable weather), the Contractor shall restrict the completion of the Works, to such portion of the Site which is safe and not affected by the said contingency. The Contractor represents and confirms that by signing the Contract Agreement, the Contractor accepts total responsibility for having foreseen all difficulties and costs of successfully completing the Works and that the effect of all contingencies have been considered by the Contractor prior to entering into the Contract Agreement and that the Contractor shall not be entitled to extension of time or an increase in the Contract Price on account of the same.
- (b) The Contractor represents and confirms that it has entered into the Contract on the basis of a proper examination of the data relating to the New admin. & Engg. Block on the basis of information that the Contractor could have obtained from a visual inspection of the Site and of other data readily available to it relating to the New admin. & Engg. Block. The Contractor acknowledges that any failure to verify and interpret any data and information in relation to the Site and/or the New admin. & Engg. Block shall not relieve it of its responsibility for properly estimating the difficulty or cost of successfully performing its obligations under the Contract.

## 16. SUB-CONTRACTORS

### 16.1. Experience

The Contractor represents that each Sub-Contractor has the requisite skill, expertise, experience, capacity, capability and has successfully executed works similar to the Works, in the immediately preceding [3 (three) years] from the Commencement Date.

#### 16.2. **List of Sub-Contractors**

A list of all major items and the approved Sub-Contractors for each of such major items has been provided by the Contractor and incorporated in the Technical Specifications. The Client and the Contractor have agreed on a list of approved Sub-Contractors, from the list provided in the Technical Specifications, and the same is set out in **Schedule XV** (Approved List of Sub-Contractors) ("**Approved List**"). The Client, after due consultation and agreement with the Contractor, shall have the right to add or delete from the Approved List, from time to time, and approve any successor or replacement of any person listed on the Approved List.

#### 16.3. **Sub-Contracting**

With regard to major items, as specified in the Technical Specifications, the Contractor shall, subject to Clause 16.2, only contract with the Sub-Contractors provided in the Approved List. Further, any sub-contracting in terms of this Clause 16.3, shall not relieve or discharge the Contractor from any of its liabilities or obligations under the Contract and the Contractor shall be responsible for the acts, defaults and neglects of all Sub-Contractors and its agents, servants or workmen, or any of them, as fully, as if they were the acts, defaults or neglects of the Contractor under the terms of the Contract and the Client shall not be liable on account of the same. No acts or omissions on the part of any of the Sub-Contractors will allow the Contractor to claim an extension of time, an increase in the Contract Price, or any other dispensation pursuant to the Contract.

#### 16.4. **Other Sub-Contractors**

If the Contractor intends on contracting with Sub-Contractors, other than those specified in the Approved List, the Contractor shall provide the Client with details in relation to the same. The Client shall, no later than 10 (ten) days from such additional details being provided by the Contractor, approve or disapprove the same. In the event the Client approves the additional Sub-Contractors in terms of this Clause 16.4, such additional Sub-Contractors shall be deemed to be included in the Approved List. The Client shall also have the right to propose a Sub-Contractor other than those specified in the Approved List and upon mutual agreement with the Contractor in this regard, require the Contractor to contract with such Sub-Contractor. In the event of such mutual agreement, the sub-contractor proposed by the Client shall be deemed to be included in the Approved List. Provided that, any agreement between the Parties in terms of this Clause 13.4 shall not relieve or discharge the Contractor from any of its liabilities or obligations under the Contract and the Contractor shall be responsible for the acts, defaults and neglects of all such Sub-Contractors and its agents, servants or workmen, or any of them, as fully, as if they were the acts, defaults or neglects of the Contractor under the terms of the Contract.

#### 16.5. **Client's Consent**

The Contractor shall not sub-contract the whole of its obligations under the Contract. Notwithstanding the Client's consent to any Sub-Contractor, the Contractor shall at all times remain fully responsible to the Client for the proper performance of its obligations under the Contract. The Client shall, at no given point of time, be considered to have any duties or obligations towards any Sub-Contractor as a result of the Contract or by virtue of providing its consent to the Contractor with respect to a Sub-Contractor. The Contractor shall not be relieved of any obligation or responsibility under the Contract by subcontracting of any portion of the Works to a Sub-Contractor.

#### 16.6. **Copies of Sub-Contracts**

The Contractor shall, upon request, provide to the Client copies of technical ordering specifications and principal commercial terms (un-priced) of the sub-contracts with regard to the major items as identified in the Technical Specifications, to be executed with the Sub-Contractors.

#### **16.7. Form of Sub-Contracts**

- (a) The Contractor shall ensure that all contracts with its Sub-Contractors are made in writing. The Contractor shall also ensure that each Sub-Contractor includes provisions which will entitle the Contractor to discharge its obligations and liabilities to the Client in terms of the Contract. The Contractor shall further ensure that all contracts with the sub-contractors shall require each Sub-Contractor, to the extent of the Works to be performed by the Sub-Contractor, to be bound by the terms of the Contract and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by the Contract, assumes toward the Client. Each contract with a Sub-Contractor shall preserve and protect the rights of the Client under the Contract with respect to the Works being performed by the Sub-Contractor so that such sub-contracting does not prejudice the rights of the Client.
- (b) Each instrument evidencing any contract with its Sub-Contractors shall provide that, pursuant to its terms, in form and substance satisfactory to the Client, the rights of the Contractor under such contract with its Sub-Contractors (including all warranties provided by the sub-contractor) are assignable to the Client. The Contractor shall assign to the Client, its successors and assigns, any such contract with its Sub-Contractors as may be required by the Client in its sole discretion, prior to the issuance of the Final Acceptance Certificate or following termination of the Contract, as the case may be.

#### **16.8. Client's Rights**

The Contractor warrants that no arrangement, agreement or understanding with any sub-contractor shall directly or indirectly interfere with, restrict or impede the Client in the exercise of any right or remedy under the Contract.

#### **16.9. Evidence of Payment**

- (a) The Contractor shall promptly pay all amounts due to any Sub-Contractor. The Contractor shall, by an appropriate agreement with each Sub-Contractor, require each Sub-Contractor to make payments to its sub-contractors, if any, in a timely manner. The Client shall have no obligation to pay or to verify the payment of any monies to any sub-contractor. However, the Client may, at its discretion, verify the payments made by the Contractor to the Sub-Contractors.
- (b) The Contractor shall provide to the Client documentary evidence that the Contractor has made or caused to be made all payments due to its Sub-Contractors and when final payment has been made to the Contractor under the Contract, that the Contractor has made final payment to its Sub-Contractors.

### **17. TRANSFER OF OWNERSHIP**

#### **17.1. Ownership**

The ownership of the New admin. & Engg. Block shall, at all times vest with the Client. Without prejudice to this Clause 17.1, the Contractor shall, until the issuance of the Take Over Certificate, be responsible for the care of the New admin. & Engg. Block, together with the risk of damage thereto. After the issuance of the Take Over Certificate, the Client shall be responsible for the care of the New admin. & Engg. Block, provided that any damage to the New admin. & Engg. Block on account of reasons attributable to the Contractor, shall at all times during the term of the Contract and the expiry of the Defect Liability Period, be to the Contractor's account.

#### **17.2. Warranty as to Title**

The Contractor warrants that the Contractor's equipment and material shall remain free from defects in title including liens of any kind. The Contractor shall defend the title to the same against any third party and shall indemnify, defend and hold the Client harmless from and against any and all losses arising out of or otherwise resulting from any failure to comply with this Clause 17.2.

#### **17.3. Ownership of the Contractor's equipment & materials**

The ownership of the Contractor's Equipment, used by the Contractor or its Sub-Contractors, shall at all times remain with the Contractor.

**17.4. Excess Material**

The ownership of any Materials, in excess of the requirements for the New admin. & Engg. Block, as may be determined by the Client and Contractor, shall vest with the Contractor.

**18. REPRESENTATIONS AND WARRANTIES**

**18.1. Contractor's Representations and Warranties**

The Contractor makes the following representations and warranties to the Client, each of which is true and correct as on the date of issuance of Letter of Award which representations and warranties shall continue to be true and correct throughout the term of the Contract:

- (a) it has been incorporated as a company under the Companies Act, [1956/2013], is validly existing and has the power and authority to carry on its business in India;
- (b) it has the power to enter into the Contract and comply with its obligations under it;
- (c) it has in full force and effect the authorizations necessary for it to enter into the Contract and the transactions contemplated under it;
- (d) it has satisfied itself as to the correctness and sufficiency of the Contract Price, which shall, except as otherwise provided for in the Contract, cover all its obligations under the Contract; and
- (e) it and its Sub-Contractors have the requisite knowledge, skill, experience, expertise, capacity and capability to execute the Works in a timely manner and to satisfy and fulfill all their respective obligations and responsibilities under the Contract.

**18.2. Client's Representations and Warranties**

The Client makes the following representations and warranties to the Contractor, each of which is true and correct as on the date of issuance of Letter of Award which representations and warranties shall continue to be true and correct throughout the term of the Contract:

- (a) it has been incorporated as a company under the Companies Act, 2013, is validly existing and has the power and authority to carry on its business in India;
- (b) it has the power to enter into the Contract and comply with its obligations under it;
- (c) it has in full force and effect the authorizations necessary for it to enter into the Contract and the transactions contemplated under it; and
- (d) it shall, with the necessary assistance of the Contractor, as and when required, acquire permits, approvals and/or licenses specified in the Technical Specifications.

**19. WARRANTIES**

**19.1. Contractor's Warranties**

The Contractor hereby warrants to the Client that the New admin. & Engg. Block has been and shall have been engineered, designed, tested and the Works shall be executed in a manner consistent with the terms of the Contract, in accordance with Prudent Industry Practices and Applicable Law,

- (a) using the skill, care and diligence to be expected of appropriately qualified and experienced professionals with experience in ELECTRICAL AND ELV works of a type, nature and complexity similar to the ELECTRICAL AND ELV in the industry;
- (b) in accordance with good modern engineering principles and of appropriate grade compatible with the intended purpose;
- (c) using only Materials and goods for incorporation into the New admin. & Engg. Block which are new, and do not contain any refurbished components, are free of lien and encumbrances, are unused and the standards of all workmanship, manufacture and fabrication have conformed in all respects to the Technical Specifications, and shall be of such quality as is intended for the purpose for which it is intended;
- (d) using the standards of all workmanship and fabrication which conform in all respects to the Codes and Standards and being of such quality as is intended for the purpose for which it is intended;
- (e) conforming to the Technical Specifications and being free of defects and deficiencies. The engineering and design shall be such that the Works shall meet all safety and applicable criteria as specified in the Contract;
- (f) being suitable for the use in accordance with the requirements necessary to meet the Performance Parameters;
- (g) using means, methods and techniques required for the completion of the Works which are appropriate for the conditions and materials involved and in accordance with the current state of the art; and
- (h) ensuring that the Works when completed will conform in all respects with the requirements of, and will be suitable for, the purpose of the Contract.

## 19.2. **Other Warranties**

The New admin. & Engg. Block shall:

- (a) upon Final Completion, be in accordance with all requirements of the Contract unless otherwise agreed by the Client, or altered in accordance with a Change in accordance with Clause 22 (Change in Contract Elements) instructed by the Client;
- (b) be capable of being operated in accordance with the requirements of the Contract and Prudent Industry Practices; and
- (c) comply with Applicable Law in effect on the Final Completion Date.

## 20. **INSURANCE**

### 20.1. **Insurance Policies**

- (a) All insurance policies, whether required to be obtained under this Clause 20 or otherwise, wherever possible shall be taken out in the joint names of the Client, the Contractor and Sub-Contractor, wherever applicable.
- (b) All the insurance shall be arranged by Contractor from a reputable insurance company which can deal with all matters pertaining to the subject and is acceptable to the Client. The Client has reserved its right to nominate the insurance company or take the insurance policies under which the claims will be lodged by the Contractor.



- (c) The Contractor must ensure that the policy amounts cover the Contract Price and adequately cover the maximum possible liability that may arise on the occurrence of the risks covered.
- (d) The Contractor shall deposit the original insurance policy and the premium paid receipts with the Client on the date of issuance of the Letter of Award. If the Contractor fails to procure such policy or deposit the same and the premium receipts in original with the Client, the Client shall be entitled, but not obligated to procure such policy and recover the payments thereon from the Contractor either by withholding the amounts payable to the Contractor or otherwise. Any deviation from the same shall be subject to the prior written approval of the Client. The Client shall be entitled to prosecute and/ or compromise or settle the claims under such policies in such manner as may be deemed fit without reference to the Contractor. The Contractor shall provide necessary assistance to the Client in this regard.
- (e) The Client, however reserves the right to take all or some of the insurance policies on its own and thereafter the Contractor shall be required to process the claims if any for settlement under the policies so taken by the Client. The Client further reserves its right to nominate an insurance company with whom the Contractor will be required to obtain the policies, insurance of Works, etc.
- (f) Without limiting its obligations and responsibilities, the Contractor shall insure in the joint names of the Client and the Contractor against all loss or damage from whatever cause arising, for which it is responsible under the terms of the Contract and in such manner that the Client and Contractor are covered for the period stipulated in hereof, and are also covered during the Defects Liability Period.
- (g) Such insurance shall be effected with an insurer and in terms approved by the Client which approval shall not be unreasonably withheld, and the Contractor shall, whenever required produce to the Client or its representative the policy or policies of insurance and the receipts for payment of the current premiums.
- (h) The Contractor shall take out a Contractor's all risk insurance policy for the full amount of the Contract Price valid till the expiry of the Defects Liability Period, within 10 (ten) days of the date of issuance of the Letter of Award jointly in the name of the Client and the Contractor and the original policy shall be deposited with the Client.
- (i) The Contractor shall similarly indemnify the Client against all claims, which may be made upon the Client, whether under the Workman's Compensation Act, 1923 or any Applicable Law in force during the currency of the Contract or at common law in respect of any employee of the Contractor or any Sub-Contractor and shall at its own expense effect and maintain up to the Defect Liability Period, with an approved office, a policy of insurance in the joint names of the Client and the Contractor against such risks and deposit such policy or policies with the Client from time to time during the currency of the Contract.

## 20.2. **Third Party Insurance**

- (a) Before commencing the Works, the Contractor shall insure against loss for any material or physical damage, loss or injury which may occur to any property, including that of the Client, or to any person, including any employee of the Client, the Project Manager, other contractors/ Sub-Contractor(s) or their respective employees, agents, representatives and visitors, by or arising out of the completion of the Works or in the carrying out of the Contract.
- (b) The Contractor shall, whenever required, produce to the Client or its representative the policy or policies of insurance and the receipts for payment of the current premiums.
- (c) The term of such insurance shall be up to the end/ expiry of the Defect Liability Period and shall include for any damage to the properties and/ or injury including death to the persons of the general/ public/ architects and anyone else deemed to be third party.



**20.3. Provisions to indemnify Client**

The terms of such insurance shall include a provision whereby, in the event of any claim in respect of which the Contractor would be entitled to receive and indemnify under the policy being bought or made against the Client, the insurer will indemnify the Client against such claims and any cost, charges and expenses in respect thereof and the Contractor to indemnify the Client for any shortfall in the realization of the claims. The Client shall be entitled to set off any such amounts from the amounts due and payable by it to the Contractor under the terms of the Contract.

**20.4. Accident or Injury to workmen**

The Contractor shall be responsible and liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workman or other person in the employment of the Contractor or any Sub-Contractor. The Client shall not be liable for or in respect of any damages or compensation payable by law in respect or in consequence of any accident or injury to any workman or other person in the employment of the Contractor or any person working under/with the Contractor. The Contractor shall fully indemnify and keep indemnified the Client against all such damages and compensation, against all claims, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

**20.5. Insurance against accident, etc., to workmen**

- (a) The Contractor shall insure against such liability with an insurer approved by the Client, which approval shall not be unreasonably withheld, and shall continue such insurance during the whole of the time that any persons are employed by it on the Works and shall, when required, produce to the Client or its representative such policy of insurance and the receipt for payment of the current premium. Provided always that, in respect of any persons employed by any Sub-Contractor, the Contractor's obligation to insure as aforesaid under this sub-Clause shall be satisfied if the Sub-Contractor shall have issued against the liability in respect of such persons in such manner that the Client is indemnified under the policy, but the Contractor shall require such Sub-Contractor to produce to the Client or its representative, when required, such policy of insurance and the receipt for the payment of the current premium.
- (b) Notwithstanding the requirements mentioned in the above, the Contractor shall at the minimum provide for Contractor's all risk insurance policy to cover the following:
  - (i) entire Contract Price for the period of completion including Defect Liability Period;
  - (ii) third party insurance to cover for any damages to third party. This shall be up to the end of the Defect Liability Period and shall include for any damage to the properties and/ or injury including death to the persons of the general/ public/ architects and anyone else deemed to be third party;
  - (iii) policy to cover Contractor's liability under Employee's Compensation Act 1923, Minimum Wages Act 1948, Contract Labour (Regulation and Abolition) Act 1970 and other Applicable Laws. This shall be for the period up to issue of the Final Acceptance Certificate, including the Defect Liability Period;
  - (iv) insurance cover against damage, theft or any other loss of all Materials and Contractor's Equipment brought to the Site; and
  - (v) the Contractor shall insure against all such liabilities and shall continue such insurance during the term of the Contract including Defect Liability Period. Premium for all insurance policies shall be paid and borne by the Contractor and shall not be reimbursable.
- (c) These insurance certificates shall be executed and shall state that the policies cannot be surrendered for 10 (ten) days after written notice of the Client having consented to such surrender.

- (d) The Contractor shall obtain written confirmation of similar certificates from all Sub-Contractors and thereby assume responsibility for any claims or losses to the Client resulting from failure of any of the Sub-Contractors to obtain adequate insurance protection in connection with the Works.
- (e) If the Contractor fails to effect and keep in force the insurances referred to in Clause 20, or any other insurance which it may be required to effect under the terms of the Contract, then and in any such case the Client may effect and keep in force any such insurance and pay such premiums as may be necessary for that purpose and from time to time deduct the amount so paid by the Client as aforesaid from any monies due or which may become due to the Contractor, or recover the same as a debt due from the Contractor.

**20.6. Insurance for Contractor's Equipment**

- (a) The Contractor shall insure the Contractor's Equipment against all loss or damage. This insurance shall cover loss or damage from any cause in so far as such insurance is readily obtainable. Such insurance shall be for a limit of not less than the full replacement value (including delivery to the Site). Such insurance shall be in such a manner that each item of Contractor's Equipment is insured while it is being transported to and from the Site or the right of way and throughout the period it is on or near the Site or the right of way.
- (b) The Client shall have no liability for the loss/ damage to the Contractor's Equipment unless such loss or damage are due to reasons attributable to the Client.
- (c) Client shall deduct from any amount due to the Contractor under the Contract entire insurance premium and other costs that the Client shall have paid to the insurer or incurred or may otherwise recover such amount as a debt due from the Contractor.

**20.7. Insurance for Contractor's Personnel**

The Contractor shall effect and maintain insurance against liability for claims, Contractor's Personnel damages, losses and expenses (including legal fees and expenses) arising from the death, injury, sickness or disease to any person employed by the Contractor or any Sub-Contractor of all types. The Client and the Client's representatives shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Client or of the Client's representative's personnel. For a Sub-Contractor's employees, such insurance may be effected by the Sub-Contractor, but the Contractor shall be responsible for compliance with this Clause.

**20.8. General Requirements for Insurance**

- (a) The Contractor shall comply with the conditions stipulated in each of the insurance policies. The Contractor shall not make any adverse material alteration to the terms of any insurance without the prior approval of the Client.
- (b) If the Contractor fails to effect and keep in force any of the insurance required wherever applicable under the Contract, or fails to provide satisfactory evidence policies and receipts in accordance with this sub-Clause, the Client may, without prejudice to any other right or remedy, effect insurance for the coverage relevant to such default, and pay the premiums due. Such payments shall be recoverable from the Party whose obligation it was to effect the insurance.
- (c) Nothing in this Clause limits the obligations, liabilities or responsibilities of the Contractor, under the other terms of the Contract or otherwise. Any amounts not insured or not recovered from the insurers shall be borne by the Contractor in accordance with the Contract.

## **21. DEFECT LIABILITY PERIOD**

21.1. **General** During the Defect Liability Period, the Contractor shall remain liable for any technical or other defects in the Works.

- (a) The Defect Liability Period shall be [12 (twelve months)] from the issuance of the Take Over Certificate ("**Defect Liability Period**"). If the Contractor re-performs any of the Works or otherwise makes good the Works (as the Client shall, at its discretion, determine) a defect in terms of this Clause 21.2, then the Defect Liability Period with respect to any such re-performed Works, or Works which have been otherwise made good, shall be a period of [12 (twelve) months] from the date of re-performance of such Works, or the date when such Works, have otherwise been made good, as the case may be. Provided that, the Defect Liability Period pursuant to this Clause 21.2 shall be subject to a maximum period of [30 (thirty) months] from the issuance of the Take Over Certificate. Provided further that, if the Contract is terminated prior to the issuance of the Take Over Certificate, then, the provisions of this Clause 21.2 with respect to the Defect Liability Period for repair, replacement, or otherwise making good shall apply *mutatis mutandis*, and in such an event the Defect Liability Period shall be [12 (twelve) months] from the date of termination.
- (b) If during the Defect Liability Period, any defect is found in the design, construction, or engineering being part of the Works, of the New admin. & Engg. Block, the Contractor shall promptly and in any event no later than [3 (three) days] from the receipt of the notice from the Client in terms of Clause 21.2, commence the correction of any errors, omissions, defects or deficiencies in the Works, re-perform any part of the Works, or repair, replace or otherwise make good (as the Client shall, at its discretion, determine) such defect, in addition to any damage to the New admin. & Engg. Block caused by such deficiency in Works, at the sole risk and expense of the Contractor. Provided that, the Contractor shall not be responsible for the repair, replacement or making good of any defect or of any damage to the New admin. & Engg. Block arising out of or resulting from normal wear and tear.
- (c) The Contractor shall perform all remedial action and re-perform any part of the Works required in such a manner and at such time, and shall co-ordinate its activities in connection therewith as notified by the Client in this regard.
- (d) The Contractor shall in re-performing the Works or undertaking any repair/ replacement under this Clause 21, which could affect the safe and effective use of the New admin. & Engg. Block or any part thereof, observe all requirement of the Client and the Project Manager with regard to safe and effective use or operation thereof.
- (e) During the Defect Liability Period, any re-design, repair or replacement of any part of the New admin. & Engg. Block requiring the New admin. & Engg. Block to be shut-down, shall be undertaken in co-ordination with Client so as to minimize disruption of the ongoing operations of the New admin. & Engg. Block. Such re-design, repair or replacement may, at Client's option, require Works to be carried out at the Site by the Contractor's personnel, beyond the normal working hours, including weekends and public holidays. All costs required for the performance of such re-design, repair or replacement shall be to the account of the Contractor.
- (f) During the performance of the re-design, repair or replacement of any part of the New admin. & Engg. Block as provided in Clause 21.6, the Contractor shall procure that the Contractor's personnel act in compliance with Applicable Law, the Site regulations, work rules, workmen's compensation requirements as well as safety procedures.

### **21.2. Notice of Defect**

The Client shall provide the Contractor a notice stating the nature of any defect in the New admin. & Engg. Block and/or Works, together with all available evidence, promptly following the discovery of such defect. The Client shall afford all reasonable opportunity to the Contractor to inspect any such defect. The Contractor shall, within 3 (three) days of the notice from the Client in this regard, submit to the Client details of the proposed re-

performance of the Works and/or the repairs or replacements, which it proposes to make, the estimated duration of the repairs or the duration required to effect the replacement Works, details or parts of the New admin. & Engg. Block considered necessary to shut down and the proposed dates for such re-performance, repairs or replacements. All Works and repairs and replacements shall be carried out at a time and for periods agreed with the Client pursuant to Clause 21.

### 21.3. Access

With regard to repairs or re-performance of Works needed, the Client shall afford the Contractor, subject to its reasonable security restrictions, the necessary access to the New admin. & Engg. Block and the Site to enable the Contractor to perform its obligations under this Clause 21.

### 21.4. Tests

- (a) The Contractor shall carry out the tests, in relation to the repaired part of the New admin. & Engg. Block and shall endeavor not to disrupt the New admin. & Engg. Block as a whole, to demonstrate that such defect has been removed and that the repaired part of the New admin. & Engg. Block is functioning in the manner in which it is required to function under the Contract. Such tests shall be conducted, solely at its cost and expenses and the Contractor shall provide all materials, manpower, tools and tackles etc., which are required for carrying out the said tests.
- (b) In addition to the tests conducted under Clause 21.10(a), if the repair or making good is of such a nature that it may affect the efficiency of the New admin. & Engg. Block or any part thereof, the Client shall provide the Contractor a notice of [28 (twenty eight) days] requiring additional tests to be conducted on the defective part of the New admin. & Engg. Block and the Contractor shall promptly, at its own risk and cost, carry out any such additional tests.
- (c) If any part of the New admin. & Engg. Block fails the tests as set forth in Clause 21.10.(a), the Contractor shall carry out further repair, replacement or making good, as the case may be, until that part of the New admin. & Engg. Block passes such tests. The tests, in character, in no event shall be inferior to what has been agreed upon by the Client and the Contractor.

### 21.5. Failure to Remedy Defects

- (a) If the Contractor fails to commence repair of the defect or any damage to the New admin. & Engg. Block caused by such defect, within the time frame stipulated in Clause 21.3, following the notice from the Client in this regard, the Client may, by notice to the Contractor, proceed to repair such defect.
- (b) In addition to the Client's rights pursuant to Clause 21, if, in the reasonable opinion of the Client, a defect in the New admin. & Engg. Block or part thereof, is expected to cause serious loss or damage which can be prevented by immediate action, such defect may be corrected by the Client or a third party designated by the Client. Upon intimation by the Client in this regard, the Contractor shall assist wherever possible in undertaking any necessary corrections. Notwithstanding anything to the contrary stated in the Contract, any action undertaken by the Client pursuant to this Clause 21.11.(b), shall not in any way relieve the Contractor of its responsibilities under the Contract and the warranties set forth in Clause 18 and Clause 19 (Warranties) shall not be reduced or affected on account of the Client undertaking such action.
- (c) All costs incurred by the Client in terms of this Clause 21.11.(a), shall be paid to the Client by the Contractor and/or may be deducted by the Client from any monies due to the Contractor and/or claimed by invoking the Performance Bank Guarantee. For the avoidance of doubt, it is clarified that any action undertaken by the Client in terms of this Clause 21.11 shall not extinguish the Contractor's liabilities arising pursuant to the terms and conditions of the Contract.
- (d) If the Contractor fails to remedy the defect or damage under Clause 21.11, the Client shall have the right to:

- (i) terminate the Contract pursuant to Clause 34 as a whole or in respect to such major part which cannot be put to the intended use and without prejudice to any other rights, under the Contract or otherwise, the Client shall then be entitled to recover all sums paid for the Works or for such part (as the case may be), the cost of dismantling the same and clearing the Site; or
- (ii) accept the deficient New admin. & Engg. Block and proportionately reduce the Contract Price to reflect the diminished value to the Client and such reduction shall be determined by the Client at its discretion.

#### 21.6. Latent Defect

- (a) If, any defect appearing in any part of the Works, is of a kind that would not have been apparent to the eye prior to the expiry of the Defect Liability Period (a "**Latent Defect**") and arises within a period of [5 (five) years] from the Completion Date, the same shall be made good by the Contractor by repair or replacement. The Client shall, upon discovery of Latent Defect, notify the Contractor. The Contractor shall commence repair on such Latent Defect no later than [3 (three) days], or such other mutually agreed time period, from the receipt of a notice from the Client in this regard.
- (b) The Contractor shall have the right to investigate the cause of any problem or abnormality in the New admin. & Engg. Block, which the Client reasonably believes is due to a Latent Defect.
- (c) If the Contractor fails to commence repair of any Latent Defect within the time specified in Clause 21.12(a), following receipt of a notice from the Client, the Client may cause such repairs to be affected at the Contractor's expense.

#### 21.7. Serial Defect

- (a) If, during the Defect Liability Period, more than [15% (fifteen percent)] of the Works contains the same defect ("**Serial Defect**"), then a Serial Defect shall be deemed to exist in all such parts of the Works.
- (b) If a Serial Defect exists, then it shall be deemed to be a defect for the purposes of this Clause 21.13 and all provisions with regard to the rectification of defects as set out in this Clause 21.13 shall apply *mutatis mutandis* to the rectification of the Serial Defect.
- (c) Without prejudice and in addition to Clause 21.13(b), if a Serial Defect exists, the Contractor shall:
  - (i) promptly perform a thorough investigation to ascertain the cause of the Serial Defect and provide a report to the Client detailing the cause and effect of the Serial Defect;
  - (ii) subject to Clause 21.6, remedy all Works which are deemed to be effected by the Serial Defect including carrying out any necessary alterations, additions, modifications, design modifications, repairs or replacements regardless of whether a defect has made itself apparent in such parts of the Works at the time that the threshold stated under Clause 21.13(a) is exceeded.

#### 21.8. Costs, Taxes and Duties

The Contractor shall be responsible for payment of all costs, taxes (including all indirect taxes except excise duty, entry tax and octroi and duties incurred in the course of performance of its obligations under this Clause 21.

### 22. VARIATIONS AND CHANGE IN CONTRACT ELEMENTS

#### 22.1. Introducing a Change

The Client shall have the right to propose and subsequently require the Contractor, from time to time, till the issuance of the Take Over Certificate, to make a Change in accordance with the procedure set out in Clause 22.3

("Change"). The Contractor shall execute and be bound by a Change proposed by the Client, unless the Contractor promptly provides a notice to the Client (along with supporting documents) that, the Change:

- (a) will have an adverse impact on the achievement of the Performance Parameters; or
- (b) comprises the omission of any Works which are to be carried out by a third party.

## 22.2. **No Change for Default**

No variation made on account of any default of the Contractor in the performance of its obligations under the Contract shall be deemed to be a Change, and such variation shall not result in any adjustment of the Contract Price or the postponement of the Completion Date.

## 22.3. **Changes Originating from Client**

- (a) If the Client proposes a Change pursuant to Clause 22.1, it shall send to the Contractor, a notice ("**Request for Change Proposal**") requiring the Contractor to prepare and provide to the Project Manager within [15 (fifteen) days] of the Request for Change Proposal, a proposal ("**Change Proposal**") which shall include the following:
  - (i) brief description of the Change, including a description of the proposed corrective activities and/or Works to be executed or modified, and a programme for its execution, together with supporting calculations containing a break down for the actual cost of supplies for any items required/Works to be executed to give effect to the Change;
  - (ii) effect on the Completion Date and the necessary modifications;
  - (iii) the effects of implementation of the Change, taking into account the omission of execution of a portion of the Works, if any;
  - (iv) the cumulative impact of effects resulting from the stated Change on all prior Works and any changes in the Works to be executed as scheduled; and
  - (v) estimated cost of the Change;
  - (vi) effect of the Change on the safety of the New admin. & Engg. Block, if any; and
  - (vii) effect on any other provisions of the Contract.
- (b) In addition to the information specified in this Clause 22.3(b), the Change Proposal shall include such other information as the Client may reasonably request in connection with each Change, and shall include copies of all price quotations and other documents as may enable the Client to verify the Contractor's proposed costs or savings in respect of the Change. For the avoidance of doubt, it is clarified that Contractor shall bear all costs and expenses in relation to the Change Proposal, whether or not such proposal is ultimately implemented.
- (c) The pricing of a Change shall, as far as practicable, be calculated in accordance with the rates and prices included in the Contract as set out in Bidding Documents. If the rates and prices of any Change are not available in the Contract, the Parties shall agree on specific rates for the valuation of the Change. If the Contractor is instructed to proceed with a Change, prior to the determination of its value, the Contractor shall keep contemporary records of all labour hours, cost of Materials and Contractor's Equipment and any other cost related to undertaking the Change. Such records shall be provided to the Client upon request.
- (d) If before or during the preparation of the Change Proposal, it becomes apparent that the aggregate effect of compliance with the Change and with previously issued Change Orders, would have the effect

of increasing or decreasing the Contract Price as originally set forth by more than [15% (fifteen percent)], the Contractor shall provide a notice of objection prior to providing the Change Proposal. If the Client accepts the Contractor's objection, the Client and the Contractor shall agree on specific rates for the valuation of the Change and the Contractor shall submit the Change Proposal accordingly. If the Client does not accept the Contractor's objection, then the Client may cancel or vary the Request for Change Proposal, in which case, the Contractor shall submit the Change Proposal in accordance with the Client's revised Request for Change Proposal. However, in case of any Dispute in this regard, the matter may be resolved in terms of Clause 35 (Dispute Resolution).

- (e) Upon receipt of the Change Proposal, the Client and the Contractor shall mutually agree upon all matters in the Change Proposal, including agreement on rates if such rates are not available in the Contract or if the limit of [15% (fifteen percent)] has been exceeded. Within 15 (fifteen) days of such agreement, the Client shall, if it intends to proceed with the Change, issue to the Contractor an order ("**Change Order**") whereby:
  - (i) the Client shall grant an extension of time, if necessary;
  - (ii) the agreed adjustments, if any, shall be made to the Contract Price and the Completion Date; and
  - (iii) such other changes may be ordered as may be required to give effect to the Change.
- (f) The Client shall only instruct a Change under this Clause 22.3(f), upon mutual agreement with the Contractor on the quotation and the terms and conditions of the implementation of the Change.
- (g) If the Client is unable to reach a decision within 15 (fifteen) days of the receipt of the Change Proposal, it shall notify the Contractor with details of the expected time by when the Contractor can expect a decision. For the avoidance of doubt, it is clarified that the Contractor shall continue to perform its obligations under the Contract, whilst awaiting a response from the Client in relation to the Change Proposal.
- (h) If the Client decides not to proceed with the Change, for any reason whatsoever, it shall, within 30 (thirty) days from the receipt of the Change Proposal, or such later date indicated to the Contractor, notify the Contractor accordingly.
- (i) If the Client and the Contractor cannot reach an agreement on:
  - (i) the price for the Change;
  - (ii) an equitable adjustment to the Completion Date; or
  - (iii) any other matters identified in the Change Proposal,then, the Client has the right to instruct the Contractor to proceed with the Change by issuing an instruction in this regard ("**Pending Agreement Change Order**").
- (j) Upon receipt of a Pending Agreement Change Order, the Contractor shall immediately proceed with effecting the Change under the Pending Agreement Change Order. The Parties shall thereafter attempt to reach an agreement on the outstanding issues under the Change Proposal. If the Parties cannot reach an agreement within 60 (sixty) days from the date of issuance of the Pending Agreement Change Order, then the matter may be resolved in terms of Clause 35 (Dispute Resolution).

#### 22.4. **Changes Originating from Contractor**

- (a) The Contractor shall have a right to propose a Change only, when in the Contractor's opinion, if adopted, such change would:



- (i) accelerate Completion;
- (ii) reduce the cost to the Client of constructing and developing the New admin. & Engg. Block;
- (iii) improve the efficiency or value to the Client of the completed Works;
- (iv) improve the quality, efficiency or safety of the New admin. & Engg. Block or any part thereof;  
or
- (v) otherwise be of benefit to the Client,

in each instance, by submitting to the Client a written application in this regard, at its own cost and expense, giving reasons for the proposed Change and including the information stated in Clause 22.4 ("**Application for Change Proposal**").

- (b) Without prejudice to the above, the Contractor shall, during the term of the Contract, have a continuing obligation to suggest to the Client for its consideration, Changes known to the Contractor, as may be necessary to incorporate significant new developments in technology which are applicable or appropriate for the New admin. & Engg. Block or any part thereof. If the Contractor proposes such a Change, it shall submit to the Client an Application for Change Proposal, *inter-alia*, identifying the benefits of such Change.
- (c) Upon receipt of the Application for Change Proposal under this Clause 22.4., the provisions of Clauses 22.3(c) to 22.3(j) shall apply *mutatis mutandis*.

#### 22.5. Improvements

The Client or the Contractor may propose changes in the Technical Specifications in respect of the New admin. & Engg. Block or quality thereof, which enhances the performance of the New admin. & Engg. Block. If the Parties agree upon any such changes, the same shall be given effect to in accordance with the procedure specified in this Clause 22.

#### 22.6. Exclusions

- (a) Notwithstanding anything to the contrary, no Change Order shall be granted if:
  - (i) the Contractor seeks any Change or variation in its obligations which is due to any fault in the Documents supplied by it or due to any misrepresentation relating to any warranties provided by the Contractor;
  - (ii) the Change is necessary in order for the Contractor to satisfy its responsibility to complete the Works and ensure that the New admin. & Engg. Block is capable of performing as contemplated under the Contract and as specified in the Technical Specifications; or
  - (iii) the Change relates to the re-performance of any of the Works due to the Contractor's failure to comply with the Technical Specifications.
- (b) Notwithstanding any other provision of the Contract, none of the following shall:
  - (i) be considered under any circumstances as a Change;
  - (ii) be taken into account when calculating the effect upon the Contract Price; or
  - (iii) by itself, be considered the basis for any adjustment of the Contract Price:
    - (A) any escalation in the cost of materials or labour; or



- (B) any normal design improvements effected by the Contractor.

## **23. CONTRACT PRICE AND INVOICING**

### **23.1. Payment of Contract Price**

- (a) The Contract Price is exclusive of service tax and works contract tax and the applicable taxes and duties shall be payable in accordance with the provisions of Clause 21.14 (Taxes and Duties).

### **23.2. Mobilization Advance**

- (a) 10% of Contract Value against an irrevocable bank guarantee as prescribed in the tender form for equivalent value and recoverable 12.5% basis from 2nd RA bills however 100% mobilization will be recovered once the value of work done reached of 80% of contract value.

### **23.3. Escalation/Contract Price Variation**

Subject to the provisions of Clause 22 (Variation and Change in Contract Elements) and Contract Price, the Contract Price shall be firm till the completion of the obligations of the Contractor under the Contract and there shall be no escalation whatsoever of the Contract Price.

### **23.4. Full and Complete Payment**

- a) The Contract Price shall be the full and complete payment for satisfactory discharge of the Contractor's performance of its obligations under the Contract and all things necessary for the proper execution and completion of the Works and the remedying of any defects and except as otherwise provided, includes all costs necessary for the completion of the Works and compliance with the terms and provisions of the Contract.
- b) For the avoidance of doubt, it is clarified that the Contract Price includes all Direct Taxes, direct, indirect and ancillary charges, cess, costs and expenses of whatsoever nature, including for the Contractor's Equipment & Materials, license, royalty and fees, accessories, Intellectual Property licenses and Documents to be provided under the Contract. The applicable indirect taxes shall be paid in accordance with Taxation.

## **24. TERMS OF PAYMENT**

### **24.1. General**

The Contract Price shall be paid in accordance with this Clause 24.

### **24.2. Effect of Payment**

No payment of the Contract Price made by the Client, shall be deemed to constitute acceptance by the Client of the Works or any part(s) thereof and shall not relieve the Contractor of any of its obligations under the Contract.

### **24.3. Currency of Contract Price**

All payments of the Contract Price shall be made by the Client to the Contractor in INR (Indian Rupees).

### **24.4. Terms and Procedure of Payments of the Contract Price**

- (a) The Contractor shall submit an invoice to the Client [in triplicate] by the 1<sup>st</sup> week of each month providing details of the achievement, in the immediately preceding month. The Invoices shall be accompanied with relevant supporting documents (including work completion reports to be submitted by the Contractor) and any relevant documents required by the Client in this regard. The Contractor shall submit to the Client, for its approval, a copy of each Invoice to be submitted by the Contractor pursuant to this Clause 24. The approval of the Client shall be made within 30 (Thirty) Days, (10 days to the PMC + 20 days to the Client) from the submission of such Invoice in a manner satisfactory to the Client. The proforma of the Invoice and the documents and details to accompany it shall be mutually discussed and agreed to by the Parties, provided that, the Contractor shall at all times ensure that Invoices are raised in accordance with the relevant provisions of Applicable Law, so as to enable the Client to avail credit of the taxes indicated in the said Invoice.

For the avoidance of doubt, it is clarified that if an Invoice is not accompanied by the supporting documents, then such amounts of the Invoice shall not be due and payable by the Client, until the supporting documents have been provided by the Contractor. Further, the withholding of any amounts by the Client pursuant to this Clause 24, shall not constitute an event of default for non-payment, on the part of the Client.

- (b) If an amount under an Invoice is disputed for any reason by the Client in terms of Clause 24, or if the Invoice is not raised in accordance with the relevant provisions of Applicable Law, then such amounts of the Invoice shall not be due and payable by the Client and the Client shall be entitled to withhold payment of the amounts under such Invoice, which shall only be released upon the resolution of the Dispute in terms of Clause 35, or upon receipt of a revised Invoice raised in accordance with the relevant provisions of Applicable Law, from the Contractor, as the case may be. Further, the withholding of any amounts by the Client pursuant to this Clause 24 shall not constitute an event of default for non-payment, on the part of the Client. The Contractor shall provide details concerning the description of the Works executed and any further substantiation as Client may reasonably require, including any other information or documentation relating to the performance of the obligations of the Contractor under the Contract, that the Client might reasonably need to present, from time to time, to a Government Instrumentality.
- (c) The Client shall, subject to Clause 24.4.(b), make payments of undisputed amounts under an Invoice, within 30 (Thirty Days) days following the approval by the Client of the Invoice pursuant to Clause 24. The Client shall pay amounts under each Invoice directly to such bank account(s) of the Contractor, as may be instructed by the Contractor to the Client.
- (d) 5% (five percent) retention of the value of Works certified by the Project Manager, shall be made in every Invoice by the Client.
- (e) It is expressly clarified that the value of the Retention Money shall not exceed 5% (five percent) of the Contract Price in aggregate and shall be retained by the Client till the expiry of the Defect Liability Period.
- (f) The Retention Money shall be released by the Client, subject to the following conditions being satisfied:
- (i) the Contractor has achieved Final Completion;
  - (ii) the New admin. & Engg. Block has been handed over to the Client in terms of Clause 11.4;
  - (iii) the Contractor has executed all the Works to the sole satisfaction of the Client;
  - (iv) the Defect Liability Period has expired, and the Contractor has rectified all defects in terms of Clause 21;
  - (v) the Contractor has paid all liquidated damages, indemnity sums and other payments due from the Contractor under this Agreement.

- (vi) the Contractor has assigned to the Client or provided Client with all warranties or guarantees that Contractor has received from Sub-Contractors to the extent Contractor is obligated to do so pursuant to this Agreement.
- (vii) all Contractor's Materials and other supplies, equipment, surplus, waste, huts, wreckage, debris, rubbish, and temporary facilities to which Client does not, and is not entitled to hold title, have been removed from the Site, and the Site have been restored in accordance with the terms of this Agreement provided that, all activities in relation to clearing and disposal shall be conducted in accordance with all Applicable Laws;
- (viii) all the Contractor's Personnel and the personnel of the Sub-Contractors and their personnel, have been removed from the Site;
- (ix) all Sub-Contractors have been paid their dues by the Contractor and Contractor has delivered the final release and waiver of Liens and claims pursuant to this Agreement and has delivered such other documents and certificates as Client has reasonably requested to ensure compliance with all Applicable Laws; and
- (x) all activities required as per Applicable Law on account of the completion of the Works have been completed by the Contractor.

Provided that the Retention Money may be released upon submission an unconditional and irrevocable bank guarantee from a reputable bank acceptable to the Client for an amount equivalent to the Retention Money. The Retention Money Bank Guarantee shall be valid up to the expiry of the Defect Liability Period and shall have a claim period of 3 (three) months from the date of its expiry. If requested by the Client, the Contractor undertakes to extend the validity period of the Retention Money Bank Guarantee.

- (g) The Client shall withhold from payments to be made to the Contractor and pay to the Governmental Authority, any and all taxes required to be withheld pursuant to Applicable Law. The Client shall provide to the Contractor the tax deduction certificates, for such withheld amounts.
- (h) All Invoices shall be endorsed with the contract number and title.
- (i) Payments made by the Client against any Invoice shall not preclude the right of the Client to thereafter dispute any items invoiced and paid for.
- (j) Except as provided in Clause 24, if any other amounts are due and payable from one Party to the other, including payments pursuant to Clause 10 (Liquidated Damages) and Clause 28 (Indemnity), then the Party to whom such amounts are owed shall provide to the other Party an invoice accompanied by/along with the calculations and with the relevant documentary proof showing the basis for the calculations substantiating the claimed payments. The Party liable to make payment under a Miscellaneous Invoice shall make payment against the same within 30 (thirty) days from the date of receipt of such Miscellaneous Invoice.
- (k) Notwithstanding the provisions of this Clause 24, the Parties shall have the right to dispute, in good faith, any invoiced item. Where any amount, under an Invoice or a Miscellaneous Invoice, as the case may be, is disputed by a Party, then such Party shall, within 21 (twenty one) days of receipt of the Invoice or Miscellaneous Invoice, as the case may be, notify the other Party of such Dispute and the Parties shall seek to resolve the Dispute by mutual consultation. If the Parties fail to resolve the Dispute by mutual consultation within 15 (fifteen) days of the date of such notice then the disputing Party shall withhold payment of such disputed amount till the resolution of such Dispute pursuant to Clause 35 (Dispute Resolution). Provided that, the disputing Party shall duly make payment of the undisputed amount in accordance with this Clause 24 (Terms of Payment).
- (l) The Client shall withhold sums equivalent to taxes at applicable rates on the amount payable to the Contractor by way of consideration under the Contract in accordance with the provisions of the Income

Tax Act, 1961, as amended or modified and applicable. The Client shall not make such withholdings in the event that the Contractor produces a certificate from the appropriate authority constituted under the Indian Income Tax laws to the effect that no withholding taxes would be required on the payments received by the Contractor from the Client.

- (m) The Contractor shall adhere to the directions of the Client, Project Manager and/or the Architect, as the case may be in terms of the provisions laid down in the Contract.

#### 24.5. Client's Claims

- (a) If the Client considers itself to be entitled to any payment under any Clause of the Contract or otherwise in connection with the Contract, and/or to any extension of the Defect Liability Period in accordance with Clause 21, it shall, as soon as practicable after becoming aware of its claim or circumstances giving rise to such claim, provide the Contractor with notice and particulars of such claim. A notice relating to any extension of the Defect Liability Period shall be given before the expiry of such period.
- (b) The notice for claim shall specify the provisions of the Contract which the Client relies upon or other basis of the claim, and shall include substantiation of the amount and/or extension to which the Client considers itself to be entitled in connection with the Contract. The Client shall then proceed to agree or determine (i) the amount (if any) which the Client is entitled to be paid by the Contractor, and/or (ii) the extension (if any) of the Defect Liability Period in accordance with Clause 21.
- (c) The Client may deduct the amount due to it pursuant to such a claim from the Contractor, from any monies due, or that become due, to the Contractor or may issue a Miscellaneous Invoice with regard to such amounts.

#### 25. SITE OFFICES, SECURITY AND FACILITIES

- 25.1. The Contractor shall supply and erect a well-lit, temporary Site office for use by it at its own cost, if required. The layout of the Site office, Drawing shall be as approved by the Client in consultation with the Project Manager. The Site office shall contain wash rooms, seating arrangement with furniture and good ventilation.
- 25.2. A fully furnished Site office to be provided to the Client and the Project Manager for total 10 (TEN) members crew for a period of 90 days beyond actual project completion date. The Site office to contain workstations, meeting/conference room, manager cabin, air conditioning, grid ceiling, chairs, flooring, washrooms, maintenance of wash rooms/office, tea and drinking water facility, projector, projector screen, walky talky, fridge, dining area, safety PPE (safety helmet, google, shoes (with steel toes), reflective vest, public address system, for the Client and Project Manager and their visitors.
- 25.3. No photos/CCTV shall be installed by the Contractor without prior written permission from the Client.
- 25.4. The Contractor shall deploy Site security team for material storage as well as for manpower movement at Site till the Take Over Certificate is issued by the Client. The Contractor security team should work closely with the Client and the Project Manager for maintaining the Site logistics.

#### 26. SAFETY REQUIREMENTS

- 26.1. The Contractor shall comply with the safety precautions, protective measures, housekeeping requirements, etc. as set out in **Section 10**. The Client shall have the right to stop the work at Site, if in its opinion, proceeding with the Works will lead to an unsafe and dangerous condition. The Contractor shall get the unsafe condition removed or provide protective equipment. The Contractor shall ensure that all workmen are aware about the nature of risk involved in their work and have adequate knowledge for carrying out their work safely.

- 26.2. The instructions issued by the Client and/or the Project Manager pursuant to the Contract are indicative and not exhaustive. Therefore, the Contractor shall be responsible to ensure that adequate safety measures are adopted in the course of execution of the Works in accordance with the Contract in accordance with safety standards / statutory regulations, as applicable.
- 26.3. In case of any non-compliance by the Contractor of any of the provisions of this Clause 26 above would, without prejudice to any other remedy that the Client may be entitled to under Applicable Law or in the Contract or otherwise, the Client shall be entitled to impose an amount as compensation in its sole discretion.

## **27. LIMITATION OF LIABILITY**

- 27.1. The total liability of the Contractor to the Client under or in connection with the Contract, shall not exceed the Contract Price, provided that, this limitation shall not apply to any obligation of the Contractor to:
- (a) pay liquidated damages to the Client in accordance with Clause 10;
  - (b) indemnify the Client in accordance with the provisions of the Contract;
  - (c) pay the indemnity amount that may be payable under Clause 28.2; or
  - (d) pay for losses caused due to the Contractor's gross negligence, fraud or willful misconduct.

### **27.2. No Consequential Loss**

Notwithstanding anything to the contrary, except in cases of payment to be made pursuant to Clause 27.1., neither the Contractor nor the Client shall be liable to the other, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that, this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Client.

## **28. INDEMNITY**

- 28.1. **General:** The Contractor shall protect, defend, indemnify and hold the Client, and their directors, key managerial personnel, employees, agents and representatives harmless from and against:
- (a) any and all losses, damages, costs, expenses (collectively "**Losses**") incurred by reason of the acts or omissions of the Contractor, its officers, directors, employees, in the performance of the Contract or execution of Works, including without limitation any and all Losses, arising directly or indirectly from or incurred by reason of any failure of the Contractor or any Sub-Contractor (i) to pay any taxes, duties, cesses etc. required to be paid by such person, (ii) to make any payments in respect of taxes, duties, cesses which are to be paid by such person in connection with the performance of its obligations relating to the Contract, (iii) any such Losses arising from injury to or death of third parties or damage to or loss of property of third parties;
  - (b) any and all Losses, incurred by reason of or arising from claims or sanctions or penalties imposed by any Governmental Authorities or others for any actual or asserted failure by the Contractor, Sub-Contractor(s) or any of their respective officers, directors, employees to comply with any Applicable Laws;
  - (c) any and all Losses, arising directly or indirectly from or incurred by reason of the Works being undertaken at the Site post Completion Date;
  - (d) any damage caused by the Contractor to the Site;
  - (e) all Contractor and/or Sub-Contractor employee claims, failure of Contractor or its Sub Contractors to comply with Applicable Law and Prudent Industry Practices and liability for any hazardous substances claims; and

- (f) any and all Losses, arising directly or indirectly as a result of any violation of any patents, design rights, trademark or copyright, confidentiality and other protected rights arising in connection with the Contractor's Equipment or in the course of the completion of the Works; and
- (g) any and all Losses, damages, costs, expenses, claims, demands, proceedings, or liability however arising against or incurred by the Client relating to the Project due to or arising from or contributed to by any act, omission or default on the part of the Contractor.

#### 28.2. **Zero Fatality Rate at Site**

- (a) The Contractor acknowledges that having a zero fatality rate at the Site is important for the Client and a material requirement of the Safety Requirement. If the Contractor does not take all safety precautions and/or fails to comply with the Safety requirement or the Applicable Laws for the safety at the Site while performing its obligations under the Contract, then without prejudice to the provisions of Clause 28.1 or any other obligation of the Contractor under the Contract, the Contractor shall pay to the Client:
  - (i) a sum of [INR 10,00,000 (Rupees ten lakh only)] in case of death of any workman/employee at the Site; and
  - (ii) a sum of [INR 2,50,000 (Rupees two lakh fifty thousand only)] in case of permanent disability of any workman/employee at the Site,

in each case occurring during the course of the Contract.

- (b) The Contractor shall pay such amounts to the Client, immediately upon a demand being made for the same, but in no event later than the time period prescribed in Clause 24.4.(g) for payment of a Miscellaneous Invoice. The Parties agree that such amounts received by the Client from the Contractor shall be paid by the Client to the family of such deceased workman/employee or such disabled workman/employee. The compensation mentioned in this Clause 28.2. is in addition to the compensation payable to the workman under the relevant provisions of the Employee's Compensation Act, 1923 and rules framed there under or any other Applicable Law.

#### 28.3. **Proceedings**

On receipt of any notice of any claim from any third Party, which would entitle any Party ("**Indemnified Party**") to claim indemnification from the other Party ("**Indemnifying Party**"), the Indemnified Party shall within a reasonable time provide a written notice of the same to the Indemnifying Party along with all the documents available with it in respect of the said claim specifying in detail the claim, the amount claimed by the third Party, the date on which the claim arose and the nature of the default to which such item is related (including a reference to the applicable provision of the Contract). The Indemnifying Party shall be entitled to but not obliged to participate in and control the defense of any such suit, action or proceeding at its own expense or direct the Indemnified Party to defend such claim, at the cost of the Indemnifying Party. If the Indemnifying Party elects to control the defense of any such suit, action or proceeding, the Indemnified Party shall render all necessary assistance including grant of access to premises and personnel and to relevant documents and records that it possesses or controls to the extent required by the relevant adjudicatory authorities or is necessary for the purposes of investigating the matter and enabling the Indemnifying Party to take the action referred to in this clause. The Indemnifying Party may also request the Indemnified Party, at the cost of the Indemnifying Party to dispute, resist, appeal, compromise, defend, remedy or mitigate the matter or enforce against the Third Party the Indemnifying Party's rights in relation to the matter and in connection with proceedings related to the matter or use reputable advisers and lawyers chosen by the Indemnifying Party. The Indemnified Party shall not settle any such suit, action or proceeding without the prior written consent of the Indemnifying Party.

#### 28.4. **Payment of Indemnities**

Where a Party is entitled to payment from the other Party pursuant to this Clause 28, such Party shall promptly notify the other Party of the same and issue a Miscellaneous Invoice. The other Party shall make payment of such Miscellaneous Invoice in accordance with Clause 24.4.(g).

## **29. CONFIDENTIAL INFORMATION**

- 29.1. Each Party shall treat as confidential, the other Party's information consisting of specifications, designs, plans, drawings, software, data, prototypes, or other business and/or technical information, methodologies, know-how, processes, quotations, which such party discloses to the other party ("**Information**").
- 29.2. Each Party agrees that for a confidentiality period beginning on the date of execution of the Contract and ending 2 (two) years from the termination of the Contract, the receiving Party shall use information only for the purpose of the Contract ("**Purpose**"), shall hold information in confidence using the same degree of care as it normally exercises to protect its own proprietary information, but not less than reasonable care, taking into account the nature of the information, and shall grant access to Information only to its employees who have a need to know, shall reproduce Information only to the extent essential to fulfilling the purpose, and shall prevent disclosure of information to third parties. The receiving Party may, however, disclose the Information to its consultants and contractors with a need to know; provided that by doing so, the receiving Party agrees to bind those consultants and contractors to terms at least as restrictive as those stated herein, advise them of their obligations, and indemnify the disclosing party for any breach of those obligations.
- 29.3. Upon the disclosing Party's request, the receiving Party shall either return to the disclosing Party all Information or shall certify to the disclosing Party that all media containing Information have been destroyed.
- 29.4. The foregoing restrictions on each Party's use or disclosure of Information shall not apply to information that the receiving Party can demonstrate:
- (a) was independently developed by or for the receiving Party without reference to the information, or was received without restrictions; or
  - (b) has become generally available to the public without breach of confidentiality obligations of the receiving Party; or
  - (c) was in the receiving Party's possession without restriction or was known by the receiving party without restriction at the time of disclosure; or
  - (d) is required to be disclosed pursuant to legal or administrative requirement for disclosure; provided that the receiving Party has given the disclosing Party prompt notice of such demand for disclosure and the receiving Party reasonably cooperates with the disclosing Party's efforts to secure an appropriate protective order.

## **30. INTELLECTUAL PROPERTY RIGHTS**

- 30.1. All designs, Drawings, specifications, data, Documents, reports, studies, manuals, programs, analyses and all other items produced by the Contractor or the Sub-Contractors or the suppliers in the performance of the Works (herein collectively referred to as the "**Work Product**"), shall become and remain the property of the Client, and the Contractor shall deliver the same (properly sorted and indexed) to the Client in accordance with the provisions of the Contract and in any event upon termination of the Contract. For the avoidance of doubt, the Parties acknowledge and agree that the Drawings and plans, and all ELECTRICAL AND ELV and construction plans and Drawings relating to the Project, are the Client's property.
- 30.2. The Contractor hereby irrevocably assigns to the Client any rights it may have or acquire in (and waives and will require each supplier, vendor and Sub-Contractor to waive all "moral rights" it may have with respect to) any and all such Work Product.
- 30.3. The Contractor shall save harmless and indemnify the Client from and against all claims and proceedings for or on account of infringement of any intellectual property rights including patent rights, designed trademark or



name or other protected rights in respect of any constructional plant, technology, design, machine work, or Material used for or in connection with the Works or any of them and from and against all claims, proceedings, damages, cost, charges and expenses whatsoever in respect thereof or in relation thereto. Except where otherwise specified, the Contractor shall pay all tonnage and other royalties, rent and other payments or compensation, if any, for any document/materials required for the Works.

#### 30.4. **Ownership of Documents**

All Documents and other documents prepared by the Contractor and used in the performance of the Works shall be the property (including all intellectual property rights vested in the documents prepared by the Contractor for the purposes of the development of the New admin. & Engg. Block) of the Client. The Contractor shall supply to the Client all such Documents and other documents, as well as any drawings, specifications, calculations, memoranda, data, notes and other materials at the earlier of Final Acceptance or termination of the Contract. The Client shall have the right to copy, use, transfer and communicate the documents for the purposes of completing, operating, maintaining, altering, adjusting, or repairing the New admin. & Engg. Block.

#### 30.5. **Use of Drawings by Contractor**

The Contractor shall be entitled to retain a reproducible set of all Drawings and Documents and other documents delivered to the Client by the Contractor in accordance with the Contract. Provided that the Contractor shall not at any given point of time use the information provided in such documents or such documents for any purpose other than the completion of the Works.

#### 30.6. **Royalties and License Fees**

The Contractor shall pay all required royalties and license fees with respect to proprietary rights, intellectual property licenses and agreements and shall procure (at its cost), as required, the appropriate proprietary rights, intellectual property licenses and agreements for materials, methods, processes and systems in accordance with the provisions of the Contract. The Contractor shall not incorporate any materials, methods, processes or systems that involve the use of any Confidential Information, intellectual property or proprietary rights that the Client does not have the right to use or that may result in claims or suits against the Client or the Contractor arising out of claims of infringement of any domestic or foreign patent rights, copyrights or other proprietary rights, or applications for any such rights, or use of Confidential Information.

### 31. **FORCE MAJEURE**

31.1. Except as otherwise specifically provided in the Contract, neither Party shall be liable to the other Party or be deemed to be in breach of the Contract by reason of any delay in performing or observing, or any failure to perform or observe, any of its obligations under the Contract, if the delay or failure was due to any event or circumstance which is not within the reasonable control, of the Party, and with the exercise of due diligence, was not reasonably foreseeable and could not reasonably be prevented, avoided or removed by such party ("**Affected Party**") through the exercise of reasonable skill or care, and does not result from the Affected Party's negligence or the negligence of its agents, employees or Sub-Contractors, which causes the Affected Party to be delayed, in whole or in part, or unable to partially or wholly perform its obligations under the Contract ("**Force Majeure Event**"). Force Majeure Event shall include:

- (a) acts of God, fire, flood, lightning, storm, typhoon, hurricane, tornado, earthquake, epidemics, or other natural disaster;
- (b) act of Government Authority which makes the performance of obligations under the Contract to be impossible for either Party;
- (c) event of war (whether declared or not), invasion, act of foreign enemy, hostilities, revolution, rebellion, terrorism, insurrection, military, usurped power, mutiny or civil war.

For the avoidance of doubt, it is clarified that insufficiency of finances or funds or any obligation for the payment of money or the Contract becoming onerous to perform shall not be a Force Majeure Event.



- 31.2. The Affected Party shall give notice to the other Parties of any Force Majeure Event as soon as practicable, but not later than 7 (seven) days after the date on which such Party becomes aware of the occurrence of the Force Majeure Event or should reasonably have known of the commencement of the Force Majeure Event. If an event of Force Majeure results in a breakdown of communications rendering it unreasonable to give notice within the applicable time limit specified herein, then the Affected Party shall give such notice as soon as reasonably practicable after reinstatement of communications, but not later than 1 (one) day after such reinstatement.
- 31.3. The notice of occurrence of a Force Majeure Event shall be a pre-condition to the Affected Party's entitlement to claim relief under the Contract. Such notice shall include full particulars of the event of Force Majeure, its effects on the Party claiming relief and the remedial measures proposed. The Affected Party shall give the other Party regular reports on the progress of those remedial measures and such other information as the other Party may reasonably request about the Force Majeure Event.
- 31.4. The Affected Party shall give notice to the other Parties of:
- (a) the cessation of the relevant Force Majeure Event; or
  - (b) the cessation of the effects of such Force Majeure Event, on the performance of its obligations under the Contract.
- 31.5. To the extent not prevented by a Force Majeure Event pursuant to Clause 31, the Affected Party shall continue to perform its obligations under the Contract. The Affected Party shall use its reasonable efforts to mitigate the effect of any Force Majeure Event as soon as practicable.
- 31.6. Subject to Clause 31.3, the Affected Party shall not be responsible or liable for failure to perform its obligations under the Contract, if such failure is due to a continuing Force Majeure Event, provided that a Force Majeure Event shall not release the Affected Party of its obligations to perform the other obligations, which are unaffected by such Force Majeure Event.
- 31.7. For avoidance of doubt, no Party's obligation to make payments of money due or payable prior to occurrence of the Force Majeure Events under the Contract shall be suspended or excused due to the occurrence of a Force Majeure Event in respect of such Party.

## **32. CHANGE IN LAW**

- 32.1. For the purpose of the Contract, the term "**Change in Law**" shall mean the occurrence of any of the following events after the Execution Date, resulting into any increase or decrease in the Contract Price:
- (a) the enactment, coming into effect, adoption, promulgation, amendment, modification or repeal (without re-enactment or consolidation) in India, of any Applicable Law, including rules and regulations framed pursuant to such Applicable Law;
  - (b) a change in the interpretation of any Applicable Law by any Government Authority having the legal power to interpret or apply such Applicable Law;
  - (c) the imposition of a requirement, for obtaining any applicable approvals/licenses/ permits which were not required earlier;
  - (d) a change in the terms and conditions prescribed for obtaining any approvals/licenses/ permits required by a Party for the performance of its obligations under the Contract or the inclusion of any new terms or conditions for obtaining such approvals/licenses/ permits;
  - (e) any change in tax or introduction of any tax made applicable for performance of the Works as per the terms of the Contract.

For the avoidance of doubt, it is clarified that any revision to the Contract Price or the Completion Date would be restricted to direct transactions between the Parties.

- 32.2. If the Contractor is affected by an incident of Change in Law and considers itself eligible for relief for such Change in Law, then, it shall give notice to the Client and the Project Manager of such Change in Law, along with the documentary evidence, if any, establishing the impact of such Change in Law. The notice served pursuant to this Clause 32 shall provide, amongst other things, precise details of:
- (a) the Change in Law;
  - (b) effect on the Contractor;
  - (c) adjustment required in the Contract Price.
- 32.3. If after the date of issuance of the Letter of Award, there is a Change in Law, due to which the Completion Date needs to be changed, the same shall be revised reasonably in accordance with Clause 7.2, to the extent that Contractor has thereby been affected in the performance of any of its obligations under the Contract.
- 32.4. If the Parties fail to agree upon a revision to the Contract Price, the matter shall be referred to an internationally recognized firm of auditors, mutually acceptable to the Parties. If the Parties cannot agree on a firm of auditors, then the Client shall appoint an internationally recognized firm of auditors. The said firm of auditors, shall within 10 (ten) days of such appointment, make a determination as to such proposed revision, which determination shall be binding on the Parties.

### **33. SUSPENSION**

#### **33.1. Suspension of works:**

The Contractor confirms and acknowledges that the Client shall have the right to, by giving a 1 (one) day prior written notice to the Contractor, with the previous approval of the Client, direct the Contractor to suspend the progress of the Works or any part thereof for such time and in such manner as the Client may consider necessary and shall during such suspension require the Contractor to properly protect and secure the Works, so far as is necessary in the opinion of the Client. The extra cost incurred by the Contractor in giving effect to the instructions of the Client under this Clause shall be borne by the Client unless such suspension is:

- (a) otherwise provided for in the Contract, or
- (b) necessary by reason of some default on the part of the Contractor, or
- (c) necessary by reason of climatic conditions on Site, or
- (d) necessary for the proper completion of the Works or for the safety of the Works or any part thereof in so far as such necessity does not arise from any act or default by the Project Manager or the Client.

Provided that the Contractor shall not be entitled to recover any such extra cost unless it gives written notice of its intention to claim such costs to the Client and the Project Manager within 15 (fifteen) days of the order of the Client. The Client shall settle and determine any extra payment and/or extension of time under to be made to the Contractor in respect of such claim in accordance with the provisions of the Contract.

#### **33.2. Suspension of Work**

The Contractor shall, on the instructions of the Client and/or the Project Manager, suspend the progress of the Works or any part thereof for such time and in such manner as the Client and/or the Project Manager may consider necessary and shall, during such suspension, properly protect and secure the Works or such part thereof so far as is necessary in the opinion of the Client and/or the Project Manager.

- 33.3. The Project Manager shall after due consultation with the Client and the Contractor, determine any extension of time to which the Contractor is entitled on account of such suspension.

#### **34. TERMINATION**

- 34.1. The Contract may be terminated by the Client by issuing a written notice of 7 (seven) days to the other Parties upon occurrence of the any of the following events:
- (a) any breach of the terms of the Contract and/or Applicable Law which breach has not been rectified by the Contractor within 7 (seven) days of issuance of notice by the Client; or
  - (b) if the Contractor fails to complete the Works by the Completion Date.
- 34.2. The Client shall have the right to terminate the Contract forthwith if the Contractor becomes insolvent or an order is made or a resolution passed for the liquidation, administration, winding-up, bankruptcy or dissolution of the other Party (otherwise than for the purposes of a solvent amalgamation or reconstruction) or an administrative or other receiver, manager, trustee, liquidator, administrator, insolvency resolution professional or similar officer is appointed over all or any substantial part of the assets of the Contractor or the Contractor enters into or proposes any composition or arrangement with its creditors generally or anything analogous to the foregoing occurs in any applicable jurisdiction.
- 34.3. Expiry or termination of the Contract shall not relieve the Parties of their obligations due up to the time of such expiry or termination, nor shall such expiry or termination prejudice any claim of either Party that has already accrued prior to such expiry or termination.
- 34.4. If the Client elects to terminate the Contract pursuant to Clause 34, the Client shall be entitled (but not obliged) to complete the remaining Works either by itself or by any other contractor on account of and at the risk and cost of the Contractor. If the Client decides to complete the remaining Works, it shall be entitled to recover the cost and other charges associated with such completion from the Contractor. In all cases, and irrespective of whether the Client decides to complete the remaining Works, the Client shall be entitled to recover all costs, expenses or losses flowing from the termination from the Contractor.
- 34.5. The Contractor shall, at Client's request and at Contractor's cost and expense, perform the following services in relation to the Works so affected:
- (a) cease all further Works which is the subject of the termination, except such Works as Client may specify in the termination notice for the sole purpose of protecting that part of the Works already executed;
  - (b) assist the Client in preparing an inventory of all equipment in use or in storage at the Site;
  - (c) assign to the Client or to any replacement contractor designated by Client, without any right to compensation, title to all Works not already owned by Client, together with all subcontracts and other contractual arrangements (including warranties) as may be designated by Client, all of which subcontracts and contractual arrangement shall be so assignable and assign to Client;
  - (d) remove from the Site all such Contractor's equipment and materials and waste material as the Client may request; and
  - (e) deliver to Client all design and other information in the possession of the Contractor as may be requested by Client for the completion of the Works.
- 34.6. The Parties agree that in the event of termination of the Contract, the Client shall pay to the Contractor the Contract Price proportionate to the Works completed by the Contractor to the Client's satisfaction by the date of termination.

#### **35. GOVERNING LAW AND DISPUTE RESOLUTION**

- 35.1. The Contract including all questions concerning the construction, validity and interpretation of the Contract will be governed by the laws of India. Subject to Clause 35.2 below, the courts at Gautam Buddh Nagar, Uttar Pradesh, India shall have exclusive jurisdiction on any matter arising under the Contract.
- 35.2. The Parties shall amicably resolve by mutual discussions any and all controversy, claim, differences or disputes arising out of or in connection with the Contract including any question regarding its existence, validity, invalidity, breach or termination ("**Dispute**"), failing which the Disputes shall be settled by arbitration in accordance with provisions of the Indian Arbitration and Conciliation Act, 1996. The arbitral tribunal shall consist of 1 (one) arbitrator. The seat for arbitration shall be Gautam Buddh Nagar, Uttar Pradesh, India and the language for arbitration shall be English. Any arbitral award shall be final and binding on the Parties.
- 35.3. The Contract and the rights and obligations of the Parties contained in the Contract shall remain in full force and effect pending issuance of the award in such arbitration proceedings, which award, if appropriate, shall determine whether and when any termination shall become effective.

36. **MISCELLANEOUS**

36.1. **Notices**

Any notice and other communications provided for in the Contract shall be in writing and shall be transmitted by e-mail or registered post or courier service in the manner as elected by the Party giving such notice to the following addresses:

In the case of notices to the Client:

Attn: [ ]  
Add: [ ]  
Email: [ ]

In the case of notices to the Project Manager:

Attn: [ ]  
Add: [ ]  
Email: [ ]

In the case of notices to the Contractor:

Attn: [ ]  
Add: [ ]  
Email: [ ]

Any Party may, from time to time, change its address or representative for receipt of notices provided for in the Contract by giving to the other prior written notice.

36.2. **Waiver**

Waiver by a Party of any default by the other Party(ies) in the observance and performance of any provision of or obligations under the Contract:

- (a) shall not operate or be construed as a waiver of any other or subsequent default hereof or of other provisions or obligations under the Contract;
- (b) shall not be effective unless it is in writing and executed by a duly authorised representative of such Party;
- (c) shall not affect the validity or enforceability of the Contract in any manner.

Neither the failure by a Party to insist on any occasion upon the performance of the terms, conditions and provisions of the Contractor any obligation hereunder nor time or other indulgence granted by a Party to the other Party shall be treated or deemed as waiver/breach of any terms, conditions or provisions of the Contract.

**36.3. Survival**

Termination of the Contract (a) shall not relieve the Parties of any obligations already incurred hereunder which expressly or by implication survives termination hereof, and (b) shall not relieve a Party of any obligations or liabilities for loss or damage to the other Party(ies) arising out of or caused by acts or omissions of such Party prior to the effectiveness of such termination or arising out of such termination.

**36.4. Partial Invalidity**

If any provision of the Contract is held to be invalid or unenforceable to any extent, the remainder of the Contract shall not be affected thereby, and each provision of the Contract shall be valid and enforceable to the fullest extent permitted by applicable law. Any invalid or unenforceable provision of the Contract shall be replaced with a provision which is valid and enforceable and most nearly reflects the original intent of the unenforceable provision.

**36.5. Amendments**

Subject to the terms of the Contract, no modification or amendment to the Contract shall be valid or binding unless made in writing and duly executed by all the Parties.

**36.6. Cost**

Except as otherwise provided in the Contract, each Party will bear its own costs and expenses incurred in connection with the preparation and execution of the Contract and for performance of transactions contemplated hereunder including any accounting, tax, legal and other advisors' expenses and expenses.

**36.7. Further Assurances**

Each Party will, at its own respective cost and expense, execute and do (or procure to be executed and done by any other necessary party) all such deeds, documents, acts and things as may be required from time to time or as may be necessary to give full effect to the Contract or for performance of its obligations under the Contract or for compliance with the provisions of Applicable Law.

**36.8. No Partnerships**

Nothing contained or implied in the Contract shall constitute or be deemed to constitute a partnership or agency between the Parties and none of the Parties hereto will have any authority to bind, commit or make any representations on behalf of the other Party(ies).

**36.9. Anti-Corruption**

(a) The Parties shall not, and shall ensure that their respective Affiliates, officers, agents, directors and representatives shall not, in the course of conduct of performance of their obligations under the Contract: (i) the (Indian) Prevention of Corruption Act, 1988, or any other applicable anti-bribery or anti-corruption laws under any Applicable Law; or (ii) offer, pay, promise to pay, or authorize the payment of any money, or offer, give, promise to give, or authorize the giving of anything of value, to anyone, including Public Officials, either directly or indirectly, to improperly influence official action or obtain an improper advantage. This includes acting through a third party under circumstances where the Parties (or their respective Affiliates, officers, agents, directors and representatives) know, or are aware of circumstance that may cause a significant risk, that all or a portion of such money or thing of value would be offered, given or promised to anyone, including a Public Official, for the purpose of:

(i) improperly influencing any act or decision of such Public Official in his official capacity;

- (ii) inducing such Public Official to do or omit to do any act in relation to his lawful duty;
  - (iii) securing any improper advantage; or
  - (iv) inducing such Public Official to influence or affect any act or decision of any Government Authority;
  - (v) (any such payment, a "**Prohibited Payment**"), provided that Clause 36.9 shall not apply to any payment that is permitted by Applicable Law.
- (b) For the purposes of this Clause 36, the term "**Public Official**" means any officer or employee of a government, public entity or public international organization (including any department, or agency thereof or any government-owned or controlled entity including state-owned enterprises), or any person acting in an official capacity for or on behalf of a government or public international organization.

Each of the Parties shall, and shall procure that each of their respective Affiliates, officers, agents, directors and representatives shall, promptly report to the other Party any Prohibited Payment of which they obtain knowledge, become aware of, or which they have reasonable grounds to believe has occurred during the term of the Contract.

### **37. Priority of Documents**

The documents forming the contract are to be taken as mutually explanatory of one another, for the purpose of interpretation, the priority of the documents shall be in accordance with the following sequence:

- a. The contract Agreement
- b. The Letter of Intent
- c. The Letter of Tender
- d. GCC
- e. Schedule of quantities and rates
- f. The specifications
- g. The Drawings
- h. The schedules and any other documents forming part of the Contract.

## SECTION: 5

### FISCAL ASPECTS

#### SCHEDULE OF FISCAL ASPECTS

Description	Schedule of Fiscal Aspects.
Location Of work	Engineering & Admin Block Project at Galgotias University, Yamuna Expressway, Greater Noida, Uttar Pradesh
Scope of Work	Main Scope: The detailed Scope for execution shall conform to the BOQ, Technical specification and drawings for the PLUMBING & FIRE FIGHTING works. This Contract is re measurable Item rate contract and all the scope as per the drawings/tender/attached annexure shall be included. The quoted rates hold firm for the entire work plus the period up to the settlement of final bill. No escalation will be entertained towards labor, materials, petrol, diesel and or any such account.
Type of Contract	Item rate & Re-measurable type of contract.
Escalation	This is a fixed price contract with all rates being firm till completion of project and no escalation is admissible on any item, for any reason.
Date of Commencement	Immediate from the date of issuance of LOI/Work Order.
Contract Construction Period	Commencement of work: Immediate from the date of issuance of LOI. Total time for the completion of all works under the scope of this contract and handover shall be 10 (Ten) Calendar months form the date of issuance of LOI including final handing over and de-snagging. Contractor shall submit a detailed Construction programme in the form of bar-chart for major milestones along with resource loading.
Mobilization Advance	10% of Contract Value against an irrevocable bank guarantee as prescribed in the tender form for equivalent value and recoverable 12.5% basis from 2nd RA bills however 100% mobilization will be recovered once the value of work done reached of 80% of contract value.
Payment cycle	The owner, after submission of bill from Contractor and recommendation from the Project Manager, shall pay 100% of the bill amount to the Contractor. This payment shall be released within 30 (Thirty) working days (10 days for PMC + 20 Days for client) from the date of application for payment from Contractor; if the Project Manager disputes any items shown on the application for payment or the Owner disputes on the certificate for payment, the Project Manager shall bring the disputed items to the attention of the Contractor, and within said time period, the Owner shall pay the amount of such application for payment that is not in dispute.

Payment terms	The Terms of payment shall be as follows: - 10% against submission of shop drawings on Pro-rata basis 50% against supply on Pro-rata basis 15% against installation on pro-rata basis 15% against testing and commissioning at site on pro-rata basis 10% after handing over the work.
Amount of Liquidated Damage	Time is the essence of the contract. If the works are not completed within 10 months' time, liquidated damages of 1% of the Contract Value per week will be deducted, subject to a maximum of 5% of the contract value, after which the contract can be terminated at the option of M/s. Galgotias University, Plot No 2, Sector 17A, Yamuna Expressway, Opp Budha International Circuit, Greater Noida, Uttar Pradesh – 203201.
Defects Liability Period	12 months from the date of issuance of Final Completion Certificate.
Performance Guarantee	5% of the Accepted Contract Amount, within 7 days of issue of Agreement, and shall be released upon successful completion of Defect Liability Period.
Performance Bonus	If works completed within 10 (Ten) calendar months form the date of issuance of LOI, bonus of 1% of the contract value will give to the contractor
Percentage of retention	5% from each certified or an unconditional, irrevocable and divisible bank guarantee from any nationalized bank of the equal amount. 50% retention money shall be released upon the issuance of final completion certificate against unconditional, irrevocable and divisible bank guarantee from any nationalized bank of the same amount and balance 50% shall be released at the end of Defect Liability Period.
Bank Guarantees	The bank guarantees required to be submitted by the successful contractor shall be as per the forms and formats provided by Client. Only bank guarantees drawn from nationalized banks shall be accepted
Insurance	The contractor will take Contractors All Risk Insurance (CAR) Policy in our joint name for the full contract value together with the value of material supplied by M/s. Galgotias University, Plot No 2, Sector 17A, Yamuna Expressway, Opp. Budha International Circuit, Greater Noida, Uttar Pradesh – 203201 In addition to the above you should also take <ul style="list-style-type: none"> <li>• Workmen Compensation Insurance for your direct workmen and your subcontractor's Labour.</li> <li>• Group Personnel Accident Insurance to your staff.</li> <li>• Third party liability insurance.</li> </ul> Personal Injury: You will take insurance policy for a value as may be required subject to an individual limit of Rs.1.00 lakh per person per incident
Price for Extra Items	The accepted rates in the schedule of quantities will apply for the entire project. Any item of work which is not covered in the schedule of quantities shall be paid as per the actual cost of materials, Labour, 2% (will be towards tools, cartage, power, and water) and 15% (towards all overheads and profits), provided the



	same cannot be derived from quoted rates from similar comparable items. It is to be clearly understood that claims for extras of any nature will not be entertained unless such extras are duly authorized by project manager in advance
Taxes & Duties	The rate shall include all customs duties and Excise Duties, taxes, like sales tax any other direct or indirect taxes (if applicable) works contract tax, GST, entry tax etc. There shall be no extras on any account whatsoever, excluding the statutory variations after award of contract.
ESI and PF	The accepted rates are inclusive of ESI and PF as applicable
Statutory Compliance of State & Central Government and Local Municipal Authorities	Following Statutory compliance obligations shall be performed during the entire Contract period without any failure. I. Labour License II. Provident Fund & ESI III. GST VI. Other compliances changes from time to time as per State and Central Government.
Construction Related Statutory Compliances	Shall be arranged by the Contractor at no additional cost to the Client.
Construction Water	Construction Water will be provided by the client free of cost at one point, the contractor must make his own arrangements for distribution at the site at his own cost.
Construction Electricity	There will be a charge for electricity provided by the client, and the contractor will install a sub-meter to measure the amount of electricity consumed. The contractor is responsible for making his own arrangements for the supply and distribution of electricity as part of the work that he is undertaking. The Contractor shall be responsible for ensuring that uninterrupted power supply is provided for their works by installing silent DG sets at their own expense as required.
Safety, Health, and Environment	Contractor shall adhere to all Health and Safety standards as issued by the Bureau of Indian Standards, National Building Code, 1983 as required by Project Management Consultant / Owner regulations of local Authorities.
Labour	Adequate number of persons to the satisfaction of the Project Manger shall be provided. Statutory requirements of EPF, ESIC and all other applicable Labour legislations to be complied with; and monthly certification to that effect to be submitted. Duty allocation and Roaster control shall be contractor's responsibility
Sanitary	The Contractor shall make all arrangements till completion of Project for sanitary and storm sewer arrangements as required and shall make all necessary payments directly to appropriate departments. The Contractor shall arrange to provide the Contractor's subcontractor, these facilities at no additional cost to the owner.
Contractors Conditions	Apart from those stated in the above provisions, no other conditions of the Contractors shall be acceptable

Storage, Safe Custody & Protection of Finished items	Rent free space will be provided at the site. The cost of construction of store, security etc. will have to be arranged by the contractor
RA Bills	<p>The RA bill in triplicate shall be submitted by 1st week of every month to the Project Manager along with all supporting documents. Only one bill per 30 days shall be admitted. Bill/Invoice submitted by the contractor shall be strictly as per the format prescribed by the Project Manager.</p> <p>Bills will not be accepted/ received by the Project Managers if bills are not in the correct format as prescribed by the Project Managers or are not presented along with material invoices/ delivery challans, measurement sheets, rate analysis etc. The final bill shall be accompanied with all necessary and relevant handover/closure documents.</p>
Final Bill	Within 45 days of Final completion of works and submission of handing over documents duly signed by the Architect/Project Manager/Client.
Correctness of Measurement.	In case measurements submitted with bills are found to contain incorrect information, the bill would be returned and would be admissible only with the next bill after correction of all measurements. The correct information shall be as per defined norms of measurement or generally accepted practices; any queries shall be discussed and clarified during project pre-Commencement meeting.
Weekly meetings/Monthly Meeting	The Project Manager will hold and preside over weekly progress meetings at the site. The scheduling of such meetings will be arranged by the Project Manager in advance or set up on a regular basis at a set time. Senior Management of Contractor shall be part of Monthly meeting arranged by Project Manager.
Billing Address/Shipping Address	<p>M/s. Galgotias University, Plot No 2, Sector 17A, Yamuna Expressway, Opp Budha International Circuit, Greater Noida, Uttar Pradesh – 203201</p>

**SECTION: 6**  
**SPECIAL CONDITIONS OF CONTRACTS**

## SPECIAL CONDITIONS

### 1. GENERAL

These special conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply.

### 2. SCOPE OF WORK

The general character and the scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The contractor shall furnish all labour, materials and equipment (except those to be supplied by the owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract.

### 3. ASSOCIATED CIVIL WORKS

Following civil works associated with Plumbing / Sanitary installation are excluded from the scope of this contract. These shall be executed by other agencies in accordance with approved shop drawings of and under direct supervision of the Plumbing / Sanitary contractor.

- a. RCC foundation for machines, pumps & large equipment with angle iron frame work at the edges to protect these from damage.
- b. RCC work for water tanks
- c. PCC foundation blocks with angle iron frame work edging for all motor control centre.
- d. Water proofing of floors.
- e. Masonry drain channels and sumps in plant room.

### 4. ASSOCIATED SERVICES WORKS

- a. All associated **ELECTRICAL WORKS** listed below are excluded from the scope of this contract. These shall be installed by other agencies in accordance with approved shop drawings of, and under direct supervision of the Plumbing / Sanitary contractor.
- b. Providing power supply with earthing at the incoming of control panel in plant room.

### 5. BUILDING AUTOMATION SYSTEM

The scope of Plumbing / Sanitary Contractor shall include the following for the interface to Building Automation System and no additional cost shall be paid for providing the interface feasibility.

- a. Stop/Manual/ Auto switches along with potential free contacts for monitoring the manual operation status, to be provided for those equipment whose start / stop is controlled by Building Automation System.

- b. Potential free 'NO' contacts for monitoring 'Run' status of equipment wherever required.
- c. Necessary contactor with potential free contacts and Stop/Manual/ Auto switches to be provided for all 1-phase equipment wherever the starter is not provided and which requires starting / stopping through Building Automation System.
- d. Sockets /Nipples including shut-off valve for mounting sensors/transmitters on pipe lines.
- e. The space provision in all the equipment panel (MCC) for mounting Current/ Potential transformers & transducers and power supply to the transducer shall be provided by the Plumbing / Sanitary contractor. Separate current transformers shall be provided by Plumbing / Sanitary contractor for monitoring current / KWH (wherever required) through BAS.
- f. The installation of current transformer & Transducer along with wiring between Current Transformer & Transducer up to the terminal block shall be provided by the Plumbing / Sanitary contractor. All transducers shall be supplied by BAS contractor.
- g. The low voltage BAS Cables shall be brought upto the electric panel by BAS contractor and all terminations into the electrical panels shall be made by Plumbing / Sanitary contractor after satisfying himself of the wiring system. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the Plumbing / Sanitary system, lies solely with the contractor.
- h. All necessary Hardware/ Software shall be made available by the Plumbing / Sanitary Contractor on the Microprocessor based panel for the integration of such panel to Building Automation System for remote monitoring / controlling of marking / equipment thru BAS.

#### 6. PROJECT EXECUTION AND MANAGEMENT

The Contractor shall ensure that senior planning and erection personnel from his organisation are assigned exclusively for this project. They shall have minimum 10 years experience in this type of installation. The Contractor shall appoint one Project Director holding senior management position in the organisation. He shall be assisted on full time basis by a minimum of two erection engineers & three senior supervisors. The entire staff shall be posted at site on full time basis.

The project management shall be through modern technique. The Contractor's office at site shall be fully equipped with fax, modem, computers, plotter and photocopier. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, contractor shall assign at least one full-time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the installation.

The Contractor shall arrange to have mechanised & modern facilities of transporting material to place of installation for speedy execution of work.

Following manpower deployment shall be provided by the contractor:-

- a. One Project Director
- b. 1 Senior Engineer (minimum 10 years experience) & 1 Junior Engineer (5 years experience).
- c. 2 Senior Supervisors
- d. 1 QA/QC Engineer (Part Time)
- e. 1 Housekeeping in charge with at any given time minimum 3 years experience.

f. 1 Store Keeper.

## 7. PERFORMANCE GUARANTEE

The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the system as installed shall maintain the design conditions as described under "Basis of Design" and relevant clauses in the specifications. The guarantee shall be submitted in the proforma given in Appendix - II.

Complete set of architectural drawings is available in the Architect/Consultant's office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipments individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

## 8. INSPECTION AND TESTING

The owner shall carry out inspection and testing at manufacturer's works for items such as water treatment plant, electrical panels & pumps covered under this contract. No equipment shall be delivered without prior written confirmation from Project Manager. In case factory inspection is carried out then all travelling and lodging expenses shall be borne by Client for maximum two persons. All expenses related to testing shall be to Contractor account. Tests on site of completed works shall demonstrate the following, among other things.

That the equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.

That all items operate efficiently and quietly to meet the specified requirements

That all electrical circuits are correctly protected and that protective devices are properly coordinated.

The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Project Manager and shall provide test certificate signed by a properly authorized person. Such test shall be conducted on all materials and equipments and tests on completed work as called for by the Project Manager at contractor's expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out, then the contractor shall be liable for the rectification and retesting of the same as called for by the Project Manager whose decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Project Manager.

9. BYE-LAWS AND REGULATIONS

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

10. FEES AND PERMITS

The Tenderer shall pay any and all fees and obtain permits required for the installation of this work. On completion of the work, the tenderer shall obtain and deliver to the Owner's certificate of final inspection and approval by the local Plumbing (Municipal, State / Central govt. whichever is applicable) at its own cost Owner's not to pay for any clearances. The contractor is liable to take necessary permits and approvals for the entire system installation works pertaining to other allied engineering services. However, all receipted amount shall be reimbursed on production of proof of payment.

11. DRAWINGS

The Drawings which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings.

The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

12. TECHNICAL DATA

Each tenderer shall submit along with his tender, the technical data for all items listed in Appendix-IV in the indicated format. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

13. SHOP DRAWINGS

- 13.1 All the shop drawings shall be prepared on computer through Autocad System based on Architectural Drawings, site measurements and Interior Designer's Drawings. Within four weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, Pump room, showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; external insulation details for pipe insulation

etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations. These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect / Consultant / Owner's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 12 sets of drawings shall be submitted after final approval along with CD.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix and quoted by the tenderer in technical data part of Appendix.

When the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The contractor shall submit further twelve sets of shop drawings to the Owner's site representative for the exclusive use by the Owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/ equipment/ installation.

- 13.2 Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.
- 13.3 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.
- 13.4 Samples of all materials like valves, pipes, insulation, control wires etc shall be submitted to the Owner's site representative prior to procurement. These will be submitted in two sets for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.
- 13.5 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.
- 13.6 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect/Consultant/ Owner's site representative. Any delay on such account shall be at the cost of and consequence of the Contractor.



- 13.7 Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, the contractor shall prepare composite working drawings and sections at 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, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.
- 13.8 Within two weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.
14. **QUIET OPERATION AND VIBRATION ISOLATION**  
All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Owner's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the desired NC levels.
15. **ACCESSIBILITY**  
The Contractor shall verify the sufficiency of the size of the openings, clearances in cavity walls and suspended ceilings for proper installation of his piping and other ancillaries. His failure to communicate insufficiency of any of the above, shall constitute his acceptance of sufficiency of the same. The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be standardized for each piece of equipment / device / accessory and shall be clearly nomenclature / marked.
16. **MATERIALS AND EQUIPMENT**  
All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per Appendix.
17. **MANUFACTURERS INSTRUCTIONS**  
Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.
18. **ELECTRICAL INSTALLATION**  
The electrical work related to Plumbing / Sanitary services, shall be carried out in full knowledge of, and with the complete coordination of the contractor. The electrical installation shall be in total conformity with the control wiring drawings prepared by the contractor and approved by the Architect/Consultant. All equipment shall be connected and tested in the presence of an authorized representative of the contractor.

The Plumbing / Sanitary system shall be commissioned only after the contractor has certified in writing that the electrical installation work for Plumbing / Sanitary services has been thoroughly checked, tested and found to be totally satisfactory and in full conformity with the contract Drawings, Specifications and manufacturers instructions. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the electrical installation work for Plumbing / Sanitary services, lies solely with the contractor.

19. **COMPLETION CERTIFICATE**

On completion of the Electrical installation for Plumbing / Sanitary services, a certificate shall be furnished by the contractor, counter signed 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.

The contractor shall be responsible for getting the entire electrical installation for Plumbing / Sanitary system duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

20. **BALANCING, TESTING AND COMMISSIONING**

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASPE / ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps, equipment, panels etc. at factory with two personnel from Owners / Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner's site representative. All tests shall be carried out in the presence of the representatives of the Architect/Consultant and Owner's site representative.

21. **COMPLETION DRAWINGS**

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of floppies / CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, piping layouts, location of wiring and sequencing of automatic controls, location of all concealed piping, valves, controls, wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The contractor shall frame under glass, in the plant room, one set of these consolidated control diagrams.

22. **OPERATING INSTRUCTION & MAINTENANCE MANUAL**

Upon completion and commissioning of part Pumps and allied system the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

***"Preventive Maintenance Schedule for each equipment / panel shall be submitted along with Operation and Maintenance Manual".***

**23. ON SITE TRAINING**

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed.

**24. MAINTENANCE DURING DEFECTS LIABILITY PERIOD**

**24.1 Complaints**

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

**24.2 Repairs**

All equipment that require repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

**25. UPTIME GUARANTEE**

The Contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all pressures, power consumption. starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

**26. OPERATION AND MAINTENANCE**

Contractor may be required to carry out the operation of the Pumps and allied installation for the defects liability period. Further, he may also be required to carry out operation and all inclusive maintenance of the entire system for a period of three years beyond the defects liability period.

**26.1 Operation contract:**

- a. 24 hours a day, year round.
- b. All stand-by equipment to be operated as per mutually agreed programme.
- c. Proper entry and unkeep of relevant log books.

- d. Maintain complaints register. Submit weekly report.
- e. Proper housekeeping of all areas under the contract.
- f. Prepare daily consumption report and summary of operation.

#### 26.2 Terms of payment

- a. Monthly at the end of each month on pro-rata basis.

#### 26.3 All Inclusive Maintenance Contract

- a. Routine Preventive Maintenance Schedule to be submitted
  - i. Schedule to cover manufacturer's recommendation and/or common engineering practice (for all plant and machinery under contract).
  - ii. Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.
  - iii. Monthly status report.
  - iv. Entire installation to be painted in fourth year (from commissioning) before the expiry of operation and maintenance contract.
- b. Uptime during maintenance contract
  - i. 98% uptime of all systems under contract.
  - ii. Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.
  - iii. There shall be no reimbursement for the extended period.
  - iv. Break-downs shall be attended to within ten hours of reporting.
  - v. Spare compressor/motor assembly to be made available within seven calendar days in case of total breakdown/burnout.
- c. Manpower
  - i. Adequate number of persons to the satisfaction of the Owner's site representative shall be provided including relievers.
  - ii. Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.
  - iii. Duty allocation and Roaster control shall be contractor's responsibility.
  - iv. No overtime shall be payable by Owner for any reason whatsoever.
- d. Shut Downs
  - i. Routine shut downs shall be permitted only during winter season.

- ii. Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.
- e. Payment Terms
  - i. Quarterly payment at the beginning of each quarter on pro-rata basis.

27. PARTIAL ORDERING

Owner through the Architect/Consultant/ Owner's site representative reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers.

28. LIST OF MAIN DOCUMENTS AND SUBMITTALS

S. No.	Items	Clause No.	Remarks
1.	4-Copies of Proforma Invoice 4- sets of Technical Literature Packing Specifications.		
2.	Performance Guarantee		
3.	All Permits / Licenses		
4.	Technical Data		
5.	Manufacturer's Drawings, Catalogues & Pamphlets & Other Documents		
6.	Variation in Quantity Statement.		
7.	Electrical Installation Certificate.		
8.	Operating Instructions & Maintenance Manual		
9.	Soft water & Power Requirement		
10.	Testing, Adjusting and Balancing		

**Note :**

The above list is only for guide line of the contractor. The contractor shall thoroughly check all document and submittals required as per the tender document and submit them in time as per the requirement.

**APPENDIX - I**

**GUARANTEE PROFORMA**

**GUARANTEE FOR PLUMBING SYSTEM**

We hereby guarantee the year round Plumbing System Which We Have Installed In The Complex Described Below :

Building:

Location:

For a period of one year from the date of acceptance of the total installation, WE AGREE TO repair or replace to the satisfaction of the Owner, any or all such work that may prove defective in workmanship, equipment or materials within that period, ordinary wear and tear and unusual abuse or neglect excluded, together with any other work, which may be damaged or displaced in so doing. In the event of our failure to comply with the above mentioned conditions within a reasonable time, after being notified in writing, we collectively and separately, do hereby authorize the Owner to proceed to have the defects repaired and made good at our expense, and we shall pay the cost and charges thereof, immediately upon demand.

WE ALSO HEREBY UNDERTAKE to test the entire installation in first SUMMER, WINTER AND MONSOON on following the completion of the installation, to check and do everything necessary to ensure that the specified design conditions and functional requirement are met, that all water, sewage, air pollution control systems are properly balanced, that all controls are calibrated accurately, and that all units are functioning satisfactorily.

**SIGNATURE OF CONTRACTOR**  
*for PLUMBING WORKS*

**DATE :**

**SEAL**

**APPENDIX – II****SCHEDULE OF TECHNICAL DATA****1.**

## TRANSFER PUMPS

***Pump***

Make :

Type &amp; Model :

Discharge in LPS / GPM :

Head (Meters of WC) :

Shut off Head (Meters of WC) :

Efficiency (%) :

No. of Stages

Suction End I.D. :

Delivery End I.D. :

Details of N.P.S.H. :

Vibration Isolation Detail :

Skid Details :

Operating Weight :

Overall Dimension (MM) :

Mechanical Seal Detail :

***Material***

Body :

Impeller :

Type of Impeller

Shaft :

Is it suitable for direct coupling :

**Motor** :

Make :

Model :

Power Requirement (HP / KW) :

R.P.M. :

Rating :

Over Load Capacity :

Class of Insulation :

Details of Additional protection in winding :

Motor Efficiency :

Is it suitable for direct coupling to pump? :

Type of rotary movement :

Method of Starting :

Size and type of cable for connections. :

Number of variable frequency drive :

Detail of VFD :

**2. WATER FLOW SWITCHES**

Manufacturer :

Country of Origin :

Local Agent :

Type :

Model :

Body Construction Material :



Stem Construction Material :  
Flapper Construction Material :  
No. of Contacts :  
Type of Contacts :  
Connections :  
Power Supply :  
Switch Rating :  
Degree of Protection (IP) :

**3. PRESSURE SWITCHES**

Manufacturer :  
Country of Origin :  
Local Agent :  
Type :  
Model :  
Construction Material :  
Dimensions (mm) :  
Mounting :  
Switch Rating :  
Body Construction Material :  
Sensing Element Material :  
Fill Material :  
Sensing Range :  
Over Range Protection :  
Maxm. Static Pressure on one side :  
No. of Contacts :  
Type of Contacts :

Power Supply :

Degree of Protection (IP) :

**4. SEWAGE PUMP & CLEAR WATER PUMP** (Submit separate technical data sheet)

*Pump*

Make :

Type & Model :

Discharge in LPS/ GPM :

Head (Meters of WC) :

Shut off head (Meters of WC) :

Efficiency (%) :

No. of stages :

Suction end I.D. :

Delivery end I.D. :

Details of N.P.S.H. :

Solid Handling size. :

Vibration Isolation Detail :

*Skid Details*

*Operating Weight*

Overall Dimension :

Mechanical Seal Detail :

*MATERIAL*

Body :

Impeller :

Shaft :

Type of Impeller :

Is it suitable for direct coupling :  
:  
*MOTOR*  
Make :  
Model :  
Power Requirement (HP/KW) :  
R.P.M. :  
:  
Rating :  
Over Load Capacity :  
Class of Insulation :  
Details of additional protection in winding :  
Motor efficiency :  
If it suitable for direct coupling to pump ? :  
Type of rotary movement :  
Method of starting :  
Size and type of cable for connections :

**5. ELECTRICAL ACCESSORIES**

**MAKE OF THE FOLLOWING:**

- a. Motor Control Centre (Electrical Panel)
- b. MCCB
- c. Motor
- d. MPCB
- e. MCB
- f. Rotary switch
- g. Soft Starter

- h. Timer
  
- i. Automatic Star Delta Starter
  
- j. Direct on line Starter
  
- k. Contactor
  
- l. Current Transformer (cast resin type)
  
- m. Single phase preventor
  
- n. Push Button
  
- o. Change over switch
  
- p. Ammeter & Voltmeter  
KWH meter
  
- q. Relay
  
- r. Indication lamp
  
- s. Cables
  
- t. Wires

**SECTION: 7**

**TECHNICAL SPECIFICATION**

## TECHNICAL SPECIFICATIONS OF PLUMBING WORKS

S. No.	Description
1	<b>SANITARY FIXTURES AND C.P. FITTINGS:</b>
2	INTERNAL DRAINAGE (SOIL, WASTE, VENT, RAIN WATER PIPE & FITTINGS):
3	WATER SUPPLY (INTERNAL & EXTERNAL):
4	GARDEN HYDRANT SYSTEM:
5	EXTERNAL STORM WATER DRAINAGE & RAIN WATER HARVESTING PIT:
6	WATER SUPPLY, DRAINAGE PUMPS & EQUIPMENT
7	WATER TREATMENT EQUIPMENT
8	<b>SHOP DRAWINGS, TESTING &amp; COMMISSIONING, QUALITY CONTROL</b>
9	ELECTRICAL WORK
10	LIST OF I.S.CODES AND REFERENCE STANDARDS:
11	PIPE COLOR CODE
12	TECHNICAL INFORMATION
13	DEVIATION SHEET

**TECHNICAL SPECIFICATIONS**

**SUBHEAD-1. SANITARY FIXTURES AND C.P. FITTINGS:**

**1 SCOPE OF WORK:**

- 1.1. Work under this section shall consist of providing and fixing and installing all sanitary fixtures, chromium plated fittings and accessories as required as per drawings specified hereinafter and given in the Drawings.
- 1.2. Without restricting to the generality of the foregoing the sanitary fixtures & C.P. fittings shall include the following:
  - a) Sanitary fixtures
  - b) Chromium plated fittings
  - c) Stainless steel sinks
  - d) Accessories e.g. toilet paper holders, coat hook, dispenser etc.
  - e) Mirror
- 1.3. Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.
- 1.4. All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

**2 GENERAL REQUIREMENTS:**

- 2.1. All materials, sanitary fixtures and fittings shall be new and of best quality confirming to CPWD specification and subject to the approval of Engineer in charge. Wherever particular makes are mentioned, the choice of selection shall remain with the Engineer in charge.
- 2.2. All Appliances, fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not specifications, and drawings. Accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connection pieces.
- 2.3. Fixing screws shall be half round head chromium plated brass screws with C.P. washers where necessary.
- 2.4. Porcelain sanitary ware shall be glazed vitreous china of first quality free from warps, cracks and glazing defects confirming to I.S. 2556.
- 2.5. Sinks for pantry or kitchen shall be stainless steel or as specified in the Drawings.
- 2.6. Chromium plated fittings shall be cast brass chromium plated of the best quality approved by Engineer in charges.
- 2.7. All Appliances, 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 at proper location and height. Faulty locations

shall be made good and any damage to the finished floor, Filing Plaster, Paint, insulation shall be made good by the Contractor at his own cost.

- 2.8. Sanitary appliances, subject to the type of appliance and specific requirements, shall be fixed in accordance with the relevant standards and the following :
- a) Contractor shall, during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection so as to absolutely prevent any damage to the appliances until handing over. (The original protective wrapping shall be left in position for as long as possible).
  - b) The appliance shall be fixed in a manner such that it will facilitate subsequent removal if necessary.
  - c) All appliances shall be securely fixed. Manufacturers' brackets and fixing methods shall be used wherever possible. Compatible rust- proofed fixings shall be used. Fixing shall be done in a manner that minimizes noise transmission.
  - d) Pipe connections shall be made with demountable unions. Pipe work shall not be fixed in a manner that it supports or partially supports an appliance.
  - e) Appliances shall be fixed so that water falls to the outlet.
  - f) Appliances shall be fixed true to level firmly fixed to anchor or supports provided by the manufacturer and additional anchors or supports where necessary.
- 2.9. Sizes of Sanitary fixtures given in CPWD specifications or in the Drawings are for identification with reference to the catalogues of makes considered. Dimensions of similar models of other makes may vary within + 5% and the same shall be provided and no claim for extra payment shall be entertained nor shall any payment be deducted on this account.

### **3 SANITARY FIXTURES**

- 3.1. WC, Urinal, partition, was basins, sinks, showers, toilet paper holder, towel rail, hand drier etc shall be of premium quality of approved make, as per architect's drawing, requirement of space, location complete in all respects. Including accessories, labor, workmanship etc,
- 3.2. Colour shade, shape, size shall be selected and approved by engineer or his consultant.
- 3.3. All appliances, fixtures and fittings shall be tested before and after installation. Water seals of all appliances shall be tested. The Contractor shall block the ends of waste and ventilation pipes and shall conduct an air test with a pressure of 38mm water gauge for minimum of 3 minutes in accordance with BS: 5572.

### **4 PRE-FABRICATED DRAINS**

- 4.1. Pre-fabricated drain shall be provided at drop-off locations, entrance to the building, pedestrian plazas etc.
- 4.2. These drains shall be made of Polymer concrete or Polypropylene with integrated cast iron edge protection and sealable channel groove to EN 1433.
- 4.3. The drains shall be as per desired load class for vehicular traffic and fire tender load.
- 4.4. Installation and commissioning shall be as per manufacturer's details.
- 4.5. Slope and size shall be as per design.



4.6. Makes shall be as per list of makes provided

## 5 GREASE TRAPS

5.1. Prefabricated Grease traps shall be provided in the basement. These shall be used for oil and grease removal of kitchen area wastes

5.2. They shall be made of Polypropylene/HDPE material and shall be designed for the appropriate number of meals and users in the cafeteria

5.3. Sizing shall be as per manufacturer's recommendations

5.4. Treated water outflow shall be sent to the STP to be mixed with other wastes

5.5. Makes and Model shall be as per list of makes provided and as per BOQ.

## 6 FIXTURE AND FLOW RATES

6.1. Supplying, installation testing and commissioning of all fixture of given flow rates as per Green Building requirements including SITC of all accessories, bottle trap, WC pan connector etc. Contractor shall apprise the above mentioned vendors of the following flow rates. Makes and model recommended by competent authority shall be as per drawing:-

S.No.	Type of Fixture	Flowrate (LPM/LPF)
1.	WC Concealed Cistern	3/6 LPF
2.	Urinal	0.9 LPF to 1.2 LPF
3.	Sensor Faucet	1.5 LPM or Less
4.	Health Faucet	4.0 LPM or Less
5.	Kitchen Sink	6.0 LPM or Less
6.	Shower	6.75 LPM or Less

## 7 EUROPEAN WATER CLOSET

7.1 WC shall be single or double siphonic wash down type floor wall mounted set, as shown in the drawings, flushed by means of a flushing cistern.

7.2 Each W.C. set shall be provided with a solid plastic seat of colour given in the schedule of quantities, rubber buffers and chromium plated hinges. Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

7.3 Flush pipe/bend shall be connected to the Water Closet by means of suitable rubber adapter.

7.4 Wall hung Water Closet shall be supported by C.I. chair.

## 8 URINALS

- 8.1 Urinals shall be lipped type half stall white glazed vitreous china of best quality and size as mentioned in the Schedule of Quantities.
- 8.2 Half stall urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange and shall be fixed to wall by C.I. brackets, C.I. wall clips and CP brass screws as recommended by manufacturer complete as directed by Architect/Consultants.
- 8.3 Flushing for urinals shall be by means of no hand operation, infra-red electric flush valve with complete kit of plumbing, infra-red photo cells, solenoid valve. The automatic flush sensor plate shall be flush and press fitted and be of high quality mirror polish finish. Each urinal shall be provided with one flush valve unit.
- 8.4 Flush pipes shall be UPVC pipes concealed in wall chase but with chromium plated bends at inlet and outlet or as given in Schedule of Quantities. These shall be measured and paid for separately.
- 8.5 UPVC waste pipes shall be provided for urinals wash basin, sink.

## **9 URINAL PARTITIONS**

- 9.1 Urinal partitions shall be white glazed vitreous china of size specified in the Schedule of Quantities.
- 9.2 Porcelain partitions shall be fixed at proper heights with CP brass bolts, anchor fasteners and MS clips as recommended by the manufacturer and directed by the Architect/Consultants.

## **10 WASH HAND BASIN**

- 10.1 Wash basins shall be coloured or white glazed vitreous china of best quality, size, shape and type specified in the Schedule of Quantities.
- 10.2 Each basin shall be provided with painted MS angle or CI brackets and clips and the basin securely fixed to wall. Placing of basins over the brackets without secure fixing shall not be accepted. The MS angle shall be provided with two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and colour as approved by the Architect/Consultants.
- 10.3 Each basin shall be provided with 32 mm dia C.P. waste of standard pattern with pop-up waste or rubber plug and chain as specified in the Schedule of Quantities, 32 mm dia C.P. brass bottle trap and angle valve with C.P. pipe to wall and flange as given in the schedule of quantities.
- 10.4 Each basin shall be provided with single hole mixing fitting or as specified in the Schedule of Quantities.
- 10.5 Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms or as directed by Architect/Consultants.

## **11 SINKS**

- 11.1 Sinks shall be white glazed fireclay or vitreous china or stainless steel or any other material as specified in the Schedule of Quantities.
- 11.2 Each sink shall be provided with M.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable painted angle iron brackets or clips as recommended by the manufacturer.

Each sink shall be provided with 40 mm dia C.P. waste with china and rubber plug with CP Brass chain as given in the Schedule of Quantities. The MS Angle shall be provided with Two coats of red oxide primer and two coats of synthetic enamel paint of make, brand and colour as approved by the Architect/Consultants.

- 11.3 Each sink shall be provided with hot and cold mixing fittings or CP taps as specified in the schedule of quantities.

## **12 SHOWER SET**

- 12.1 Shower set shall comprise of single lever shower mixer, C.P. Shower arm with wall flange and shower head of approved quality or as specified in the Bill of Quantities or supplied by the project Manager.
- 12.2 Shower Mixer and shower arm shall be so fixed as to keep the wall flange clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

## **13 MIRRORS**

- 13.1 Mirrors shall be electro coated copper 5.5mm thick of approved make. The size shall be as specified in the Schedule of Quantities or as shown on the drawings. The image shall be clear and without waviness at all angles of vision.
- 13.2 Mirrors shall be provided with backing of 12mm thick marine plywood or 6mm thick cement asbestos sheet fixed with CP brass semi round headed screws and cup washers or CP brass clamps as specified or instructed by Architect/Consultants.

## **14 TOILET PAPER HOLDER**

- 14.1 Toilet paper holder shall be of CP brass, powder coated/S.S. heavy duty of approved make and colour or as specified in Bill of Quantities.

## **15 TOWEL RAIL**

- 15.1 Towel rail shall be of C.P. brass with reinforced bends and circular flanges. The size of the rail shall be as specified. The brackets shall be fixed by means of CP brass screws to wooden cleats firmly embedded in the wall.

## **16 HAND DRIER**

- 16.1 The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position.
- 16.2 The hand drier shall be fully hygienic, rated for continuous repeat use (CRU).
- 16.3 The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds.
- 16.4 The hand drier shall be of wall mounting type suitable for 230V, single phase, 50 Hz, AC power supply.

-----: END OF SUBHEAD :-----

**SUBHEAD-2. INTERNAL DRAINAGE (SOIL, WASTE, VENT, RAIN WATER PIPE & FITTINGS):****1. SCOPE OF WORK:**

- 1.1. Internal drainage shall be designed by the contractor and got approved by Consultant. The contractor has to associate specialized agency who shall execute and design the internal drainage system and the shop drawings layout plans.
- 1.2. Work under this section shall consist of providing and fixing all labor, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent, rain water pipe and fittings as per relevant BIS code and CPWD specification.
- 1.3. Without restricting to the generality of the foregoing, the soil, waste, vent, rain water pipe system shall include the following:-
  - a) Vertical and Horizontal soil, waste and vent pipes, and fittings, joints, clamps and connection to sewer line as shown on the drawings
  - b) Floor and Urinal traps, Cleanout plugs and inlet fittings.
  - c) Waste pipe connection from all fixtures e.g. washes basins, sinks, urinals, kitchen equipment's and plant room equipment.
  - d) Rain water pipes & fitting (Terrace Rain Water and Balcony Drain).
  - e) All pipe fittings exposed or on wall shall be painted with two or more coat of desired shade and color. All sanitary fittings, hanger where no sunken floor provided.
  - f) Testing of all pipes.

**2. GENERAL:**

- 2.1. All materials shall be new of the best quality conforming to BIS code and specifications and subject to the approval of Engineer in charge.
- 2.2. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.
- 2.3. Pipes shall be fixed in a manner as to provided easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.4. Pipes shall be securely fixed to walls and ceilings by suitable adjustable clamps/steel structural supports at intervals specified.
- 2.5. Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.
- 2.6. All work shall be executed as directed by the Engineer-in-charge.

**3. SOIL, WASTE, VENT & RAIN WATER PIPE SYSTEM:**

- 3.1. The soil, waste system above ground has to be planned as "Two Pipe System" [Double Stack System] as defined in IS : 5329 having separate pipes for waste for wash basins, showers, bath tub, kitchen sinks, Floor drains, AHU's, condensate drain and separate pipe for soil discharge. All piping work shall be executed as per CPWD specification and shall got tested and of required diameter as per diameter.

- 3.2. Vertical soil & waste stack shall be connected to separate horizontal Header/drain at basement ceiling.
  - 3.3. All soil/waste from below grade Driver Toilet/Garbage Area/Room will be collected in sewerage sump and pumped into sewer line/STP.
  - 3.4. Each fixtures connected to the soil & waste pipe must be provided with trap separately and should be vented completely.
  - 3.5. The scope includes all fittings P/S trap, WC pan connector and long arm, tyton joints to make joints minimum as possible
  - 3.6. All open Terrace/Balcony shall be drained by rain water down takes.
  - 3.7. Rain water down takes are separate and Independent of the soil & waste system and will discharge into the underground storm water drainage system.
  - 3.8. Wherever required, all balconies, terraces, Planter and other formal landscape area will be drained by vertical down takes or other type of drainage system shown on the drawing and directed by the Project Manager.
- 4. GI PIPES & FITTINGS (FOR CAR PARKING DRAINAGE PIPES, SEWAGE & DRAINAGE SUMP RISERS, STP BYPASS/OVERFLOW LINE, VENTILATION CUTOUT DRAINAGE)**
- 4.1 All pipes for drainage as mentioned above and/or where specified in the BOQ shall be galvanized steel tubes of Class 'C' conforming to IS: 1239.
  - 4.2 Fittings shall be of malleable galvanized iron of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes etc. Fittings etc. shall conform to IS: 1879. (Part 1 to X) 1987.
  - 4.3 Pipes and fittings shall be jointed with screwed joints using Teflon tape suitable for water pipes. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. Necessary vents and drains shall be provided at all high and low points respectively. G.I pipes inside toilets shall be fixed in wall chases well above the floor. No pipes 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.
  - 4.4 Pipe Support
    - a) All pipes clamps, supports, hangers, pipe support shall be factory made galvanized MS steel or alternatively galvanized after fabrication to suit site requirement pipe supports.
    - b) G.I pipes in shafts and other locations shall be supported by G.I clamps of design approved by the architect/Consultants. Pipes in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from MS structural. Pipes in shafts shall be supported on slotted angles/ channels as specified/ as directed.
- 4.4.1 Anchor Fasteners
- a) All pipe supports, hangers and clamps to fixed on RCC walls, beams, columns, slabs and masonry walls 230 mm thick and above by means of galvanized expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by

approved type of power drill as recommended and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the owner for any damage that may be caused by such failures.

#### 4.5 Unions

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock or check valve and on straight runs as necessary at appropriate locations as required for easy dismantling and/or as directed by Architect/Consultants.

#### 4.6 Flanges

Flanged connections shall be provided on pipes as required for maintenance/ ease in dismantling or where shown on the drawings, all equipment connections as necessary and required or as directed by the Architect/Consultants. Connections shall be made by the correct number and size of the GI nuts/ bolts as per relevant IS Standards and made with 3mm thick insertion rubber washer/ gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Architect/Consultants. Bolt hole diameter for flanges shall conform to match the specification for CI sluice valve as per IS: 780. Gaskets shall conform to IS: 11149.

#### 4.7 Trenches

All G.I pipes below ground shall be laid in trenches with a minimum cover of 600mm. The width and depth of the trenches shall be as follows:-

S.No	Dia of Pipe	Width of Trench	Depth of Trench
1	15 mm to 50 mm	300 mm	750 mm
2	65 mm to 100 mm	450 mm	1000 mm

#### 4.8 Sand Filling

GI pipes in trenches shall be protected with fine sand 150mm all around before filling in the trenches.

#### 4.9 Painting:

All pipes above ground shall be painted with one coat of red oxide and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard color code specified by the Architect/Consultants.

#### 4.10 Pipe protection:

Where specified in the schedule of quantities all pipes in chase below ground shall be protected against corrosion by applying two coats of bitumen paint wrapping with polythene tape and finishing with one more coat of bitumen paint.

#### 4.11 PIPING INSTALLATION:

Tender drawings indicate schematically the size and location of pipes. The contractor on the award of the work, shall prepare detailed working drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain valves and all pipe support, structural supports. He must keep in view the specific openings in buildings and other structures through which pipes are designed to pass.

- a) Piping shall be properly supported on or suspended from clamps, hangers as specified and as required. The contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency.
- b) Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated back. Where pipe and clamps are of dissimilar materials a gasket shall be provided in between. Spacing of pipe supports shall not exceed the following:

S.No	Pipe Size	Spacing between Supports
1	Upto 15 mm	1.5 m
2	15 mm to 150 mm	2.0 m
3	150 mm and above	2.5 m

- c) Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars steel structural supports attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lowest point and air vent at the highest point.
- d) Pipe sleeves, 50 mm larger diameter than pipes, shall be provided wherever pipes pass through walls and slabs, and annular space filled with fiberglass and finished with retainer rings.
- e) All pipe work shall be carried out in a workmen like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work so that particular area work shall be carried out in one trench.
- f) Cut outs in the floor slab for installing the various pipes are indicated in the drawings. Contractor shall carefully examine the cut outs provided and clearly point out wherever the cut outs shown in the drawings, do not meet with the requirements.
- g) The contractor shall make sure that the clamps, steel structural supports, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes, and include expansion joints where required.
- h) All pipes shall be accurately cut to the required sizes in accordance with relevant codes and burrs removed before laying. Open ends of the pipes shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used.

**5. CI HUB-LESS PIPES & FITTINGS (FOR VERTICAL SOIL, WASTE, RAIN WATER PIPES FROM 2<sup>ND</sup> FLOOR TO BASEMENT CEILING)**

- a) Soil, waste, vent, anti-siphonage and Rain water pipes, fittings and accessories like P-traps, bends, wye's, elbows, Tee's, swept tee's etc. shall be of CI Hubless. All pipes shall be straight and smooth and their inside free from irregular bore, blow holes, cracks and other manufacturing defects.
- b) All Internal Toilet soil & waste pipes shall be done with CI Hubless pipes for 75 mm dia and above as described in schedule of quantities.
- c) All Internal Toilet soil & waste pipes shall be done with GI heavy class C pipes up to 50 mm dia as described in schedule of quantities.
- d) All indirect water pipes inside toilet from wash basin, Sink, Urinal shall be GI heavy class C.
- e) CI Hubless Pipes and Fittings shall be conforming to IS: 15905 or EN-877, EN-681-1, EN13501-1, EN 13823, EN 14366.
- f) All pipes supports and clamps shall be as per specifications and recommendations of the manufacturer.

**6. UPVC PIPES & FITTINGS (FOR RAIN WATER, SOIL, WASTE AND VENT)**

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, free from groovings and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter and shall conform to IS:4985-1981 for rain water and IS:13592 for sanitaion pipes. The pipes shall be of Class-III; 6 Kg/sqm pressure rating.

Fittings

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

Laying and Jointing

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring for vertical line. The type of joint shall be used as per site conditions / direction of the Owner's site representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with GI adopter for insertion in the RCC slab for a water proof joint complete as directed by Owner's site representative.

Supports

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from



clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

### Repairs

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs shall be made by replacement of the damaged section. If any split or chip out occur in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

### 5.1 INSTALLATION:

The piping system must be clamped properly as required, pipes passing through walls, beams, slabs, columns should pass through sleeves which are padded with insulation material internally (between pipe and sleeve) covering the pipe to avoid transfer of body and structural borne sounds (refer manufacturer's installation guide lines). The piping must not touch any wall, structure, paneling, false ceiling etc.

#### Minimum supporting:

Nominal outer diameter DN/OD mm	Bracket distance	
	Horizontal pipe routing*) D max. m (max. 15 x da)	Vertical pipe routing*) D max. m
32	0,5	1,50
40	0,6	1,50
50	0,75	1,50
75	1,10	2,00
90	1,35	2,00
110	1,65	2,00
125	1,85	2,00
150	2,40	2,00
200	3,00	2,00
250	3,00	2,00

**DO NOT EXPOSE PIPE TO SUNLIGHT. DO NOT STORE IN OPEN**

### 5.2 Traps

#### a) Floor Traps

Floor traps where specified shall be siphon type full bore PP (WHITE), McAlpine, UK having a minimum 50 mm deep seal. All traps are under slung from the slab and shall be adequately supported.

#### b) Urinal Traps

Urinal traps shall be siphon type full bore having a minimum 50 mm deep seal. All traps are under slung from the slab and shall be adequately supported.

#### c) Cleanout Plugs

Floor Clean Out and line clean out plugs

Clean out plug for soil, waste or rain water pipes laid under floors shall be provided near pipe junctions bends, tees, “Y” and on straight runs at such intervals as required as per site conditions. Clean out plugs shall terminate flush with the floor levels. Line clean outs shall be supported with manufacturer provided bracket.

## 6. Pipe Support:

### a) Pipe Support from RCC Slab

b) Description
<p><b>Clamps :</b>            The Plumbing Pipes should be simply supported by Split Clamps.            Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.            The Split clamp should have an <b>EPDM rubber</b> lining which will prevent the direct contact of Pipe with the steel.            The rubber lining should have the capacity to reduce the structure borne noise vibration to up to <b>18 dB and 22dB</b> for waster water pipe.            Pipe clamp should be as per <b>DIN 3576</b> if support for metal pipe            The support installation should be as per <b>international plumbing code</b>.            The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.</p> <p><b>Support Channel :</b>            In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b></p> <p>The Support channel should be <b>pre galvanised with minimum GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes on back of the rail</b>.</p> <p>The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b></p>
<p><b>Accessories :</b>            The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b>.</p>
<p><b>Anchors :</b>            The Drop-in anchors used for the suspension of the rods should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete.</p> <p>It should be divided into four expansion segments for uniform pressing force distribution in the borehole.</p>
<p><b>Calculations and Approvals :</b>            The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.</p>

### b) Pipe Support from shaft

Description
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**Clamps :**

The Plumbing Pipes should be simply supported by **Split Clamps**.

Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.

The Split clamp should have an **EPDM rubber lining** which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to **18 dB and 22dB** for waster water pipe.

Pipe clamp should be as per **DIN 3576** if support for metal pipe

The support installation should be as per **international plumbing code**.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

**Support Channel :**

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1**

The Support channel should be **pre galvanised with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

In the case of pipe sizes beyond 4" for the steel pipe, it should be clamped with either a Split pipe clamp with all round welded nut or by using a Pipe strap.

**Accessories :**

The Threaded Rods used for the fixing Pipe clamp with channel that should be made up of partially annealed medium carbon steel of grade **4.8 strength class and as per DIN 976 standard**.

**Anchors :**

The Drop-in anchors or stud anchor used for the channel fixing with shaft that should be **ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

**Calculation and Approvals :**

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

**7. TESTING:**

7.1 Testing shall be done in accordance with IS: 1172 and IS:5329 except as may be modified herein under.

Before use at site all pipes shall be tested by filling up with water for at least 30 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours.

Soil and Waste pipes shall be tested in sections after installation, by filling up the stack with water. All openings and connections shall be suitably plugged as approved by the Architect/Consultants. The total head in the stack shall be 4.5m at the highest point of the section under test. The period of test shall be 30 minutes or as directed by the Architect/Consultants. If any leakage is visible, the defective part of the work shall be cut out and made good.

The Contractor shall test all vent pipes by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlets and connections. The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by the Architect/Consultants

A test register shall be maintained and all entries signed and dated by Contractor and architect/ Consultants. A proforma of the proposed test register shall be submitted to the Architect/ Consultants for approval.

All pipes in wall chase or meant to be chased or buried shall be hydro tested before the chase is plastered or the pipe encased or buried.

**8. MEASUREMENT AND RATES:**

a. General:

- i. Rates for all items shall be inclusive of all work and items called for in the specifications given above and the Schedule of Quantities as applicable for the work under floors, in shafts or at ceiling level at all heights and depths.
- ii. All rates are inclusive of cutting holes and chases in RCC and masonry work and making good the same.
- iii. All rates are inclusive of pre testing at site and final testing of the installations, materials and commissioning.

b. Pipes:

- i. The unit of measurement shall be linear metre to the nearest centimeter.
- ii. All UPVC soil, waste & vent pipes shall be measured net, when fixed correct to a centimeter, including all fittings along their length after fixing. The length shall be taken along center line of the pipes and fittings. No allowance shall be made for the portions of pipe lengths entering the sockets of the adjacent pipes or fittings. The above shall apply to all cases i.e. whether pipes are fixed on wall face or pillars or embedded in masonry or pipes running at ceiling level. The quoted rate shall include lead jointing.
- iii. UPVC pipes shall be measured in running metre correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, elbows, reducers, crosses, sockets, nipples, nuts, unions etc. The length shall be taken along center 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. In case of fittings of unequal bore, the largest bore shall be considered.

c. Pipe Encasing/Supports:

Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports, shuttering and centering, curing, cutting etc. complete as described in the relevant specifications.

d. Angles/ Channels:

Slotted angles/ channels shall be measured per linear meter of finished length and shall include support bolts and nuts, length embedded in the cement concrete blocks of 1: 2: 4 (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size) formed in the masonry walls; nothing extra shall be paid for the cement concrete block and making good the masonry wall, anchor fasteners etc. complete.

e. Traps

Unit of measurement shall be the number of pieces. All traps, trap gratings, hoppers, clean out plugs shall be measured by number and shall include all items described in the relevant specifications and Schedule of Quantities.

-----: END OF SUBHEAD :-----

**SUBHEAD-3. WATER SUPPLY (INTERNAL & EXTERNAL):****1. SCOPE OF WORK**

- 1.1. Work under this section consists of providing and fixing, pipes and fittings all labor, materials equipment and appliances necessary and required to completely for water supply system (Domestic Water Supply (Internal) + Flushing Water Supply (Internal) as required as per design and water supply system. The contractor shall be responsible to design water supply distribution system of the building both internal and external in accordance with relevant BIS Code and duly approved by Engineer in charge.
- 1.2. Without restricting to the generality of the foregoing, the water supply system shall include the following:-
  - a) Complete WTP system Piping
  - b) Hydro-pneumatic supply from Domestic/Flushing/RO/Soft Water/Irrigation Water UGT to all fixtures/appliances.
  - c) Thermal insulation to hot water pipes & valves, if required in BOQ.
  - d) Connections to all fixtures etc.
  - e) Ball valve/butterfly valve/Non Return valve/Pressure Reducing Valve/Water Meter.
  - f) All supports made of galvanized iron.
- 1.3. All concealed pipes fittings bends for water supply shall be of required diameter as per drawing & design. The scope includes smooth flow of WS pipes with equitable & proper distribution of pressure.

**2. GENERAL REQUIREMENTS:**

- 2.1. All materials shall be new and of the best quality conforming to CPWD specifications. All works executed shall be to the satisfaction of the Engineer in charge.
- 2.2. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3. Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections. As far as possible all bend shall be formed by means of a hydraulic pipe bending machine for pipe up to 65 mm dia.
- 2.4. Pipes shall be laid in a manner as to provide as far as possible easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passage etc.
- 2.5. Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.
- 2.6. Pipe shall be securely fixed to wall and ceiling by suitable clamps at intervals specified.

**3. GI PIPES, FITTINGS AND VALVES (WATER SUPPLY RISERS IN SHAFTS, BASEMENT CEILING, TERRACE PIPING, VERTICAL DOWNTAKES ETC.)**

- 3.1. All pipes inside the buildings and where specified, outside the building shall be galvanized steel tubes conforming to IS: 1239.
- 3.2. Fittings shall be of malleable galvanized iron of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes etc. Fittings etc. shall conform to IS: 1879. (Part 1 to X) 1987.
- 3.3. All excavation, trenching, painting, sand filling, pipe protection and pipe installation as shall be as per CPWD specifications and directions of engineer in charge.
- 3.4. Fittings shall be of malleable galvanized iron of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I pipes shall include couplings, bends, tees, reducers, nipples, unions, bushes etc. Fittings etc. shall conform to IS: 1879. (Part 1 to X) 1987.
- 3.5. Pipes and fittings shall be jointed with screwed joints using Teflon tape suitable for water pipes. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. Necessary vents and drains shall be provided at all high and low points respectively. G.I pipes inside toilets shall be fixed in wall chases well above the floor. No pipes 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.
- 3.6. Pipe Support
  - i. All pipes clamps, supports, hangers, pipe support shall be factory made galvanized MS steel or alternatively galvanized after fabrication to suit site requirement pipe supports.
  - ii. G.I pipes in shafts and other locations shall be supported by G.I clamps of design approved by the architect/Consultants. Pipes in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from MS structural. Pipes in shafts shall be supported on slotted angles/ channels as specified/ as directed.
- 3.6.1 Anchor Fasteners
  - a) All pipe supports, hangers and clamps to fixed on RCC walls, beams, columns, slabs and masonry walls 230 mm thick and above by means of galvanized expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommended and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the owner for any damage that may be caused by such failures.
- 3.7. Unions

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock or check valve and on straight runs as necessary at appropriate locations as required for easy dismantling and/or as directed by Architect/Consultants.
- 3.8. Flanges

Flanged connections shall be provided on pipes as required for maintenance/ ease in dismantling or where shown on the drawings, all equipment connections as necessary and required or as directed by

the Architect/Consultants. Connections shall be made by the correct number and size of the GI nuts/ bolts as per relevant IS Standards and made with 3mm thick insertion rubber washer/ gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Architect/Consultants. Bolt hole diameter for flanges shall conform to match the specification for CI sluice valve as per IS: 780. Gaskets shall conform to IS: 11149.

### 3.9. Trenches

All G.I pipes below ground shall be laid in trenches with a minimum cover of 600mm. The width and depth of the trenches shall be as follows:-

S. No	Dia of Pipe	Width of Trench	Depth of Trench
1	15 mm to 50 mm	300 mm	750 mm
2	65 mm to 100 mm	450 mm	1000 mm

### 3.10. Sand Filling

GI pipes in trenches shall be protected with fine sand 150mm all around before filling in the trenches.

### 3.11. Painting:

All pipes above ground shall be painted with one coat of red oxide and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard color code specified by the Architect/Consultants.

### 3.12. Pipe protection:

Where specified in the schedule of quantities all pipes in chase below ground shall be protected against corrosion by applying two coats of bitumen paint wrapping with polythene tape and finishing with one more coat of bitumen paint.

### 3.13. PIPING INSTALLATION:

Tender drawings indicate schematically the size and location of pipes. The contractor on the award of the work, shall prepare detailed working drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain valves and all pipe support, structural supports. He must keep in view the specific openings in buildings and other structures through which pipes are designed to pass.

- a) Piping shall be properly supported on or suspended from clamps, hangers as specified and as required. The contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency.
- b) Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated back. Where pipe and clamps are of dissimilar materials a gasket shall be provided in between. Spacing of pipe supports shall not exceed the following:



S.No	Pipe Size	Spacing between Supports
1	Upto 15 mm	1.5 m
2	15 mm to 150 mm	2.0 m
3	150 mm and above	2.5 m

- c) Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars steel structural supports attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lowest point and air vent at the highest point.
- d) Pipe sleeves, 50 mm larger diameter than pipes, shall be provided wherever pipes pass through walls and slabs, and annular space filled with fiberglass and finished with retainer rings.
- e) All pipe work shall be carried out in a workmen like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work so that particular area work shall be carried out in one trench.
- f) Cut outs in the floor slab for installing the various pipes are indicated in the drawings. Contractor shall carefully examine the cut outs provided and clearly point out wherever the cut outs shown in the drawings, do not meet with the requirements.
- g) The contractor shall make sure that the clamps, steel structural supports, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes, and include expansion joints where required.
- h) All pipes shall be accurately cut to the required sizes in accordance with relevant codes and burrs removed before laying. Open ends of the pipes shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used.

#### **4. CPVC PIPES & FITTINGS (For Water Supply Inside Toilets)**

The pipes shall be CPVC (Chlorinated Poly Vinyl Chloride) material for hot & cold water supply piping system with pipes as per CTs SDR -11at a working pressure of 320 PSI at 23 deg C and 80 PSI at 82 deg.C, using solvent welded CPVC fittings i.e. Tees, Elbows, Couplees, Unions, Reducers, Brushing etc. including transition fittings (connection between CPVC & Metal pipes / GI) i.e. Brass adapters (both Male & Female threaded and all conforming to ASTM D-2846 with only CPVC solvent cement conforming to ASTM F-493, with clamps / structural metal supports as required /directed at site including cutting chases & fitting the same with cement concrete / cement mortar as required, including painting of the exposed pipes with one coat of desired shade of enamel paint. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction of manufacturer & Project Manager. The material shall have to be gotten approved from Chief Fire Officer.

##### **i. Joining Pipes & Fittings**

- a. Cutting:

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

- b. **Deburring / Beveling:**  
 Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fittings during assembly.
- c. **Fitting preparation:**  
 A clean dry rag/cloth should be used to wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.
- d. **Solvent Cement Application:**  
 Only CPVC solvent cement conforming to ASTM-F493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket, otherwise too much of cement solvent can cause clogged water ways.
- e. **Assembly**  
 After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up.

An even bead of cement should be evident around the joint and if this bead is not continuous remake the joint to avoid potential leaks.

Set & Cure times:

Solvent cement set and cure times shall be strictly adhered to as per the below mentioned table.

Minimum Cure prior to pressure testing at 150 PSI

Ambient Temperature during Core period	Pipe Size	
	½ " - 1"	1.¼" - 2"
Above 15 deg. C	1 Hr	2 Hrs
4-15 deg.C	2 Hrs	4 Hrs
Below 4 deg C	4 Hrs	8 Hrs

Special care shall be exercised when assembling flow guard systems in extremely low temperature ( below 4°C) or extremely high temperature (above 45°C) In extremely hot temperatures, make sure that both surfaces to be joined are till wet with cement solvent when putting them together.

f. **Testing**

Once an installation is completed and cored as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 psi(10 Bar) for one hour. During pressure testing, the system should be fitted with water and if a leak is found, the joint should be cut out and replacing the same with new one by using couplers.

ii. **Transition of Flowguard CPVC to Metals**

When making a transition connection to metal threads, special Brass / plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torqued Hard tight pluts one half turn should be adequate.

iii. **Threaded Sealents**

Teflon tape shall be used to make threaded connections leak proof.

iv. **Solvent Cement**

Only CPVC solvent cement conforming to ASTM F 493 should be used for joining pipe with fittings and valves. Flowguard CPVC cement solvent have a minimum shelf life of 1 year. Aged cement solvent will often change colour or being to thicken and become gelatinous or jelly like and when this happens, the cement should not be used. The cement solvent should be used within 30 days after opening the company's seal and tightly close the seal after using in order to avoid its freezing. The freezeed cement solvent should be discarded immediately and fresh one should be used. The CPVC solvent cement usage should be adhered to as given in table below

<b>Diameter of pipe in inch ( flowguard)</b>	<b>½"</b>	<b>¾"</b>	<b>1"</b>	<b>1¼"</b>	<b>1½"</b>	<b>2"</b>
Approx. nos. of joints which can be mode per litre of solvent cement.	200 Nos	180 Nos	150 Nos	130 Nos	100 Nos	70 Nos

v. **Hangers and supports**

For Horizontal runs, support should be given at 3foot (90 cm) intervals for diameters of one inch and belwo and at 4 foot (1.2m) intervals for larger sizes.

Hangers should not have rough or sharp edges which come in contact with the tubing.

Supports should be as per the below mentioned table:

<b>Size of Pipe</b>	<b>21°C</b>	<b>49°C</b>	<b>71°C</b>	<b>82°C</b>
<b>Inch</b>	<b>Ft.</b>	<b>Ft.</b>	<b>Ft.</b>	<b>Ft.</b>
½"	5.5	4.5	3.0	2.5
¾"	5.5	5.0	3.0	2.5
1"	6.0	5.5	3.5	3.0
1¼"	6.5	6.0	3.5	3.5

1½"	7.0	6.0	3.5	3.5
2"	7.0	6.5	4.0	3.5

**5. Pipe Support:**
**a) Pipe Support from RCC Slab**

<b>6. Description</b>
<p><b>Clamps :</b>            The Plumbing Pipes should be simply supported by Split Clamps.            Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.            The Split clamp should have an <b>EPDM rubber</b> lining which will prevent the direct contact of Pipe with the steel.            The rubber lining should have the capacity to reduce the structure borne noise vibration to up to <b>18 dB and 22dB</b> for waster water pipe.            Pipe clamp should be as per <b>DIN 3576</b> if support for metal pipe            The support installation should be as per <b>international plumbing code</b>.            The Clamp should have the temperature capacity of -50 degree Celsius to +150 degrees Celsius.</p> <p><b>Support Channel :</b>            In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b></p> <p>The Support channel should be <b>pre galvanised with minimum GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes on back of the rail</b>.</p> <p>The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b></p>
<p><b>Accessories :</b>            The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b>.</p>
<p><b>Anchors :</b>            The Drop-in anchors used for the suspension of the rods should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete.</p> <p>It should be divided into four expansion segments for uniform pressing force distribution in the borehole.</p>
<p><b>Calculations and Approvals :</b>            The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.</p>

**b) Pipe Support from shaft**

<b>Description</b>
<p><b>Clamps :</b>            The Plumbing Pipes should be simply supported by <b>Split Clamps</b>.            Split Clamps should be pre-galvanised and should have a two-piece arrangement with ribbing reinforced clamp body and two captive tightening bolts, secured with loss washers for non-slipping high load bearing capacity.</p> <p>The Split clamp should have an <b>EPDM rubber lining</b> which will prevent the direct contact of Pipe with the steel. The rubber lining should have the capacity to reduce the structure borne noise vibration to up to <b>18 dB and 22dB</b> for waster water pipe.            Pipe clamp should be as per <b>DIN 3576</b> if support for metal pipe</p>

The support installation should be as per **international plumbing code**.

The Clamp should have the temperature capacity of -50 degree Celsius to +150 degree Celsius.

**Support Channel :**

In the case of multiple pipes, the supporting arrangement should be made using support channel made up of cold rolled steel of quality **DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1**

The Support channel should be **pre galvanised with minimum GSM of 275** and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible **round and long holes on back of the rail**.

The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to **RAL - GZ 655-C**.

In the case of pipe sizes beyond 4" for the steel pipe, it should be clamped with either a Split pipe clamp with all round welded nut or by using a Pipe strap.

**Accessories :**

The Threaded Rods used for the fixing Pipe clamp with channel that should be made up of partially annealed medium carbon steel of grade **4.8 strength class and as per DIN 976 standard**.

**Anchors :**

The Drop-in anchors or stud anchor used for the channel fixing with shaft that should be **ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark** for cracked and un-cracked concrete.

It should be divided into four expansion segments for uniform pressing force distribution in the borehole.

**Calculation and Approvals :**

The load bearing capacity for the selection of the split clamp for suitable size of the pipe should be provided by the contractor to the consultant for verification.

**7. TESTING:**

- 7.1 All pipes, fitting and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure.
- 7.2 Pressure shall be maintained for a period of at least thirty minutes without any pressure drop.
- 7.3 A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Project Manager.
- 7.4 In addition to the sectional testing carried out during construction, Contractor shall test the entire installation after connection to the overhead tanks or pumping system or mains. Contractor shall rectify all leakages and shall replace all defective material 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 good by the Contractor during the defect liability period without any cost.
- 7.5 After commissioning of 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 operated shall be replaced by new ones at no extra cost and same shall be tested as above.

**8. MEASUREMENT AND RATES:**

- 8.1 General:

- a) Rates for all items shall be inclusive of all work and items called for in the specifications given above and the Schedule of Quantities as applicable for the work under floors, in shafts or at ceiling level at all heights and depths.
- b) All rates are inclusive of cutting holes and chases in RCC and masonry work and making good the same.
- c) All rates are inclusive of pre testing at site and final testing of the installations, materials and commissioning.

#### 8.2 Pipes:

- a) The unit of measurement shall be linear metre to the nearest centimeter.
- b) All water supply pipes shall be measured net, when fixed correct to a centimeter, including all fittings along their length after fixing. The length shall be taken along center line of the pipes and fittings. No allowance shall be made for the portions of pipe lengths entering the sockets of the adjacent pipes or fittings. The above shall apply to all cases i.e. whether pipes are fixed on wall face or pillars or embedded in masonry or pipes running at ceiling level. The quoted rate shall include lead jointing.

#### 8.3 Pipe Encasing/ Supports:

Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports, shuttering and centering, curing, cutting etc. complete as described in the relevant specifications.

#### 8.4 Angles/ Channels:

Slotted angles/ channels shall be measured per linear metre of finished length and shall include support bolts and nuts, length embedded in the cement concrete blocks of 1 : 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate 20mm nominal size) formed in the masonry walls; nothing extra shall be paid for the cement concrete block and making good the masonry wall, anchor fasteners etc. complete.

### 9. BALL VALVES:

- 9.1. Ball valves shall be Full Bore Nickel Plated heavy duty of approved make and of the following specifications

Sizes: 15 mm to 50 mm

Body: Forged Brass CW617N

Bonnet: Forged Brass CW617N

Ball: Forged Brass

Stem: Forged Brass

Seat: PTFE

O-Ring: EPDM WRAS Approved

Packing Nut: Forged Brass

Handle: Steel Q235 with Blue Zinc Plating with PVC RAL 5002

Hex Nut: Steel Q235 Lock Nut Nylon

Joint: Threaded/Screwed/Flanged

Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)

Test Pressure: 1.5 Times of Working Pressure

**10. BUTTERFLY VALVE:**

- 10.1. All butterfly valves shall be heavy duty cast iron of approved make. The valves shall conform to the following specifications. Butterfly valve shall be of best quality conforming to IS: 13095 and AWWA Standard

Sizes: 65 mm to 200 mm

Body: CI

Disc: DI (ENP)

Liner: EPDM

Stem: ASTM A276, GR SS410

Bush: PTFE/Nylon

O-Ring: EPDM

Notch Plate: MS Powder Coated

Hand Lever: MS Powder Coated

Fastener: GI

Joint: Threaded/Screwed/Flanged

Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)

Test Pressure: 1.5 Times of Working Pressure

**11. Dual Plate Check Valve:**

- 11.1. All Check valves shall be heavy duty cast iron of approved make. The valves shall conform to the following specifications.

Body: CI

Seat: EPDM

Plates: DI (Lapped)

Shaft: ASTM A276, GR SS410

Spring: AISI 302

O-Ring: Nitrile

Plug: MS Chrome Plated

Fastener: SS

Joint: Threaded/Screwed/Flanged

Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)

Test Pressure: 1.5 Times of Working Pressure

**12. Y-Strainer:**

- 12.1. All Check valves shall be heavy duty cast iron of approved make. The valves shall conform to the following specifications.

Body: CI

Strainer Mesh: SS-304

Gasket: EPDM

Cover: CI

Bolt & Nuts: CS/GI

Joint: Threaded/Screwed/Flanged

Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)

Test Pressure: 1.5 Times of Working Pressure

**13. Pressure Reducing Valve Station:**

- 13.1. All Check valves shall be heavy duty cast iron of approved make. The PRV station shall have the following sequence.



13.2.

**Main Line Inlet:**

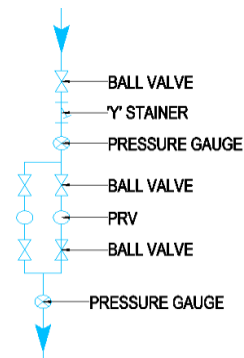
Ball Valve  
Y-Strainer  
Pressure Gauge

**PRV Main Branch:**

Ball Valve  
PRV  
Ball Valve

**PRV Bypass Branch:**

Ball Valve



**Main Line Inlet:**

Pressure Gauge

**PRV:**

Body: Forged brass nickel plated with brass diaphragm  
Seal: Stainless Steel  
O-Ring: NBR Nitrile Elastomeric Diaphragm  
DZR Brass Rod  
End: Screwed BSP female  
Pressure Range: 10 Bar down to 1.5 Bar (adjustable)

**Note: In the sketch the PRV shown on bypass line is indicative and no prv has to be provided on bypass.**

**14. Electrical Water Meter**

- Water meters shall be of multi jet magnetic drive (turbine type), Displacement and accumulative reading type, Conforming to local water works Authority standard.
- It shall be BMS compatible with MODBUS or Bacnet over IP
- Working pressure shall be corresponding with piping system.
- Standard: ISO 4064, AWWA, EEC
- Maximum working pressure: As per BOQ
- Test Pressure: 1.5 times the working pressure
- Maximum liquid temperature: 60°C
- Body MOC: Cast Iron, Polyester Coated
- Application: Potable and Drinking Water Supply
- Accuracy: The minimum Flow Meter shall be 35-58% below the ISO standard and maximum flow rate shall be ISO-233%.
- Ratio: The ratio between the extreme flow rates (Qmin and Qmax) shall be as per manufacturer specifications.

**15. Air Vent**

15.1. Air Vents shall be installed on top of water supply risers and shall conform to EN29000-ISO9000

Body: Forged Brass  
Seal: EPDM  
Float: PP  
Spring: Stainless Steel  
Pressure Rating: PN10

**16. DUCTILE IRON (D I) PIPE FITTINGS (For Water Line from Municipal line to UGT)**

- 16.1. Pipe laid in ground for water supply of municipal connection shall be laid in trenches/underground shall be of DI class K-9 of required dia and size as per drawing/design including trenching necessary fittings like union collar bends and tees with tital joints. The technical specification of ductile iron pipe confirm to indian standard is : 8329-1994, IS : 2531-1998 and EN : 545-1994
- 16.2. The ductile from pipe shall be strong, both inner and outer surfaces are smooth, free from lumps, crakes blister and scares.
- a) The ductile iron pipe shall be lined with cement moter in the manufacturing unit by centrifugal process.
  - b) The ductile iron fitting shall confirm to IS: 9523-1980
  - c) The joints for ductile iron pipe shall suitable for rubber gasket conforming to IS :5383
  - d) Laying and jointing shall be similar to cast iron pipes.
  - e) The test pressure shall be 1.5 times the maximum sustained operating pressure and the test pressure shall be as per IS: 8329-1994
  - f) Slotted angles/ channels shall be measured per linear metre of finished length and shall include support bolts and nuts, length embedded in the cement concrete blocks of 1 : 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate 20mm nominal size) formed in the masonry walls; nothing extra shall be paid for the cement concrete block and making good the masonry wall, anchor fastners etc. complete.

-----: END OF SUBHEAD :-----

**SUBHEAD-4. GARDEN HYDRANT SYSTEM:****1. SCOPE OF WORK:**

- 1.1. Work under this section consist of providing and fixing all labor, materials equipment and appliances necessary and required to install garden hydrants system as pe direction of engineer in charge the pipes shall be GI of required diameter by considering the size shape location and requirement flow of gardening purposes..
- 1.2. Without restricting to the generality of the foregoing the Garden Hydrant System shall include the following:
  - a) Ring main & branch connections.
  - b) Manholes (masonry chamber)
  - c) Garden hydrants.
  - d) Excavation and refilling of pipes trenches.
  - e) Connections tapping from Irrigation Water Lifting Pump located at Sewage Treatment Plant [STP].
  - f) Testing the entire Garden Hydrant System.

**2. GENERAL REQUIREMENTS:**

- 2.1. 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.
- 2.2. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3. Short of long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.
- 2.4. Pipes shall be laid in a manner as to provide as far as possible easy accessibility for repair and maintenance.
- 2.5. Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.
- 2.6. All excavation, trenching, painting, sand filling, pipe protection and pipe installation as shall be as per CPWD specifications and directions of engineer in charge.

**3. *uPVC PIPES – For Irrigation System*****3.1 Definition**

uPVC pipe means unplasticized Polyvinyl Chloride pipe , confirming to IS: 4985. It has density of Approx. 1.43 g / Cm<sup>3</sup> as such it is less than 1/6<sup>th</sup> the weight of C.I. and steel pipes, therefore easier to handle during installation and transportation.

3.2 The uPVC Pipes to be used for Portable water to be odorless and hygienic, and should have inside surface mirror smooth.

3.3 The Pipes should have high corrosion resistance and should be immune to chemical electrolytic and galvanic action.

3.4 These Pipes should be longer lasting because of corrosion resistance property.

3.5 **Handling Guidelines**

Pipes should be kept on an even surface while storing. They should be properly supported and should not be stacked for heights more than 1.5 meters for longer duration.

3.6 **Jointing Instructions**

The uPVC Pipes are of two types i.e. Selfit and Ringfit. The following procedure may be adopted while jointing the Pipes: -

(a) **Selfit Pipes**

- Cut the Pipes as square as possible and ensure fitment of Pipes with socket of fitting is correct. Total length of insertion of sockets to be marked from the Pipe.
- The Pipe and the socket should be clean and dry. Dust, Oil, water, grease etc. should be wiped out with dry cloth or cleaner from the surfaces to be coated with Solvent Cement.
- Roughen the outside of Pipe and inside of Socket using sand Paper up to the entry mark. Stir adhesive i.e. Solvent Cement thoroughly.
- Apply thick coat of Solvent Cement using a flat clean brush evenly on the inside of the socket mouth for full length of insertion and then outside of the Pipe end up to the marked line.
- After application of Solvent Cement, insert the Pipe within one minute in to the Socket. Hold the Joint for few seconds and ensure that the Pipe does not come out of the fittings. Wipe off extra cement and allow it to dry for at least 24 Hours. The PVC Pipe with joint is ready for use.

**Consumption of Solvent Cement**

Diameter of Pipe (mm)	20	25	32	40	50	63	75	90	110	160	200	250	315	400
Approx. No: of joints which can be made per liter of Solvent cement	324	270	225	180	130	125	103	79	54	27	15	9	5	2

(b) **Ring-fit Pipes**

- Clean the inside of Socket. Remove all traces of mud, dirt, grease, gravel and also clean sealing ring.
- Form the EPDM ring into heart shape by pinching a portion of ring inside. Insert it into the socket and release to seat in to the groove.
- Mark the insertion depth on spigot portion of the pipe. Clean and apply lubricant to insertion depth before pushing in to the Socket. Ensure that no sand or dirt adheres to the lubricated surface of the Pipe.
- Push the Spigot into the Socket until it reaches the depth of entry mark, taking care not to over insert. This can be done manually. Make sure that the insertion of Spigot end inside the socket should be at correct angle. The Pipe and Joint are ready for use.
- In case of large diameter Pipes if crow bar does not give sufficient leverage, use of jointing jack may be helpful.

**Precautions**

1. uPVC Pipes and Fittings should not be cleaned by Solvent Cement.
2. For large diameter and Higher class Pipes ( $6 \text{ kgf/cm}^2$  & above), use heavy duty Solvent cement.
3. uPVC pipes and fittings to be used of same Brand and Manufacturer.

-----: **END OF SUBHEAD** :-----

**SUBHEAD-5. EXTERNAL SEWER, STORM WATER DRAINAGE & RAIN WATER HARVESTING PIT:****1. Scope of Work:**

- 1.1. All underground Storm Water Drainage Pipe of all the building shall laid in proper slope ad required pipe and material capable to smooth flow of water in accordance with designed system.
- 1.2. The scope includes all catch basin, storm manholes..
- 1.3. All underground Storm Water Drainage work include earth work in excavation for all type of soils, disposal, and compaction, Pipe laying, Pipe Embedment and back filling, Testing complete.
- 1.4. Submit shop drawings detail and descriptive literature showing pipe dimension, joint and fitting details, recommended method of cutting pipes and other relevant detail etc. all complete as per engineer in charge.
- 1.5. Taking approval and all Liasoning work under in scope of contractor.

**2. General Requirements:**

- 2.1. All material shall be new and of the best quality conforming to CPWD specification.
- 2.2. Establish and maintain quality control to assure compliance with contract document and local codes (Local municipal bye Laws).
- 2.3. All Storm Water Drainage Line/Open Drain Channel shall be laid to the required gradients and profile.
- 2.4. All drainage work shall be done in accordance with Local Municipal bye laws.
- 2.5. Water works shall be executed as per CPWD specification.

**3. Reinforced cement concrete pipes for Underground Installation:**

3.1.1 All underground storm water drainage pipes where specified (other than those specified cast iron Hubless) shall be centrifugally spun S & S RCC pipes of specified class NP3 as specified in schedule of quantities. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

**3.1.2 Laying**

R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. Cradles or concrete bed may be omitted, if directed by the Project Manager.

**3.1.3 Jointing**

After setting out the pipes the socket shall be centered over the spigot and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools.

All joints shall be finished at an angle of 45 degrees to the longitudinal axis of the pipe on both sides of the collars neatly.

### 3.1.4 Testing

All pipes shall be tested to a hydraulic test of 1.5 m head for atleast 30 minutes at the highest point in the section under test. Test shall also be carried out similar to those for stoneware pipes given above. The smoke test shall be carried out by the Contractor, if directed by the A test register shall be maintained which shall be signed and dated by Contractor, / Project Manager.

### 3.0 UPVC Drain Pipe for Underground Installation:

- 3.1. Providing and fixing of underground Sewerage/Drainage Pipe of UPVC conforming to IS: 15328-2003 of normal ring stiffness SN specified.
- a) All specification shall be as per CPWD.
  - b) Fittings for U-drain pipe shall be molded fitting conforming to BS: EN-1401-1998.
  - c) Rubber ring/solvent shall be of make and type approved by pipe and fitting manufacturer. Joint shall be made in an approved manner as recommended by the manufacturer.
  - d) Provide cement concrete around of U-drain pipe
  - e) Dimension and stiffness class of U-drain pipes as per IS: 15328-2003.

S. No.	Normal Ring Stiffness SN (KN/m <sup>2</sup> )	2	4	8
	SDR	51	41	34
	OD mm (D)	Wall Thickness (t)		
1	110	-	-	3.2 + 0.5
2.	125	-	3.2 + 0.5	3.2 + 0.7
3.	160	3.2 + 0.5	4.0 + 0.6	4.7 + 0.7
4	200	3.9 + 0.6	4.9 + 0.7	5.9 + 0.8
5	250	4.9 + 0.7	6.2 + 0.8	7.3 + 1.0
6	315	6.2 + 0.8	7.7 + 1.0	9.2 + 1.2
7	400	7.9 + 1.0	9.8 + 1.2	11.7 + 1.4

### 3.2 Excavation and Preparation of Trench:

- f) Open trenches only as for in advance of pipe laying in order to maintain continuity of operations. Keep trench and other excavation dry at all times, and lead drainage to natural drainage channel.
- g) The width of the trench at the crown of the pipe should be as narrow as practicable but not less than the outside diameter of the pipe plus 300 mm to allow proper compaction of the side fills and at a height of 225 mm above the crown of the pipe the trench may be of any convenient width.
- h) Depth of trench plays an important role and depend on the diameter of the pipe and cover required, depth of beam and slope of pipes.
- i) The minimum depth should be width plus outer diameter of pipe or 0.75 m above the crown of pipe, whichever is more.
- j) The excavated material should be deposited at a sufficient distance away from the edge of the trench to avoid damage to the pipes through falling stories or debris.
- k) As with pipe of other materials, it is necessary to ensure with PVC pipes, that sharp edged objects such as large flints do not bear directly upon the pipes, and also that they are not placed in a way where they may come in contact with such tough objects with the passage of times.

#### 3.2.1 Trench Bottom

The trench bottom should comply with limiting width set out in the following table:-

S. No.	Nominal Pipe Size (mm)	Trench width (mm)	
		Min.	Max.
1.	110	450	600
2.	160	450	600
3.	200	600	700
4.	225	600	700
5.	250	600	700
6.	315	700	850
7.	355	750	900
8.	400	800	950
9.	450	850	1000

#### 3.2.2 Depth of Cover

Normally, pipes should be laid with cover measured from the top of pipe to the surface of the ground, of not less than:

- a) 1.2 M under roads
- b) 1.0 M in agriculture land
- c) 0.5 M in garden with boundaries of dwelling.



### 3.2. Pipe Laying:

3.3.1 Pipes should be lowered into the trench with tackle suitable for the weight of the pipes using suitable lifting slings preferably flat. On no account should chains or wire ropes be used.

3.3.2 When unstable trench walls are encountered, this condition must be stabilized before laying the pipe. To obtain the desired lateral support for pipe laid, the trench width should be a maximum of 5 pipe diameter, otherwise sheeting, trench box or any other method would be used to control such condition. In some severe cases, well points or underdrain may be used to control excessive ground water conditions.

### 3.3. Pipe Jointing:

3.4.1 Clean the inside of socket, remove all traces of mud, dirt, grease, gravel and clean elastometric sealing ring.

3.4.2 Form the ring into a hearth shape by pinching a portion of ring from inside. Insert into the socket and release to seat into the groove.

3.4.3 Factory supplied pipes are provided with a 15o chamfer. Mark the insertion depth on spigot portion of pipe. Clean and apply lubricant to insertion depth before pushing in to the socket.

3.4.4 If pipe need to be cut, it should be cut perpendicular to the axis of the pipe. Then it should be chamfered properly.

3.4.5 Align the socket and spigot correctly in the horizontal and vertical planes (before insertion, ensure that no sand or dirt adheres to the lubricated surface of the pipe). Care should be taken that the spigot end is inserted in the socket at the correct angle.

3.4.6 Push the spigot into the socket until it reaches the depth of entry mark, do no over insert. This must be done manually. Use a steel crow bar if necessary. Protect the pipe with wooden block. Insertion of spigot end inside the socket should be at the correct angle.

3.4.7 In case of large diameter pipes, if crow bar does not give sufficient leverage, use of a jointing jack may be helpful.

### 3.5 Bedding & Side filling:

3.5.1 The bedding should be thoroughly compacted in layers not more than 150 mm thick to give a uniform bed, true to gradient on which the pipe may be laid so that they maintain substantially continuous contact with the bed. Excavation should be made under the bell of each pipe so that the entire length of the pipe, except the bell, will be supported on the bottom of the trench. If due to steep gradient or waterlogged conditions, the bedding tends to act as a drain for subsoil water, the insertion of water stops by means of puddle clay dams across the trench may be necessary to resist the passage of water.

3.5.2 Provide concrete encasement to pipeline where indicated to dimensions and lengths specified on the drawings. Concrete for encasement shall have compressive strength of not less than 21.0 MPa. Protect pipeline from damage or displacement by the encasement operations. Provide appropriate concrete saddles to support pipes prior to encasement. Concrete encasement shall be discontinued for a length of 150 mm each side of the centre line of each pipe joint, to maintain flexibility of the pipeline.

- 3.5.3 The prepared under-bed should consist of bedding material laid to the correct gradient and depth over the full width of the trench as excavated and should give uniform support to the pipe over its entire length. In normal clay excavation, the thickness of the bedding under the barrel of the pipe should not be less than 1/3rd of the diameter, and a minimum of 100mm. In rock, a thickness of at least 150 mm should be provided.
- 3.5.4 With flexible pipes it is of great importance that the side fill should be firmly compacted between the sides of the pipe and the soil sides of the trench. The bedding should be thoroughly compacted in layers not more than 150 mm thick to give a uniform bed, true to gradient, on which the pipe may be laid. Pipes should be laid directly on this bedding. Bricks or other hard materials must not be placed under the pipes for temporary support. Further bedding material should be placed around the pipe and be thoroughly compacted in 75 mm layers by careful tamping up to the crown of the pipe, eliminating all cavities under the two lower quadrants of the pipe.
- 3.5.5 The same material should then be placed over the crown of the pipe for not less than 2/3rd of the diameter, with a minimum height of 300 mm and be thoroughly compacted. The process of filling and tamping should proceed equally on either side of the pipe, so as to maintain equal pressure on both sides.
- 3.6 Backfilling:
- 3.6.1 For protection of the pipe, the sidefilling and initial backfilling operations should be carried out as soon as possible, after the pipes have been laid and tested.
- 3.6.2 The entire pipe work outside the building shall be covered with wooden box and shall be provided with proper identification tags/wires to avoid damage of pipes due to Heavy vehicle movement or any further excavation work in that area.
- 3.6.3 The material should be placed and compacted by hand in layers not more than 100 mm thick and should extend over the crown of the pipe to a depth of 100 mm for 110 mm pipe and 150 mm for pipes of larger diameter. It should extend over the full width of the trench as excavated. If 'as-dug' material contains stones larger than 40mm, or the pipe is deeper than 2 meter in poor ground, extend the processed granular material for at least 100 mm above the pipe crown,. In both cases, hand tamps the material fully at the sides of the pipe simultaneously, while tamping lightly over the crown. Continue hand tamping until a finished layer of 300 mm has been placed over the pipe. Mechanical compactors, other than hand vibrators, should not be used until the total depth of backfill over the pipe is 450 mm.
- 3.7 Testing:
- 3.7.1 All testing shall be done in accordance with IS: 15328 and IS: 5329 except as may be modified herein under.
- 3.7.2 All lengths of the storm/drain/pipelines shall be fully tested for water tightness by means of water pressure. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5m head of water at the highest point of section under test. The test pressure shall, however, not exceed 6m head at any point. The pipes shall be plugged preferably with upper end shall, however, be connected to a pipe for filling with water and getting the required head. The Storm Water Drainage Pipe Line shall be filled with water and left to stand for 24 hours and topped up. The leakage over 24 hours shall then be measured.
- 3.7.3 Storm lines shall be tested for straightness and obstruction by:

- a) Inserting a smooth ball 13mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end, means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light shall be seen otherwise obstruction or deviation shall be apparent.
- 3.7.4 A test register shall be maintained which shall be signed and dated by the Contractor and the Architect/Consultants.
- 3.7.5 The pipeline shall be covered only after the testing is successfully completed & verified & signed by the Site engineer with date & time.

#### 4. Manholes and Chambers:

- 4.1. All manholes, chambers and other such works as specified shall be constructed in brick masonry as per CPWD specification or as specified in the Drawings.
- 4.2. All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:4 (1 cement: 4 coarse sand) or as specified in the Schedule of Quantities.
- 4.3. All manholes and chambers, etc shall be supported on base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the drawings.
- 4.4. Where not specified, manholes shall be constructed as follows:

(All dimensions are clear internal dimensions in mm)

Size of Manholes Type of Manhole	900x800 Rect.	1200x900 Rect.	900 dia Conical	1200 dia Conical
Maximum Depth	1000	2400	1650	2300
Average thickness of RCC slab	150	150		
Reinforcement	As directed by Architect/Consultants			
Size of Cover and Frame	600x450	560dia	560dia	560dia
Weight of Cover and Frame	38 kg light duty	182 kg heavy duty HD 20	182 kg heavy duty HD 20	182 kg heavy duty HD 20

- 4.5. All manholes shall be provided with cement concrete benching in 1:2:4 nominal mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have slope of 1:10 towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.
- 4.6. All manholes shall be plastered with 12/15mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster with waterproofing compound.
- 4.7. All manholes with depths greater than 0.8m shall be provided with 20 mm square or 25 mm round CI foot rests set in cement concrete blocks 250x100 mm in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size), at 300 mm center to center vertically and staggered. Foot rests shall be coated with coal tar before embedding.

4.8. All manholes shall be provided with Steel Fibers Reinforced Concrete (SFRC) with frame as specified in the Schedule of Quantities or given above.

**5. Measurement and Rates:**

5.1. ~~UPVC~~ RCC Drain pipes shall be measured for the finished length of the pipeline per linear meter.

- a) Lengths between manholes shall be recorded from inside face of one manhole to inside face of other manhole.
- b) Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside face of manhole. Rate shall include all items given in the Schedule of Quantities and specifications.

5.2. Manholes:

- a) All manholes shall be measure by numbers and shall include all items specified above and necessary excavation in all types of soils, refilling, compaction and disposal of surplus earth.
- b) Manholes with depths greater than that specified under the main items shall be paid for under “extra depth” and shall include all items as given for manholes. Measurement shall be done to the nearest centimeter. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.

-----: END OF SUBHEAD :-----

**SUBHEAD-6. WATER SUPPLY, DRAINAGE PUMPS & EQUIPMENT****1. Scope of work**

1.1. Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to supply, install and commission the water supply and drainage pumps as described hereinafter and given in the Drawings and/or shown on the drawings.

**2. General requirements**

- 2.1. All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer in charge.
- 2.2. All equipment shall be of the best available make manufactured by reputed firms.
- 2.3. All equipment shall be installed on suitable foundations true to level and in a neat workmanlike manner.
- 2.4. Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.
- 2.5. Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.
- 2.6. Each pumping set shall be provided with a butterfly valve on the suction and delivery side and a flap type non return valve on the delivery side.
- 2.7. All pump couplings and belt guards for air compressors shall be totally enclosed with 5 mm mesh.

**3. System of Water Supply**

- 3.1. The water supplied by the authorities and tanker water will be stored in the raw water U.G. tank.
- 3.2. Raw water after treatment in a water filtration plant will be stored in the domestic tank.
- 3.3. Water from domestic U.G. tank shall be pumped to supply domestic water to the entire building by means of a hydro-pneumatic system.

**Specifications for Pumps****4. Hydro-pneumatic Pumps**

- 4.1. Water supply pumps shall be suitable for clean filtered water.
- 4.2. All parts in contact with water shall be corrosion resistant stainless steel DIN-Nr.1.4401.
- 4.3. Pump or the whole set shall be stable on rubber vibration eliminating pads appropriate for each pump as recommended by the manufacturer and accepted by the Engineer in charge.
- 4.4. The HPN Set shall be Pre-engineered, factory fabricated, factory assembled & tested, fully integrated, highly efficient pump, skid mounted Hydro Pneumatic system.
- 4.5. It shall be complete ready-to-connect packaged variable speed water pressure booster station, pump fitted with
  - a) 3-phase, fan-cooled, permanent-magnet synchronous motors, motor efficiency is classified as IE3/IE5 in accordance with IEC 60034-30-2.

- b) The packaged variable speed water pressure booster station shall be complete with vertical inline multi stage centrifugal pumps, high efficiency IE3/IE5 motors and should comply to the highest minimum efficiency index MEI 0.7.
- c) The motor integrated with dedicated frequency converter in the motor terminal box. This enables continuously variable control of the motor speed, which again enables adaptation of the performance to a given requirement.
- d) The pump shall consist of Cast iron with CED coated base & head, SS-304 casing chamber and impeller and SS-304 shaft along with TEFC motor & mechanical seal, pressure transmitter, NRV, Isolation valve on delivery line. Isolation valve (PN-16), strainer at suction.
- e) The pump shall be suitable for  $415 \pm 10\%$  volts 3 phase AC. Supply, complete in all respects as per directions of Engineer in charge. A dedicated intelligent multi-pump logic controller for control and monitoring of pumps shall be from the pump manufacturer with easy interface graphical display unit with key function. Modbus for BMS; hot Dipped Galvanized suction and delivery CED coated manifolds; isolation ball valves on suction and discharge of each pump; non return valve on discharge side of each pump; flow meter with 4-20mA output; hot dip galvanized common base frame; and diaphragm pressure vessel PN16.

#### 4.6. Pump:

Pump Head - Cast Iron EN-GJ-200  
 Shaft- Stainless Steel 316 or Better  
 Impeller - Stainless Steel 304 or SS316  
 Outer Sleeve - Stainless Steel 304 or Better  
 Chamber - Stainless Steel 304 or Better  
 Pump Base- Cast Iron EN-GJL-250 or SS304 or SS316  
 Coupling Guard- Stainless Steel 430  
 Shaft Seal- Stainless Steel 316  
 Neck Ring – PTFE  
 O-Ring for Sleeve - EPDM or FKM  
 Shaft Seal (Seal Face) - Silicon Carbide/SiC  
 Rubber Parts - EPDM or FKM

#### 4.7. Motor:

Efficiency class--IE3/IE5 (as per BOQ)  
 Totally enclosed fan-cooled, squirrel cage permanent magnet motor  
 Insulation class-F  
 Enclosure class-IP 55  
 Supply Frequency-50Hz  
 Electrical Tolerance comly with EN 60034  
 Supply voltage-3X380-500V  
 Built in Thermistor-PTC

#### 4.8. Controller:

A dedicated intelligent multi-pump logic controller for control and monitoring of pumps shall be from the pump manufacturer with easy interface graphical display unit with key function. Controller should be able to monitor multiple operating parameters (flow, inlet pressure, outlet pressure, cumulative flow and speed etc. to calculate best operating algorithm to pump sequence optimally. The system should be able to provide information about -operation set point of system, speed of individual pump, power

& energy consumption of individual pump, running hours of individual pumps, operation mode, control mode, process value and set point of the system, fault readout. Also should have some additional functions namely -

- a) Maximum Limit Control unit shall be able to cut off the system when excess pressure in discharge common manifold is register
- b) Minimum Limit Controller should be able to cut off booster system in case of low pressure registered
- c) Dry Run Protection Controller should be capable of receiving either analogue or digital input signal concerning shortage of water supply, preventing dry run.
- d) Alarm Log Controller should store at least 5 fault conditions experienced by the pump system for subsequent display when panel is interrogated.
- e) Master Slave Controller of each pump should be able to function without the need of a external controller to alternating time, energy, and cascade control.
- f) Stop Function Controller must incorporate an energy saving function that allows the system when there is no or very little consumption.
- g) Standby Pump In case if failure due to motor overload, the standby pump is switched on automatically, alarm signal should be displayed on display unit and alarm lights should be activated.
- h) Pipe Filling Function Control Unit should ensure soft start of systems with from instance empty pipework. The pipework shall slowly fill with water in an empty pipework, when the pressure sensor of the system detects the pipework has been filled with water, the pressure is increased until it reaches set point.
- i) Pump Alternation System must ensure automatic equal running hours of pumps

#### 4.9. Pressure tank capacity:

(As per manufacturer recommendation) Note: Back up calculation need to be provided for the same.

A pre-charged Carbon Steel body diaphragm tank shall be fitted to the discharge pipe with a compatible Butyl-rubber diaphragm. It shall supply water a very low flows to minimize frequent pump start and stop and water hammering. There shall be complete separation between water and air and there should be no contact between water and tank compounds to avoid corrosion. Bladders shall be suitable for sufficient elasticity to permit full expansion inside the tank to ensure better performance and longer working life.

#### 4.10. Other Accessories

Pressure Transmitter (0-10/16/25bar based on system design pressure)

Pressure Gauge - 0-16bar

Suction & Delivery Manifolds - Hot Dip Galvanized Iron CED coated

All cast iron parts should be CED coated.

One NRV and isolating valve for each pump is provided on delivery side and one isolating valve is provided on suction side.

Complete set system to be mounted on a common base frame and shall follow following duty.

### 5. Submersible pumps

- 5.1. Submersible pumps for sewage/drainage shall be single stage, single entry pump. Pump shall be with two vane open type dynamically balanced impeller connected to a common shaft to the motor. The vane for sewage pump will be open type, while for drainage pump etc. It will be of semi open type.

- 5.2. Stuffing box shall be provided with mechanical seals
- 5.3. Each pump shall be provided with water cooled squirrel cage induction motor suitable for 415 volts, 3 phase, 50 cycles AC power supply.
- 5.4. Each pump shall be provided with liquid level controller for automatic operation of the pump between predetermined levels. Operation of level controller shall be similar to as discussed in subsequent paras below.
- 5.5. The pumping set shall be for stationary application and shall be provided with pump connector in it. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation, without disturbing delivery pipe the pump unit shall have a back pull out design. A rust proof chain shall be provided for each pump.
- 5.6. Dewatering submersible pump with double mechanical cartridge seal, F class motor insulation, moisture detector for automatic cut-out for water leakage, cable connection to motor via SS cable plug and reliable clamp connection for easy access of internals of the pump without usage of special tools. The compact design makes the pump suitable for both temporary and permanent installation. The impeller shall be of semi-open /Vortex type with CI Housing (EN-GJL-200) and Impeller to be Ductile Cast Iron (EN-GJS-450-10) with double Mechanical Seal having Faces having Primary Face SIC/SIC & Secondary Cermaic / Carbon.

The pump is cast iron, with side discharge port and integrated submersible 3-phase totally enclosed motor in insulation class F (155°C).

The pump has a side discharge and a double mechanical seal.

The pump is ready for installation either free-standing or on an auto-coupling system.

The pump is equipped with temperature bi-metal sensor for motor protection in case of overheating.

Solid Handling shall be as per BOQ

#### 5.7. Control Panel

Each Control Panel shall be suitable for operation of 2 numbers of pumps in Auto /manual mode. The Digital pump controller shall mainly comprise of following: Drainage by liquid level control through float switches & probes, Dry running protection without switches or probes, Dynamic LCD displaying for pump running status, push button calibration, pump accumulative run time, RS485 Modus communication, Mains isolator incomer of suitable rating, Auto / Manual Selector Switch with potential free contacts provided for BMS connectivity, Cyclic Timer to Alternate the Pumps based on Time Interval, Individual Start stop option, pump "ON" and pump "TRIP" indication, 3 pole MCB of suitable rating for each feeder, Incoming, outgoing and control terminals, Controller for pumps having sensor controls - Optional, Float Switch connection for Dry or Auto Operation.

All pumps shall be factory fabricated and factory tested. The test reports shall be submitted during the installation. Note: Control panel is in PHE Vendor scope.

- 5.8. Pump shall be provided with all accessories and devices necessary and required for the pump to make a complete working system.



## **6. Feed/Transfer Pumps**

- 6.1. Vertical multistage pump, in-line design which enables installation in a horizontal one pipe system where the suction and discharge ports are in the same horizontal level and have the same pipe dimensions. This design provides a more compact pump design and pipework.
- 6.2. The pump, electric motor, coupling and coupling guard shall be factory assembled at the pump manufacturer's facility. Installation instructions shall be included with pump at time of shipment. Pump shall be fitted with a 3-phase, fan-cooled, permanent-magnet, synchronous motor. Motor shall include a frequency converter and PI controller in the motor terminal box.
- 6.3. Pump and motor shall be of integrated and user-friendly compact design. Sound pressure level of pumps shall be less than 73 dBA according to EN ISO 3743.
- 6.4. Pump Base / Housing:
- Pump Base shall be a robust construction with integrally-cast support in order to transmit pipe load to the foundation. Liquid passages in the casing shall be smooth finish to ensure high Efficiency. Pump base shall be EN-GJL-250 or EN-GJS-500-7 grade Cast Iron according to ASTM 25B or ASTM A536-84 70-50-05 or equivalent
- 6.5. Impeller:
- The impeller shall be AISI 304 stainless steel enclosed type with smooth surface finishes for minimum frictional loss. This ensures high Efficiency IE3.
- 6.6. Shaft:
- Shaft shall be AISI 316 stainless steel with splined design, and shall be adequately sized To with stand all stresses, hydraulic loads, vibrations and torques coming in during operation.
- 6.7. Motors:
- Motor shall be a vertical, totally enclosed fan-cooled, permanent magnet type with principal dimensions according to EN 50347 standards. Electrical tolerances shall comply with IEC 60034. Motor shall be to with IP 55 enclosure, designed for up to 50 deg ambient temperature. Motor shall be suitable for operation on a 3 X 380-500V ( $\pm 10\%$  variation), 50/60Hz  $\pm 5\%$ , and 3phase AC supply.

## **7. Terrace Booster Pump**

- 7.1. Pre-engineered, factory assembled & tested, fully integrated, highly efficient pump, Single pump terrace booster system with integrated Frequency convertor. The pump shall be Horizontal Multistage consist of Cast iron with CED coated base & head, SS-304 casing chamber and impeller and SS-304 shaft with single mechanical seal and pressurized tank of necessary capacity, complete with all standard accessories including Pressure Transmitter , Pressure gauges, Non-return valves, with necessary protection and operational devices. Motor Along with frequency convertor shall comply with UL 60370-1 and CSA E 60730-1 standards. Motor shall be horizontal, totally enclosed fan-cooled, permanent magnet type with principal dimensions according to EN 50347 standards with IP 55 enclosure, designed for 50 deg ambient temperature to be operated on 415 V ( $\pm 10\%$  ) Variation, 50 HZ ( $\pm 5\%$  ) Variation 3 Phase AC supply .
- 7.2. Pumps shall have an integrated frequency convertor and a PI controller incorporated within the motor terminal box.

Motor terminal box shall provide the following connections either with basic terminals or with additional function modules provided as required

- a) One dedicated digital input
- b) Two analog inputs, 0(4)-20 mA, 0-5 V, 0-10 V, 0.5 - 3.5 V
- c) 5V voltage supply to potentiometer and sensor
- d) One configurable digital input or open-collector output
- e) 24V voltage supply for sensors
- f) Two signal relay outputs (potential-free contacts)
- g) Interface for fieldbus module.

7.3. Sound pressure level of Terrace Booster pumps shall be less than 65 dBA according to EN ISO 4871

## **8. Level Controllers**

8.1. Level controllers shall be electronic low voltage type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe. The level controller will be used for following applications: -

### **8.2. Water transfer pump.**

- a) To cut off all operating pumps when:-
- b) Water level is low in storage water tanks with low water level audible alarm.

### **8.3. Sump Pump level controller & high water alarm**

- a) To cut off the drainage sump pump when the sump is empty and to start when:-
- b) Duty pump No. 1 at pre-determined level No.1
- c) Duty pump No.2 at a higher pre-determined level.No.2 and also to sound alarm

### **8.4. Pipe & Fittings (for Headers and Connections)**

8.5. Pump suction and delivery headers shall be Galvanized iron pipes/MS heavy class with matching fittings. The pipe joints shall be threaded as per manufacturer's instructions.

## **9. Vibration Eliminators**

9.1. All suction and delivery lines as shown on the drawings shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

## **10. BALL VALVES:**

10.1. Ball valves shall be Full Bore Nickel Plated heavy duty of approved make and of the following specifications

Sizes: 15 mm to 50 mm  
Body: Forged Brass CW617N  
Bonnet: Forged Brass CW617N  
Ball: Forged Brass  
Stem: Forged Brass  
Seat: PTFE

O-Ring: EPDM WRAS Approved  
Packing Nut: Forged Brass  
Handle: Steel Q235 with Blue Zinc Plating with PVC RAL 5002  
Hex Nut: Steel Q235 Lock Nut Nylon  
Joint: Threaded/Screwed/Flanged  
Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)  
Test Pressure: 1.5 Times of Working Pressure

## **11. BUTTERFLY VALVE:**

- 11.1. All butterfly valves shall be heavy duty cast iron of approved make. The valves shall conform to the following specifications. Butterfly valve shall be of best quality conforming to IS: 13095 and AWWA Standard

Sizes: 65 mm to 200 mm  
Body: CI  
Disc: DI (ENP)  
Liner: EPDM  
Stem: ASTM A276, GR SS410  
Bush: PTFE/Nylon  
O-Ring: EPDM  
Notch Plate: MS Powder Coated  
Hand Lever: MS Powder Coated  
Fastener: GI  
Joint: Threaded/Screwed/Flanged  
Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)  
Test Pressure: 1.5 Times of Working Pressure

## **12. Dual Plate Check Valve:**

- 12.1. All Check valves shall be heavy duty cast iron of approved make. The valves shall conform to the following specifications.

Body: CI  
Seat: EPDM  
Plates: DI (Lapped)  
Shaft: ASTM A276, GR SS410  
Spring: AISI 302  
O-Ring: Nitrile  
Plug: MS Chrome Plated  
Fastener: SS  
Joint: Threaded/Screwed/Flanged  
Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)  
Test Pressure: 1.5 Times of Working Pressure

## **13. Y-Strainer:**

- 13.1. All Check valves shall be heavy duty cast iron of approved make. The valves shall conform to the following specifications.

Body: CI

Strainer Mesh: SS-304  
Gasket: EPDM  
Cover: CI  
Bolt & Nuts: CS/GI  
Joint: Threaded/Screwed/Flanged  
Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)  
Test Pressure: 1.5 Times of Working Pressure

## **14. Measurement**

### **14.1. General**

- a) Unit rate for individual items, e.g, Pumps, MCC and level controller are for purposes of payments only. Piping, headers, valves, accessories, cabling and MCC to measured separately in this contract only.
- b) All items must include all accessories fittings as described in CPWD specifications, BOQ and shown on the drawings.

### **14.2. Water Transfer pumps**

- a) Pumps shall be measured by numbers and shall include all items as given in CPWD specifications and Drawings to provide a complete working system.

### **14.3. Drainage Sump Pumps**

- a) Drainage pumps shall be measured by numbers and shall include all items as given in CPWD specifications and Drawings to provide a complete working system.

### **14.4. Level controllers & Alarms**

- a) Level controllers for each set of pumps shall be measured by number and inclusive of probes, cabling unto surface box near the pump and shall include all items as given in CPWD specifications and Drawings to provide a complete working system.

### **14.5. Piping Work**

- a) Suction and delivery headers for each pumping system shall be measured per linear meter of finished length and shall include all items as given in the Drawings. Painting shall be included in rate of headers.
- b) G.I./M.S. pipes between various equipment's shall be measured per linear meter of the finished length and shall include all fittings, flanges, jointing, clamps for fixing to walls or hangers and testing. Flanges shall include 3 mm thick insertion rubber gasket, nuts, bolts and testing.
- c) Vibration eliminators, "Y" strainers, butterfly valves, slim non return valves shall be measured by numbers and shall include all items as given in the Drawings and specifications.

-----: END OF SUBHEAD :-----

## **SUBHEAD-7. WATER TREATMENT EQUIPMENT**

### **1. General requirements**

- 1.1. All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer in charge.
- 1.2. All equipment shall be of the best available make manufactured by reputed firms.
- 1.3. All equipment shall be installed on suitable foundations, true to level and in a neat workmanlike manner.
- 1.4. Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.
- 1.5. Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.
- 1.6. Each pumping set shall be provided with a butterfly valve on the suction and delivery side and a flap type non return valve on the delivery side
- 1.7. All pump couplings and belt guards for air compressors shall be totally enclosed with 5 mm mesh.

### **2. Corrosion Resistant Material**

- 2.1. All piping, valves and accessories from outlet of raw water to inlet of treated water tank shall be of material fully resistant to internal and external corrosion. Such material may be stainless steel, PVC, rubber or other type of lining material accepted in international water works engineering practice.

### **3. Water filters for water supply**

- 3.1. Filter shall be designed in accordance with the code of unfired pressure vessel conforming to I.S. 2825.

### **4. Multi-Port Valves**

- 4.1. 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.
- 4.2. Provide suitable sampling cocks to draw water samples for raw water and treated water.

### **5. Chemical Dosing Pump**

- 5.1. Pump applications
  - a) Chlorination of raw water from tube wells,
  - b) Chlorination of drinking water transfer pump
- 5.2. Dosing system comprising of an electronic metering pump with, 100 lit capacity uPVC/HDPE/FRP solution tank with level gauge and lid on top.
- 5.3. Electronic driven metering pumps with mechanically actuated diaphragm with oil lubricated gear mechanism. The output of the pump should be adjustable for operation from 10-100%. Pump construction shall be corrosion resistant polypropylene or similar material. Pump electrical circuit shall be interlocked with the main raw water /pool recirculation pumps so that they operate only when the pumps are operating.

**6. Pipe & Fittings (for Headers and Connections)**

6.1. Pump suction and delivery headers shall be of approved corrosion resistant material with matching fittings. The pipe joints shall be threaded or as per manufacturer's instructions.

**6.2. Vibration Eliminators**

- a) Provide on all suction and delivery lines as shown on the drawings double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

**6.3. Valves**

- a) Valves 50 mm dia and above shall be rubber lined butterfly valves.
- b) Non return valves shall be rubber lined cast iron slim type of approved make.

**7. Flow measurement**

7.1. Provide rota meter reading "LPH" or "LPM" on delivery line of the plant.

7.2. Provide one direct reading flanged type water meter with strainer on outlet of water softener or water filter.

-----: **END OF SUBHEAD** :-----

## **SUBHEAD-8. SHOP DRAWINGS, TESTING & COMMISSIONING, QUALITY CONTROL**

### **1.0 INSPECTION & TESTING**

The owner/client shall carry out inspection and testing at manufacturer's facility/works for items such as fire pumps covered under this contract. No equipment shall be delivered without prior written confirmation from Project Manager. In case factory inspection is carried out then all travelling and lodging expenses shall be borne by owner/client for maximum two persons. All expenses related to testing shall be to Contractor account. Tests on site of completed works shall demonstrate the following, among other things.

- a) That the equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.
- b) That all items operate efficiently and quietly to meet the specified requirements

The contractor shall provide all necessary instruments and labor for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Project Manager and shall provide test certificate signed by a properly authorized person Such test shall be conducted on all materials and equipment's and tests on completed work as called for by the Project Manager at contractor's expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out, then the contractor shall be liable for the rectification and retesting of the same as called for by the Project Manager whose decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Project Manager.

### **2.0 BYE-LAWS & REGULATIONS**

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

### **3.0 FEES & PERMITS**

The tenderer shall obtain all permits/ licenses and pay for any and all fees required for the inspection, approval and commissioning of their installation. However, all receipted amount shall be reimbursed on production of proof of payment.

### **4.0 DRAWINGS**

The drawings issued with tenders are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of sprinklers, hydrants, equipment's and water supply / drainage piping etc.

The tenderer shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom and space shall be maintained at all points. Where headroom appears inadequate, the tenderer shall notify the Architect/Consultant/Client's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and tenderer shall rectify the same at his own cost.

The tenderer shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the client's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Client's site representative without additional cost to the client. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

#### **5.0 TECHNICAL DATA**

Each tenderer shall submit along with his tender, the technical data for all items listed in Appendix-IV in the indicated format. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

#### **6.0 SHOP DRAWINGS**

All the shop drawings shall be prepared on computer through Autocad System based on Consultant's Tender Drawings Architectural Drawings, site measurements and Interior Designer's Drawings. Within four weeks of the award of the contract, tenderer shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, Pump room drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc. external insulation details for pipe insulation etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations.

These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/client's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other tenderers. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 6 sets of drawings shall be submitted after final approval along with CD.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix-III and quoted by the tenderer in technical data part of Appendix - IV.

When the Architect/Consultant makes any amendments in the above drawings, the tenderer shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The tenderer shall submit further 6 sets of shop drawings to the client's site representative for the exclusive use by the client's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the tenderer has in his possession, the approved shop drawing for the particular material/equipment/installation.



Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

Manufacturers' drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labelled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

Samples of all materials like valves, pipes etc. shall be submitted to the client's site representative prior to procurement. These will be submitted in two sets for approval and retention by client's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.

Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the tenderer of the responsibility or requirement to furnish material and perform work as required by the contract.

Where the tenderer proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the tenderer at his own expense and gotten approved by the Architect/Consultant/client's site representative. Any delay on such account shall be at the cost of and consequence of the Tenderer.

Fire Fighting Tenderer shall prepare coordinated services shop drawings based on the drawings prepared by Fire Fighting, Electrical, HVAC & Low Voltage Tenderers to ensure adequate clearances are available for installation of services for each trade.

Where the work of the tenderer has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the client's site representative, the tenderer shall prepare composite working drawings and sections at 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 Tenderer installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the OWNER.

Within two week of approval of all the relevant shop drawings, the tenderer shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers') imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to client for acceptance of anticipated variation in contract amounts and also advise client to initiate action for procurement of spare parts and tools at the completion of project.

## **7.0 QUIET OPERATION AND VIBRATION ISOLATION**

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the client's site representative. In case of rotating machinery sound or

vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Tenderer at his own expense. The tenderer shall guarantee that the equipment installed shall maintain the desired NC levels.

#### **8.0 ACCESSIBILITY**

The Tenderer shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his piping and other ancillaries. His failure to communicate insufficiency of any of the above, shall constitute his acceptance of sufficiency of the same. The Tenderer shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Tenderer shall make all the necessary repairs and changes at his own expense. Access panel shall be standardized for each piece of equipment / device / accessory and shall be clearly nomenclature / marked.

#### **9.0 MATERIALS AND EQUIPMENT**

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per Appendix - III.

#### **10.0 MANUFACTURERS INSTRUCTIONS**

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

#### **11.0 ELECTRICAL INSTALLATION**

The electrical work related to the services shall be in the scope of the tenderer. Designing, Supply, installation, testing and commissioning of Firefighting panels along with all cabling, earthing, terminations etc. as mentioned in detail in the BOQ, shall be done by the Firefighting contractor.

#### **12.0 BALANCING, TESTING AND COMMISSIONING**

Balancing of the complete system and all tests as called for the Specifications shall be carried out by the tenderer through a specialist group, in accordance with the Specifications and NBC, BIS Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps etc. at factory with two personnel from Client/Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the client's site representative. All tests shall be carried out in the presence of the representatives of the Architect/Consultant and client's site representative.

#### **13.0 COMPLETION DRAWINGS**

Tenderer shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of floppies / CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, piping layouts, location of wiring and sequencing of automatic controls, location of all concealed piping, valves, controls, wiring and other services. Each portfolio shall also contain consolidated control

diagrams and technical literature on all controls. The tenderer shall frame under glass, in the plant room, one set of these consolidated control diagrams.

#### **14.0 OPERATING INSTRUCTION & MAINTENANCE MANUAL**

Upon completion and commissioning of part system the tenderer shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the tenderer shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and client's site representative and two for client's Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

"Preventive Maintenance Schedule for each equipment / panel shall be submitted along with Operation and Maintenance Manual".

#### **15.0 ON SITE TRAINING**

Upon completion of all work and all tests, the Tenderer shall provide necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the client's staff to get acquainted with the operation of the system. During this period, the tenderer shall train the client's personnel in the operation, adjustment and maintenance of all equipment installed.

#### **16.0 MAINTENANCE DURING DEFECTS LIABILITY PERIOD**

##### Complaints

The Tenderer shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

##### Repairs

All equipment that require repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs for one year concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the OWNER.

#### **17.0 UPTIME GUARANTEE**

The tenderer shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall be extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Tenderer shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all pressures, power consumption. Starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Tenderer shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the client's site representatives/Consultant's review. This shall include the type of service planned to be

offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

## **18.0 OPERATION AND MAINTENANCE**

Tenderer may be required to carry out the operation of the installation for a period of one year from the date of commissioning and handing over of the entire system. Further, he may also be required to carry out operation and all-inclusive maintenance of the entire system for a period of four years beyond the defects liability period.

Operation contract

- i. 16 hours a day, year round.
- ii. All stand-Ay equipment to be operated as per mutually agreed program.
- iii. Proper entry and upkeep of relevant log books.
- iv. Maintain complaints register. Submit weekly report.
- v. Proper housekeeping of all areas under the contract.
- vi. Prepare daily consumption report and summary of operation.

Terms of payment

Monthly at the end of each month on pro-rata basis.

All Inclusive Maintenance Contract

- Routine Preventive Maintenance Schedule to be submitted
  - a) Schedule to cover manufacturer's recommendation and / or common engineering practice (for all plant and machinery under contract).
  - b) Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.
  - c) Monthly status report.
  - d) Entire installation to be painted in fourth year (from end of defects and liability period) before the expiry of operation and maintenance contract.
- Uptime during maintenance contract
  - a) 98% uptime of all systems under contract.
  - b) Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.
  - c) There shall be no reimbursement for the extended period.
  - d) Break-downs shall be attended to within ten hours of reporting.
  - e) Spare compressor/motor assembly to be made available within seven calendar days in case of total breakdown/burnout.
- Manpower

- a) Adequate number of persons to the satisfaction of the OWNER's site representative shall be provided including relievers.
  - b) Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.
  - c) Duty allocation and Roaster control shall be tenderer's responsibility.
- Shut Downs
    - a) Routine shut downs shall be permitted only during winter season.
    - b) Tenderer shall be at liberty to carry out routine maintenance as and when required but with prior permission of the OWNER.
- Payment Terms
    - a) Monthly payment at the end of each month on pro-rata basis.

**19.0 PARTIAL ORDERING**

Client through the Architect/Consultant/ OWNER's site representative reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers.

**20.0 Commissioning**

**20.1** On completion of the work in all its aspects, the contractor shall start up the equipment in a manner normally done for the continuous operation for a period of not less than 48 hours and shall rectify and adjust the equipment for leakages and balancing the system.

**20.2** After satisfactory commissioning of the plant, the contractor shall conduct performance tests on the equipment to satisfy the Engineer in charge that all equipment is performing to the rated outputs. Any or all equipment's shall be rectified or replaced if the same is are not performing in accordance with CPWD specifications.

**21.0 Guarantees**

**21.1** On completion of the work contractor shall submit a guarantee covering the quality and performance of all materials supplied and installed under the contract. This guarantee shall cover each and every material whether manufactured by the contractor or not.

**21.2** Contractor shall specify a suitable procedure to test the rated performance of the equipment's and shall provide all necessary equipments, gauges etc. for conducting such tests.

**21.3** The guarantee shall cover a period of one year from the date of installation and handing over.

**22.0 Completion**

**22.1** On completion of the job, the contractor shall hand over to the Engineer in charge the following:-

**22.2** One flow chart drawn in ink on thick paper and mounted in a glass frame showing the flow diagram of the process including legend showing valves to be normally open or closed and instructions for back washing, operation and maintenance of chlorination & other chemical feeding pumps and other equipments.

**22.3** Five sets of operating and maintenance instructions with spare parts list and their manufactures and/or suppliers.

**22.4** Five sets of catalogues and drawings for all equipment supplied.

-----: **END OF SUBHEAD** :-----

**SUBHEAD-9. ELECTRICAL WORK****A. PANEL & DISTRIBUTION BOARD, LT SWITCH GEAR, VFD'S, STARTERS, IMPORTANT NOTES ON STARTERS, CONSTRUCTION FEATURES AND GENERAL NOTES ON PANELS / DISTRIBUTION BOARDS****1.00 MOULDED CASE CIRCUIT BREAKERS (MCCB'S)**

- The Moulded case circuit Breaker (MCCB) shall conform to the latest IEC 60947-2 and IEC 947-3-1989. MCCB's shall be suitable for rated operation voltage upto 415 VAC & rated insulation voltage upto 690 VAC.
- MCCB's in AC circuits shall be of triple pole / four pole construction as per enclosed BOQ. Operating mechanism shall be quick-make, quick-break and trip-free type ( Roto-Active design) . The "ON", "OFF" and "TRIP" positions of the MCCB's shall be clearly indicated and visible to the operator when mounted as in service. Front of door operating handle shall be provided with pad lock and door interlock. Front of door operating handle shall be provided with door interlock defeat mechanism to facilitate inspection of the MCCB during 'ON' position. MCCB shall be suitable for Positive isolation / disconnection according to IEC 60947-1 & 2 for optimum user safety.
- The Service short circuit Breaking capacity (Ics at 415 VAC) of all MCCB's shall be as specified in SLD / BOQ and shall have ( Ics=Icu=100%).

All MCCB should have "Class-II" front facia as per IEC 60664.

Electrical life of MCCB's shall not be less than 10000 operations and mechanical life shall not be less than 20000 operations.

- The MCCB shall be current limiting type. MCCB shall have Arc extinguishing device contained in a compact, high strength, heat resistance, flame retardant, halogen free insulating moulded case with high withstand capability against thermal and mechanical stresses.
- MCCB's shall be either with Thermal-magnetic releases for over load and short circuit or with microprocessor based releases for over load and short circuit as asked for in the BOQ.

Load indication LED shall be integral part of electronic releases. All electronic releases shall be EMI / EMC compatible.

- Wherever microprocessor earth fault add on earth fault Module is asked for, additional CBCT shall be provided.

It should not be possible to by pass / switch off the S/C, E/F protection in MCCB. The E/F setting should be provided with 10% to 60% with time delay of 0.3 to 3 seconds. LED Indication should be provided in case of earth Fault. E/F Module should have Test Push Button for self diagnostic features without tripping the ckt breaker. Also Over current and earth fault differentiation should be provided.

- The trip command of releases in MCCB shall over ride all the other commands. The MCCB shall employ maintenance free double break contact system to minimize the set through energies and capable of achieving Total Discrimination up to the full short circuit capacity of the downstream MCCB. The MCCB shall not be restricted to line / load connections. MCCB shall be provided with

test trip Push Button to check the proper function of tripping mechanism. MCCB shall comply with RoHS & WEEE norms

- Where Earth fault protection are indicated in drawings / BOQ they shall be thru Add on Module MCCB's and have adjustability from 10% to 60% of rated current with adjustable time delays to aid discrimination on earth faults. The system shall be immunized against nuisance tripping as per IEC 61000-4 standards.
- 
- MCCB's shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings of the motor starting equipment and the mechanical stress caused by the peak short-circuit current of value associated with the switchgear rating. The maximum tripping time under short circuit shall not exceed 8 milliseconds.
- MCCB terminals shall be shrouded and designed to receive Bus Bar Links /cable lugs for cable sizes relevant to circuit ratings.
- The MCCB shall have common field fittable snap-on auxiliaries common for entire range. The remote tripping coil should be of continuous duty cycle.
- Where mechanical interlocking is called-for between two Incomer and Bus Coupler or between two Incomers without Bus Couplers, proper arrangement for built-in Ronis / Coded key interlocking shall be provided.
- MCCB's shall be with bus bar spreaders. (Spreaders shall be of the same make of MCCB i.e. spreaders shall come along with the MCCB, to be supplied by the MCCB manufacturer).  
MCCB's shall be with direct / extended Rotary Handle.  
ARRANGEMENT OF PAD LOCKING & FOOL PROOF LOTO (LOCKOUT & TAG OUT) TO BE AVAILABLE WITH ALL MCCB'S FOR MAINTENANCE SAFETY REASONS ON MOTORS / EQUIPMENT.

## **2. MOTOR PROTECTION CIRCUIT BREAKER (MPCB)**

Motor circuit breakers shall conform to the general recommendations of standard IEC 947 -1,2 and 4 (VDE 660, 0113 NF EN 60 947-1-2-4, BS 4752) and to standards UL 508 and CSA C22-2 N°14. The devices shall be in utilization category A, conforming to IEC 947-2 and AC3 conforming to IEC 947- 4.MPCB shall have a rated operational and insulation voltage of 690V AC (50 Hz) and MPCB shall be suitable for isolation conforming to standard IEC 60947-2 and shall have a rated impulse withstand voltage (Uimp) of 6 kV. The motor circuit breakers shall be designed to be mounted vertically or horizontally without derating. Power supply shall be from the top or from the bottom. In order to ensure maximum safety, the contacts shall be isolated from other functions such as the operating mechanism, casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the motor circuit breakers must have snap action opening and closing with free tripping of the control devices. All the poles shall close, open, and trip simultaneously. The motor circuit breakers shall accept a padlocking device in the "isolated" position.

The motor circuit breakers shall be equipped with a "PUSH TO TRIP" device on the front enabling the correct operation of the mechanism and poles opening to be checked. The auxiliary contacts shall be front or side mounting, and both arrangements shall be possible. The front-mounting attachments shall not change the breaker surface area. Depending on its mounting direction the single pole contact block could be NO or NC. All the electrical auxiliaries and accessories shall be equipped with terminal blocks and shall be plug-in type. The motor circuit breakers shall have a combination with the downstream



contactor enabling the provision of a perfectly co-ordinated motor-starter. This combination shall enable type 1 or type 2 co-ordination of the protective devices conforming to IEC 60947-4-1. Type 2 co-ordination shall be guaranteed by tables tested and certified by an official laboratory: LOVAG (or other official laboratory). The motor circuit breakers, depending on the type, could be equipped with a door-mounted operator which shall allow the device setting. The motor circuit breakers shall be equipped with releases comprising a thermal element assuring overload protection and a magnetic element for short-circuit protection. In order to ensure safety and avoid unwanted tripping, the magnetic trip threshold (fixed) shall be factory set to an average value of 12 Ir.

All the elements of the motor circuit breakers shall be designated to enable operation at an ambient temperature of 60°C without derating. The thermal trips shall be adjustable on the front by a rotary selector. The adjustment of the protection shall be simultaneous for all poles. Phase unbalance and phase loss detection shall be available. Temperature compensation (-20°C to +60°C).

MPCB shall be with bus bar spreaders. (Spreaders shall be of the same make of MPCB i.e. spreaders shall come along with the MPCB, to be supplied by the MPCB manufacturer). MPCB'S shall be with direct / extended rotary handles.

ARRANGEMENT OF PAD LOCKING & FOOL PROOF LOTO (LOCKOUT & TAG OUT) TO BE AVAILABLE WITH ALL MPCB'S FOR MAINTENANCE SAFETY REASONS ON MOTORS / EQUIPMENT.

MPCB's shall be with microprocessor-based releases. MPCB's shall be two of types as called for in the bill of quantities as follows:

- a) MPCB's shall be with thermal & magnetic releases with adjustable thermal setting.
- b) MPCB's with magnetic release only shall be with fixed magnetic setting.

### **3. MINIATURE CIRCUIT BREAKER (MCB)**

- Miniature Circuit Breaker shall comply with IS 8828 – 1996 / IEC 898 – 1995.
- Miniature Circuit Breaker shall be quick make and break type for 230 / 415 V AC and 50 Hz application. The housing of MCB's shall be heat resistant and having a high impact strength. The breaking current of MCB's shall not be less than 10000 Amps, at 230 V / 415 V. The MCB's shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical 'ON' and 'OFF' indications. MCB's shall be suitable for isolation function and line load reversibility.
- MCB's shall be current limiting type class – 3. MCB's shall be classified as B, C, and D as per standard Ref. IS as per the Tripping characteristics curves defined by all the manufactures. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS / IEC and the manufactures shall publish the value.
- MCB's shall be calibrated at an ambient temperature of 40 degree.
- The MCB contacts shall be silver nickel alloy and contact tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic coil releases for short circuit protection and thermal release for over load protection. The over load or short circuit devices shall have a common trip bar in the case of DP, TP, TPN and FP Miniature Circuit Breakers and shall have 20000 electrical operations upto 63A. The terminals shall be protected against finger contact to IP 20 Degree of protection.

- MCB's shall have a facility to accommodate accessories like auxiliary contacts, trip alarm contact, shunt trip and under voltage add-on blocks.

Use of MCB's shall be application based i.e.: (Even if it not mentioned specifically in the BOQ)

For computers / IT equipment / Servers	:	Type 'D' characteristics
For motors, inductive loads and Discharge Lamps	:	Type 'C' characteristics
For lighting & small power	:	Type 'B' characteristics

#### **MCB's 'KA' RATINGS:**

- MCB's are available in standard 10 KA fault with stand rating indigenously produced.
- Imported MCB's in 16KA, 25KA & 36 KA fault ratings are also available.
- 16KA fault rating may be 15% more expensive than 10 KA rating.
- For 25KA & 36KA MCB rating wherever required, MCCB / MPCB may be opted for cost & delivery reasons.

#### **4. METERS**

- a. All voltmeters / multi-function meters and indicating lamps shall be protected through MCB's / MPCB's depending upon fault level.
- b. Meters and indicating instruments shall be flush type.
- c. All CT's connection for meters shall be through Test Terminal Block (TTB).
- d. CT ratio and burdens shall be as specified on the Single line diagram/ in the BOQ/ as required for the application.

#### **5. CURRENT TRANSFORMERS (CT'S) & VOLTAGE / POTENTIAL TRANSFORMERS (PT'S)**

Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondary's for operation of associated metering.

The CTs shall conform to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and metering CTs shall be of accuracy class I.

Accuracy class and VA burden shall be as per the application as required as per metering / protection needs.

PT shall be Class-1 accuracy for metering.

PT shall be cast resin type.

PT shall be of suitable burden (VA).

#### **6. INDICATING PANEL**

All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted digital type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB/MPCB as per required fault level. Indicating Lamps shall be of LED type. All digital instruments shall have shrouded terminals and suitable for 0°C to 50°C temperature range and shall with stand 1.2 time over loading. Accuracy class and VA burdens shall be as per the requirement. Meters shall be with RS 485 port wherever called for in the BOQ's for communication.

**7. SELECTOR SWITCH**

Where called for selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

**8. CONTACTOR**

Contactors shall be built into a high strength thermoplastic body and shall be provided with a shield for quick arc extinguishing. Silver alloy tips shall be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starter's contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta Starters. The insulation for contactor coils shall be of Class "E".

Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for 240 / 415 + 10% volts, 50 cycles AC supply. Contactors shall be of 3P / 4P design as required.

**9. THERMAL OVERLOAD RELAY**

Thermal overload relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing. The relay shall operate on the differential system of protection to safeguard against three phase overload, single phasing and unbalanced voltage conditions.

Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from -5deg C + 55 deg C.

All overload relays shall be of three element, positive acting ambient temperature compensated time logged thermal over load relays with adjustable setting. Relays shall be directly connected for motors upto 35 HP capacity. C.T. operated relays shall be provided for motors above 35 HP capacities.

**10. TIME DELAY RELAYS**

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

**11. TOGGLE SWITCH**

Toggle switches, where called for in Schedule of Quantities, shall be in conformity with relevant IS codes and shall be of 5 amps rating.

**12. PUSH BUTTON STATIONS**

Push button shall be provided for manual starting and stopping of motors / equipment "Green" and "Red" colour push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start' or 'Stop' indicating flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. The push button contacts shall be suitable for 6 amps current capacity.

**13. Coordination Study In LV Network**

LV Switchgear Manufacturer shall submit coordinated & Discriminated solution for LV Network protection devices i.e. **ACB, MCCB, MPCB & MCB** for all Incoming and outgoing devices for all Panels/ DB's as per BOQ with the help of published discrimination tables. Total discrimination shall be provided up to the short circuit breaking capacity of downstream circuit Breakers.

## **14. VARIABLE FREQUENCY DRIVE (VFD'S)**

### **14.1 SCOPE**

This specification covers the general design, materials, construction features, manufacture, shop inspection and testing at manufacturer's works, delivery at site, installation, testing, commissioning and carrying out performance test at site of Variable Frequency Drives.

### **14.2 CODES and STANDARDS**

The design, materials, construction features, manufacturer, inspection, testing and performance of variable frequency drives shall comply with all currently applicable statues, regulations, codes and standards in the locality where the system is to be installed. Nothing in this specification shall be construed to relieve the Contractor of this responsibility. In particular, the air distribution system shall conform to the latest edition of following standards.

### **14.3 GENERAL REQUIREMENTS**

- ✓ This specification covers complete variable frequency drives (VFDs) designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD.
- ✓ The frequency converter shall not be a general purpose product, but a dedicated HVAC engineered design.
- ✓ The VFD and its options shall be factory mounted and tested as a single unit under full load before dispatch.
- ✓ The VFD shall be tested to UL 508C. The appropriate UL label shall be applied. VFD shall be manufactured in ISO 9000, 2000 certified facilities.
- ✓ The VFD shall be CE marked and conform to the European Union Electro Magnetic Compatibility directive.
- ✓ The VFD shall be UL listed for a short circuit current rating of 100 kA and labeled with this rating.
- ✓ The manufacturer shall have been engaged in the production of this type of equipment for a minimum of thirty years.
- ✓ The frequency converter shall be supported locally by the manufacturer who will provide full technical support, spares holding and troubleshooting capability from their own local facility. A training course shall be provided by the manufacturer to the consultant / contractor / maintenance engineers.
- ✓ To ensure adequate technical and factory support, VFDs manufactured by others and brand labeled shall not be acceptable.

### **14.4 TECHNICAL REQUIREMENTS**

The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for the driven load and to eliminate the need for motor derating.

*When properly sized, the VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.*

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*The VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.*

*The VFD shall have a dual 5% impedance DC link reactor (harmonic filters) on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable.*

*VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.*

IEEE519, 1992 recommendations shall be used for the basis of calculation of total harmonic distortion (THD) at the point of common coupling (PCC). On request VFD manufacturer shall provide THD figures for the total connected load. The contractor shall provide details of supply transformer rating, impedance, short circuit current, short circuit impedance etc to allow this calculation to be made.

All VFDs shall contain integral EMC Filters to attenuate Radio Frequency Interference conducted to the AC power line. The VFDs shall comply with the emission and immunity requirements of IEC 61800-3 : 2004, Category C1 with 50m motor cable (unrestricted distribution). The suppliers of VFDs shall include additional EMC filters.

The VFD's full load output current rating shall meet or exceed the normal rated currents of standard IEC induction motors. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 second while starting.

The VFD shall provide full motor torque at any selected frequency from 20 Hz to base speed while providing a variable torque V/Hz output at reduced speed. This is to allow driving direct drive fans without high speed derating or low speed excessive magnetization, as would occur if a constant torque V/Hz curve was used at reduced speeds. Breakaway current of 160% shall be available.

A programmable automatic energy optimization selection feature shall be provided as standard in the VFD. This feature shall automatically and continuously monitor the motor's speed and load to adjust the applied voltage to maximize energy savings.

The VFD must be able to produce full torque at low speed to operate direct driven fans.

Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.

An Automatic Motor Adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.

Galvanic isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete digital I/O shall include additional isolation modules.

VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.

The VFD shall allow up to at least 100 meters of SWA (Single Wire Armour) cable to be used between the FC and the motor and allow the use of MICS (Mineral Insulated Copper Sheath) cable in the motor circuit for fire locations.

#### 14.5 **PROTECTIVE FEATURES**

A minimum of Class 20 I<sup>2</sup>t electronic motor overload protection for single motor applications shall be provided. Overload protection shall automatically compensate for changes in motor speed.

Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable.

Protect VFD from input phase loss : The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.

Protect from under voltage : The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output, without faulting, with an input voltage as low as 70% of the nominal voltage.

VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.

If the temperature of the VFD's heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. It shall also be possible to program the VFD so that it reduces its output current limit value if the VFD's temperature becomes too high.

In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.

The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.

Protection from output switching: The VFD shall be fully protected from switching a contactor / isolator at the output without causing tripping e.g.: for switching on/off the isolators of the AHU / ventilation fans / pumps near the motor with VFD in ON mode.

The VFD shall store in memory the last 10 alarms. A description of the alarm, and the date and time of the alarm shall be recorded.



When used with a pumping system, the VFD shall be able to detect no-flow situations, dry pump conditions, and operation off the end of the pump curve. It shall be programmable to take appropriate protective action when one of the above situations is detected.

#### 14.6 INTERFACE FEATURES

Hand, Off and Auto keys shall be provided on the control panel to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation.

There shall be an "Info" key on the keypad. The Info key shall include "on-line" context sensitive assistance for programming and troubleshooting.

The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.

Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes. All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.

To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters. Keypad shall provide visual indication of copy status.

Display shall be programmable to communicate in multiple languages including English, Chinese, Korean, Japanese, Thai and Indonesian.

A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD. The VFD shall also have individual Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.

A three-feedback PID controller to control the speed of the VFD shall be standard.

This controller shall accept up to three feedback signals. It shall be programmable to compare the feedback signals to a common setpoint or to individual setpoints and to automatically select either the maximum or minimum deviating signal as the controlling signal. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals.

The VFD shall be able to apply individual scaling to each feedback signal.

For fan flow tracking applications, the VFD shall be able to calculate the square root of any or all individual feedback signals so that a pressure sensor can be used to measure air flow.

The VFD's PID controller shall be able to actively adjust its setpoint based on flow. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system.

The VFD shall have three additional PID controllers which can be used to control damper and valve positioners in the system and to provide setpoint reset.

Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

Five simultaneous meter displays shall be available. They shall be selectable from (at a minimum), frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, feedback signals in their own units, among others.



Programmable Sleep Mode shall be able to stop the VFD. When its output frequency drops below set “sleep” level for a specified time, when an external contact commands that the VFD go into Sleep Mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop. When the VFD’s speed is being controlled by its PID controller, it shall be possible to program a “wake-up” feedback value that will cause the VFD to start. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD.

A run permissive circuit shall be provided to accept a “system ready” signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of initiating an output “run request” signal to indicate to the external equipment that the VFD has received a request to run.

VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F). Examples can be room temperature in °C, return air temperature in °C, supply air temperature in °C, CO<sub>2</sub> concentration in ppm, pressure in bar, differential pressure in PSI etc.

VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.

#### Standard Control and Monitoring Inputs and Outputs

Four dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.

Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status.

Each relay shall have an adjustable on delay / off delay time.

Two programmable analog inputs shall be provided that can be either direct-or-reverse acting.

Each shall be independently selectable to be used with either an analog voltage or current signal.

The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA.

A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.

The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,

One programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.

It shall be possible to read the status of all analog and digital inputs of the VFD through serial bus communications.

It shall be possible to command all digital and analog output through the serial communication bus.

#### Optional Control and Monitoring Inputs and Outputs

It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.

These modules shall use rigid connectors to plug into the VFD’s control card.

The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module.

Modules may include adequate number of such items as may be required as follow:

Additional digital outputs

Additional digital inputs

Additional analog outputs

Additional analog inputs, including Ni or Pt temperature sensor inputs  
Additional relay outputs (minimum 2 NO + 2 NC) suitable for 230 V, AC.

It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.

Standard programmable firefighter's override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display FIREMODE whenever in firefighter's override mode. Fire mode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.

A real-time clock shall be an integral part of the VFD.

It shall be possible to use this to display the current date and time on the VFD's display.

Ten programmable time periods, with individually selectable ON and OFF functions shall be available. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. It shall be possible to program unique events that occur only during normal work days, others that occur only on non-work days, and others that occur on specific days or dates. The manufacturer shall provide free PC-based software to set up the calendar for this schedule.

All VFD faults shall be time stamped to aid troubleshooting.

It shall be possible to program maintenance reminders based on date and time, VFD running hours, or VFD operating hours.

The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log.

The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time.

The VFD shall include a sequential logic controller to provide advanced control interface capabilities.

This shall include:

Comparators for comparing VFD analog values to programmed trigger values

Logic operators to combine up to three logic expressions using Boolean algebra

Delay timers

A 20-step programmable structure

The VFD shall include a Cascade Controller which allows the VFD to operate in closed loop set point (PID) control mode one motor at a controlled speed and control the operation of 3 additional constant speed motor starters.

#### 14.7 SERIAL COMMUNICATIONS

The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:

Metasys N2

Modbus RTU

VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.

The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD's control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

#### 14.8 ADJUSTMENTS

The VFD shall have a manually adjustable carrier frequency that can be adjusted in 0.5 kHz increments to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.

Four independent setups shall be provided.

Four preset speeds per setup shall be provided for a total of 16.

Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.

Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period.

If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload.

The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

An automatic "start delay" may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.

Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

#### 14.9 **OPTIONAL FEATURES**

*All optional features shall be built and mounted by VFD manufacturer as an inbuilt factory solution. All optional features shall be UL listed by the VFD manufacturer as a complete assembly and carry a UL label.*

#### 14.10 **SERVICE CONDITIONS**

*Ambient temperature at full speed, full load operation with continuous drive rated output current:*

*-10°C to 45°C for ratings upto 90 kW without derating*

*-10°C to 40°C for ratings 110 kW and higher without derating*

*Relative Humidity : 0 to 95%, non-condensing.*

*Elevation : Up to 3,300 feet without derating.*

*AC line voltage variation :  $\pm$  10% of nominal with full output.*

*VFD Enclosure protection : IP 20 with Mains Disconnect switch, integral, with no additional cabinets.  
– Not applicable. Protection shall be for Indoor installation.*

*Side Clearances : No side clearance shall be required for cooling.*

*All power and control wiring shall be done from the bottom.*

*All VFDs shall be plenum rated.*

*All the contacts mounted on each VFD should be brought to the terminal blocks of each starter in order to enable BMS vendor to do termination of his cables. None of the terminations of the BMS cables be done directly to the VFD.*

#### 14.11 QUALITY ASSURANCE

*To ensure quality, the complete VFD shall be tested by the manufacturer. The VFD shall drive a motor connected to a dynamometer at full load and speed and shall be cycled during the automated test procedure.*

*All optional features shall be functionally tested at the factory for proper operation.*

#### 14.12 SUBMITTALS

This specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.

#### 14.13 ADDITIONAL NOTES

- VFD's should have inbuilt DC choke.
- THDI on current side shall be limited to 35% to 40% (Total harmonics distortion).
- VFD's shall be complete with RFI & EMC filters as may be required for type of building/installation/project to limit the interference .
- VFD's to work with input voltage variation of 415V  $\pm$  10%
- IP 20 for installation inside panels.
- In open : IP 55

#### 14.14 IMPORTANT NOTES:

##### a. HARMONIC FILTERATION

##### i. VFD'S FOR CHILLER

- Chiller VFD shall have passive harmonic filters comprising LC circuit with inductance and capacitance to achieve THDI not more than 25%.
- Passive filtration shall be part of / inclusive in VFD enclosure / VFD Panel.

##### ii. VFD FOR AHU'S, FAN'S AND PUMPS:

- VFD's for AHU's, Ventilation and Pressurization fans & pumps shall have DC Chokes to achieve THDI not more than 40%.
- DC chokes shall be part of / inclusive in VFD enclosure.

##### b. EMC & RFI FILTRATION

VFD's for sensitive installations where life critical data communications are of importance like:

**These installations Must have 'C1' category of RFI & EMC filters for 50 meters of cable length. These are applicable to all the VFD's of AHU's, fans, blowers, pumps, cooling towers & chillers. .**

**For these above mentioned critical applications, if chiller motors and pump motors are more than 90Kw, then 'C2' category of filters to be used if 'C1' is not available.**

VFD's for normal buildings and others similar installations shall have 'C3' category of RFI & EMC filter for AHU's, fans, blowers, pumps, cooling towers & Chillers.

**c. METERING DISPLAY OF VFD'S**

The following parameters shall be available on display in the VFD:

A, V, Hz, PF, KW, KWH, KVA, KVARH, KVAH

**d. PROTECTION OFFERED BY VFD**

It must offer, overload, short circuit, over & under voltage, single phasing and earth fault protections to motors.

**e. VFD STATUS:**

VFD display screen will display faults like:

- Over current i.e. over load.
- Phase loss i.e. single phasing & will trip.
- A small light will start blinking on the screen also and this will go off only when a fault is removed and drive is 'RESET'.
- These status details will also be available at BMS.

VFD Front Display & Buttons:

AUTO 'ON' / 'OFF'	(Means remotely through BMS)
HAND 'ON'	(Means 'ON' from drive itself)
RESET	If trip on fault or on fire signal & can be 'Reset' from the Drive only after fault is cleared.

**15. MOTOR STARTER AND VARIABLE FREQUENCY DRIVE FEEDERS WITH IN MCC's (Motor Control Centre)- SPECIFICATIONS**

**Type of Motor Starters:**

- DOL starters upto 10HP / 7.5 KW motors.
- Star-Delta starters from 12.5HP / 9.3 KW onwards.
- Soft starters / VFD's for fire pumps.
- VFD's for motors, wherever specified.

All Starter feeders for **DOL, Star-Delta and Soft Starter** shall be complete with and inclusive of the following:

**DOL starter feeder upto 7.5 KW / 10HP Motor** shall be complete with and inclusive of the following, but refer specifications for details:

- TP MPCB with in built Thermal & Magnetic releases.
- MPCB shall be Microprocessor based with adjustable O/L trip class.
- 3 Pole Contactor (110 V contactor coil voltage).
- A/M selector switch- 2pole/2way (for BMS connectivity)
- ON / OFF Push buttons
- ON /OFF / Trip indications (110V) (ON /OFF Indication from contactor's 2NO / 2NC Aux. Contacts & trip indication from MPCB Aux. contact) with additional trip contact multiplier for BMS.

- Digital Ammeter with inbuilt selector switch and with metering class CT's (Upto 10 HP, only one CT in one of the phases)
- Internal wiring
- Type-II coordination

**Star Delta starter feeder from 9.3KW / 12.5HP and upto 30 KW / 40 HP Motor** shall be complete with and inclusive of the following, but refer specifications for details:

- TP MPCB with in built Thermal & Magnetic releases.
- MPCB shall be Microprocessor based with adjustable O/L trip class.
- 3 Pole Contactors (110 V contactor coil voltage). Star, Delta & Main Contactors.
- Timers
- A/M selector switch- 2pole/2way (for BMS connectivity)
- ON / OFF Push buttons
- ON /OFF / Trip indications (110V) (ON /OFF Indication from contactor's 2NO / 2NC Aux. Contacts & trip indication from MPCB Aux. contact) with additional trip contact multiplier for BMS.
- Digital Ammeter with inbuilt selector switch and with metering class CT's (one per phase) (Three CT's)
- Internal wiring
- Type-II coordination

**Star Delta starter feeder from 37 KW / 50HP and upto 187 KW / 250 HP Motor** shall be complete with and inclusive of the following, but refer specifications for details:

- TP MPCB with in built Thermal & Magnetic releases.
- MPCB shall be Microprocessor based with adjustable O/L trip class.
- 3 Pole Contactors (110 V contactor coil voltage). Star, Delta & Main Contactors.
- Timers
- External Digital Motor protection relay, CT operated (3 Nos. protection class CT's). Motor protection relay to offer protection against thermal O/L, O/C, Under correct, SPP, Locked rotor and earth leakage. Motor Protection relay shall be with current display. Motor protection relay with additional trip contract multiplier for BMS
- A/M selector switch- 2pole/2way (for BMS connectivity)
- ON / OFF Push buttons
- ON /OFF / Trip indications (110V) (ON /OFF Indication from contactor's 2NO / 2NC Aux. Contacts).
- Internal wiring
- Type-II coordination

All **VFD feeders** shall be complete with and inclusive of the following, but refer specifications for details :

- For Motor Upto 45 KW / 60 HP, TP MPCB with inbuilt Magnatic release.
- MPCB shall be Micro-processor based.
- For Motor from 55 KW / 75 HP and upto 187 KW / 250 HP, TP Motor Duty MCCB, Thermal - Magnetic Release type with inbuilt fixed magnetic release.
- VFD as per specifications.
- VFD cooling fan (110V)
- Type-II coordination

All **VFD feeders with by-pass starter** shall be complete with and inclusive of the following, but refer specifications for details:

- For Motor Upto 45 KW / 60 HP, TP MPCB with inbuilt Magnatic release.
- MPCB shall be Micro-processor based.
- For Motor from 55 KW / 75 HP and upto 187 KW / 250 HP, TP Motor Duty MCCB, Thermal - Magnetic Release type with inbuilt fixed magnetic release.

- VFD as per specifications.
- VFD cooling fan (110V)
- Bypass starter if called for as described in above starter paragraphs (110V contactor coil voltage). DOL or Star Delta depending upon Motor HP.
- Internal wiring
- Type-II coordination

**Following motor control centres / panels shall have:**

- 3 Pole incomer switch i.e. MCCB or ACB & 3P bus bars
  - a. Plumbing panel

**16. CONSTRUCTION FEATURES & GENERAL NOTES OF MOTOR CONTROLS CENTRES (MCC)**

**GENERAL SPECIFICATIONS**

Main & Sub Distribution Boards shall be classified as FBA (Factory Built Assemblies) as per IEC: 61439 of Cubicle type, Sheet steel clad, Totally enclosed, Dust & Vermin proof, Indoor type/ out door type, Rigid, Free standing, Floor mounted compartmentalized, Single front for use on 415 volts, 3 phase, 50 cycles, AC system with a fault level withstand capacity as per B.O.Q. /as required, RMS Symmetrical. Complete with busbars interconnections, power, control/auxiliary circuits/ wiring & earthing, with switchgear as per B.O.Q of approved makes as specified. All Panels shall comply to IEC-61439 as type tested panel for all fault withstand capacities upto 65KA for 1 sec.

**BASE FRAME: 3MM**

Normal Indoor Application: CRCA WITH POWDER COATING (minimum 60 micron coating).

Outdoor Application: ALUZINC WITH POWDER COATING (minimum 80 micron coating).

CRCA Sheet Type: PN02/ Equivalent as approved.

CRCA Sheet Make: TISCO/ Equivalent as approved.

ALUZINC Sheet Type: Grade CS Type A.

ALUZINC Sheet Make: Dongbu Steel South Korea.

**STRUCTURE, COVER BACK & FRONT DOOR: 2MM**

Normal Indoor Application: CRCA WITH POWDER COATING (minimum 60 micron coating).

Outdoor Application: ALUZINC WITH POWDER COATING (minimum 80 micron coating).

CRCA Sheet Type: PN02/ Equivalent as approved

CRCA Sheet Make: TISCO/ Equivalent as approved

ALUZINC Sheet Type: Grade CS Type A.

ALUZINC Sheet Make: Dongbu Steel South Korea.

**INTERNAL PARTITIONS: 1.6MM**

Normal Indoor Application: ALUZINC

Outdoor Application: ALUZINC

ALUZINC Sheet Type: Grade CS Type A.

ALUZINC Sheet Make: Dongbu Steel South Korea.

**CABLE GLAND PLATES: 3MM**

Multi Core Cables: ALUZINC

Single Core Cables: Aluminum

**INTERNAL SWITCHGEAR MOUNTING PLATES: 2MM**

Normal Indoor Application: ALUZINC

Outdoor Application: ALUZINC  
ALUZINC Sheet Type: Grade CS Type A.  
ALUZINC Sheet Make: Dongbu Steel South Korea.

### **CONSTRUCTION**

- Completely modular & compartmentalized, form 3B separation. Separate adequately spaced Unit Chamber, Bus bar & cable compartments.
- IP20 ingress protection to be ensured compartment to compartment inside the panel.

### **EXTENSIBILITY**

Readily extensible on both ends.  
Panels should be made in easily transportable sections.

### **DIMENSIONS**

Operating height	1800mm max. 300mm min.
Overall height	2400mm max.
Compartment size HXW	225mm x 500mm min
Cable chamber	300mm min.

### **DEGREE OF PROTECTION**

#### **IP: 42 for totally Indoor application.**

- Plumbing Panel
- **IP: 54 for Indoor Application**
- Sump pump panel

#### **IP: 55 for Outdoor Application.**

- Feeder Pillar
- Outdoor Junction boxes
- Outdoor boards / panels/Outdoor DG Panel
- ACB/MCCB Isolators (outdoors)

All outdoor IP 55 panels shall be:

- a. Double door design
- b. With canopy
- c. Panel shall have forced ventilation mechanism with Rital fan & filter section, to avoid temperature rise and at the same time maintaining IP 55 integrity.
- d. Complete ALUZINC Powder coated construction. 80 microns powder coating.

### **DOOR HINGES**

Concealed, Powder Painted

### **DOOR LOCKS**

Zinc alloy powder painted with provision for pad locking..

### **GASKET**

Neoprene / PE foam of suitable profile to provide desired degree of protection.



**LIFTING ARRANGEMENT**

Eye bolt of removable design, when removed these shall not leave any opening in the boards.

**PAINTING**

Pre-treatment eight tank process on CRCA sheets or on line automatic spray system with oven for drying after Pre-treatment as per IS: 101-1988 effective temperature and concentration control. Powder coating of desired shade as per requirement. Paint thickness min. 60 micron

**CORROSION RESISTANCE**

Withstand 500 hrs of Salt Spray as per IS: 101-1988

**BUS BARS MAIN**

Aluminum E-91E grade, min. 53% IACS  
Copper min 99% IACS (Tinned copper)  
Configuration: Interleaved 2000A & above

Minimum clearances shall be:

Phase to Phase	32mm
Phase to Neutral	25mm
Phase to earth	25mm
Neutral to earth	25mm

**BUS BARS EARTH**

As per material of main busbar of size suitable to withstand fault level specified / as required. Continuous length of earth bus to be provided.

UPS Output Panels shall have two earth bars of tinned copper of suitable rating. One of the earth buses shall be dedicated i.e. mounted on insulated supports.

**BUS BAR TEMP. RISE**

Ambient 45°C  
Maximum bus bar temperature rise 40° C over ambient  
No deration of Switchgear & Panels upto 45°C

**BUS BAR SIZING / CROSS-SECTION**

Bus bars to be sized to carry the full rated load current without exceeding maximum temperature rise as limited above. Bus bar size calculations to be submitted with shop drawings. Busbars to withstand the maximum short circuit current as specified / as per requirement.

**BUS BAR SUPPORTS**

Non Hygroscopic Epoxy/SMC/Nylon 6.6 supports at suitable distance to withstand forces of short circuit as per requirement.

**BUS BAR INSULATION**

Black heat shrinkable, fire retardant, self extinguishing type sleeves suitable to withstand 110°C  
Colour coding to be followed as per IS codes. Phase sequences and polarity to be followed as per IS codes.

### SHROUDING

All live parts should be shrouded with IP2 protection Fire Retardant, Non Inflammable, Non Hygroscopic e.g. Polycarbonate, FRP.

### BUS BAR SLEEVING

Heat shrinkable sleeves rated for minimum 110 deg C for one hour.

### HARDWARE

#### A. For Internal Connections of switch gear, bus bars & cables etc.

- High Tensile MS Alloy, Zinc coated, Grade 8.8 (Minimum 10 micron coating thickness). (Trivalent Plating CR3+).
- Salt Mist spray test with stand: 120 Hours duration.

1.	Steel Hardware		
	Salt mist spray withstand	:	120 Hours
	Bolt and nuts		
	Hardware quality	:	8.8
	According to	:	EN 20898, EN ISO 3506-1, 4759-1 (=S=FT30860)
	Contact Washers		
	Washer quality	:	8.8
	Class	:	160 HV
	According to	:	EN 20898, EN ISO 3506-1, 4759-1

Note: Contact washer to be fixed on both sides (Plain Washer & Spring Washer).

- #### B. For External Body & Enclosure Construction: High Tensile MS Alloy, Zinc Coated Grade 8.8 (minimum 10 micron coating thickness). (Trivalent Plating CR3+).

### PANEL COOLING / VENTILATION:

110V 1phase, heavy duty/ sturdy, panel ventilation fans to be employed, which shall be controlled by a thermostat. Or in VFD motor modules, module ventilation fan to be linked with VFD operation i.e. "On" operation of fan through relay contacts of the VFD, so that ventilation fan for VFD will be "On" only when the particular VFD is "On". Relay contacts of any VFD are suitable for 230V, so 110V will not be any problem.

### PANEL SPACE HEATING /CONDENSATION CONTROL:

230V or 415V space heaters with humidistat to be employed for moisture condensation control.

### WIRING

1100V Fire retardant, virgin PVC color coded flexible wire

Voltage circuit	1.5 sq mm
Current circuit	2.5 sq mm
Earth circuit	2.5 sq mm
As per IS: 694	

**WIRING IDENTIFICATION**

Computerized ferrule on both ends as per IS: 375

**TERMINAL BLOCK**

Power - Melamine stud type.

Control - Polyimide color coded screw less clamp fit type.

Not more than one wire connected to one terminal block.

Plug in type terminal block at each transport section.

**COMPONENT LEGEND**

Computerized labels for all control component & terminal block

**FEEDER DESCRIPTION PLATES**

Powder coated Al. Plate with computerized printing, size:

MDB = 150 x 50 mm

S/DB = 100 x 40 mm

**SPARE FEEDERS**

It shall be as per B.O.Q. / SLD. If B.O.Q. / SLD does not specify anything, then an average of 20% of a mix of various ratings / feeders to be provided as spare feeders in each board / panel. Spare feeders must include a minimum one biggest and a minimum of one smallest rated feeders as spares along with other spares.

**CABLING**

Provision for top/ bottom/ top & bottom entry of cables, as per requirement / as per site. Adequately sized cable chambers. Easy and safe termination & maintenance facility.

**BUS TRUNKING TERMINATION**

Wherever specified in B.O.Q power connection arrangement at top suitable for bus trunking.

**SWITCHGEAR**

As per specification & Makes specified. IS: 13947 I- IV, 1993

Only one make of switchgear to be used in a board/panel. The switchgear selection shall be as per manufacturer's co-ordination tables. Type 2 coordination to be achieved as a minimum.

**CONTROL MCB'S / MPCB'S**

For control and metering circuit/wiring, these shall be of fault level as required.

**CONTROL COMPONENTS**

As per specification & Makes specified. IS: 13947 I - IV, 1993

**INDICATING INSTRUMENTS**

Analog/Digital as per specifications, notes, B.O.Q. & Makes specified. IS: 13779

BMS compatible multifunction meters shall be complete with communication card, shall be networkable and shall be wired on to common RS 485 Bus and information from these meters to BMS to be released at one point.

**INDICATING INSTRUMENTS ACCESSORIES**

CT/PT-Cast resin as per specifications & make specified. IS: 2705, 1992

**SPACE HEATER**

All ACB Incomer & bus couplers shall be provided with Space Heater & Thermostat & 11 watt panel illumination. Heaters shall be controlled by a 6A MCB / MPCB as per the required fault level.

#### **PLC'S FOR LOAD MANAGEMENT & INTERLOCKING OF BREAKERS:**

Use separate PLC's for Load management and for separate for interlocking of breakers and bus couplers and closing of bus couplers.

#### **SHOP DRAWINGS**

Notes, General arrangement, Elevations, Single line diagram, Bill of material, Control and inter locking scheme to be submitted for approval prior to manufacturing and approval taken from PMC / Consultant / Owner.

#### **TESTING & PRE-DISPATCH QUALITY CONTROL**

- A.** Fabrication, Pre-treatment, painting, assembly and wiring.
- B. Tests:**
- Physical, Electrical, and Operational tests of all Breakers / Switches.
  - Operational check of all meters and relays.
  - Dielectric strength test for insulation at 2.5kV for 1 sec.
  - Insulation resistance test at 1000V megger,
  - Protective measures and continuity of circuits, as per IS: 8623-I, 1993.
  - Testing of protection relays by secondary injection kit before commissioning.
  - Interlocking Function Test.
  - Earth continuity test between various Non-current carryings parts of equipment steel work etc. & the earth bus provided in the panel.

#### **INSPECTION**

To be offered at works to PMC / Owner.

#### **TEST CERTIFICATE TYPE AND ROUTINE**

Test results for routine tests conducted at works should be submitted. Type tests as per IS: 8623 - Part I for Short circuit, Temperature rise, Degree of protection to meet the specifications and B.O.Q must be furnished.

#### **PACKING**

Wooden Crates/ Wooden Cases/ Polythene & Water proof paper to be used.

#### **AS MANUFACTURED DRAWINGS**

To be submitted in CD format with catalogues and test certificates of switchgear, controlgear and other components used within MDB & PDB.

#### **AFTER SALES SERVICE**

Manufacturer to have an Independent department to render after sales support for Installation, commissioning & trouble shooting during and after warranty period.

#### **OPERATING CONDITIONS:**

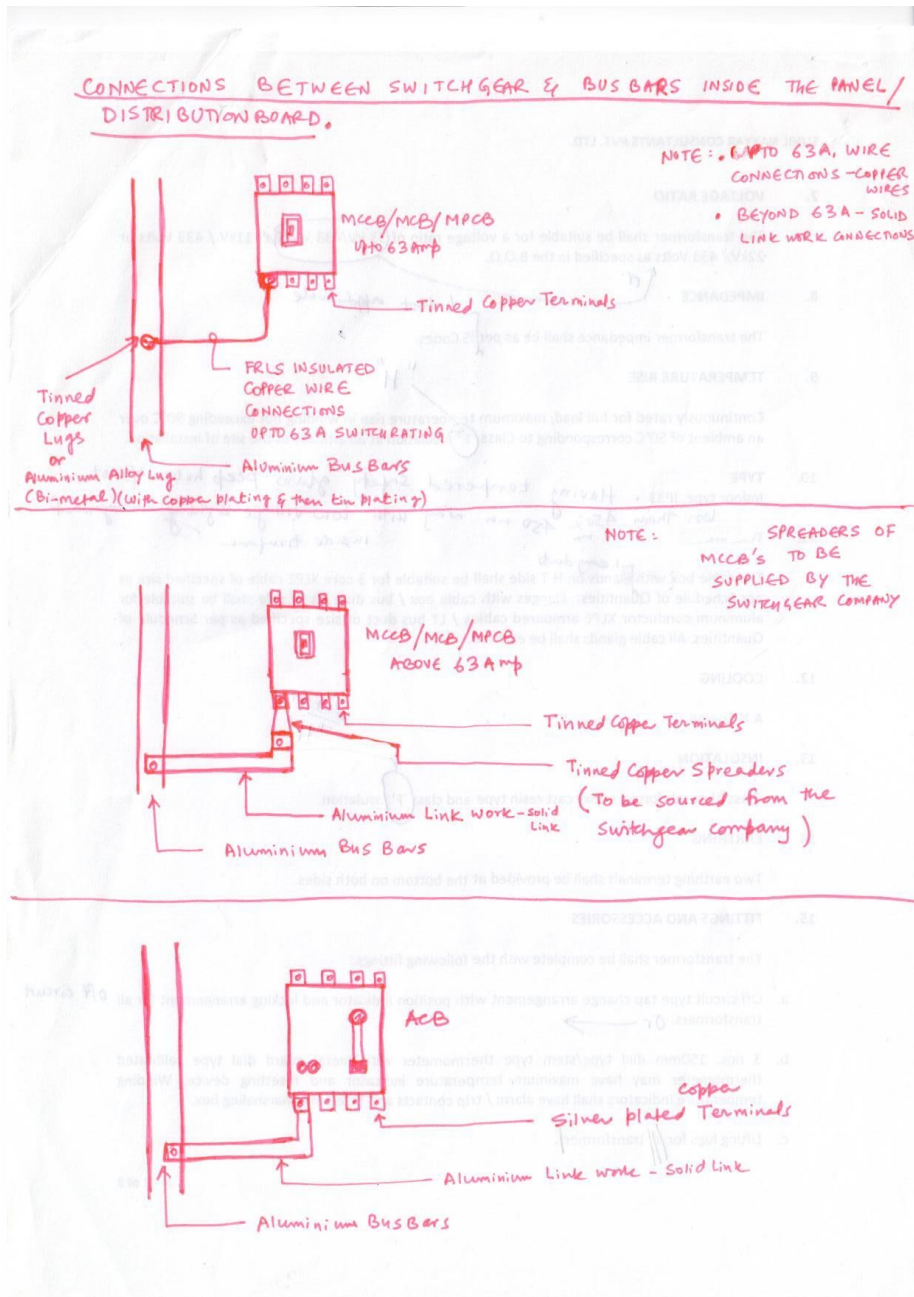
- No De-rating of panels, Switchgear/Equipment & Busbars upto 45 Deg. C & Altitude of 1000M above MSL for indoor panels.
- No De-rating of panels, Switchgear/Equipment & Busbars upto 50 Deg. C & Altitude of 1000M above MSL for outdoor panels / feeder pillars.

**CONNECTION BETWEEN BUSBARS & SWITCHGEAR**

- Upto 63Amp Switch rating with 1.1 KV grade FRLS PVC insulated flexible single core copper cables. Tinned copper or silver plated copper lugs shall be used on copper wires.
- Above 63Amp Switch rating, with solid aluminium / copper busbar links, to be used.
- Neutral Bus bars for four pole feeders shall be of the same size as phase.  
Neutral Bus bars for triple pole feeders shall be of 50% size of phase.  
Neutral Bus bars for UPS panels shall be of 200% size of phase.

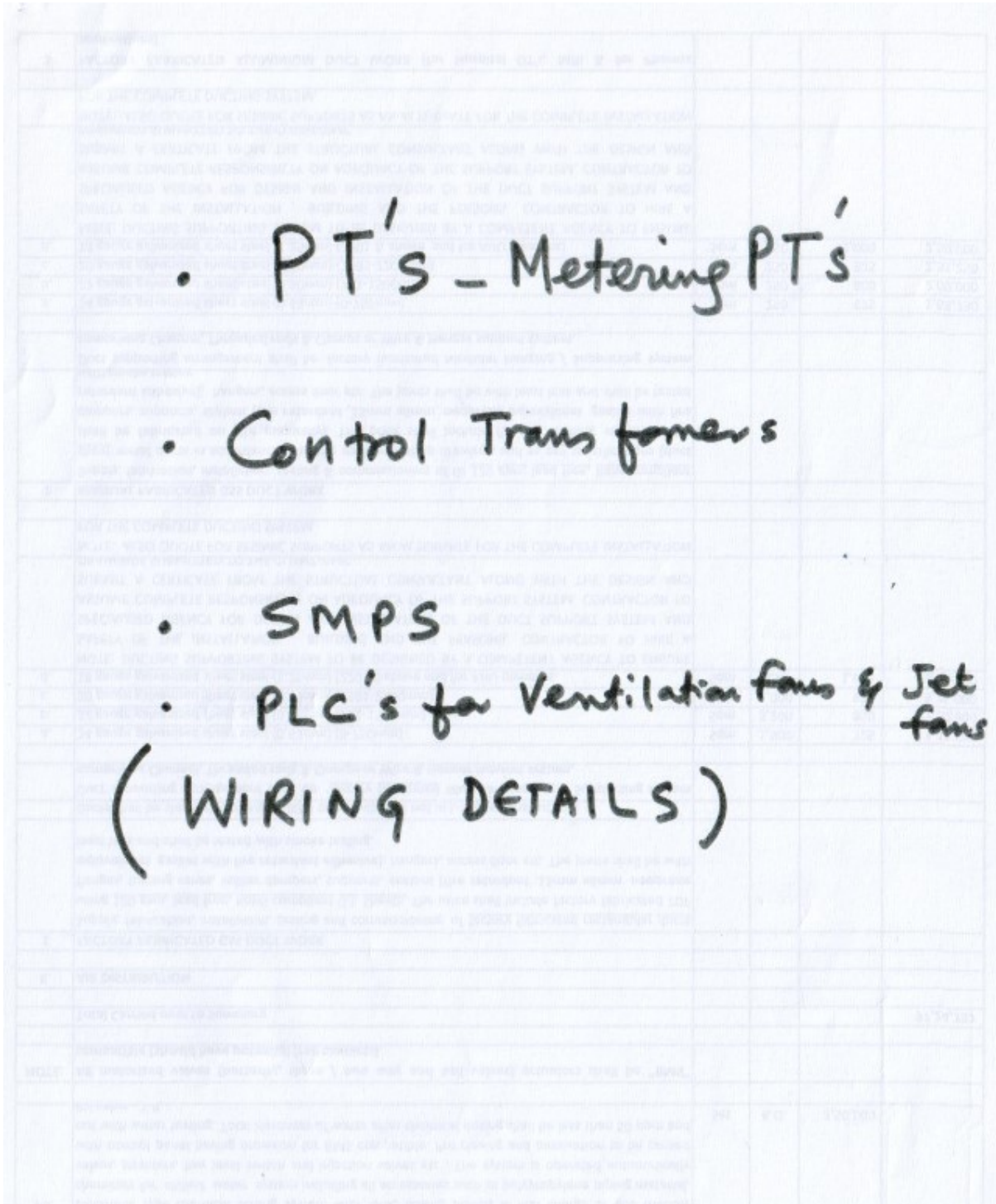
**ROTARY HANDLES & LOTO FEATURES IN MCCB'S & MPCB'S:**

- ALL MCCB'S & MPCB'S SHALL BE WITH DIRECT / EXTENDED ROTARY HANDLES.
- ARRANGEMENT OF PAD LOCKING & FOOL PROOF LOTO (LOCKOUT & TAG OUT) TO BE AVAILABLE WITH ALL MCCB'S & MPCB'S FOR MAINTENANCE SAFETY REASONS ON MOTORS / EQUIPMENT.
- MAINTENANCE TEAM TO UTILIZE LOTO FEATURE BEFORE INITIATING ANY REPAIR / MAINTENANCE ON ALL ELECTRICAL EQUIPMENT / PUMPS / MOTORS



16a. Construction Typology: Block set of Schneider /R2K of ABB if called for in the BOQ specifically.

16b.

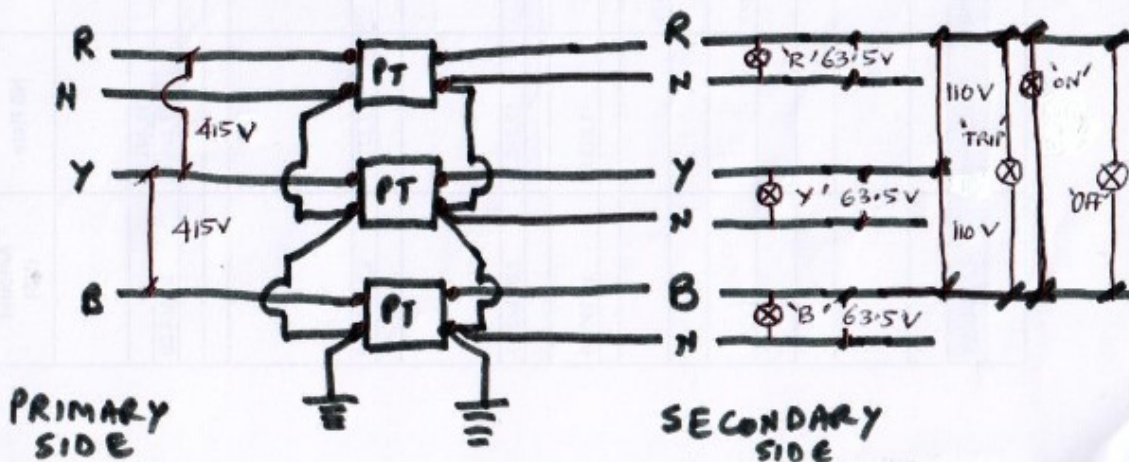




## 1. PT @ Panel's incomer: Metering PT

- $415\text{V}/\sqrt{3} \mid 110\text{V}/\sqrt{3}$
- 3 nos. Single Phase PT's.
- I put voltages : Primary side  
Phase to Phase : 415V  
Phase to Neutral : 230V
- Output Voltages : Secondary side  
Phase to Phase : 110V  
Phase to Neutral : 63.5V

- For :
- \* R, Y, B phase indication lamps : 63.5V (1 phase)
- \* MFM's : 3pl (110V)
- \* On/off/Trip indication lamps : 110V (2 phase)

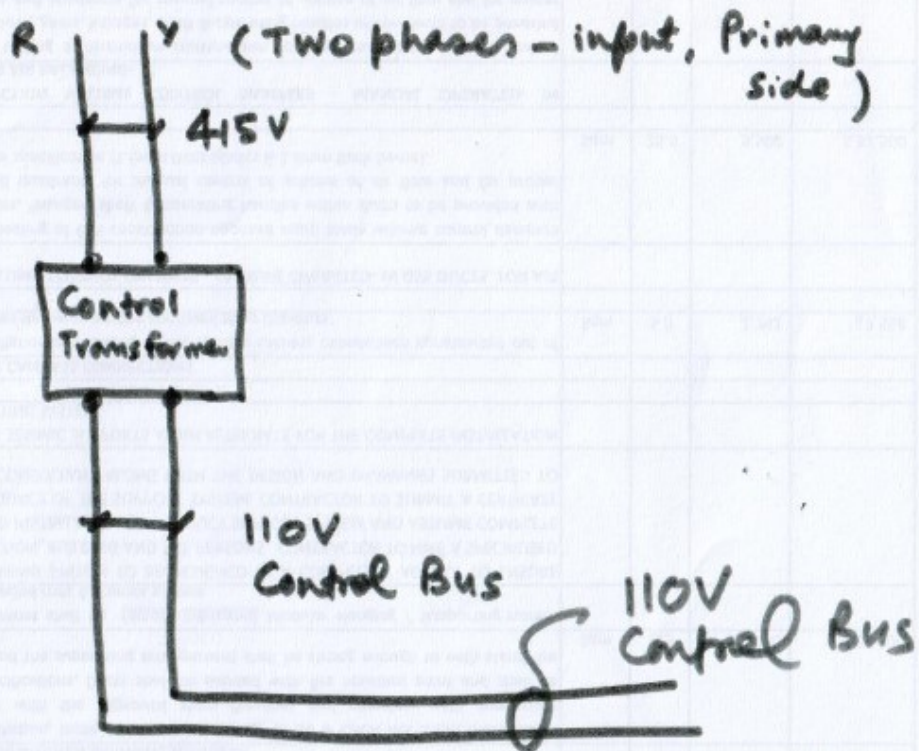




2. CONTROL TRANSFORMER : 415V (2Ph.) / 110V (1Ph.)

For : starter's / Contactor coils : 110V

: 'On', 'off', 'Trip' indication Lamps : 110V

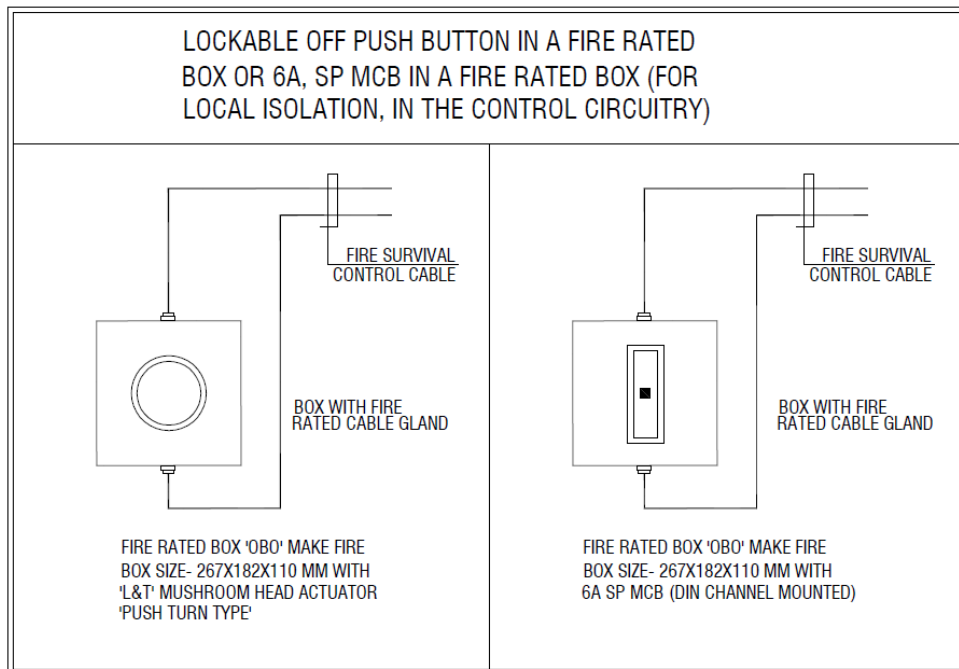


- \* For 110V Contactors / starter coils
- \* For 'on' / off / Trip indications of feeders (outgoings) : 110V
- \* VFD module cooling fan : 110V
- \* Panel heaters : 110V

**17 LOCAL ISOLATORS FOR MOTORS**

**Local Isolators**

- Power Cables Isolators in power cables:
  - Cooling tower motor.
  - TFA motor.
  - HRW fresh air fan & exhaust air fan motors.
  - Staircase pressurization fan motor.
  - Lift lobby pressurization fan motor.
  - Lift well pressurization fan motor.
  - Toilet exhaust fan motor.
  - Pantry exhaust fan motor.
  - Terrace located smoke venting fan motor for smoke & fresh air fans.
  - STP exhaust fan motor.
  - STP fresh air fan motor.
  
- Lockable off push buttons in control wiring for fans with fire rated cables (to avoid jointing in fire rated power cables):
  - Basement ventilation fan motors (fresh air & exhaust air).
  - Podium ventilation fan motors (fresh air & exhaust air).
  - Floor smoke venting fan motors (for fresh air & exhaust air).
  - MEP Rooms ventilation fan motors.



## **B. LT CABLES - 1.1 KV GRADE & CABLE TRAYS**

### **1. GENERAL**

The cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, Specifications, relevant Indian Standard and cable manufacturer's instruction.

### **2. MATERIAL**

#### **2.1 XLPE INSULATED, FR-LSH PVC SHEATHED (IS: 7098 PART-1) CABLES**

Specification of 1.1KV grade Single / Multicore XLPE insulated, **FR-LSH** PVC sheathed Aluminium / Copper conductor Armoured / Unarmoured cables shall be as per IS: 7098 Part-1:

#### **i. Conductor:**

- Material : Aluminium / Copper : Electrolytic grade
- Shape : Aluminium conductor : 6 & 10 sqmm. Solid circular
- : Copper conductor : 16 sqmm. & above stranded compacted shaped
- : 4 & 6 sqmm. stranded non compacted circular
- : 10 sqmm. stranded compacted circular
- : 16 sqmm. & above stranded compacted shaped

- ii. Insulation Material : Cross linked polyethylene XLPE (Red, Yellow, Blue & Black)
- iii. Inner Sheath : Extruded inner FR-LSH PVC sheath type ST-2.
- iv. Armouring : Single layer of galvanized steel round wires / flat strips.
- v. Outer sheath : FR-LSH PVC Sheath type ST-2.
- vi. Colour of sheath : Black.

**Note: Single core armoured cables shall be with “Non-magnetic” type armouring.**

### **3. CABLE LAYING AND HANDLING**

It should be ensured that both ends of the cable are properly sealed to prevent ingress / absorption of moisture.

### **4. CABLE HANDLING**

When cable drums have to be moved over short distance, they should be rolled in the direction of the arrow marked on the drum.

While removing cables, the drums shall be properly mounted on jacks or on a cable wheels or any other suitable means, making sure the spindle, jack etc. are strong enough to take the weight of the drum.

The cables shall not be given a sharp bend to a small radius. The minimum safe bending radius for all types of PVC/XLPE cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multicore cable shall not be less than 15 times its overall diameter.

Cable with kinks and straightened kinks, or with similar apparent defects like defective armoring etc. shall not be installed / laid.

Cables of different voltages as well as power and control cables should be kept in different trenches/racks with adequate separation. Where available space is restricted, LV/MV cable shall be laid above HV cables.

Where cables cross over cannot be avoided, the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

Installation of cables including jointing shall be carried out as per IS: 1255 amended and revised to date.

Power and communication cables shall, as far as possible cross at right angles. Where power cables are laid in proximity to communication cables, the horizontal and vertical clearances shall not normally be less than 60 cm. Cables shall be laid direct in ground, in pipes / closed ducts, in open ducts or on surface depending on environmental conditions, and as required in schedule of quantities.

During the preliminary stages of laying the cable, consideration should be given to proper location of the joint position so that when the cable is actually laid, the joints are made in the most suitable places and as approved by Consultant. As far as possible, water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible places, ducts, pipes, racks, etc. shall be avoided.

The cable shall not in any circumstances be bent so as to form an abrupt right angle but must be rounded off at the corners to a radius not less than 12 times the overall diameter of the cable.

In case, where there are chances of any damage to the wiring/cables, such wiring/cables shall be covered with a sheet metal protective covering (not less than 16 SWG), the base of the covering being flush with the plaster or brickwork as the case may be, or the wiring /cables shall be drawn through a heavy gauge metal conduit pipe by complying with all the requirements of conduit wiring system.

Such protective covering shall, in all cases, be fitted on all down drops within 1.5 m from the floor or from floor level upto the switch board, whichever is less.

While cutting and stripping of the outer sheathing of the cable, care shall be taken that the sharp edge of the cutting instrument does not touch the inner insulation of the conductors. The protective outer covering of the cable shall be stripped off near connecting terminal and this protective covering shall be maintained upto close proximity of connecting terminals. The cables laid near junction boxes shall be made moisture proof with a plastic compound.

## **5. CABLE JOINTING & TERMINATION**

Jointing shall be as per the manufacturer's recommendations using standard kits. Cable joints shall be made in suitable, approved cable joint boxes, jointing of cables in the joint boxes and filling of compound shall be done as per manufacturer's recommendations. Heat shrinkable joints shall be made.

Cables shall be terminated onto the terminals of switchgear through crimping lugs of proper size and of heavy duty. Cable lugs shall be fitted onto the cable by crimping or compression jointing.

Continuity of cable armouring is to be maintained. Double compression glands to be used. Proper crimping tools to be used.

### **5a. CABLE GLANDS:**

Heavy duty Brass-Nickel plated Double compression glands to be employed for cable termination into the panels & boards.

See photos of glands as below:



- i. Single compression gland, IP-68 rated, shall be used for flexible un-armoured copper cables.
- ii. Double compression glands, weatherproof IP-67 rated, shall be used for all the armoured / un-armoured cables.
- iii. Double compression flame proof glands, IP-66 rated, shall be used for fire rated / fire survival cables.

#### **5b. CABLE LUGS & THIMBLES:**

Heavy duty lugs & thimbles to be employed for making cable & wire connections.

- Aluminium cables connection with aluminium bus bars shall be made with aluminium lugs / thimbles.
- Copper cables / copper wire connections with copper bus bars or with tinned copper switch gear terminations or with silver plated switchgear terminals shall be made with tinned copper lugs / thimbles.
- Copper cables / copper wire connections with aluminium bus bars shall be made with tinned copper lugs / thimbles or with bi-metal lugs / thimbles i.e. aluminium alloy lugs / thimbles with copper plating & then tinning.
- Hardware for cabling connections to panel's bus bars, to switch gear, to DB's and motors etc.: High tensile MS Alloy grade 8.8, Zinc coated (minimum 10microns coating). (Trivalent Plating CR3+).

Bolts, nuts & washers for cabling connections shall be:

1.	Steel Hardware		
	Salt mist spray withstand	:	120 Hours
	Bolt and nuts		
	Hardware quality	:	8.8
	According to	:	EN 20898, EN ISO 3506-1, 4759-1 (=S=FT30860)
	Contact Washers		
	Washer quality	:	8.8
	Class	:	160 HV
	According to	:	EN 20898, EN ISO 3506-1, 4759-1

Note : double washers to be employed. (plain and spring washers).

## 6. TRENCHING & CABLE LAYING

The minimum width of trench shall be 45 cm and depth shall be 75cm for laying of cable. Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the minimum gap between the cables is one diameter of the cable unless specified otherwise.

The clearance between axis of the end cables and the sides of the trench shall be minimum 1.5 D (diameter) of the end cable.

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided.

Where gradients and changes in depth are unavoidable, these shall be gradual.

The bottom of the trenches shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 9 cm in depth.

Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 20 cms. above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation, after the first cable has been laid, a sand cushion of 30 cms shall be provided over the initial



bed before second tier is laid. If additional tiers are formed, each of the subsequent tiers shall have a sand cushion of 30 cms as stated above. The top-most cable shall have final sand covering not less than 17 cms before the protective cover is laid.

Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20 cm x 10 cm x 10 cm (nominal size) as per CPWD building specification, or protection covers placed on top of the sand, (brick to be laid breadth wise) for the full length of the cable to satisfaction of the owner. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5 cm over the sides of and cables.

The trenches shall be then back filled with excavated earth free from stone or other sharp-edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm. Unless otherwise specified, a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of earth, however, should not exceed 10 cms.

Where road bends or lawns have been cut or kerb stones displaced, the same shall be repaired to the satisfaction of the architect and all surplus earth or rock removed to places as specified. In locations such as road crossing, entry to building in paved areas etc. cables shall be laid in pipes or closed ducts.

All cable entry/exit points into the building through pipe sleeves shall be properly sealed with water and fire safe sealants in an approved manner to avoid any seepage of water into the building.

Manholes of adequate size, as decided by the Architect, shall be provided to facilitate of adequate strength feeding/drawing in of cables and to provide working space for persons. Suitable manhole covers with frame of proper design shall cover Manholes.

CABLE LOOPS: Sufficient cable loop length shall be left at both ends.

## **7. CABLES ON HANGERS OR RACKS / TRAYS**

The contractor shall provide and install all iron hangers racks, or racks with die-cast cleat, with fixing rag bolts or girder clamps or other specialist fixing as required.



Where hangers or racks are to be fixed to wall sides ceiling and other concrete structures, the contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good the damages as required.

The hangers or racks shall be designed to leave at least 25 mm clearance between the cables and the face to which it fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 500 mm intervals. These shall be designed to keep provision of some spare capacity for future development. Minimum spacing between the cables shall be one diameter of the cable or as specified.

**Cable Clamps , saddles and screws :**

Cable fixing clamps, saddles & screws on trays / walls / slabs	<u>Indoor Application:</u> <ul style="list-style-type: none"> <li>• Aluminium</li> <li>• Readymade type clamps or Made from 20mm x 3mm aluminium sheet / strips.</li> <li>• 8mm SS-304 Screws for cable size 90mm<sup>2</sup> and above.</li> <li>• 6mm SS-304 Screws for cable size less than 90mm<sup>2</sup>.</li> </ul> <u>Outdoor Application:</u> <ul style="list-style-type: none"> <li>• SS-304</li> <li>• Clamps Made from 20x1.8mm SS-304 sheet / strips.</li> <li>• 8mm SS-304 Screws for cable size 90mm<sup>2</sup> and above.</li> <li>• 6mm SS-304 Screws for cable size less than 90mm<sup>2</sup>.</li> </ul>
Clamps spacing	<ul style="list-style-type: none"> <li>• 600mm C/C in vertical fashion in shaft on vertical trays.</li> <li>• 1000mm C/C on horizontal tray or cable racks.</li> </ul>

**8. TESTING OF CABLES**

The Megger value in normal dry weather shall be 50 mega ohm for 1.1 KV grade cable. Cables shall be tested at works for the following tests before being dispatched to site by the project team:

- a. Insulation Resistance Test.
- b. Continuity resistance test.
- c. Sheathing continuity test.
- d. Earth test.(in armoured cables)
- e. Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner's site representative:

- a. Insulation Resistance Test( Sectional and overall)
- b. Continuity resistance test.
- c. Sheathing continuity test.
- d. Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the PMC / Owner representative.

## **9. CABLE TAGS**

Cable tags shall be made out of 2mm thick aluminum sheets. Each tag shall be 2" in dia or 3" x 3" square with one hole of 2.5mm dia, 6 mm below the periphery, or as approved by Consultant. Cable designations are to be punched with letters / number punches and the tags are to be tied to cables with piano wires of approve quality & size. Tags shall be tied inside the panels beyond the glanding as well as above the glands at cable entries. Along trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 meters.

Cables shall be secured to cable trays with 3mm thick x 25mm wide aluminum strips/suitable GI clamp, or as approved by Consultant, at 1000 mm intervals and screwed by means of rust proof screws, washers and bolts, of adequate but not excessive lengths. Cable trays for horizontal runs suspended from the ceiling will be supported with mild steel straps or brackets, at 1000 mm intervals and the overall tray arrangement shall be of a rigid construction. External cabling route marker with GI plate marked with "DANGER 1.1 kV CABLE" with 1 meter long GI angle iron grouting bracket including 1:3:6 ratio cement concrete base block of minimum size 200 x 200 x 350 mm to be provided or as approved by Elect. Supply Company.

## **10. CABLE TRAY**

- a) The MS cable trays should have undergone rigorous rust proofing process, which should comprise of alkaline, degreasing, descaling in diluted sulphuric acid and a recognized phosphating process. The sheet work shall then be given two coats of oxide primer before two coats of final painting. Cable trays

& tray supports shall be either painted (Stove enameled) or hot dip galvanized as called for in the schedule of quantities.

- b) Cable trays shall be complete with bends, joints, coupler plates and accessories as may be required for joining the cable trays.
- c) Cable trays shall be either perforated or ladder type as called for in the schedule of quantities.

### 11. PERFORATED CABLE TRAYS

Standard Technical details of perforated cable tray shall be as follows:

SI No	SIZE OF TRAY (Width)	THICKNESS & COLLAR HEIGHT
1.	150mm to 450mm width	2mm thick & 50mm collar
2.	600mm to 750mm width	2mm thick & 50mm collar
3.	900mm to 1200mm width	3mm thick & 50mm collar

**Note: Supports shall not be charged extra. It shall be considered to be included in the rate of the tray.**

### 12. LADDER TYPE CABLE TRAYS

Standard technical details of ladder type cable trays shall be as follows:

S. No.	SIZE OF TRAY	SIZE OF MAIN CHANNEL OR RUNNER	SIZE OF RUNG & SPACING	CABLE TRAY SUPPORT
1.	900mm to 1500mm	25 x 100 x 25 x 2.5mm	20 x 50 x 20 x 2.5mm @ 250 C/C	50 x 50x 5mm angle @ 1000mm spacing.
2.	450mm to 750mm	20 x 75 x 20 x 2.0mm	20 x 50 x 20 x 2mm @ 250 C/C	40 x 40 x 5mm angle @ 1250mm spacing.
3.	150mm to 300mm	20 x 75 x 20 x 2.0mm	15 x 35 x 15 x 2mm @ 250 C/C	40 x 40 x 3mm angle @ 1500mm spacing.

Hangers shall be minimum 10mm dia GI Round bar.

Fixing /supporting arrangement shall be as approved by the Consultant / Owner / PMC

Hardware to be used in cable tray system shall be hot dip galvanized.

**Note: Supports shall not be charged extra. It shall be considered to be included in the rate of the tray. All structural steel shall be according to the latest revision of IS: 226 & 808.**

**a. Quality of Zinc**

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1992.

**b. Coating Requirement**

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs; rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing, pickling in acid, cold rinsing and then galvanizing.

**13. CABLE TRAY SUPPORT / INSTALLATION SYSTEM:**

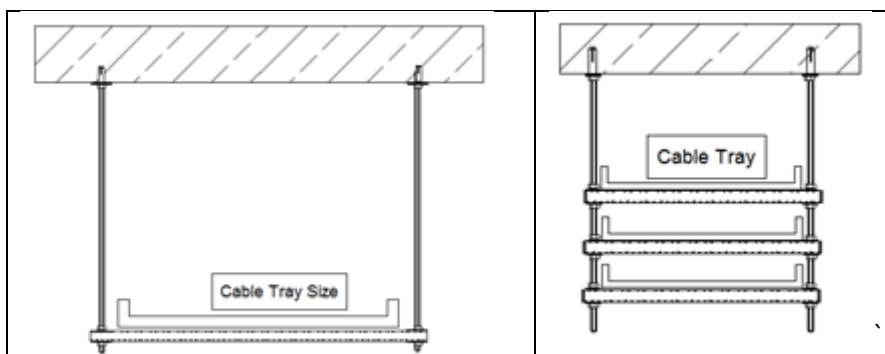
**13.1 FACTORY FABRICATED MODULAR SUPPORTING SYSTEM:**

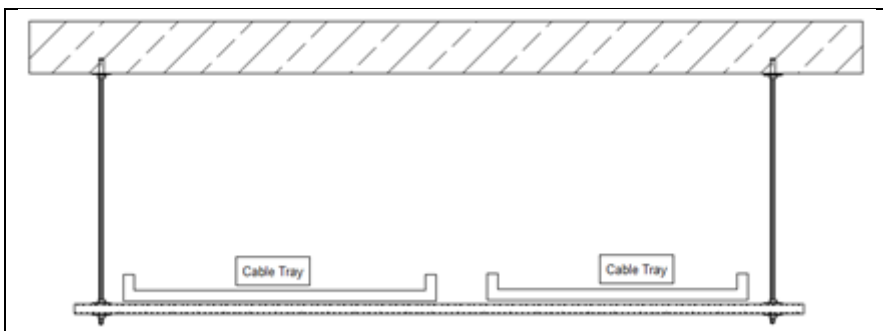
**a. Cable tray support from RCC slab**

Description
The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b>
The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b> .
The Threaded Rods used for the suspension of the Cable tray should be made up of partially annealed medium carbon steel of grade <b>4.8 strength class and as per DIN 976 standard</b> .
The Drop-in anchors used for the suspension of the rods should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.

Supporting DETA(European Technical Approval)ils for Cable Trays is given below			
Cable Tray Size	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig p. Typical Arrangement for cable tray support From RCC slab



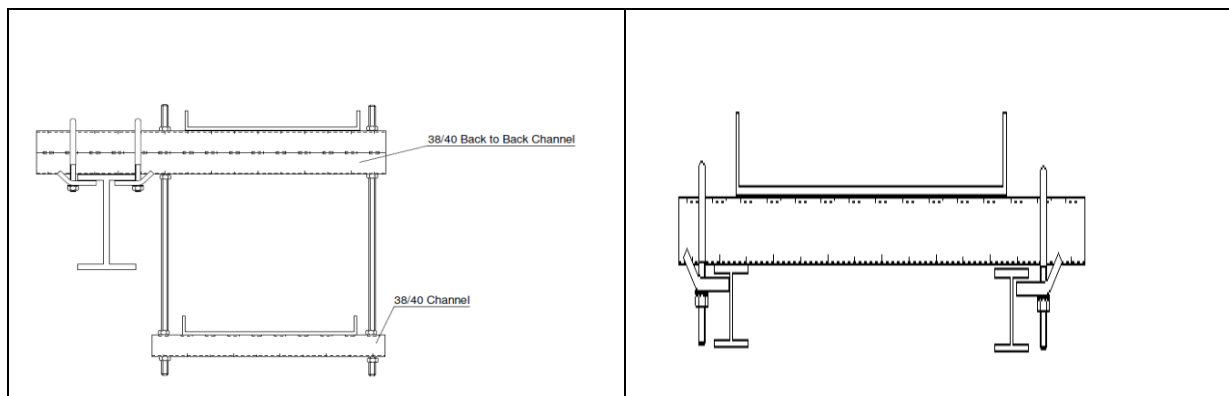


**b. Cable tray support from PEB Structure:**

Description
<p>The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b></p> <p>The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.</p> <p>The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b>.</p>
<p>The Threaded Rods used for the suspension of the Cable tray should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b>.</p>
<p>For parallel to beam application. The Girder cleat for attachment of support channel to steel girder Girder cleat should be <b>Vds approved</b>.</p> <p>For perpendicular to beam application The Girder clamp for suspension of threaded pins and threaded rods for support channels. Girder clamps should be <b>FM and Vds Approved</b>.</p>
<p>The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.</p>

Supporting DETA(European Technical Approval)ils for Cable Trays is given below			
Cable Tray Size	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig q. Typical Arrangement for cable tray support From PEB structure

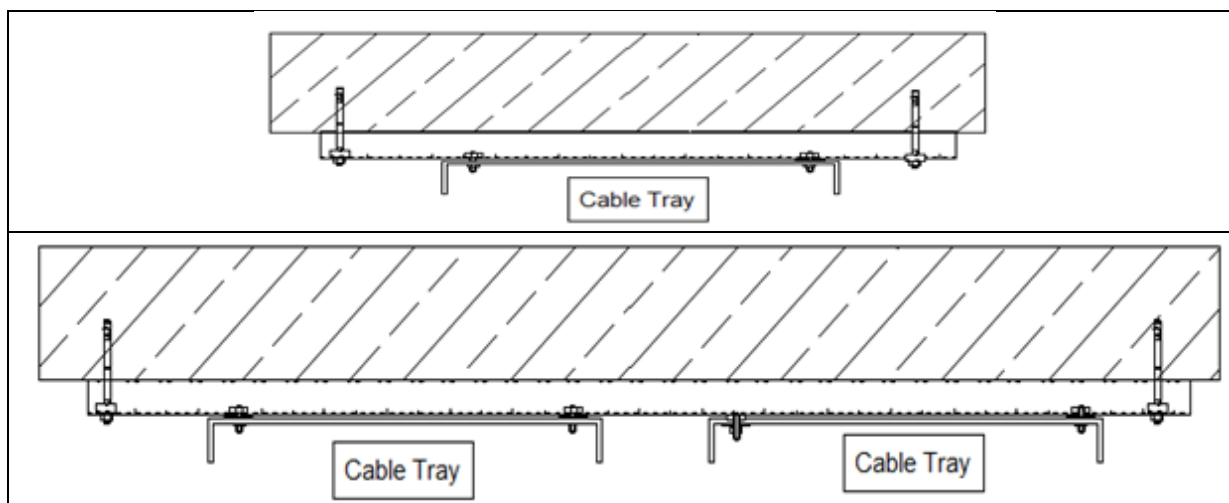


**c. Cable tray support from Building shaft**

Description
The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b>
The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b> .
The Threaded Rods used for the Channel fixing with shaft that should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b> .
The Drop-in anchors or stud anchor used for channel fixing with shaft that should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.

Supporting DETA(European Technical Approval)ils for Cable Trays is given below			
Cable Tray Size	Support Channel mm	Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig r. Typical Arrangement for cable tray support from building shaft



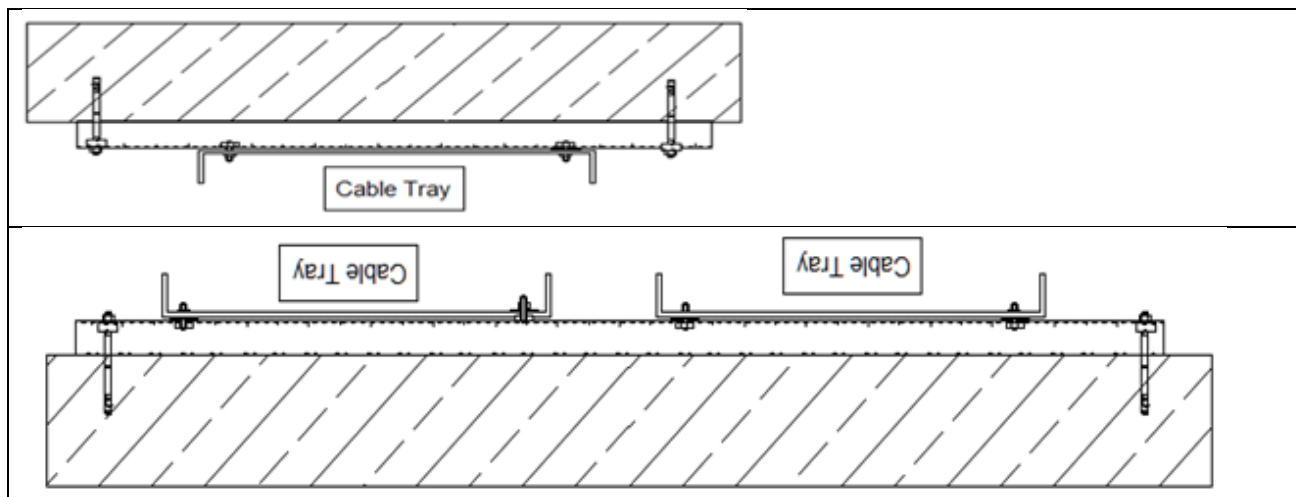
**d. Cable tray support from on terrace**

Description
The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b>
The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b> .
The Threaded Rods used for the Channel fixing with terrace that should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b> .
The Drop-in anchors or stud anchor used for channel fixing with terrace that should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.

Supporting DETA(European Technical Approval)ils for Cable Trays is given below			
Cable Tray Size	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig s. Typical Arrangement for cable tray support from building terrace



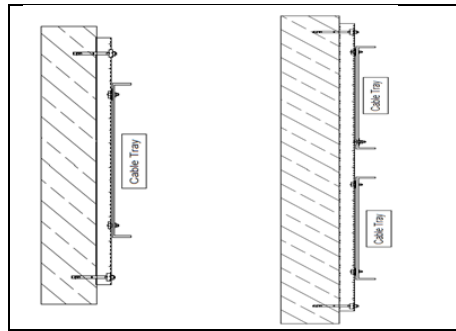


**e. Cable tray support from Building shaft**

Description
The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b>
The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b> .
The Threaded Rods used for the Channel fixing with wall that should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b> .
The Drop-in anchors or stud anchor used for channel fixing with Wall that should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.

Supporting DETA(European Technical Approval)ils for Cable Trays is given below			
Cable Tray Size	Support Channel mm	Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig t. Typical Arrangement for cable tray support from wall



## **C. EARTHING**

### **1. SYSTEM OF EARTHING**

The system shall be TNS with 4 wires supply system (R, Y, B, N and 2 Nos. E) brought from the main LT Panel.

All non-current carrying metal parts of the electrical installation shall be earthed as per IS: 3043 – 2018 with latest amendment. All metal conduits, cable sheath, switchgear, DB's, light fixture, equipment and all other parts made of metal shall be bonded together and connected to earth electrodes. Earthing shall be in conformity with provisions of rules 32, 61, 62, 67 and 68 of Indian Electricity Rules, 1956.

All earthing conductors shall be of high conductivity copper or GI, as specified in the schedule of quantities & shall have protection against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor.

Main earthing conductors shall be taken from the earth connections at the main L T panel to an earth electrode with which the connection is to be made. All joints in tapes shall be with S.S. Straight through or cross connectors or copper brazing in case of copper tapes and by Exothermic welding or bolting or S.S. connectors (straight through or cross connectors) in case of GI tapes. Wires shall be connected with suitable crimping lugs, all bolts shall have plain and spring washers spring washers. Sub- mains earthing conductors shall run from the main distribution panel to the sub distribution panel. Final distribution panel earthing conductors shall run from sub-distribution panel.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured

in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed.

a. All Lighting fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with copper wire as specified in schedule of quantities. The earth wire ends shall be connected with solderless/bottle type copper lugs.

b. All the earth wires in switch boxes, sockets outlets, DB's and light fixtures shall be of green Colour (PVC insulated).

c. Main earth bus shall be taken from the L.T. switch board to earth electrodes. The electrical resistance of earthing conductors shall be low enough to permit passage of fault current necessary to operate fuse or circuit breaker, and it shall not exceed 1 ohm.

**2. SIZING OF EARTHING CONDUCTORS**

The cross sectional area of earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80 Sq.mm. If the area of the largest current carrying conductor or bus bar exceeds 160 sq.mm then two or more earthing conductors shall be used in parallel, to provide at least half the cross sectional area of the current carrying conductor or bus bars. All fixtures, outlet boxes, junction boxes and power circuits upto 15 amps shall be earthed with FRLS PVC insulated copper wire.

All 3 phase switches and distribution panels upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper / GI wires. All 3 phase switches and distribution panels upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper / GI wires. All switches, bus bar, ducts and distribution panels of rating 200 amps and above shall be earthed with minimum of 2 nos separate and independent 25 mm x 3 mm copper / GI tape.

Earthing details given in Table – A & B shall be referred to as a general guidance. Exact sizes to be worked out by the contractor as per relevant IS Codes.

**TABLE - A**

Size of earth leads  
(a) For Transformer/Generator Neutral Point Earthing:

Transformer/ DG Set Rating	Electrolytic Bare copper Conductor Wire or strip	Galvanized Iron Conductor wire or strip
----------------------------------	---	--

50KVA & below/4mm dia	4mm dia	25mm x 6.0mm
75 KVA	25mm x 3.0mm	25mm x 6.0mm
100 KVA	25mm x 6.0mm	32mm x 6.0mm
150 KVA	25mm x 6.0mm	40mm x 6.0mm
200 KVA	25mm x 6.0mm	40mm x 6.0mm
250 KVA	25mm x 6.0mm	40mm x 6.0mm
300 KVA	25mm x 6.0mm	40mm x 6.0mm
500 KVA	40mm x 6.0mm	40mm x 6.0mm
750 KVA	40mm x 6.0mm	50mm x 6.0mm
1000 KVA	40mm x 6.0mm	50mm x 6.0mm
1250 KVA	50mm x 6.0mm	50mm x 6.0mm
1500 KVA	50mm x 6.0mm	75mm x 6.0mm
2000 KVA	50mm x 6.0mm	75mm x 6.0mm

**NOTE:** - EXACT SIZE OF EARTH LEAD TO BE DETERMINED AS PER LATEST IS CODES.

**TABLE – B**

- (b) For Equipment Earthing (Applicable to Transformer, Generators, Switchgears, Panels, DB's, Motors etc.)

Rating of 400-V, 3ph 50 cy. Equipment In KVA	Bare Electrolytic Copper conductor Wire / Strip	Galvanised Iron Wire / Strip
upto 5	2mm dia	2mm dia
6 to 15	3mm dia	3mm dia
16 to 30	4mm dia	4mm dia
31 to 50	6mm dia	6mm dia
51 to 100	25mm x 3.0mm	25mm x 6.0mm
101 to 125	25mm x 3.0mm	32mm x 6.0mm
126 to 150	25mm x 3.0mm	32mm x 6.0mm
151 to 200	25mm x 6.0mm	40mm x 6.0mm
201 to 300	25mm x 6.0mm	50mm x 6.0mm
301 to 500	32mm x 6.0mm	50mm x 6.0mm
501 to 800	40mm x 6.0mm	50mm x 6.0mm
Above 800	50mm x 6.0mm	50mm x 6.0mm

**NOTE:** EXACT SIZE OF EARTH LEAD TO BE DETERMINED AS PER LATEST IS CODES.

**NOTE:** ALL THREE PHASE EQUIPMENT SHALL BE DOUBLE EARTHED

### **3. PROHIBITED CONNECTIONS**

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as an earthing conductor.

### **4. CONNECTION/JOINTS**

#### **A. GI Earth Tape Jointing shall be:**

##### **a. Bolted Joints for all exposed GI earth tape joints on cable trays:**

Tape to tape bolted connections are to be made by sufficiently over lapping two tapes, one above the other and then making connection by not less than two sets of Nuts, bolts & washers. Washers shall be used at both sides. Overlapped joint with 2 sets of bolting arrangement per joint.

Zinc passivated / coated high tensile alloy MS grade 5.6 Hardware shall be used for making joint. (See attached sketches with the specifications).

High grade S.S. hard ware shall be used in coastal areas.

##### **b. Fixing of GI Earth tape on cable tray:**

Earth tape bolting on to GI cable trays shall be made by nuts, bolts & washers of same quality as mentioned earlier but at any fixing location on the tray, a small piece of GI tape shall be over lapped on the main earth tape so as to compensate for the area loss due to hole for fixing.

##### **c. Exo Thermic welding of GI earth tape for tape joints buried in ground or clamped on wall, floor, slab:** 'UL' listed exothermic welding to be employed for such joints.

##### **d. S.S. Cross / Straight through connectors for GI tape joints clamped on wall, floor, slab:**

Cross or straight through connectors may be used for making such joints.

**B. Copper Earth Tape Jointing shall be:**

- a. S.S. Cross or straight through connectors to be used for making such joints.
- b. By copper Brazing.
- c. S.S. 304 nuts, bolts, plain and spring washers. Overlapped joint with 2 sets of bolting arrangement per joint.

**5. EARTHING**

The following must always be ensured in earthing system:

- All earth pits should be at equi - potential. Main equipotential bonding conductors shall be provided.
- Extraneous conductive parts such as gas pipes, other service pipes and ducting risers and pipes of fire protection equipment and exposed metallic parts of the building structure shall be bonded to earth.
- The Contractor shall get the soil resistivity test done at his own cost of the area where earthing pits are to be located before starting the installation.
- 

**6. RESISTANCE TO EARTH**

The resistance of earthing system shall be less than 1 ohm.

**SPECIFICATION FOR HOT DIP GALVANIZING PROCESS FOR MILD STEEL USED FOR EARTHING FOR ELECTRICAL INSTALLATION****7. GENERAL REQUIREMENTS****a. Quality of Zinc**

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1992 (refer latest codes).

**b. Coating Requirement**

Minimum weight of zinc coating for mild steel flats shall be in accordance with latest IS:6745-1972 (refer revised code) but shall not be less than 500 gsm & 70 microns coating.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs; rust stains bulky white deposits, blisters.

Recycled steel is not to be used for making earth tapes.

Mild steel flats / wires shall undergo a process of degreasing, pickling in acid, cold rinsing and then galvanizing.

Wooden mallet to be used for straightening of GI tapes so that galvanized coating is not damaged.

**8. MAINTENANCE FREE CHEMICAL EARTHING:**

Maintenance Free Chemical Earthing shall be done strictly as per manufacturer's recommendations. It shall be completely maintenance free, long life close to 25 years, environmentally safe, non corrosive & electrically conductive. The earth resistance results shall be less than one ohm.

Maintenance Free Earthing System consisting of 1 Nos. CPRI tested 'UL' Listed copper bonded carbon steel core electrode of 25 / 20 mm dia Electrode tested according to IEC 62561-2 and as specified in the BOQ, each with a minimum coating thickness of 250 microns and length of 3 meters. 25 kgs/Electrode of earth enhancing compound needs to be considered to fill the 100mm augered hole surrounding to the electrode.

SS Universal Clamp of Size 175X50X3 mm for Connection Terminal to be used..

Earth enhancing compound(OEC) tested as per IEC 62561-7 (mimum 25 kg or more as per requirement) to be used.

Poly Propiline Heavy duty Pit cover to be employed.

9. Galvanic Corrosion between dissimilar materials:

CONNECTIONS WITHOUT RISK OF GALVANIC CORROSSION

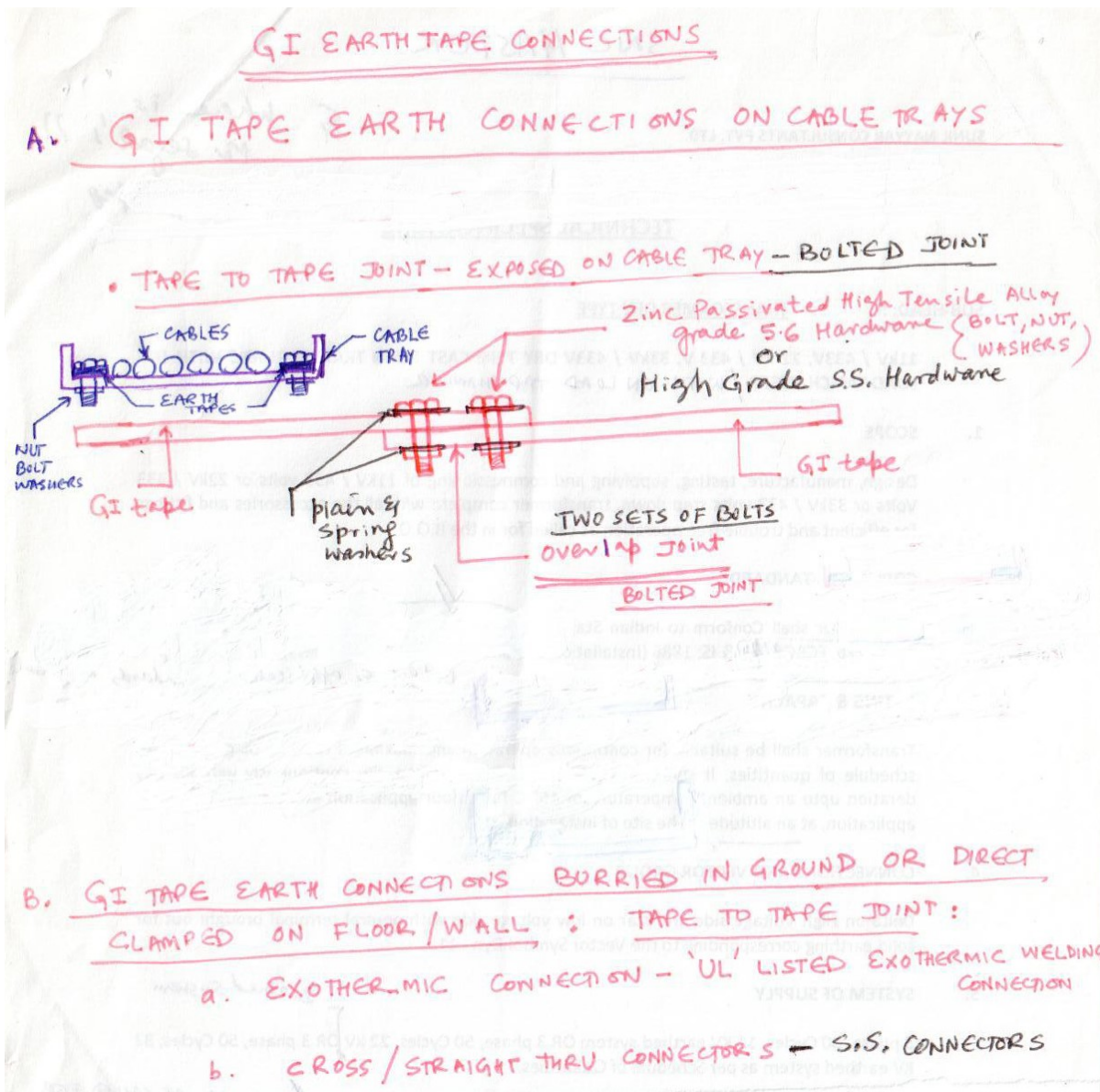
**Material combinations without increased risk of corrosion**

	Steel, galvanised	Aluminium	Copper	Stainless steel	Titanium	Tin
Steel, galvanised (GI)	Yes	Yes	No	Yes	Yes	Yes
Aluminium	Yes	Yes	No	Yes	Yes	Yes
Copper	No	No	Yes	Yes	No	Yes
Stainless steel	Yes	Yes	Yes	Yes	Yes	Yes
Titanium	Yes	Yes	No	Yes	Yes	Yes
Tin	Yes	Yes	Yes	Yes	Yes	Yes



**10. GI EARTH TAPE CONNECTIONS**

**A. GI Tape Earth Connection on Cable Trays:**



B. GI Earth Tape Fixing on GI Cable Tray:

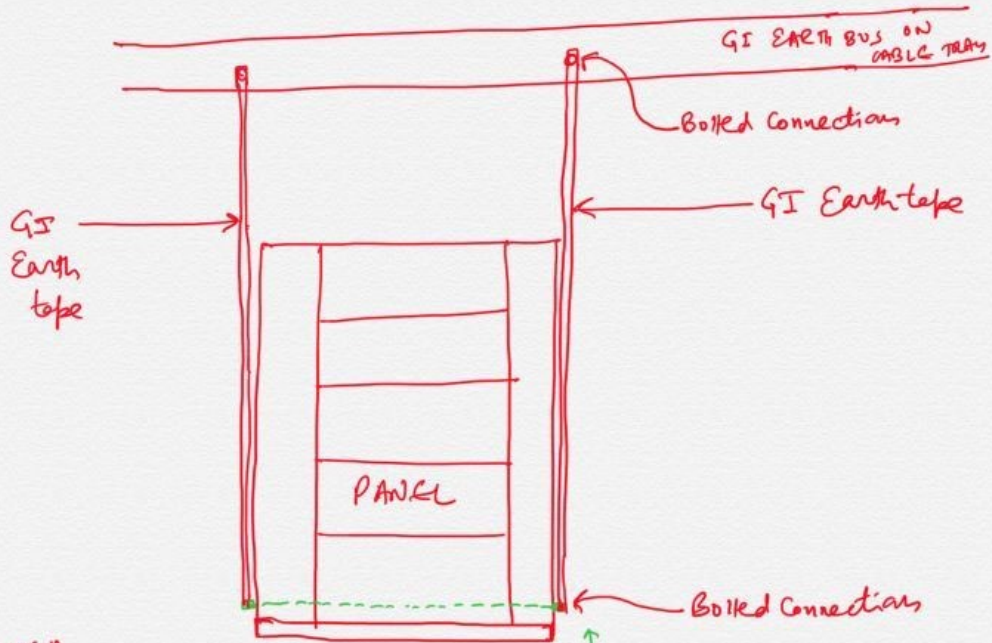
B.

## GI Earth tape fixing On GI Cable tray

- Use a piece of Earth tape of same size to overlap with main tape to compensate for the area loss due to hole.
- Use high grade S.S. nuts/bolts/washers or 5.6 grade high tensile Alloy Zinc coated (10 microns) nuts/bolts/washers.
- Use double washers i.e. plain & Spring.

**C. Earth Connection to a Panel / Board:**

C. Earth Connections to a Panel / Board

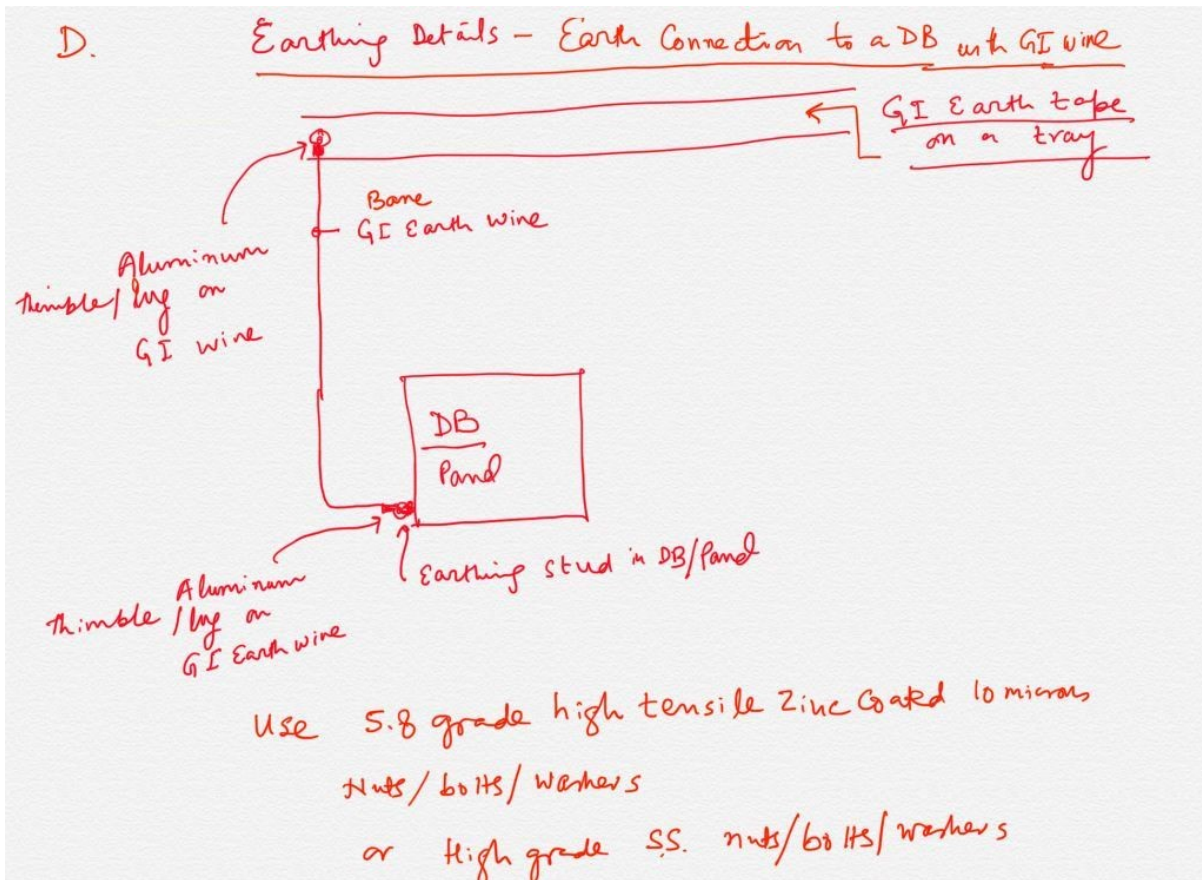


With  
 5.8 grade MS Alloy  
 Zinc Coated (10 microns)  
 Nut/Bolt/Washers  
 or  
**S.S. Nuts/Bolts/Washers**

Continuous length  
 Aluminium  
 Earth bus inside  
 the panel

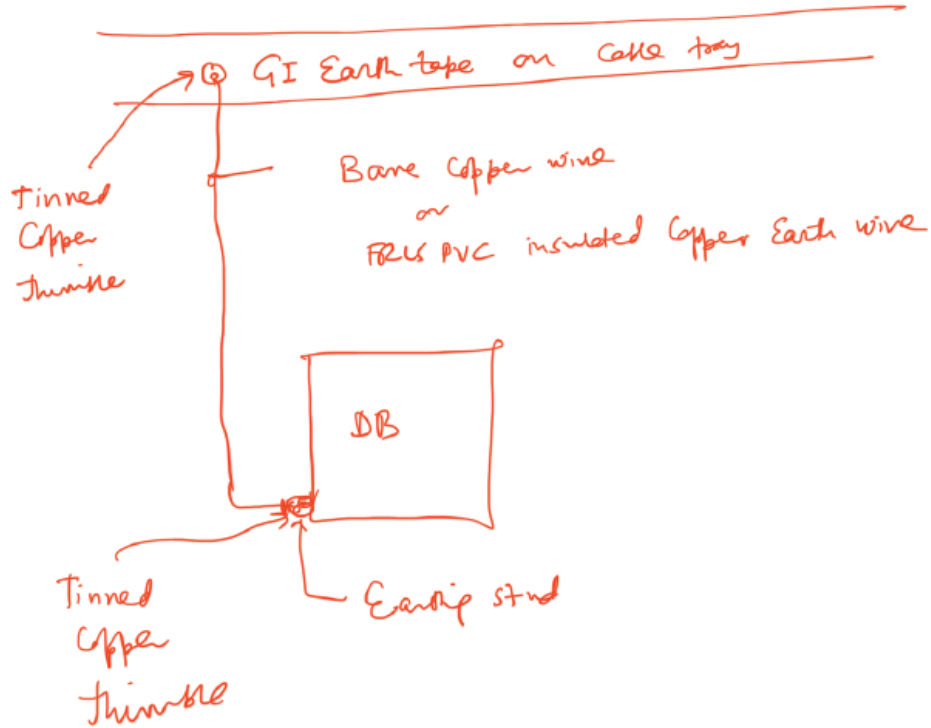


D. Earthing Details – Earth Connection to a DB with GI Wire:



E. Earthing Details – DB Earthing with Copper Wire from GI Tape:

E. Earthing Details – DB Earthing with Copper wire from GI tape



**SUBHEAD-10. LIST OF I.S.CODES AND REFERENCE STANDARDS:**

2. Codes and reference standards referred to in the contract shall be understood to form a part of the contract.
3. Alternative reference standards produced by different standards authorities may be specified in a Section. Standards of any of the specified authorities may be acceptable, however, materials specified in the Section shall be incorporated in the works from only one of the specified standards authority to ensure compatibility in the performance of the materials.
4. The contractor shall be responsible for adherence to reference standard requirements by subcontractors and suppliers.
5. Where edition date is not specified, consider that reference to manufacturer's and published codes, standards and specifications are made to the latest edition (revision or amendment) approved by the issuing organization current at issue date of the tender otherwise also the latest revised codes shall be referred.
6. The specified reference standards are INDIAN STANDARD CODES and are intended to establish the quality of materials and workmanship required for the works. Reference standards published in other countries may, in the sole judgement of the owner's consultant, also be acceptable providing that the Contractor furnishes sufficient data for the Owner's Consultant to determine if the quality of materials and workmanship at least equals or exceeds all tests prescribed by the specified reference Indian Standard codes.

Such other reference standards published by the following will be considered ;

BSI	:	British Standards Institute
AFNOR	:	Association Francaise de Normalisation (French Standards Institute)
DIN	:	Deutsche Industries Norman (German Standards)
ANSI	:	American National Standards Institute
ASTM	:	American Society for Testing and Materials

7. Reference standards and specifications are quoted in CPWD specification to establish minimum standards. Works of quality or of performance characteristics that exceed these minimum standards will be considered to confirm.
8. Should regulatory requirements or the contract conflict with specified reference standards or specifications, the most stringent in each case shall govern.
9. Where reference is made to manufacturer's directions, instructions or specifications they shall include full information on storing, handling, preparing, mixing, installing, erection, applying or other matters concerning the materials pertinent to their use in the works and their relationship to materials with which they are incorporated.
10. Obtain copies of codes applying to the Work, manufacturer's directions and reference standards referred to in the contract within 30 days of signing the contract.

11. Submit a copy of each code, reference standard and specification, and manufacturer's directions, instructions and specifications, to which reference is made in CPWD specification to the Owner's Authorized Representative's.

**12. LIST OF CODES (INDIAN STANDARD CODES) :**

- 12.1. Standards, specifications, associations, and regulatory bodies are generally referred to throughout CPWD specifications by their abbreviated designations. The materials workmanship shall be in accordance with the requirement of the appropriate I.S.code wherever applicable together with any building regulations or bye-laws governing the works.

- 12.2. The following list is included for guidance only and the omission of any C.P. I.S.codes from the list does not relieve the contractor from compliance therewith :

- 12.3. The most important Codes, Standards and Publications applicable to this section are listed hereinafter :

**13. General :**

IS 1200	Mode of Measurement
IS 12183 (Part 1)	Code of practice for plumbing in multi-storeyed buildings (Water Supply)
IS 12251	Code of practice for drainage of building basements
SP 7	National building code of India (Part IX plumbing services)
SP 6(1)	Structural Steel Sections
IS 27	Pig Lead
IS 325	Three phase induction motors
IS 800	Code of Practice for General Construction in Steel
IS 554	Dimensions for pipe threads where pressure light joints are required on the threads
IS 779	Specification for water meters (domestic type)
IS 1172	Code of Basic requirements for water supply drainage and sanitation
IS 1367	Technical supply conditions for threaded steel fasteners :
(Part 1)	Part I Introduction and general information
IS 1367	Technical supply conditions for threaded steel fasteners :
(Part 2)	Part 2 Product grades and tolerances
IS 1726	Specification for cast iron manhole covers and frames
IS 1979	High test line pipe
IS 1742	Code of practice for building drainage
IS 2064	Selection, installation and maintenance of sanitary appliances – Code of practice
IS 2065	Code of practice for water supply in buildings
IS 2643	Dimensions for pipe threads for fastening

(Part 1)	purposes : Part 1 Basic profile and dimensions
IS 2643	Dimensions for pipe threads for fastening
(Part 2)	purposes : Part 1 Tolerances
IS 2643	Dimensions for pipe threads for fastening
(Part 3)	purposes : Part 3 Limits of sizes
IS 2104	Specification for water meter boxes (domestic type)
IS 2373	Specification for water meters (bulk type)
IS 2379	Color code for the identification of pipe lines.
IS 7558	Code of practice for domestic hot water installations
IS 5329	Code of practice for sanitary pipe work above ground for buildings
IS 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage
IS 9668	Code of practice for provision and maintenance of water supplies and fire fighting.

#### **14. Pipes and Fittings :**

IS 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS 7181	Specification for horizontally cast iron double flanged pipes for water, gas and sewage
IS 1729	Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories
IS 3989	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories
IS 3486	Cast iron spigot & socket pipes
IS 1879	Malleable cast iron pipe fittings
(Part 1 to 10)	
IS 1538	Cast iron fittings for pressure pipes for water, gas and
(Part 1 to 23)	sewage
IS 6418	Cast iron and malleable cast iron flanges for general engineering practice
IS 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter)
IS 1239	Mild steel tubulars and other wrought steel pipe fittings.
Part 1	Mild steel tubes
Part 2	Mild steel tubulars and other wrought steel pipe fittings.
IS 458	Specification for pressure concrete pipes (with and without reinforcement)
IS 2501	Copper tubes for general engineering purposes
IS 651	Salt glazed stone-ware pipes and fittings
IS 1537	Vertically cast iron pressure pipes for water, gas and sewage



**15. Valves :**

IS 780 (50 to 300 mm size)	Specification for sluice valves for water works purposes
IS 13095	Butterfly Valves for general purpose
IS 2906	Specification for sluice valves for water works purposes (350 to 1200 mm size)
IS 1703	Specification copper alloy float valves (horizontal plunger type) for water supply
IS 778	Specification for copper alloy gate, globe and check valves for water works purposes
IS 3950	Specification for surface boxes for sluice valves
IS 5312 (Part 1)	Specification for swing check type reflux (non return) valves : Part 1 Single door pattern
IS 5312 (Part 2)	Specification for swing check type reflux (non return) valves : Part 2 Multi door pattern
IS 2906	Specification of sluice valve for water work (350 mm to 1200 mm)

**16. Sanitary Fittings :**

IS 8931	Specification for cast copper alloy fancy bib taps and stop valves for water services
IS 8934	Specification for cast copper alloy fancy pillar taps and stop valves for water services
IS 781	Specification for cast copper alloy screw down bib taps and stop valves for water services
IS 782	Specification for caulking lead
IS 2692	Specification for ferrule for water services
IS 6249	Specification for flush valves and fittings for marine use
IS 2326	Specification for automatic flushing cistern for urinals
IS 774	Specification for flushing cisterns for water closets and urinals (other than plastic cistern)
IS 775	Specification for cast iron brackets and supports for wash basins
IS 6411	Specification for gel-coated glass fibre reinforced polyester resin bath tubs
IS 771	Specification for glazed fire clay sanitary appliances (Part 1 to 6)
IS 5961	Specification for cast iron gratings for drainage purposes.
IS 7231	Specification for plastic flushing cisterns for water closets and urinals
IS 2548 (Part 1)	Specification for plastic seats and covers for water closets, Thermostat seats and covers
	Specification for plastic seats and covers for water closets,

(Part 2)	Thermostat seats and covers
IS 2556	Specification for vitreous sanitary appliances (vitreous china) Part 1 : General requirements
(Part 1)	
IS 2556	Specification for vitreous sanitary appliances (vitreous china) Part 2 : Specific requirements of wash-down water closets
(Part 2)	
IS 2556	Specification for vitreous sanitary appliances (vitreous china) Part 3 : Specific requirements of squatting pans
(Part 3)	
IS 2556	Specification for vitreous sanitary (Part 4) appliances (vitreous china) Part 4 : Specific requirements of wash basins
IS 2556	Specification for vitreous sanitary (Part 6 Sec 2) appliances (vitreous china) Part 6 : Specific requirements of urinals, Half stall urinals
Section 2	
IS 2556	Specification for vitreous sanitary (Part 6 Sec 4) appliances (vitreous china) Part 6 : Specific requirements of urinals, Section 4 Partition slabs
IS 2556	Specification for vitreous sanitary (Part 6 Sec 5) appliances (vitreous china) Part 6 : Specific requirements of urinals, Section 5 waste fittings
IS 2556	Specification for vitreous sanitary (Part 6 Sec 6) appliances (vitreous china) Part 6 : Specific requirements of urinals, Section 6 Water spreaders for half stall urinals
IS 2556	Specification for vitreous sanitary (Part 6 Sec 7) appliances (vitreous china) Part 7 : Specific requirements of half round channels
IS 2556	Specification for vitreous sanitary (Part 7 Sec 7) appliances (vitreous china) Part 7 : Specific requirements of half round channels
IS 2556	Specification for vitreous sanitary (Part 8) appliances (vitreous china) Part 8 : Specific requirements of siphonic wash down water closets
IS 2556	Specification for vitreous sanitary (Part 11) appliances (vitreous china) Part 11 : Specific requirements for shower rose
IS 2556	Specification for vitreous sanitary (Part 12) appliances (vitreous china) Part 12 : Specific requirements floor traps
IS 2556	Specification for vitreous sanitary (Part 15) appliances (vitreous china) Part 15 : Specific requirements of universal water closets

**17. Water Quality Tolerance :**

IS 10500	Drinking water (World Health Organization)
IS 4764	Tolerance limits for sewage effluents discharged into inland surface waters
IS 1700	Specification for drinking fountains
IS 1978	Line pipe

IS 2002	Steel plates for pressure vessels for intermediate & high temperature service including boilers
IS 2629	Recommended practice for hot dip galvanizing on iron and steel
IS 2717	Glossary of terms relating to vitreous enamelware and ceramic metal systems
IS 2825	Code for unfired pressure vessels
IS 2963	Specifications for copper alloy waste-fittings for wash basins and sinks
IS 3025	Method of sampling and test (physical and (Part 1 to 44) chemical) for water and waste water
IS 3114	Code of practice for laying of cast iron pipes
IS 3311	Specification for waste plug and its accessories for sinks and wash basins
IS 3468	Pipe nuts
IS 3589	Seamless or electrically welded pipes for water, gas and sewage
IS 4127	Code of practice for laying glazed stoneware pipes
IS 4346	Specifications for washers for use with fittings for water services
IS 4711	Methods of sampling steel pipes, tubes and fittings
IS 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes
IS 6159	Recommended practice for design and fabrication of material prior to galvanizing
IS 6411	Specification for gel-coated glass fibre reinforced polyester resin baths
IS 8090	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting
IS 8321	Glossary of terms applicable to plumbing work
IS 8419	Requirements for water filtration equipment (Part 1) Part 1 Filtration media-sand and gravel requirements for rapid sand gravity filtration equipments
IS 8419	Requirements for water filtration equipment (Part 2) Part 2 Under drainage system
IS 6392	Steel pipe flanges
IS 9758	Specification for flush valves and fitting for water closets and urinals
IS 9842	Preformed fibrous pipe insulation
IS 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines
IS 10221	Code of practice for coating and wrapping of underground mild steel pipelines
IS 10234	Recommendations for general pipeline welding
IS 10446	Glossary of terms relating to water supply and sanitation
IS 11149	Rubber Gaskets

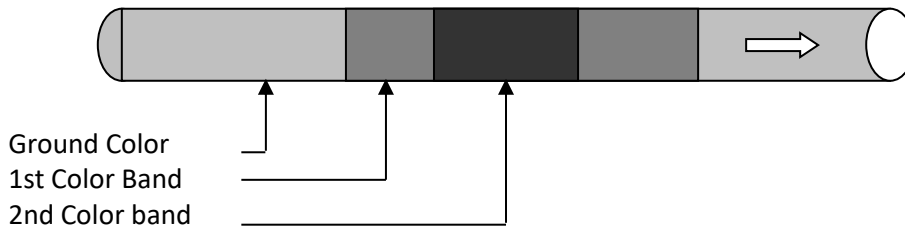
IS 11790	Code of practice for preparation of butt-welding ends for pipes, valves flanges and fittings
IS 12011	Code of safety practice for domestic LPG installation
IS 1068	Electroplated coating of nickel plus chromium and copper plus Nickel plum chromium
IS 4111	Code of practice for ancillary structures in sewerage system Part I (Part 1) manholes
IS 5455	Cast Iron steps for manholes
IS 8321	Glossary of terms applicable to plumbing work
IS 5572	Code of practice for sanitary pipe work
IS 2501	Copper tubes for general engineering purposes
IS 1979	High Test line pipe
BS 5572	1994-Code of Practice for Sanitary Pipe Work

**Note :** The codes mentioned above but not applicable for the building under construction shall be ignored.

-----: **END OF SUBHEAD** :-----

**SUBHEAD-11. PIPE COLOR CODE**

*This Color Code is as per I.S. 2379.*



Proportional width of band 4:1  
Note:-Arrow indicating the direction of flow.

Pipe lines	Ground Color	1st Color Band	2nd Color Band
1. <b>Drinking water</b> (All cold water Lines after filter)	Sea green	French blue	Signal red
2. <b>Treated water</b> (Soft water)	Sea green	Light orange	
3. <b>Domestic hot Water</b>	Sea green	Light grey	
4. <b>Drainage Sewer/SWD</b>	Black		
5. <b>Fire services</b>	Fire red		

This Color Code is as per I.S. 2379.

**Final design for color coding will be of Client only**

-----: END OF SUBHEAD :-----

**SUBHEAD-12. TECHNICAL INFORMATION:**

**Please furnish full details separately  
All information should be on this format**

S. No.	Description	PUMPS			feed
		Raw Water	Domestic water	Chemical dosing Pump	

**1. Design basis**

- 1.1. Quantity/ No. of
- 1.2. units offered
- 1.3. Capacity lit/lpm
- 1.4. Flow Range
- 1.5. Pumping Head  
(where applicable)
- 1.6. Make & Model No.
- 1.7. Power
- 1.8. Pump Type
- 1.9. Material (body)
- 1.10. Material (Impellers)
- 1.11. Material (shafts)

**Accessories**
**2. Valves**

- 2.1. Type
- 2.2. Material (body)
- 2.3. Material (Internal parts)
- 2.4. Material (Lining)

**3. Pipes**

- 3.1. Type
- 3.2. Material
- 3.3. Max. working pressure
- 3.4. Max. test pressure

<b>4.</b>	<b>Filters/softeners/ Chemical dosers</b>	<b>Pressure Sand filter</b>	<b>Activated carbon filter</b>	<b>Cartridge Softener Filter</b>	<b>R.O.Plant</b>
4.1.	Material				
4.2.	Thickness shell				
4.3.	Thickness Ends				
4.4.	Dia & Height				
4.5.	Max. working pressure				
4.6.	Max. test pressure				
4.7.	Accessories offered				
4.8.	Filter media				
4.9.	Filter media size/ depth of each layer				
4.10.	Resins make/type				
4.11.	Resin quantity				
4.12.	Design filtration				
4.13.	rate in lph/sqm				
4.14.	Regeneration period				
<b>5.</b>	<b>Consumption (For 8 hour operational period)</b>				
5.1.	Power requirement in KWH				
5.2.	Fresh water required for back wash lit.				
5.3.	Salt for regeneration				
5.4.	Chemical consumption				
5.5.	Salt rejection in kg.				
<b>6.</b>	<b>Reverse Osmosis System</b>				
6.1.	R.O. Feed flow rate				
6.2.	Permeate Flow rate				
6.3.	Overall recovery				
6.4.	No. of Working hours				

6.5. Reverse Osmosis Membranes

6.6. No. of elements

6.7. Make

6.8. Model

**7. Reverse Osmosis Pressure Tube**

7.1. No. of Units

7.2. Material of construction

7.3. Make /Model

-----: **END OF SUBHEAD** :-----



**SUBHEAD-13. SHEET FOR LISTING DEVIATIONS**

Although deviations are generally not acceptable, but in case it becomes pertinent as per Vendor, then he is requested to specifically give the details of deviations, if any on this sheet and continuation thereof in the below mentioned format only.

Sr. No.	Item Description	Specifications	Bidder's Specifications / Comments	Deviations

Deviation mentioned at any other place shall not be considered.

**-----: END OF SUBHEAD :-----**

## **TECHNICAL SPECIFICATIONS OF FIRE PROTECTION SYSTEM**

<b>SL. NO.</b>	<b>DESCRIPTION</b>
1	FIREFIGHTING SYSTEM (FIRE HYDRANT, SPRINKLER, EXTINGUISHER AND PUMPS)
2	ELECTRICAL PANELS & DRY TYPE TRANSFORMER FIRE PROTECTION SYSTEM
3	ELECTRICAL SYSTEMS
4	TECHNICAL DATA (TO BE FILLED BY BIDDERS)

## TECHNICAL SPECIFICATIONS

### **SUBHEAD-14.      FIREFIGHTING SYSTEM (FIRE HYDRANT, SPRINKLER, EXTINGUISHER AND PUMPS)**

#### **1.                SCOPE OF WORK:**

1.1.            Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel driven fire pumps, wet riser, fire hydrant system/fire extinguishing as required by the drawings and specified hereinafter or given in the Bill of Quantities.

1.2.            Without restricting to the generality of the foregoing, the work shall include but not limited to the following:-

#### **1.2.1.          Fire Pumps, Motor, Engine and Accessories:**

- a              Electrically operated and diesel driven fire fighting pumps with motors, base plate and accessories.
- b              Pressure gauge with isolation valves.
- c              M.S./Galvanized Pipes, fittings, valves, suction strainers, suction & delivery headers & accessories.
- d              Foundations, vibration eliminator pads and foundation bolts.
- e              Pressure vessel, pressure switches etc.

#### **1.2.2.          Fire Hydrant System:**

- a              Piping for wet riser/hydrant systems.
- b              Fire Hydrant valves, canvas hose pipes, hose reels, hose cabinets, connections to fire mains.
- c              Isolation & non-return valves, pipe supports/welding/Fire Brigade inlet and accessories.

#### **1.2.3.          Fire Sprinkler System:**

- a              Piping for sprinkler systems.
- b              Fire Alarm control valves/Installation Control.
- c              Sprinkler heads, Spare Sprinkler.
- d              Inspection & Testing assemblies.

**1.2.4. Hand Appliances /Fire Extinguishers:**

Supply and installation of fully charged and tested fire extinguishers hand appliances water CO<sub>2</sub>, foam, dry chemical powder type, ABC stored pressure type, CO<sub>2</sub> gas cartridge type, FE 36/HFC236-fa and k type as required by these specification and drawings.

**1.2.3 Hydraulic Calculations:**

The tenderer shall be responsible for providing fully detailed hydraulic calculations of sprinkler and hydrant system to comply with NFPA Standards and to the requirements of Gurgaon Fire Services.

**1.2.4 System Description**

System shall be designed as per

- NBC-2016, Part-IV
- IS:3844, IS:15105, IS:15301, IS:2190, IS:15683. Other relevant BIS Codes
- Local Bye-Laws
- Requirements of the Local CFO

And as per drawing under supervision of engineer in charge.

**2. FIRE PUMPS, MOTORS, ENGINE AND ACCESSORIES:****2.1. General:**

- 2.1.1. The pumps shall be factory fitted and factory assembled designed for continuous operation and shall have a continuously rising head characteristic without any zone of instability.
- 2.1.2. Pumps (excluding the jockey pump) shall be able to operate sequentially. The head vs. capacity, input power vs. capacity characteristics, etc. shall match to ensure load sharing and trouble free operation throughout the range.
- 2.1.3. All pumps shall be installed true to level on suitable concrete foundations. Base frames shall rest on vibration isolation mountings as specified, to avoid vibrations.
- 2.1.4. Pumps and motors /diesel engine shall be truly aligned to the satisfaction of Owner/ Architect/Employer's Representative.
- 2.1.5. All pump connections shall be of Indian Standard flange type with appropriate number of bolts. Manufacturers' instructions regarding installation, connections and commissioning shall be followed with respect to all pumps, switchgears and other accessories.
- 2.1.6. Contractor under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.
- 2.1.7. Automatic air release valve shall be provided to vent air from the pump discharge and also to admit to the pump to dissipate the vacuum there, upon stopping of the pump.
- 2.1.8. Automatic air release valve shall be provided to vent air from the pump discharge and also to admit to the pump to dissipate the vacuum there, upon stopping of the pump.
- 2.1.9. All pumps shall have the impeller size chosen to maximum of 80% of the largest size that can be accommodated in the casing.
- 2.1.10. The pump casing shall withstand 1.5 times the no delivery pressure or 2 times of the duty pressure whichever is higher.
- 2.1.11. One solid state electronic annunciation panel, fully wired with visual display and audible alarm unit shall be provided to indicate :

- a) Flow condition in any flow switch indicating the area of distress and fire alarm.
- b) Starting and stopping of each hydrant pump.
- c) Starting and stopping of each jockey pump.
- d) Starting and stopping of each sprinkler pump.
- e) Failure of Hydrant / Sprinkler pumps to start.
- f) Low level in HSD day tank of the fire pump.
- g) High level in Fire water storage tank compartment.
- h) Low level in fire water storage tank compartment.
- i) Low level in HSD day tank of the fire pump.

The panel shall be factory fabricated, wired and tested. All details shall be submitted with the tender. The annunciation panel shall be located in the security office / reception on the ground floor.

- 2.1.12. In case of accidental reverse flow through the pump the driver shall be capable of bringing the pump to its rated speed in the normal direction from the point of maximum possible reverse speed.
- 2.1.13. The Pump with motor, base plate, coupling device and coupling guard shall be coupled at the works of the manufacturer.
- 2.1.14. The motor shall have a 15% margin of power rating over the rated pump input power.
- 2.1.15. The pumps shall be capable of delivering a minimum of 150 percent of rated capacity at a total head of not less than 65% of the total rated head. The total shut-off head shall not exceed 120 percent of total rated head on the pump.
- 2.1.16. The pump shall be tested at the factory and test curve shall be submitted showing the performance and horse power requirement based on this test before final acceptance.
- 2.1.17. Contractor shall provide necessary test certificates, type test certificates, technical data sheets performance curves and NPSH curves of the pumps, dimension detail, foundation detail from the manufacturer while submitting data sheet for approval.
- 2.1.18. Pumps coupled with motor or engine on a common platform shall perform smoothly without any excessive noise or vibration.
- 2.1.19. Each pump shall be provided with a plate giving, in the case of centrifugal pumps, the delivery head, capacity and the number of revolutions per minute, and in the case of reciprocating pumps, the diameter of the steam cylinders and water plungers and the length of the stroke, as also the ratios of the effective aggregate areas of the suction and the delivery valves to the area of the water plungers.
- 2.1.20. Pumps and motors /diesel engine shall be truly aligned to the satisfaction of OEM/Owner/Client's Representative.

### **3. ELECTRIC MOTORS:**

- 3.1. Electrically driven pumps shall be provided with totally enclosed fan cooled induction motor. The motor shall be full load duty & shall be capable of handling the required starting torque of the pumps. Speed of motor shall be compatible with the speed of the pump.
- 3.2. Motors shall have a dust tight construction with suitable means of breathing.

- 3.3. The motor shall be designed not to draw starting current more than 3 times normal running current. Motor for fire pump 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.
- 3.4. All Components shall be of adequate mechanical strength and robustness and shall be constructed of metal unless otherwise approved.
- 3.5. The rating and design shall conform to (IS: 325) specification.
- 3.6. The motors shall be wound for Class-F insulation and the winding shall be vacuum impregnated with head and moisture resisting varnish and glass wool insulated to withstand tropical conditions.
- 3.7. Two independent earthing points shall be provided on opposite sides of the motor for bolted connections.
- 3.8. 415 Volt power terminals shall be suitable for receiving 1.1 kV grade armoured power cables.
- 3.9. The cable boxes and terminations shall be designed to enable easy disconnection and replacement of cables.
- 3.10. The motor shall have Power factor of not less than 95% under rated load condition. If motor are provided with less than 95% Power factor, provide Power factor correction in near the motor to maintain the Power factor of 95% or greater under rated load conditions.
- 3.11. Provide other specific requirements required by governing energy conservation codes.

#### **4. DIESEL ENGINE:**

##### **4.1. General:**

- 4.1.1. The engine rating shall be decided considering the de-rating factors which are based on Site conditions as per BS: 5514.
- 4.1.2. The diesel engine shall be of multi cylinder type four/six stroke cycle with mechanical (airless) injection, cold starting type.
- 4.1.3. The Engine shall be direct injection type, capable of being started without use of wicks, cartridge, heater plugs at an engine room temperature of 7oC and shall accept full load within 15 second from the receipt of the signal to start.
- 4.1.4. The Engine shall be turbo-charged and water cooled.
- 4.1.5. The Engine shall be capable of operating continuously on full load at the site elevation for a period of 8 hours and no major overloads before 300 hours of operation.
- 4.1.6. The Engine shall be provided with an adjustable governor to control the Engine speed within 10% of its rated speed under any condition of load upto the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load.
- 4.1.7. The Engine shall be provided with an in-built tachometer to indicate R.P.M. of the Engine.
- 4.1.8. Engine, after correction for altitude and ambient temperature, shall have bare engine horse power rating equivalent to the higher of the following two values :-
  - a 20% in excess of the maximum brake horse-power required to drive the pump at its duty point.
  - b The brake horse power required to drive the pump at 150% of its rated discharge.

- 4.1.9. The coupling between the Engine and pump shall allow each unit to be removed without disturbing the other.
- 4.1.10. The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection.
- 4.1.11. All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or injury to parts.
- 4.2. Starting:**
- 4.2.1. The engine shall be capable of both automatic and manual start. Generally the engine shall start automatically, but in case of the auto-start system failure the engine shall be capable of manual start.
- 4.3. Governing System:**
- 4.3.1. The engine shall have a speed control device, which will control the speed under all conditions of load. The governor shall be suitable for operation without external power supply.
- 4.3.2. The Governor shall offer following features:
- a Adjustable governor to regulate engine speed within a range of 10% between shut-off and maximum load conditions of the pumps. The governor shall be set to maintain rated pump speed at maximum pump load.
- b An over speed shutdown device to shutdown the engine at speed approximately 20% above rated engine speed with manual reset, so that the automatic engine controller will indicate an over speed signal until the device is manually reset to normal operating position.
- 4.4. Fuel System:**
- 4.4.1. The Engine fuel oil shall be of quality and grade specified by the Engine manufacturer.
- 4.4.2. The diesel engine shall be suitable to run on High Speed Diesel (HSD), the tank provided being enough to hold the volume required for 8 hours (minimum) continuous operation. The tank shall be of MS sheet of 3.0 mm thickness.
- 4.5. Cooling System:**
- 4.5.1. The engine shall be water cooled with cooling water drawn from the discharge side of the pump and with pressure reducing valve, strainer and all necessary accessories.
- 4.6. Tachometer :**
- 4.6.1. A tachometer shall be provided to indicate revolutions per minute of the engine.
- 4.7. Oil Pressure Gauge :**
- 4.7.1. The engine shall be provided with oil pressure gauges indicating lubricating oil pressure.
- 4.8. Temperature Gauge :**
- 4.8.1. The engine shall be provided with a temperature gauge to indicate cooling water temperature.
- 4.9. Automatic Control Wiring :**
- 4.9.1. All connecting wires for automatic controllers shall be harnessed or flexibly enclosed, mounted on the engine and connected in an engine junction box to terminals numbered to correspond with numbered terminals in the controller, for ready wiring in the field between the two/sets of terminals.

**4.10. Signal for Engine Running and Crank Termination :**

4.10.1. The engine shall be provided with a speed sensitive switch to signal engine running and crank termination. Power for these signals shall be taken from a source other than the engine generator.

**4.11. Engine Exhaust Pipes :**

4.11.1. The exhaust pipe shall be galvanized steel pipe and sized in accordance with the manufacturer's recommendations. The exhaust pipe shall be insulated with 50 mm of fibreglass with aluminium jacket for its entire length.

4.11.2. A stainless steel flexible connection shall be provided between the engine exhaust outlet and the exhaust pipe. An exhaust silencer shall be provided as required to satisfy the acoustic requirements.

**4.12. Battery Charging :**

4.12.1. The means of charging the batteries shall be by a 2-rate trickle charger with manual selection of boost charge and the batteries shall be charged in position. Where separate batteries are provided for automatic and manual starting, the charging equipment shall be capable of trickling charging both the batteries simultaneously. Equipment shall be provided to enable the state of charge of the batteries to be determined.

**4.13. Installation :**

4.13.1. Installation of the Diesel Engine shall be carried out exactly as per manufacturer recommendation.

**4.14. Foundation and Anti Vibration Mounting :****4.14.1. Foundation :**

a The foundation shall be constructed as per the requirement of Diesel Engine Manufacturer.

**4.14.2. Anti Vibration Mounting :**

a Suitable vibration mounting duly approved by the authorised representative shall be employed for mounting the unit so as to minimise transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

**4.15. Accessories:**

4.15.1. The engine shall be mounted on a base plate of fabricated steel construction. Adequate access shall be provided to the big end and main bearing, camshaft and governor drives, water jackets etc.

4.15.2. The engine shall be provided with inlet filter and silencer, outlet muffler, expansion joints, dampers etc. as necessary for efficient operation. Intake air shall be taken from inside the building in which the engine is located, but the exhaust shall be discharged into the air at location as desired by the employer.

4.15.3. The contractor shall provide all accessories, fittings and fixtures necessary and required for a complete operating engine set.

**5. MATERIAL OF CONSTRUCTION****5.1. Diesel, Hydrant, Sprinkler & Water Curtain Pump**

Type: Multi Stage Multi Outlet Centrifugal



Casing: Cast Iron

Diffusers: Cast Steel

Impeller: Bronze

Shaft: SS 304

Base: Cast Iron

### **5.2. Jockey Pumps**

Type: Multi Stage Multi Outlet Centrifugal

Casing: Cast Iron

Diffusers: Cast Steel

Impeller: SS 316

Shaft: SS 304

Base: Cast Iron

### **5.3. Terrace Fire Pump**

Type: Horizontal Monoblock Centrifugal

Casing: Cast Iron

Diffusers: Cast Steel

Impeller: Bronze

Shaft: SS 304

Base: Cast Iron

## **6. CODES & STANDARDS FOR PUMPS, MOTORS AND DIESEL ENGINE:**

### **6.1 PUMPS:**

The pumps shall conform to the standards and codes as given below:

- a) IS: 1520 Horizontal centrifugal pumps for clear, cold and fresh water.
- b) BS: 599 methods of testing pumps.
- c) PTC: 8 ASME Power test Codes – Centrifugal Pumps.

## 6.2 MOTOR:

The following codes shall be applicable for the motor:-

- a) IS: 325 Induction motor, three – phase.
- b) IS: 900 code of practice for induction motors, installation and maintenance.
- c) IS: 7816 guide for testing insulation resistance of rotating machines.
- d) IS: 4029 guide for testing three phase induction motor.
- e) IS: 3043 code of practice for earthing.
- f) Further to those stated above, the design, manufacture, installation and performance of motors shall conform to the latest Indian Electricity Act and Indian Electricity Rules.

## **7.0 SETTING OF PRESSURE SWITCHES/OPERATING CONDITIONS FOR FIRE PUMPS:**

- 7.1 The fire pumps shall operate on drop of pressure in the mains as given under clause below. The pump operating sequence shall be arranged in such a manner to start the pump automatically but should be capable of being stopped manually by stop push buttons only.

- 7.2 Operating Conditions for the Fire Pumps:

The Pressure Switches mounted on the pressure vessel would be set

S.No.	Description of Pump and Zone	High Pressure Zone		Low Pressure Zone	
		Cut in	Cutout	Cut in	Cutout
		Kg/cm <sup>2</sup>	Kg/cm <sup>2</sup>	Kg/cm <sup>2</sup>	Kg/cm <sup>2</sup>
A)	Jockey Pump-Sprinkler				
	Pressure Zone	15.5	16.0	8.5	9.0
B)	Jockey Pump-Hydrant				
	Pressure Zone	15.0	16.0	8.0	9.0
C)	Sprinkler Pump				
	Pressure Zone	14.5	Manual	7.5	Manual
D)	Hydrant Pump				
	Pressure Zone	13.5	Manual	6.5	Manual
E)	Diesel Fire Pump-1				
	Pressure Zone	12.5	Manual	5.5	Manual
F)	Diesel Fire Pump-2				
	Pressure Zone	11.5	Manual	4.5	Manual
G)	Terrace Fire Pump				
	Pressure Zone	--	--	3.5	Manual

**It is thus to be noted that;**

- i) Jockey Pumps shall start and stop automatically through pressure switches.
- ii) Jockey Pump shall stop when main pumps start.
- iii) Main/Diesel Engine driven fire pumps shall start automatically when pressure falls below the above specified limits, but stopping shall be manual.

## 8.0 INTERLOCKING :

8.1 The following inter-locking between the two main fire pumps (i.e. wet riser pump & sprinkler pump), the jockey pump and the diesel engine driven pumps will be followed.

8.1.1 Only one category of pumps will work at a time i.e. either jockey pump or main fire pumps and/or diesel driven pump.

### Low Pressure Zone:

S. No.	Jockey Pump Sprinkler	Jockey Pump Hydrant	Sprinkler Pump	Hydrant Pump	Diesel Driven Pump-1	Diesel Driven Pump-2	Terrace Fire Pump
i)	ON	OFF	OFF	OFF	OFF	OFF	OFF
ii)	ON	ON	OFF	OFF	OFF	OFF	OFF
iii)	OFF	OFF	ON	OFF	OFF	OFF	OFF
iv)	OFF	OFF	ON	ON	OFF	OFF	OFF
v)	OFF	OFF	ON	ON	ON	OFF	OFF
vi)	OFF	OFF	ON	ON	ON	ON	OFF
vii)	OFF	OFF	ON	ON	ON	ON	ON

### High Pressure Zone:

S. No.	Jockey Pump Sprinkler	Jockey Pump Hydrant	Sprinkler Pump	Hydrant Pump	Diesel Driven Pump-1	Diesel Driven Pump-2
i)	ON	OFF	OFF	OFF	OFF	OFF
ii)	ON	ON	OFF	OFF	OFF	OFF
iii)	OFF	OFF	ON	OFF	OFF	OFF
iv)	OFF	OFF	ON	ON	OFF	OFF
v)	OFF	OFF	ON	ON	ON	OFF
vi)	OFF	OFF	ON	ON	ON	ON

## 9.0 PIPE, FITTINGS, VALVES, SUPPORTS AND OTHER ACCESSORIES:

### 9.1 Pipes & Fittings:

#### 9.1.1 General:

- a) All materials shall be new of the best quality conforming to the specifications and subject to the approval of the Project Manager.
- b) Pipes and fittings shall be fixed truly vertical, horizontal 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 at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.
- e) Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

#### 9.1.2 Pipes and fittings of following types (depending upon the description of item) and ISI marked only shall be used:

Type of Pipe / (dia)	Size	Grade	Ends/Fitting	Pipe Code
MS/GI Pipes	Upto 50 mm dia	Heavy grade	Threaded	IS: 1239 (Part I)
DI Fittings & Valves	- do -	Heavy grade	Threaded	
MS/GI Pipes	65 mm & above dia and upto 150 mm dia	Heavy grade	<del>Grooved-Butt</del> Welded	IS: 1239 (Part I)
<del>DI MS Fittings &amp; Valves</del>	-do-	Heavy grade	<del>Grooved-Butt</del> Welded	
MS/GI Pipes	Above 150 mm dia	6.0 mm wall thickness up to 200 mm 8.0 mm wall thickness up to 300 mm	<del>Grooved-Butt</del> Welded	IS: 3589 (Part I)
<del>DI MS Fittings &amp; Valves</del>	-do-	Heavy grade	<del>Grooved-Butt</del> Welded	

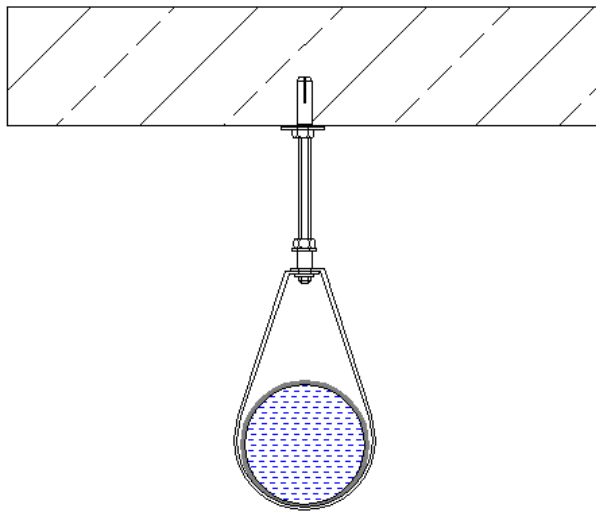
- 9.1.3 For MS/Galvanized pipes from 65 mm to 300 mm dia ~~grooved~~ butt-welded jointing shall be adopted. For 50 mm and below pipes, threaded jointing shall be adopted
- 9.1.4 The piping system and components shall be capable of withstanding 150 % of the working pressure including water hammer effects and test pressure 30 kg/cm<sup>2</sup> for High pressure zone, 22.5 kg/cm<sup>2</sup> for Intermediate pressure zone and 15 kg/cm<sup>2</sup> for low pressure zone.
- 9.1.5 Flanged joints shall be used for connections to vessels, equipment, flanged valves and also on suitable straight lengths of pipeline of strategic points to facilitate erection and subsequent maintenance work.

- 9.1.6 Flanges shall be rated for the respective pressure zones.
- 9.1.7 Wherever two horizontal headers are to run side by side, the two headers shall be located at different levels, if possible, so as to avoid unnecessary bends at tapping off from the headers. Accordingly, the supports shall also be staggered to support pipes at two levels.

## 9.2 Pipe Support:

### 9.2.1 Hydrant and sprinkler pipe Support from RCC slab

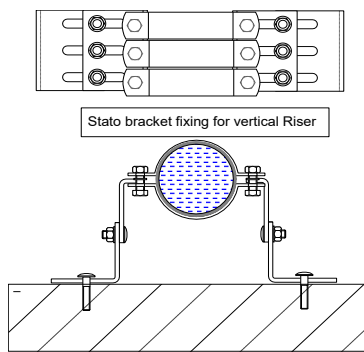
Description					
<p><b>Clamps :</b> The Firefighting pipe should be simply suspended by <b>Sprinkler Clamp having knurled nut</b>.</p> <p>The Sprinkler Clamp should be pre-galvanized with one-piece design for safe hanging of sprinkler pipes. It should have height adjustable arrangement so as to incorporate the suspended threaded rod. The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>VdS or UL /FM Approval</b>. The pipe support installation should be carried out as per <b>National Building Code 2017</b>.</p>					
<p><b>Accessories :</b> The Threaded Rods used for the suspension of the Pipe should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.</p>					
<p><b>Anchors :</b> The Drop-in anchors used for the suspension of the rods should be <b>ETA (EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete.</p> <p>It should be divided into four expansion segments for uniform pressing force distribution in the borehole.</p>					
<p><b>Calculation and Approvals :</b> The load bearing capacity for the selection of the sprinkler clamp for suitable size of the pipe should be <b>as per V d s and FM guideline</b> provided by the contractor to the consultant for verification.</p>					
Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	2.5	65	3	250	3
20	2.5	80	3	300	3
25	2.5	100	3	350	3
32	2.5	125	3	400	3
40	2.5	150	3	450	3
50	2.5	200	3	500	3



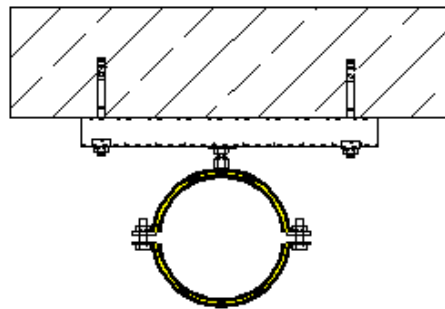
9.2.2

**Hydrant and sprinkler pipe Support from building shaft**

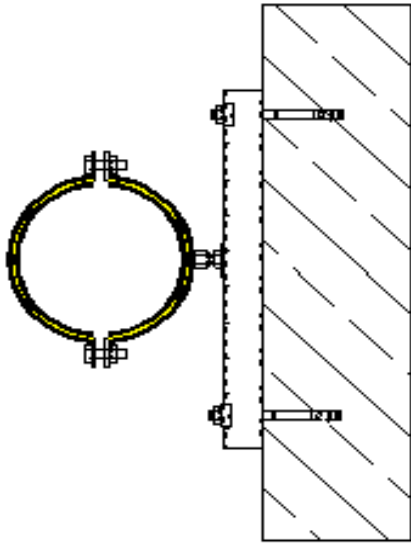
Description					
<p><b>Clamps :</b> The Riser Pipes should be mounted on the support channel with the help of a split clamps and <b>STATO BRACKET</b> which should take the entire load of the pipe.</p>					
<p><b>Support Channel :</b> The support channel should be made up of cold rolled steel of quality <b>DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1</b> The riser and hydrant pipe support installation should be as per National <b>Building Code 2017</b>. The Support channel should be pre-galvanized with <b>minimum GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.</p> <p>The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b></p>					
<p><b>Accessories :</b> The Threaded Rods used for fixing pipe clamp with support channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.</p>					
<p><b>Anchors :</b> The Through anchors used for fixing channel with building shaft that should be <b>E T A(EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked</b> and un-cracked concrete.</p> <p>It should be divided into four expansion segments for uniform pressing force distribution in the borehole.</p>					
<p><b>Calculation and Approvals :</b> The load bearing capacity for the selection of the sprinkler clamp for suitable size of the pipe should be <b>as per V d s and FM guideline</b> provided by the contractor to the consultant for verification.</p>					
Maximum Support Spacing (m)					
Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe D i a (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	Floor to Floor	65	Floor to Floor	250	Floor to Floor
20		80		300	
25		100		350	
32		125		400	
40		150		450	
50		200		500	



### 9.2.3 Hydrant and sprinkler pipe Support along the wall



Description
<p><b>Clamps :</b> The Pipes should be mounted on the support channel with the help of a <b>split clamps DIN 3567</b>.</p>
<p><b>Support Channel :</b> The support channel should be made up of cold rolled steel of quality <b>DX51 or greater and as per EC3 (Eurocode 3) or DIN EN 1993-1-1</b> The hydrant pipe support installation should be as per <b>National Building Code -2017</b>. The Support channel should be pre-galvanized with <b>minimum GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.</p> <p>The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b></p>
<p><b>Accessories :</b> The Threaded Rods used for fixing pipe clamp with support channel that should be made up of partially annealed medium carbon steel of grade 4.8 strength class and as per DIN 976 standard.</p>
<p><b>Anchors :</b> The Through anchors used for fixing channel with building wall that should be <b>E T A (EUROPEAN TECHNICAL APPROVAL) with CE mark for cracked</b> and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.</p>
<p><b>Calculation and Approvals :</b> The load bearing capacity for the selection of the sprinkler clamp for suitable size of the pipe should be <b>as per V d s and FM guideline</b> provided by the contractor to the consultant for verification.</p>
<b>Maximum Support Spacing (m)</b>



Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)	Nominal Pipe Dia (mm)	Support Distance (M)
Upto 15	2.5	65	3	250	3
20	2.5	80	3	300	3
25	2.5	100	3	350	3
32	2.5	125	3	400	3
40	2.5	150	3	450	3
50	2.5	200	3	500	3



### **9.3 SEISMIC SWAY BRACING FOR FIRE SPRINKLER SYSTEMS**

#### **9.3.1 GENERAL SUMMARY**

This Section provides the requirements for bracing fire sprinkler systems subject to earthquake loads.

#### **9.3.2 DEFINITIONS**

Retain abbreviations that remain after this Section has been edited.

NFPA 13: National Fire Protection Association, "Standard for the Installation of Sprinkler Systems", 2010 Edition

FM DS 2-8: FM Datasheet 2-8, 2010 Edition, "Earthquake Protection for Water-Based Fire Protection Systems

FM: Factory Mutual

UL: Underwriters Laboratories

#### **9.3.3 SUBMITTALS**

Design Submittal:

Drawings identifying bracing locations with corresponding details

Seismic bracing calculations and details indicated to comply with performance requirements and design criteria.

Calculations and details must be signed and sealed by a manufacturer certified Engineer or Structural Engineer experienced in seismic bracing systems

Product Data: Catalog or data sheets, specifications and installation instructions for all specified products including concrete anchors

#### **9.3.4 QUALITY ASSURANCE**

Comply with seismic bracing requirements in NFPA 13 Section 9.3, or FM DS 2-8 Section 2.3.1.

Delete first paragraph below if no welding. Retain "Welding certificates" Paragraph in "Submittals" Article if retaining below. AWS states that welding qualifications remain in effect indefinitely unless welding personnel have not welded for more than six months or there is a specific reason to question their ability.

Seismic restraint devices shall have load testing approved by FM or UL and bear the marking of the approving agency.

Concrete anchors shall be prequalified for seismic applications in accordance to NFPA 13 Section 9.3.5.9.7

Installation of all seismic restraint devices and anchors shall be in accordance with manufacturer's instructions.

#### **9.3.5 SEISMIC RESTRAINT DEVICE INSTALLATION**

Fire sprinkler sway bracing locations shall comply with NFPA 13 Section 9.3 or FM DS 2-8 Section 9.3.5.9.7, including but not limited to:

In first subparagraph below, options for 40 and 80 feet (12 and 24 m) are recommended by MSS SP-127. Consider reducing these dimensions based on the configuration of piping.

Space lateral supports a maximum of 40 feet o.c.

Space longitudinal supports a maximum of 80 feet o.c.

Install seismic bracing restraints using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

Attachment to Structure - Anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

All screws and nuts with specially designed heads must be torqued until the head shears (breaks) off.

Drilled-in Anchors:

Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

Wedge Anchors: Protect threads from damage during anchor installation.

Set anchors to manufacturer's recommended torque, using a torque wrench.

#### **9.4 External hydrant Valve:**

Each external hydrant station shall consist of one No. Stainless Steel Single headed hydrant valve along with 2 Nos. hoses and one branch nozzle.

The underground piping for external hydrants shall be MS/class 'C' (heavy duty) with wrapping-coating arrangement. The maximum spacing between two external hydrants shall not be more than 45 mts.

- One No. four way Fire Brigade Inlet connection shall be provided for filling of underground Fire tank in case of emergency.
- Draw Out-Withdrawal Connection shall be provided for extracting water from the Fire Tank
- One No. four way Fire Brigade connection is made to the Hydrant Header
- One No. four way Fire Brigade connection is made to the Sprinkler Header

External Fire Hydrant will be provided on the ring main. Hydrant shall be located at least 2 metre away from the building and not more than 15 metre away from the building.

A masonry chamber of required dimension shall be built to accommodate sluice valve/Butterfly valve placed in external ring main in at least two positions as shown in the drawing.

Single Headed Landing Valve:

- a. General:

Standard: IS: 5290:1993, Type-A  
Inlet: 75 mm, Flange Drilling as per OD 200, 4 holes of Ø19mm on 160 PCD.  
Outlet: 63 mm Female Inst. Coupling.

b. Material of Construction:

Body: SS304  
Spindle: SS304 as per IS: 6603  
Spring: SS304 as per IS: 6528  
Hand Wheel: Cast Iron as per IS: 210  
Gland Packing: Asbestos  
Coupling Washer: Rubber as per IS: 5382  
Flat Washer, Seat Washer: Synthetic Rubber  
Blank Cap: ABS  
Chain with Hook: G.I.

c. Pressure Rating:

Hydrostatic Test Pressure  
Body: 21 Kg/cm<sup>2</sup> for 2 ½ min.  
Seat: 14 Kg/cm<sup>2</sup> for 2 ½ min.

Flow Test: 900 LPM Min. at 7 Kg/sq.cm

d. Painting: Painted with Fire Red as per Shade 536 of IS: 5

e. Marking: Mfg. Name, ISI, Sr. No, Year of Mfg.

### 9.5 **Hose Reel:**

Wall mounting the swinging type first aid hose reel with drum shall conform to IS: 884-1985.

The rubber tubing shall be 20 mm dia high pressure rubber hose 36.5 m long as per IS : 444 with gunmetal shut off nozzle having 6.5 mm dia orifice and control valve, shut off valve of approved make. The wall mounted bracket shall be fixed by means of fasteners. The hose reel shall have a gun metal nozzle.

The hose reel shall be connected directly to the riser by means of 25 mm dia MS pipe with threaded bends, union & one no. ball valve.

The drum can swing up to 180 degree.

a. General:

Standard: IS: 884  
Type: Wall Mounted Swinging (180 Degree Manual)  
Inlet: 1" BSP (M) Threaded

b. Material of Construction:

Side Reel: MS Galv. Sheet  
Arm, Wall Mounting Bracket: Aluminium Alloy  
Hose: 19 mm Dia x 36.5 Mtr. Length Thermoplastic (textile-reinforced) Braided Black hose as per IS: 12585 Type II  
Shut-Off Nozzle: 19 mm. 6 mm Bore Stainless Steel

c. Pressure Rating:

Hydrostatic Test Pressure: 21 Kg/cm<sup>2</sup> for 2 ½ min

- d. Painting: Painted with Fire Red as per Shade 536 of IS: 5
- e. Marking: Mfg. Name, ISI, Sr. No, Year of Mfg.

#### **9.6 Hose Cabinets:**

Hose cabinet shall be fabricated from 16 gauge MS powder coated sheet of fully welded construction with hinged single/double door partially glazed door with suitable locking arrangement, stove enameled fire red paint with 'Fire Hose' written on it prominently. Glass panes shall be 4 mm thick.

The hydrant cabinet shall hold double headed hydrant, 2 nos. Hoses and 1 no. branch pipe.

The cabinet shall have two pipe studs of 200 mm dia in MS with base which shall be fixed to the back of the cabinet and shall be used to hold the RRL hose.

#### **9.7 RRL Hoses:**

The hoses for the internal and external hydrant system should be rubber impregnated woven jacketed type conforming to IS: 636 Type-1. Each fire hose shall be provided with quick coupling, branch pipes, nozzles, spanners etc.

Each hose shall be fitted with instantaneous spring lock type couplings at both ends. Hose shall be fixed to the coupling ends by copper rivets and the joint shall be reinforced by 1.5 mm galvanized mild steel wires and leather bands.

##### **RRL Hose:**

###### **a. General:**

Standard: IS: 636:2018, Type-1 (Uncoated)  
Size: 63 mm Dia x 15 Mtr. Length  
Internal Diameter: 63 mm tolerance of plus 2 & minus 0.0 mm.  
Mass per Meter: 63 mm – 450 g/m (Max.)  
Length: 15 meters tolerance of  $\pm 2\%$  is permitted.

###### **b. Material of Construction:**

Material: Synthetic fiber circular woven jacketed, with EPDM synthetic rubber lined.  
End Connection: SS wire bounded pair of SS Male & Female coupling as per IS: 903

###### **c. Pressure Rating:**

Working Pressure: Max. 15 Kg/Sq.cm  
Hydrostatic Test Pressure: 23 Kg/Sq.cm 2 ½ min.  
Hydrostatic Burst Pressure: 38 Kg/Sq.cm  
Kink Test: 23 Kg/Sq.cm for 30 seconds  
Change in Length: Shall not exceed 6% at 10 Kg/sq.cm  
Change in Diameter: Shall not exceed 10% at 10 Kg/sq.cm  
Adhesion Test: Shall not exceed 25 mm/Min by 2.5 Kg load  
Abrasion Test: Shall not burst before 50 cycles

###### **d. Finish:**

Hose Color: White

###### **e. Marking: Mfg. Name, BIS and ISI Mark, Type of Hose, Size, Length, Sr. No, Year of Mfg.**

##### **Coupling:**

a. General:

Type: Instantaneous Type  
Standard: IS: 903  
Size: 63 mm Instantaneous

b. Material of Construction:

Male Half Coupling: SS: 304 as per IS: 3444, Gr-1  
Female Half Coupling: SS: 304 as per IS: 3444, Gr-1  
Release Lug: SS: 304 as per IS: 3444, Gr-1  
Cam Tooth: SS: 304 as per IS: 3444, Gr-1  
Washer: Rubber as per IS: 5382  
Spring: SS as per IS: 6528

c. Pressure Rating:

Hydrostatic Test Pressure: 23 Kg/Sq.cm 2 ½ min.

d. Finish: Polished

e. Marking: Mfg. Name, BIS Mark, Sr. No, ISI Marked Year of Mfg.

### 9.8 Branch Pipes and Nozzle:

Stainless steel Standard Branch Pipe shall be used conforming to IS: 903 with Stainless steel nozzle of 16mm dia to fit standard instantaneous type 63mm dia hose coupling. Suitable spanners of approved design shall be provided in adequate numbers for easy assembly and dismantling of various components like branch pipes, nozzles, quick coupling ends.

a. General:

Type: Branch pipe with Nozzle  
Standard: IS: 903  
Inlet: 63 mm Male Instantaneous  
Nozzle Bore: 20 mm Dia

b. Material of Construction:

Branch Pipe Body, Nozzle: SS: 304 as per IS: 3444, Gr-1  
Washer: Rubber as per IS: 937, Type B

c. Pressure Rating:

Working Pressure: 7 Kg/Sq.cm  
Hydrostatic Test Pressure: 21 Kg/Sq.cm 2 ½ min

d. Finish: Polished

e. Marking: Mfg. Name, BIS Mark, Sr. No, ISI Marked Year of Mfg.

### 9.9 Hydrant Valve:

Stainless steel Hydrant valve shall be of oblique pattern provided as per IS: 5290 complete with hand wheel, quick coupling connection, spring and blank cap and chain.

Single Headed Landing Valve:

a. General:

Standard: IS: 5290:1993, Type-A  
Inlet: 75 mm, Flange Drilling as per OD 200, 4 holes of Ø19mm on 160 PCD.  
Outlet: 63 mm Female Inst. Coupling.

b. Material of Construction:

Body: SS304  
Spindle: SS304 as per IS: 6603  
Spring: SS304 as per IS: 6528  
Hand Wheel: Cast Iron as per IS: 210  
Gland Packing: Asbestos  
Coupling Washer: Rubber as per IS: 5382  
Flat Washer, Seat Washer: Synthetic Rubber  
Blank Cap: ABS  
Chain with Hook: G.I.

c. Pressure Rating:

Hydrostatic Test Pressure  
Body: 21 Kg/cm<sup>2</sup> for 2 ½ min.  
Seat: 14 Kg/cm<sup>2</sup> for 2 ½ min.

Flow Test: 900 LPM Min. at 7 Kg/sq.cm

- d. Painting: Painted with Fire Red as per Shade 536 of IS: 5
- e. Marking: Mfg. Name, ISI, Sr. No, Year of Mfg.

#### **9.10 Pressure Switch:**

The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by lines pressure. The Pressure switch shall be diaphragm type, it shall be suitable for line pressures as per requirements.

The switch shall be suitable for consistent and repeated operations without change in values.

The enclosure shall be of aluminium and pressure element and wetted parts shall be of stainless steel. The switch shall be snap acting type with 1 no. N O/NC contact.

#### **9.11 Air Vessel:**

Three air vessels shall be provided to compensate for slight loss of pressure in the system of the respective pressure zones and to provide an air cushion for counter acting pressure surges whenever the pumping set comes into operation. It shall be normally partly full of water, the remaining being filled with air, which will be under compression when the system is in normal operation.

Air vessel shall be fabricated from MS plate conforming to IS: 2002 grade 2A having 8mm thickness shell with 10 mm thick dished ends and suitable supporting legs. It shall be provided with a 80 mm dia/100 mm dia flanged connections from pump, one 25 mm drain with ball valve and 15 mm sockets for pressure gauge and pressure switches. The air vessel shall be hydraulically tested to 30 kg/cm<sup>2</sup> pressure for 30 minutes.

The pressure vessel shall be provided for hydrant and sprinkler system. The pressure switches shall be mounted on the header of each air vessel. The air vessel shall also be provided with safety valve mounted at the top.

**9.12 Valves:**

All valve shall be ~~UL/FM approved~~ and screwed/flanged ~~grooved~~ end with a pressure rating of 300 PSI or more and as specified by relevant BIS code and manufacturer recommendation. All valves shall be installed under supervision of engineer in charge.

- 16.3. Butterfly Valve - All butterfly valves shall be heavy duty cast iron/DI of approved make with tamper switch The valves shall conform to the following specifications. Butterfly valve shall be of best quality conforming to IS: 13095 and AWWA Standard

~~Approvals: UL/FM Global approved~~

~~Pressure Rating: 300 psi~~

~~Body: Grooved ends, Polyphenylene sulfide (PPS) coated ductile iron body as per ASTM A-536, Grade 65-45-12~~

~~Disc & Stem: Ductile Iron synthetic rubber encapsulated suited for the intended service, with integrally cast stem~~

~~Actuator: Weatherproof actuator and pre-wired supervisory switches.~~

~~Test pressure: 1.5 Time of operating pressure~~

Sizes: 65 mm to 200 mm

Body: CI/DI

Disc: DI (ENP)

Liner: EPDM

Stem: ASTM A276, GR SS410

Bush: PTFE/Nylon

O-Ring: EPDM

Notch Plate: MS Powder Coated

Hand Lever: MS Powder Coated

Fastener: GI

Joint: Threaded/Screwed/Flanged

Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)

Test Pressure: 1.5 Times of Working Pressure

- b) OS&Y Gate Valve Rising Stem



Approvals: ~~UL/FM Global approved~~

Pressure Rating: 300 psi

Type: OS&Y  
Body: ~~Grooved ends~~ Ductile iron body conforming to ASTM A-536  
Yoke: Cast Iron  
Hand Wheel: Conforming to ASTM A-126-B  
Disc: Cast Iron EPDM coated ASTM A-126-B  
Stem: Brass ASTM B16  
Bonnet: Cast Iron Flanged and Epoxy coated  
Stem Seal and Body Gasket: EPDM O-ring  
Test pressure: 1.5 Time of operating pressure

- c) Check Valve - All Check valves shall be heavy duty cast iron of approved make. The valves shall conform to the following specifications.

Approvals: ~~UL/FM Global approved~~

~~Pressure Rating: 300 psi~~

~~Body: Grooved Ends Black Enamel Coated Ductile Iron body conforming to ASTM A-536, Grade 65-45-12~~  
~~Disc: Elastomer Encapsulated Ductile Iron suitable for intended service~~  
~~Spring and Shaft: Stainless Steel~~  
~~Seat: Welded-in Nickel~~  
~~Test pressure: 1.5 Time of operating pressure~~

Body: CI/DI  
Seat: EPDM  
Plates: DI (Lapped)  
Shaft: ASTM A276, GR SS410  
Spring: AISI 302  
O-Ring: Nitrile  
Plug: MS Chrome Plated  
Fastener: SS  
Joint: Threaded/Screwed/Flanged  
Working Pressure Rating: PN16 or PN 20 or PN25 (As per BOQ)  
Test Pressure: 1.5 Times of Working Pressure

- d) Flow Test Meter

Grooved End Calibrated Venturi meter  
Body: Carbon steel as per ASTM A-53 with zinc Electroplated Body  
Needle Valve: Brass conforming to ASTM B-124 with attached GPM meter  
Minimum straight pipe installation of five diameters upstream and two diameters downstream.  
Test pressure: 1.5 Time of operating pressure

### 9.13 Sprinkler Heads & Curtain Nozzle:

Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly, yoke and the deflector. The sprinkler shall be of approved make and type with 15 mm nominal dia outlets.

The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches at 68<sup>0</sup> C.

The nominal bore shall be 15 mm dia and colour of liquid shall be Red.

The Sprinkler head shall bear approval of FOC/UL/FM.

Water Curtain Nozzles shall be UL/FM approved with a K-factor of 23

#### **9.14 Sprinkler Flexible Drops**

The drop system must be with ANNULAR CORRUGATION, which also allows the flex drop to be bended just after the end fittings. The drop system shall consist of a BRAIDED type 304 stainless steel flexible tube, zinc plated steel Male threaded nipple for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head and with a numbering on the reducer to ease the process for vertical positioning of the sprinklers.

The drop shall be FM & VDS approved & minimum number of 90 Degrees bends allowed should be 3 & Minimum Bend Radius should be 178 mm as per FM & 76.2 mm as per VDS.

Union joints shall be provided for ease of installation.

Flexible drop should have max. Working pressure of: 200 PSI / 13.75 bar – FM

Approval | 232 PSI / 16 bar – VDS Approval

The flexible drop shall be attached to the ceiling grid using a one-piece open gate bracket.

#### **9.15 Installation Control Valve for Sprinkler:**

Black enamel coated ductile iron body conforming to ASTM A-536, grade 65-45-12, aluminum bronze clapper, stainless steel spring and shaft, EPDM seal, and Nitrile seat O-rings. Valve internal parts shall be replaceable without removing the valve from the installed position. Water working pressure is 300 psi. Suitable for constant and variable pressure systems

It shall be installed under supervision of engineer in charge or as recommended by manufacturer.

#### **9.16 Flow Switch/Zone Control Module:**

Flow switch shall have a paddle made of flexible material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/pipe through a connecting socket. The switch shall be potential free in either NO or NC operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation panel. The seat shall be of stainless steel. The flow switch shall have IP: 55 Protection. It should operate even with the flow of one Sprinkler bursting.

Body: Cast body and compact and easy to install in zoned wet sprinkler systems.

The integrated module body should consist of a shut off valve, test and drain valve combination, sight glass and different orifice sizes (K factors), a UL Listed and FM Approved Flow Switch, and a Pressure Gauge.

Sizes from 1 ¼ through 6"/32 mm – 150 mm with grooved ends on the main pipe for installation in the horizontal or vertical up-flow positions with UL Listed, FM approved grooved couplings.

1 ¼ - 2" modules have an NPT drain port.

2 ½ - 6" modules have a grooved drain port.

Zone Control Riser Module should be FM Approved and UL and ULC Listed for working pressures up to 300psi

#### **9.17 Deluge Valve:**

With Electric Actuation, low differential, latched clapper design, black enamel coated ductile iron body conforming to ASTM A-536, grade 65-45-12, aluminum bronze clapper, stainless steel spring and shaft, peroxide cured EPDM diaphragm, EPDM seal, brass seat, and Nitrile seat O-rings. Valve internal parts shall be replaceable without removing the valve from the installed position. Valve shall be externally resettable. Required air pressure is 13 psi in case of pneumatic actuation. Water working pressure is 300 psi. Valve should be pre trimmed.

Necessary coordination with FAS vendor for cabling and power supply shall be done by the Firefighting contractor.

#### **9.18 Fire Man's Axe :**

Fire man's axe for firefighting purpose shall be used conforming to IS: 926-1985

#### **23.0 HANDING OVER :**

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.

Contractor shall also handover, to the Project Manager, all maintenance & operation manuals and all other items as per the terms of the contract.

#### **23.1 GUARANTEE :**

**The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.**

The form of warranty shall be as approved by the Project Manager.

The warranty shall be valid for a period of one year from the date of commissioning and handing over.

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.

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.

## 24.0 IS CODES FOR DESIGN, MANUFACTURE, ERECTION, TESTING AND TRAIL OPERATION OF PIPING VALVES ETC. :

The following codes and standards and their subsequent modifications shall apply for the design, manufacture, shop testing, erection, fabrication at site, resting and trial operation of piping, valves and specialties requirements:

IS: 554 : Dimensions for pipe threads where pressure tight joints are required on the threads.

IS: 638 : Sheet rubber jointing and rubber insertion jointing.

**IS: 778 : Copper alloy gate, globe and check valve for water work purposes.**

IS: 14846 : Sluice valves for water –works purposes (50 mm to 1200 mm).

IS: 901 : Couplings, double male and double female, instantaneous pattern for firefighting.

IS: 1239 : Mild steel tubes, tubulars and other wrought (Part I & II ) steel fittings.

IS: 884 : Swinging type wall mounted hose reel with drum.

IS: 388 : Hose tubing.

IS: 4038 : Foot valves for water-works purposes.

IS: 5290 : landing Valves.

IS: 10221 : Anti corrosion treatment for underground MS pipes.

IS: 5312 : Swing check type reflux (non-return) valves.

## 25.0 FIRE CURTAIN

Smoke & Fire Curtains Ltd- Automatic Fire & Smoke Curtain system

### 25.1 Description

The Automatic Fire & Smoke Curtain system is an electrically operated system that controls and descends a continuous barrier of fire resistant fabric; it seals the area and provides continuous fire containment.

### 25.2 Approved Standards

The following Standards apply to the product;

*EN12101 - 1 BS 476 : Part 31.1*

*Smoke Leakage Test (Chiltern Fire)*

*BS 7346 Part 3 BS 7346 - 6*

*Motor operational test in a fire (Chiltern Fire) BS 8434 - 2*

*Cable resistance fire test (Chiltern Fire) BS EN 1363 - 2*

*Fire resistance for doors & shutters (Warrington) BS EN 1364 - 1*

*Fire Test (Chiltern) BS EN 1364 - 1*

*Fire resistance test (Chiltern) BS EN 1634 - 1 : 2000*

*Monitoring of air temperature (Chiltern) BS EN 1634 - 3 : 2004*

*Smoke leakage at ambient temperature (Chiltern) Automatic Fire Curtains Rev.1*

### 25.3 Product Performance

The 120 minutes Fire & Smoke Curtain system is tested to BS EN 1634 – 1 achieving a rating of 120 minutes integrity by 1000 Degrees Celsius. The product is CE marked.

### 25.4 General Description

The Automatic Fire & Smoke Curtain system contains a mild steel roller assembly and bottom rail and a galvanized or powder coated steel head box casing.

The Fire & Smoke curtain barrier is formed from woven glass fiber fabric reinforced with stainless steel wire and coated both sides with micronised aluminum polymer.

The steel roller is powered by a 24V motor. Standard drop down systems are available for this unit. The control panel co-ordinates all functions of the curtains.

### **25.5 Fabric**

The 120 minute Smoke Curtain fabric is a stainless steel reinforced glass fiber fabric. The weight is approx. 500 g/m<sup>2</sup> in its finished form. Fabric thickness is 0.5mm and the weave is 4 shaft satin. .

### **25.6 Bottom Bar Assembly**

The galvanized or powder coated steel bottom bar comes in two shapes - 'T' and 'Bell' dependent on the clients view and the size of the curtain. The bottom bar is assembled by attaching it to the lower edge of the fabric and contains a metal weight to help guide the descending curtain to the ground.

### **25.7 Control System**

Main control panel fully complies to BSEN 12101-9 and contains backup batteries providing a standby power of 30minutes encase of mains power loss. The panel model number is IMC – 01 and is classified within the following EU Directives: Low Voltage Directive 2006/95/EC and Electromagnetic Compatibility Directive 2004/108/EC.

## **26.0 FIRE EXTINGUISHERS:**

### **26.1 Scope of Work:**

Without restricting to the generality of the foregoing the work shall inter-alia consist of the following:

Installation of fully charged and tested fire extinguishing hand appliances CO<sub>2</sub> and dry chemical powder type as required by these specifications and drawings.

### **26.2 Portable Fire Appliances Requirement, Type and Location as per Fire Authority:**

Portable Fire appliances as mentioned below:-

#### **a) Dry Chemical Powder/ABC Powder Type**

Capacity: As per BOQ

Filling: Mono Ammonium Phosphate 90% (MAP-90%) or MAP 50% (As per BOQ)

Type: Stored Pressure Type

Components: CE Marked NRV Valve fitted with Pressure Gauge, EPDM Rubber Hose, Helium Leak Detection Tested, Controllable Discharge Mechanism, including all accessories complete in all respect.

Class of Fire: Class ABC & Electrically Started Fire

Code: IS 15683:2018 Marked & CE Approved.

#### **b) CO2 Portable Type**

Capacity: As per BOQ

Filling: CO<sub>2</sub> Gas conforming to IS: 15222 filled to a filling ratio of not more than 0.667

Components: Wire Braided Hose & Flat Horn with Diffuser Nozzle, Valve shall be IS 3224 Marked, Discharge hose of not less than 10 mm dia. 1 M Long & Complete in all respects with wall suspension bracket,

Class of Fire: Class BC & Electrically Started Fire

Code: IS 15683:2018 Marked & CE Approved.

#### **c) CO2 Trolley Mounted**

Capacity: As per BOQ

Filling: CO<sub>2</sub> Gas

Components: Wire Braided Hose & Flat Horn with Diffuser Nozzle, Valve shall be IS 3224 Marked, High Pressure Discharge Hose, CO2 Cylinder Construction: Hot Spinning by Seamless Pipe & Bearing ISI 7285 for Body and PESO (Ex-CCOE) Approved, Fire Rating: 89B  
 Class of Fire: Class BC & Electrically Started Fire  
 Code: IS 16018:2012 Marked & ISI Marked

d) FE-36 Clean Agent Portable Type

Capacity: As per BOQ  
 Filling: Clean Agent FE-36 Gas  
 Components: Clean Agent type Fire Extinguisher, Gas Listed under EPA SNAP, EPDM Rubber Hose, CE Marked NRV Valve fitted with Pressure Gauge, Helium Leak Detection Tested  
 Class of Fire: Class ABC & Electrically Started Fire  
 Code: IS 15683:2018 Marked & CE Approved

e) ~~FE-36~~ HFC236-fa Clean Agent Modular Type

Capacity: As per BOQ  
 Filling: Clean Agent ~~FE-36~~ HFC236-fa Gas  
 Type: Ceiling Hung Modular Type Automatic in Operation  
 Components: Gas Listed under EPA SNAP, Brass Forged Sprinkler Valves with Glass Bulb Rated at 68 Deg.C  
 Class of Fire: Class ABC & Electrically Started Fire  
 Code: IS 2190:2010 Marked & CE Approved

f) K-Type Portable Extinguisher

Capacity: As per BOQ  
 Filling: Wet Chemical  
 Type: Stored Pressure Type  
 Components: UGTS Pressure Gauge, Deep Drawn, Stainless Steel Body, EPDM Rubber Hose with SS Applicator Nozzle, CE Mark NRV Valve with Safety Release Provision, Helium Leak Detection Tested, Controllable discharge mechanism  
 Class of Fire: Class F (Kitchen Fires)  
 Code: Maintenance, Care and refilling as per IS 2190:2010

**26.3 General Requirements:**

Hand appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners or by means of floor mounted supports.

Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

All appliances shall be fixed in a true workman like manner truly vertical and at correct locations. Identical type of extinguishers shall be of same make and shall have similar method of operation.

**27.0 INSPECTION & TESTING**

The owner/client shall carry out inspection and testing at manufacturer's facility/works for items such as fire pumps covered under this contract. No equipment shall be delivered without prior written confirmation from Project Manager. In case factory inspection is carried out then all travelling and lodging expenses shall be borne by owner/client for maximum two persons. All expenses related to testing shall be to Contractor account. Tests on site of completed works shall demonstrate the following, among other things.

- a. That the equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.
- b. That all items operate efficiently and quietly to meet the specified requirements

The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Project Manager and shall provide test certificate signed by a properly authorized person. Such test shall be conducted on all materials and equipments and tests on completed work as called for by the Project Manager at contractor's expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out, then the contractor shall be liable for the rectification and retesting of the same as called for by the Project Manager whose decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Project Manager.

### **28.0 BYE-LAWS & REGULATIONS**

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

### **29.0 FEES & PERMITS**

The tenderer shall obtain all permits/ licenses and pay for any and all fees required for the inspection, approval and commissioning of their installation. However, all receipted amount shall be reimbursed on production of proof of payment.

### **30.0 DRAWINGS**

The Fire Fighting Drawings listed under Appendix-I, issued with tenders are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of sprinklers, hydrants, equipments and water supply / drainage piping etc.

The tenderer shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom and space shall be maintained at all points. Where headroom appears inadequate, the tenderer shall notify the Architect/Consultant/Client's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and tenderer shall rectify the same at his own cost.

The tenderer shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the client's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Client's site representative without additional cost to the client. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

### **31.0 TECHNICAL DATA**

Each tenderer shall submit along with his tender, the technical data for all items listed in Appendix-IV in the indicated format. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.



### **32.0 SHOP DRAWINGS**

All the shop drawings shall be prepared on computer through Autocad System based on Consultant's Tender Drawings Architectural Drawings, site measurements and Interior Designer's Drawings. Within four weeks of the award of the contract, tenderer shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, Pump room drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc. external insulation details for pipe insulation etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations.

These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/client's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other tenderers. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 6 sets of drawings shall be submitted after final approval along with CD.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix-III and quoted by the tenderer in technical data part of Appendix - IV.

When the Architect/Consultant makes any amendments in the above drawings, the tenderer shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The tenderer shall submit further 6 sets of shop drawings to the client's site representative for the exclusive use by the client's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the tenderer has in his possession, the approved shop drawing for the particular material/equipment/installation.

Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

Manufacturers' drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labelled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

Samples of all materials like valves, pipes etc. shall be submitted to the client's site representative prior to procurement. These will be submitted in two sets for approval and retention by client's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.

Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supercede the contract requirements, nor does it in any way relieve the tenderer of the responsibility or requirement to furnish material and perform work as required by the contract.

Where the tenderer proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the tenderer at his own expense and gotten approved by the Architect/Consultant/client's site representative. Any delay on such account shall be at the cost of and consequence of the Tenderer.



Fire Fighting Tenderer shall prepare coordinated services shop drawings based on the drawings prepared by Plumbing, Electrical, HVAC & Low Voltage Tenderers to ensure adequate clearances are available for installation of services for each trade.

Where the work of the tenderer has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the client's site representative, the tenderer shall prepare composite working drawings and sections at 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 Tenderer installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the OWNER.

Within two week of approval of all the relevant shop drawings, the tenderer shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers') imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to client for acceptance of anticipated variation in contract amounts and also advise client to initiate action for procurement of spare parts and tools at the completion of project.

### **33.0 QUIET OPERATION AND VIBRATION ISOLATION**

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the client's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Tenderer at his own expense. The tenderer shall guarantee that the equipment installed shall maintain the desired NC levels.

### **34.0 ACCESSIBILITY**

The Tenderer shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his piping and other ancillaries. His failure to communicate insufficiency of any of the above, shall constitute his acceptance of sufficiency of the same. The Tenderer shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for each concealed valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Tenderer shall make all the necessary repairs and changes at his own expense. Access panel shall be standardised for each piece of equipment / device / accessory and shall be clearly nomenclatured / marked.

### **35.0 MATERIALS AND EQUIPMENT**

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per Appendix - III.

### **36.0 MANUFACTURERS INSTRUCTIONS**

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

### **37.0 ELECTRICAL INSTALLATION**

The electrical work related to Fire Fighting services shall be in the scope of the tenderer. Designing, Supply, installation, testing and commissioning of Firefighting panels along with all cabling, earthing, terminations etc. as mentioned in detail in the BOQ, shall be done by the Firefighting contractor.

### **38.0 BALANCING, TESTING AND COMMISSIONING**

Balancing of the complete system and all tests as called for the Specifications shall be carried out by the tenderer through a specialist group, in accordance with the Specifications and NBC, BIS, NFPA Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps etc. at factory with two personnel from Client/Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the client's site representative. All tests shall be carried out in the presence of the representatives of the Architect/Consultant and client's site representative.

### **39.0 COMPLETION DRAWINGS**

Tenderer shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of floppies / CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, piping layouts, location of wiring and sequencing of automatic controls, location of all concealed piping, valves, controls, wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The tenderer shall frame under glass, in the plant room, one set of these consolidated control diagrams.

#### **40.0 OPERATING INSTRUCTION & MAINTENANCE MANUAL**

Upon completion and commissioning of part Fire Fighting system the tenderer shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the tenderer shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and client's site representative and two for client's Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

"Preventive Maintenance Schedule for each equipment / panel shall be submitted along with Operation and Maintenance Manual".

#### **41.0 ON SITE TRAINING**

Upon completion of all work and all tests, the Tenderer shall provide necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the client's staff to get acquainted with the operation of the system. During this period, the tenderer shall train the client's personnel in the operation, adjustment and maintenance of all equipment installed.

#### **42.0 MAINTENANCE DURING DEFECTS LIABILITY PERIOD**

Complaints

The Tenderer shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

Repairs

All equipment that require repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs for one year concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the OWNER.

#### **43.0 UPTIME GUARANTEE**

The tenderer shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall be extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Tenderer shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all pressures, power consumption. Starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Tenderer shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the client's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

#### **44.0 OPERATION AND MAINTENANCE**

Tenderer may be required to carry out the operation of the FIRE FIGHTING installation for a period of one year from the date of commissioning and handing over of the entire system. Further, he may also be required to carry out operation and all-inclusive maintenance of the entire system for a period of four years beyond the defects liability period.

Operation contract (Fire Fighting)

- i. 16 hours a day, year round.
- ii. All stand-Ay equipment to be operated as per mutually agreed programme.
- iii. Proper entry and upkeep of relevant log books.
- iv. Maintain complaints register. Submit weekly report.
- v. Proper housekeeping of all areas under the contract.
- vi. Prepare daily consumption report and summary of operation.

#### Terms of payment

Monthly at the end of each month on pro-rata basis.

#### All Inclusive Maintenance Contract

- a. Routine Preventive Maintenance Schedule to be submitted
  - i. Schedule to cover manufacturer's recommendation and / or common engineering practice (for all plant and machinery under contract).
  - ii. Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.
  - iii. Monthly status report.
  - iv. Entire Fire Fighting installation to be painted in fourth year (from end of defects and liability period) before the expiry of operation and maintenance contract.
- b. Uptime during maintenance contract
  - i. 98% uptime of all systems under contract.
  - ii. Up time shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.
  - iii. There shall be no reimbursement for the extended period.
  - iv. Break-downs shall be attended to within ten hours of reporting.
  - v. Spare compressor/motor assembly to be made available within seven calendar days in case of total breakdown/burnout.
- c. Manpower
  - i. Adequate number of persons to the satisfaction of the OWNER's site representative shall be provided including relievers.
  - ii. Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.
  - iii. Duty allocation and Roaster control shall be tenderer's responsibility.
- d. Shut Downs
  - i. Routine shut downs shall be permitted only during winter season.
  - ii. Tenderer shall be at liberty to carry out routine maintenance as and when required but with prior permission of the OWNER.
- e. Payment Terms  
Monthly payment at the end of each month on pro-rata basis.

**45.0 PARTIAL ORDERING**

Client through the Architect/Consultant/ OWNER's site representative reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers.

**-----: END OF SUBHEAD :-----**

## **SUBHEAD-2. ELECTRICAL PANELS & DRY TYPE TRANSFORMER FIRE PROTECTION SYSTEM**

### **Specifications**

Electrical Panel / Transformer Protection System: This includes Supply, Installation, Testing and Commissioning of ~~3M Novec-1230~~ HFC236-fa gas Suppression system in accordance with the Contract Documents.

#### **1.0 Scope of Work:**

- a. Supply, Installation, Testing and Commissioning of clean Agent (~~Novec-1230~~) HFC236-fa Fire Suppression system designed to provide a uniform concentration within the electrical panels / Transformer in accordance with NFPA 2001 and requirements of the contract documents).
- b. Provide all engineering design and materials for a complete agent suppression system including gas storage cylinders with steel bracket, extinguishing agent, detection tube, cylinder valve and associated accessories including but not limit to; adaptors, pressure switch, tube fittings etc, required for complete operation of system.
- c. All necessary safety requirements such as warning signs, discharge alarm shall be part of system.
- d. The necessary nomenclature such as pressurization level, agent volume, gross/net weight of cylinder shall be clearly marked on cylinder.
- e. Prior to supply of material at site. Contractor must submit following documents for approval of Engineer-in-charge.
  - a) Drawing in A-4 size, clearly showing the panel, routing of tube inside the panel, location and fixing arrangement of cylinder & system components.
- f. All doors and holes in the enclosed/equipments should be closed or sealed to maintain the tightness of enclosure.

#### **2.0 System Description:**

- a) The detection tube shall be fixed with cylinder valve at top of cylinder. The tube shall be pressurized with dry nitrogen. In case of reach of pre-determined temperature (100-120°C), the tube shall rupture and gas shall be released from tube over the protected area.
- b) The pressure switch shall be provided for necessary indication of discharge of gas.
- c) The Extinguishing Agent shall be stored in cylinder as liquefied compressed gas, super pressurized with dry nitrogen at 195 psi.
- d) The cylinder shall be equipped with brass valve, pressure gauge (to monitor agent pressure) and isolation valve for maintenance purposes. The cylinder bracket shall be of steel construction with quick release clamp.
- e) The detection tube shall be installed throughout the compartments of panel. The location and spacing of tube shall be above the hazard, to be protected.
- f) In case of fire, the tube shall rupture at a point. The rupture of tube shall result in formation of discharge point and release the agent in uniform pattern.
- g) With system activation, a signal should be generated via Audio Visual Alarm installed at convenient location as per Engineer-in-Charge.

#### **3.0 System Components:**

The bidder shall provide an under taking from Principle Manufacturer of CE marked product they intent to install, that manufacturer will fully support the bidder for this specific project.

#### **4.0 Extinguishing Agent**

##### **~~NOVEC 1230~~ HFC236-fa**

- (a) The agent shall not contain any Hydro-fluro-carbons (HFC).
- (b) The ozone depletion potential should be zero.
- (c) The Global warming potential should be equal to or less than 1.
- (d) The Extinguishing Agent should be UL Listed/ FM approved.
- (e) The extinguishing agent should be filled in an UL Listed or FM approved filling station.

#### **5.0 Installation**

- a) The system shall be installed on basis of approved drawing/manufacturer recommendation.

-----: **END OF SUBHEAD** :-----

### SUBHEAD-3. ELECTRICAL SYSTEMS:

#### A. PANEL & DISTRIBUTION BOARD, LT SWITCH GEAR, VFD'S, STARTERS, IMPORTANT NOTES ON STARTERS, CONSTRUCTION FEATURES AND GENERAL NOTES ON PANELS / DISTRIBUTION BOARDS

##### 1. AIR CIRCUIT BREAKERS (ACB)

- The ACB shall conform to IEC/IS – 60947-2. The ACB shall have a rated service short circuit breaking capacity (Ics) as specified in SLD's and BOQ "Technical parameters" at rated operational voltage (Ue) at 415V, frequency at 50 Hz. The ultimate breaking capacity (Icu) shall be equal to Service breaking capacity (Ics) and Short Ckt Withstand capacity (Ics=Icu=Icw for 1 sec) rated Impulse withstand voltage (Uimp) shall be 12kv and rated insulation voltage (Ui) at 1000V. The ACB release should have true RMS sensing. ACB should have single frame size up to 4000A and shall be suitable for "Switch Disconnect" function (AC 23 utilization category). The construction of circuit breakers shall be as per **pollution degree 3**.
- Circuit breakers shall be three / four pole, air break, horizontal drawout / fixed type as indicated in SLD/BOQ.
- Drawout type Circuit breakers alongwith its operating mechanism shall be provided with suitable arrangement for easy withdrawal. Suitable guides shall be provided to minimize misalignment of the breaker.
- There shall be "SERVICE", "TEST" and "FULLY WITHDRAWN" positions for the breakers. In "TEST" position the circuit breaker shall be capable of being tested for operation without energizing the power circuits i.e. the power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the "SERVICE", "TEST" or "FULLY WITHDRAWN" position. Safety interlock must be provided to prevent the ACB from falling out in a fully withdrawn position. It shall be possible to close the door in "TEST" position.
- Suitable mechanical indications shall be provided on all circuit breakers to show "OPEN", "CLOSE", "SERVICE", "TEST", and "SPRING CHARGED" positions.
- All ACBs should be provided with Microprocessor based release as specified in BOQ / SLD's should be provided on circuit breaker for short circuit, over current and earth fault protection with adjustable settings with intentional delay. Specific LED indications should be provided for short circuit, over current and earth fault operation for faster fault diagnosis and reduced down time. All ACBs should be provided with "Auto Protection" facility. Opening and closing time of ACB should be <40 m Sec and <70 m sec respectively. All Incomer ACB Release should be provided with display for current and voltage parameters (for each phase & Ground Fault). Control unit shall have fault history data & store **last 10 trip causes**.

The Circuit Breaker shall have minimum **mechanical life of 10000 operations without maintenance**.

The electrical life of circuit breaker upto 2000 Amps shall not be less than 5000 operations and beyond 2000 Amps shall be greater than 1000 operations.

ACB releases shall be EMI / EMC compatible. In case of Four Pole ACB, Fully rated Neutral with protection against O/L & S/C with settings at 50%-100%- OFF. ACBs should comply with RoHS. Microprocessor releases shall be provided with integral LCD Display of load current and individual loading of all the three phases. Microprocessor release shall also be suitable for zone selective interlocking (ZSI). Microprocessor releases shall also have 1<sup>st</sup> ON/OFF time delay protection for short circuit and Earth fault.

All ACBs release shall have in-built thermal memory before and after the fault. ACB release should be provided with Rotary Dial for release setting. Separate LEDs should be provided on release itself for fault differentiation.

- Relays should be CT operated through shunt trip, under voltage trip for short circuit and earth fault protection.
- Wherever microprocessor earth fault release is asked for. Additional CT shall be provided on the neutral bus link. This CT shall have characteristics matching to the CT's installed in the ACB for the purpose. It should be possible to change the setting of release in "ON" condition.
- All circuit breakers shall be provided with "4 NO" and "4NC" potential free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker and should be directly operated from breaker operating mechanism.



- All circuit breakers shall be provided with the following interlocks :
- Movement of a circuit breaker between “SERVICE” and “TEST” position shall not be possible unless it is in open position. Attempted withdrawal of a closed circuit breaker shall preferably not trip the circuit breaker. In cases the offered circuit breaker trips on attempted withdrawal as a standard interlock, it shall be ensured that sufficient contact exist between the fixed and drawout contact at the time of breaker trip, so that no arcing takes place even with the breaker carrying it's full rated current.
- Closing of a circuit breaker shall not be possible unless it is in “SERVICE” position, “TEST” position or in “FULLY WITHDRAWN” position.

All ACB's shall have **door interlock**

- Circuit-breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the stationary isolated contacts when the breaker is withdrawn. It shall however be possible to open the shutters intentionally against pressure for testing purposes.

ACBs shall be provided with a flexibility to rotate power terminals by 90 degree to suite stringent site requirements.

- A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.
- There should be a provision of positive earth connection between fixed and moving portion of the ACB either through connector plug or sliding solid earth mechanism. Earthing bolts must be provided on the cradle or body of fixed ACB.
- It should be possible to bolt the drawout frame not only in CONNECTED position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.
- Circuit breakers shall provide with castle key / electrical interlocking devices, as specified in “Bill Of Quantity”.
- Mechanical tripping shall be possible by means of front mounted Red “trip” push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.

The **racking handle shall be stored on the air circuit breaker** in such a manner as to be accessible without defeating the door interlocking

- Alternatively Means shall be provided to slowly close the circuit breaker in “withdrawn position”, if required, for inspection and setting of contacts. In “service position” slow closing shall not be possible.
- All accessories like shunt release, undervoltage, motorized mechanism etc. shall be front mounted, requiring no adjustments and can be fitted at site.
- The manufacturer shall provide details of opening time and duration with temperature to ensure discrimination and proper selection for feeder protections. All ACB's of 4000A and above shall be a single ACB unit. The manufacturer shall also indicate the mechanical and electrical life of circuit breaker.
- Circuit breaker shall be provided with either of the following mechanisms as specified in “Bill Of Quantity”.

The trip unit shall have following protection settings, based on the type of trip unit.

- › Adjustable over load current ( $I_r$ ) settings from 40% to 100% of rating of ACB ( $I_n$ ).
- › Over load time setting ( $t_r$ ) from 0.5s, 1s, 2s, 4s.....24s as field selectable curves
- › Short circuit setting ( $I_{sd}$ ) from 1.5 to 10 times of  $I_r$  setting
- › Short circuit time delay adjustable from 0 to 400 msec.
- › Instantaneous ( $I_i$ ) protection with an adjustable pick-up and an OFF position.
- › Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400 ms.

### 1.01 Manually Operated Mechanism

- Manually operated mechanism shall be of manual spring charging stored energy type.
- The circuit breaker shall have a spring charging handle and push-button for closing the breaker mechanically after the spring has been charged. However, closing by spring charging handle after the spring has been fully charged shall also be acceptable, provided the movement of contacts does not

take place with the movement of handle and the contacts operate only when the spring stored energy is released. Overcharging of spring shall not be possible.

- The closing action of the circuit breaker shall charge the tripping spring, thus making it ready for tripping.
- The circuit breaker shall be provided with the interlocks so that it shall not close unless the spring is fully charged.
- The mechanism shall be suitable for addition of motor mechanism at site if required for future upgrade without the need of any special accessories.

## 1.02 Power Operated Mechanism

- Power operated mechanism shall be provided with a universal motor suitable for operation on 240 AC / DC Control supply, with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class "E" or better.

All ACBs should be provided with "Ready to Close" Contact

- The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring at minimum available control voltage.
- Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.
- The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operation shall be possible. After failure of power supply at least one open-close-open operation shall be possible.
- Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.
- All circuit breakers shall be provided with closing and trip coils (Shunt release + Under voltage release). The closing coil shall operate correctly at all values of voltage between 85% to 110% of rated control voltage. The trip coil shall operate satisfactorily at all values of voltage between 70% to 110% of rated control voltage and shall have continuous rating.
- Provision for mechanical closing of the breaker only in "TEST" and "WITHDRAWN" positions shall be made. Alternately, the mechanical closing facility shall be normally made inaccessible; accessibility being rendered only after deliberate removal of shrouds.

## 2.00 MOULDED CASE CIRCUIT BREAKERS (MCCB'S)

- The Moulded case circuit Breaker (MCCB) shall conform to the latest IEC 60947-2 and IEC 947-3-1989. MCCB's shall be suitable for rated operation voltage upto 415 VAC & rated insulation voltage upto 690 VAC.
- MCCB's in AC circuits shall be of triple pole / four pole construction as per enclosed BOQ. Operating mechanism shall be quick-make, quick-break and trip-free type ( Roto-Active design) . The "ON", "OFF" and "TRIP" positions of the MCCB's shall be clearly indicated and visible to the operator when mounted as in service. Front of door operating handle shall be provided with pad lock and door interlock. Front of door operating handle shall be provided with door interlock defeat mechanism to facilitate inspection of the MCCB during 'ON' position. MCCB shall be suitable for Positive isolation / disconnection according to IEC 60947-1 & 2 for optimum user safety.
- The Service short circuit Breaking capacity (Ics at 415 VAC) of all MCCB's shall be as specified in SLD / BOQ and shall have ( Ics=Icu=100%).

All MCCB should have "Class-II" front facia as per IEC 60664.

Electrical life of MCCB's shall not be less than 10000 operations and mechanical life shall not be less than 20000 operations.

- The MCCB shall be current limiting type. MCCB shall have Arc extinguishing device contained in a compact, high strength, heat resistance, flame retardant, halogen free insulating moulded case with high withstand capability against thermal and mechanical stresses.

- MCCB's shall be either with Thermal-magnetic releases for over load and short circuit or with microprocessor based releases for over load and short circuit as asked for in the BOQ.

Load indication LED shall be integral part of electronic releases. All electronic releases shall be EMI / EMC compatible.

- Wherever microprocessor earth fault add on earth fault Module is asked for, additional CBCT shall be provided.

It should not be possible to by pass / switch off the S/C, E/F protection in MCCB. The E/F setting should be provided with 10% to 60% with time delay of 0.3 to 3 seconds. LED Indication should be provided in case of earth Fault. E/F Module should have Test Push Button for self diagnostic features without tripping the ckt breaker. Also Over current and earth fault differentiation should be provided.

- The trip command of releases in MCCB shall over ride all the other commands. The MCCB shall employ maintenance free double break contact system to minimize the set through energies and capable of achieving Total Discrimination up to the full short circuit capacity of the downstream MCCB. The MCCB shall not be restricted to line / load connections. MCCB shall be provided with test trip Push Button to check the proper function of tripping mechanism. MCCB shall comply with RoHS & WEEE norms

- Where Earth fault protection are indicated in drawings / BOQ they shall be thru Add on Module MCCB's and have adjustability from 10% to 60% of rated current with adjustable time delays to aid discrimination on earth faults. The system shall be immunized against nuisance tripping as per IEC 61000-4 standards.

- MCCB's shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings of the motor starting equipment and the mechanical stress caused by the peak short-circuit current of value associated with the switchgear rating. The maximum tripping time under short circuit shall not exceed 8 milliseconds.

- MCCB terminals shall be shrouded and designed to receive Bus Bar Links /cable lugs for cable sizes relevant to circuit ratings.

- The MCCB shall have common field fittable snap-on auxiliaries common for entire range. The remote tripping coil should be of continuous duty cycle.

- Where mechanical interlocking is called-for between two Incomer and Bus Coupler or between two Incomers without Bus Couplers, proper arrangement for built-in Ronis / Coded key interlocking shall be provided.

- MCCB's shall be with bus bar spreaders. (Spreaders shall be of the same make of MCCB i.e. spreaders shall come along with the MCCB, to be supplied by the MCCB manufacturer).  
MCCB's shall be with direct / extended Rotary Handle.

ARRANGEMENT OF PAD LOCKING & FOOL PROOF LOTO (LOCKOUT & TAG OUT) TO BE AVAILABLE WITH ALL MCCB'S FOR MAINTENANCE SAFETY REASONS ON MOTORS / EQUIPMENT.

### 3. MOTOR PROTECTION CIRCUIT BREAKER (MPCB)

Motor circuit breakers shall conform to the general recommendations of standard IEC 947 -1,2 and 4 (VDE 660, 0113 NF EN 60 947-1-2-4, BS 4752) and to standards UL 508 and CSA C22-2 N°14. The devices shall be in utilization category A, conforming to IEC 947-2 and AC3 conforming to IEC 947-4. MPCB shall have a rated operational and insulation voltage of 690V AC (50 Hz) and MPCB shall be suitable for isolation conforming to standard IEC 60947-2 and shall have a rated impulse withstand voltage (Uimp) of 6 kV. The motor circuit breakers shall be designed to be mounted vertically or horizontally without derating. Power supply shall be from the top or from the bottom. In order to ensure maximum safety, the contacts shall be isolated from other functions such as the operating mechanism,

casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the motor circuit breakers must have snap action opening and closing with free tripping of the control devices. All the poles shall close, open, and trip simultaneously. The motor circuit breakers shall accept a padlocking device in the “isolated” position.

The motor circuit breakers shall be equipped with a “PUSH TO TRIP” device on the front enabling the correct operation of the mechanism and poles opening to be checked. The auxiliary contacts shall be front or side mounting, and both arrangements shall be possible. The front-mounting attachments shall not change the breaker surface area. Depending on its mounting direction the single pole contact block could be NO or NC. All the electrical auxiliaries and accessories shall be equipped with terminal blocks and shall be plug-in type. The motor circuit breakers shall have a combination with the downstream contactor enabling the provision of a perfectly co-ordinated motor-starter. This combination shall enable type 1 or type 2 co-ordination of the protective devices conforming to IEC 60947-4-1. Type 2 co-ordination shall be guaranteed by tables tested and certified by an official laboratory: LOVAG (or other official laboratory). The motor circuit breakers, depending on the type, could be equipped with a door-mounted operator which shall allow the device setting. The motor circuit breakers shall be equipped with releases comprising a thermal element assuring overload protection and a magnetic element for short-circuit protection. In order to ensure safety and avoid unwanted tripping, the magnetic trip threshold (fixed) shall be factory set to an average value of 12 Ir.

All the elements of the motor circuit breakers shall be designated to enable operation at an ambient temperature of 60°C without derating. The thermal trips shall be adjustable on the the front by a rotary selector. The adjustment of the protection shall be simultaneous for all poles. Phase unbalance and phase loss detection shall be available. Temperature compensation (-20°C to +60°C).

MPCB shall be with bus bar spreaders. (Spreaders shall be of the same make of MPCB i.e. spreaders shall come along with the MPCB, to be supplied by the MPCB manufacturer). MPCB'S shall be with direct / extended rotary handles.

**ARRANGEMENT OF PAD LOCKING & FOOL PROOF LOTO (LOCKOUT & TAG OUT) TO BE AVAILABLE WITH ALL MPCB'S FOR MAINTENANCE SAFETY REASONS ON MOTORS / EQUIPMENT.**

MPCB's shall be with microprocessor-based releases. MPCB's shall be two of types as called for in the bill of quantities as follows:

- c) MPCB's shall be with thermal & magnetic releases with adjustable thermal setting.
- d) MPCB's with magnetic release only shall be with fixed magnetic setting.

#### 4. MINIATURE CIRCUIT BREAKER (MCB)

- Miniature Circuit Breaker shall comply with IS 8828 – 1996 / IEC 898 – 1995.
- Miniature Circuit Breaker shall be quick make and break type for 230 / 415 V AC and 50 Hz application. The housing of MCB's shall be heat resistant and having a high impact strength. The breaking current of MCB's shall not be less than 10000 Amps, at 230 V / 415 V. The MCB's shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical 'ON' and 'OFF' indications. MCB's shall be suitable for isolation function and line load reversibility.
- MCB's shall be current limiting type class – 3. MCB's shall be classified as B, C, and D as per standard Ref. IS as per the Tripping characteristics curves defined by all the manufactures. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS / IEC and the manufactures shall publish the value.
- MCB's shall be calibrated at an ambient temperature of 40 degree.
- The MCB contacts shall be silver nickel alloy and contact tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic coil releases for short circuit protection and thermal release for over load protection. The over load or short circuit devices shall have a common trip bar in the case of DP, TP, TPN and FP Miniature Circuit Breakers and shall have 20000 electrical operations upto 63A. The terminals shall be protected against finger contact to IP 20 Degree of protection.
- MCB's shall have a facility to accommodate accessories like auxiliary contacts, trip alarm contact, shunt trip and under voltage add-on blocks.

Use of MCB's shall be application based i.e.: (Even if it not mentioned specifically in the BOQ)

For computers / IT equipment / Servers	:	Type 'D' characteristics
For motors, inductive loads and Discharge Lamps	:	Type 'C' characteristics
For lighting & small power	:	Type 'B' characteristics

#### MCB's 'KA' RATINGS:

- MCB's are available in standard 10 KA fault with stand rating indigenously produced.
- Imported MCB's in 16KA, 25KA & 36 KA fault ratings are also available.
- 16KA fault rating may be 15% more expansive than 10 KA rating.
- For 25KA & 36KA MCB rating wherever required, MCCB / MPCB may be opted for cost & delivery reasons.

#### 5. METERS

- a. All voltmeters / multi-function meters and indicating lamps shall be protected through MCB's / MPCB's depending upon fault level.
- b. Meters and indicating instruments shall be flush type.
- c. All CT's connection for meters shall be through Test Terminal Block (TTB).
- d. CT ratio and burdens shall be as specified on the Single line diagram/ in the BOQ/ as required for the application.

#### 6. CURRENT TRANSFORMERS (CT'S) & VOLTAGE / POTENTIAL TRANSFORMERS (PT'S)

Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondary's for operation of associated metering.

The CTs shall conform to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and metering CTs shall be of accuracy class I.

Accuracy class and VA burden shall be as per the application as required as per metering / protection needs.

PT shall be Class-1 accuracy for metering.

PT shall be cast resin type.

PT shall be of suitable burden (VA).

**7. INDICATING PANEL**

All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted digital type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB/MPCB as per required fault level. Indicating Lamps shall be of LED type. All digital instruments shall have shrouded terminals and suitable for 0°C to 50°C temperature range and shall with stand 1.2 time over loading. Accuracy class and VA burdens shall be as per the requirement. Meters shall be with RS 485 port wherever called for in the BOQ's for communication.

**8. SELECTOR SWITCH**

Where called for selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

**9. CONTACTOR**

Contactors shall be built into a high strength thermoplastic body and shall be provided with a shield for quick arc extinguishing. Silver alloy tips shall be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starter's contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta Starters. The insulation for contactor coils shall be of Class "E".

Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for 240 / 415 + 10% volts, 50 cycles AC supply. Contactors shall be of 3P / 4P design as required.

**10. THERMAL OVERLOAD RELAY**

Thermal overload relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing. The relay shall operate on the differential system of protection to safeguard against three phase overload, single phasing and unbalanced voltage conditions.

Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from -5deg C + 55 deg C.

All overload relays shall be of three element, positive acting ambient temperature compensated time logged thermal over load relays with adjustable setting. Relays shall be directly connected for motors upto 35 HP capacity. C.T. operated relays shall be provided for motors above 35 HP capacities.

**11. TIME DELAY RELAYS**

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

**12. TOGGLE SWITCH**

Toggle switches, where called for in Schedule of Quantities, shall be in conformity with relevant IS codes and shall be of 5 amps rating.

**13. PUSH BUTTON STATIONS**

Push button shall be provided for manual starting and stopping of motors / equipment "Green" and "Red" colour push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start' or 'Stop' indicating



flaps shall be provided for push buttons. Push buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. The push button contacts shall be suitable for 6 amps current capacity.

**14. COORDINATION STUDY IN LV NETWORK**

LV Switchgear Manufacturer shall submit coordinated & Discriminated solution for LV Network protection devices i.e. **ACB, MCCB, MPCB & MCB** for all Incoming and outgoing devices for all Panels/ DB's as per BOQ with the help of published discrimination tables. Total discrimination shall be provided up to the short circuit breaking capacity of downstream circuit Breakers.

**15. MOTOR STARTER AND VARIABLE FREQUENCY DRIVE FEEDERS WITH IN MCC's (Motor Control Centre)- SPECIFICATIONS**

**Type of Motor Starters:**

- DOL starters upto 10HP / 7.5 KW motors.
- Star-Delta starters from 12.5HP / 9.3 KW onwards.
- Soft starters / VFD's for fire pumps.
- VFD's for motors, wherever specified.

All Starter feeders for **DOL, Star-Delta and Soft Starter** shall be complete with and inclusive of the following:

**Soft Starter** feeders shall be complete with and inclusive of the following, but refer specifications for details:

- For Motor Upto 45 KW / 60 HP, TP MPCB with inbuilt Magnatic release.
- MPCB shall be Micro-processor based.
- For Motor from 55 KW / 75 HP and upto 187 KW / 250 HP, TP Motor Duty MCCB, Thermal - Magnetic Release type with inbuilt fixed magnetic release.
- Thyristar circuit with inbuilt O/L and SPP feature (in case of fire pumps no O/L & SPP protection)
- Bypass contactor to Thyristar circuit (110 V contactor coil voltage)
- A/M selector switch- 2pole/2way (for BMS connectivity)
- ON /OFF push buttons
- Necessary 'DO' & 'DI' ports
- Modbus communication port
- ON /OFF / Trip indications (110V)
- Digital Ammeter with inbuilt selector switch and with metering class CT's (one per phase) (3CT's)
- Internal wiring
- Type-II coordination

Note: **Soft starter** for fire pumps shall be without O/L relay feature.

**16. SOFT STARTER:**

- Soft starter shall be used to limit the starting inrush current of motors.
- Soft starter shall have Thyristor to limit the starting current.
- As the motor attains its full speed, the motor running is shifted to a by-pass contactor, which is part of the soft starter assembly.
- Soft starter will have inbuilt overload and single phasing protection.
- Soft starter shall have RS485 (Modbus) communication port.
- Soft starter shall also have programmable DO & DI (Digital Output & Input) ports, as required.
- Soft starter shall be complete with motor duty MPCB or MCCB as incomer or HRC Fuses for short circuit protection and isolation purposes to attain Type-2 coordination.
- Soft starter shall be complete with local ON / OFF push buttons and A/M selector switch.

- For fire pumps, if soft starters are used, then it's overload / over current feature will be kept disabled.
- Soft starter shall have panel door mounted display unit for display of Electrical parameters & ON / OFF / Run status.
- Soft starter shall be integrated with fire alarm system and BMS system.

#### **17. IMPORTANT NOTES FOR ELECTRICAL PANELS, SWITCHGEAR & MOTOR CONTROL CENTRES**

- Switchgear of only one make / manufacturer to be used.
- Type-2 co-ordination to be followed.
- Motor duty MPCB'S & MCCB'S to be selected as per switchgear manufacturer's recommendation / charts.
- In case of any discrepancy between specifications, BOQ & drawing (SLD), the best of the three to be considered or clarification to be sought from the consultant / Client / PMC.
- Temperature deration of switchgear to be taken into account while selecting it even if it is not accounted for in the BOQ / drawing (SLD).
- Motor duty MCCB's are available in 50KA fault withstand capacity only , even if it is specified otherwise in BOQ / drawings (SLD).
- MPCB's less than 36KA fault withstand capacity not to be used, even if it has been specified otherwise.
- Standard range of MCCB's is:  
16A, 25A, 32A, 40A, 50A, 63A, 80A, 100A, 125A, 160A, 225A, 250A, 320A, 400A, 500A, 630A
- Standard fault withstand ratings of MCCB's are:  
16KA, 25KA, 35KA/36KA, 50KA, 65KA/70KA, 100KA
- Standard MPCB's fault withstand ratings are:  
25KA, 36KA, 50KA, 100KA, 150KA
- Fire Pump panel Motor control centres will not have any neutral bus bar and only 3C cable shall be terminated in motor control centres.
- All metering, protection, indication lamps etc. shall be of 110V i.e. 230V supply shall not be used for these purposes & panel door will not have 230V metering & lamps etc.
- Contactor's coil shall be 110V, AC. Necessary PT's to be used.
- Switchgear selection should achieve discrimination even if it is not shown in BOQ / drawing (SLD).
- Burden calculations for CT's, PT's and control transformers to be submitted along with shop drawings.
- Incomer switchgear, bus bars, supports and outgoing switchgear shall be of same fault level withstand capacity as mentioned for the panel.

**IMPORTANT NOTE:** - VENDORS TO SUBMIT SWITCHGEAR SELECTION/ RATINGS FOR ALL  
THE PANELS ALONG WITH THE BID.

#### **18. CONSTRUCTION FEATURES & GENERAL NOTES OF MOTOR CONTROLS CENTRES (MCC)**

##### **GENERAL SPECIFICATIONS**



Main & Sub Distribution Boards shall be classified as FBA (Factory Built Assemblies) as per IEC: 61439 of Cubicle type, Sheet steel clad, Totally enclosed, Dust & Vermin proof, Indoor type/ out door type, Rigid, Free standing, Floor mounted compartmentalized, Single front for use on 415 volts, 3 phase, 50 cycles, AC system with a fault level withstand capacity as per B.O.Q. /as required, RMS Symmetrical. Complete with busbars interconnections, power, control/auxiliary circuits/ wiring & earthing, with switchgear as per B.O.Q of approved makes as specified. All Panels shall comply to IEC-61439 as type tested panel for all fault withstand capacities upto 65KA for 1 sec.

**BASE FRAME: 3MM**

Normal Indoor Application: CRCA WITH POWDER COATING (minimum 60 micron coating).  
 Outdoor Application: ALUZINC WITH POWDER COATING (minimum 80 micron coating).  
 CRCA Sheet Type: PN02/ Equivalent as approved.  
 CRCA Sheet Make: TISCO/ Equivalent as approved.  
 ALUZINC Sheet Type: Grade CS Type A.  
 ALUZINC Sheet Make: Dongbu Steel South Korea.

**STRUCTURE, COVER BACK & FRONT DOOR: 2MM**

Normal Indoor Application: CRCA WITH POWDER COATING (minimum 60 micron coating).  
 Outdoor Application: ALUZINC WITH POWDER COATING (minimum 80 micron coating).  
 CRCA Sheet Type: PN02/ Equivalent as approved  
 CRCA Sheet Make: TISCO/ Equivalent as approved  
 ALUZINC Sheet Type: Grade CS Type A.  
 ALUZINC Sheet Make: Dongbu Steel South Korea.

**INTERNAL PARTITIONS: 1.6MM**

Normal Indoor Application: ALUZINC  
 Outdoor Application: ALUZINC  
 ALUZINC Sheet Type: Grade CS Type A.  
 ALUZINC Sheet Make: Dongbu Steel South Korea.

**CABLE GLAND PLATES: 3MM**

Multi Core Cables: ALUZINC  
 Single Core Cables: Aluminum

**INTERNAL SWITCHGEAR MOUNTING PLATES: 2MM**

Normal Indoor Application: ALUZINC  
 Outdoor Application: ALUZINC  
 ALUZINC Sheet Type: Grade CS Type A.  
 ALUZINC Sheet Make: Dongbu Steel South Korea.

**CONSTRUCTION**

- Completely modular & compartmentalized, form 3B separation. Separate adequately spaced Unit Chamber, Bus bar & cable compartments.
- IP20 ingress protection to be ensured compartment to compartment inside the panel.

**EXTENSIBILITY**

Readily extensible on both ends.  
 Panels should be made in easily transportable sections.

**DIMENSIONS**

Operating height	1800mm max. 300mm min.
Overall height	2400mm max.
Compartment size HXW	225mm x 500mm min
Cable chamber	300mm min.

**DEGREE OF PROTECTION**

**IP: 42 for totally Indoor application.**

- Fire Pump Panel

**DOOR HINGES**

Concealed, Powder Painted

**DOOR LOCKS**

Zinc alloy powder painted with provision for pad locking..

**GASKET**

Neoprene / PE foam of suitable profile to provide desired degree of protection.

**LIFTING ARRANGEMENT**

Eye bolt of removable design, when removed these shall not leave any opening in the boards.

**PAINTING**

Pre-treatment eight tank process on CRCA sheets or on line automatic spray system with oven for drying after Pre-treatment as per IS: 101-1988 effective temperature and concentration control. Powder coating of desired shade as per requirement. Paint thickness min. 60 micron

**CORROSION RESISTANCE**

Withstand 500 hrs of Salt Spray as per IS: 101-1988

**BUS BARS MAIN**

Aluminum E-91E grade, min. 53% IACS  
 Copper min 99% IACS (Tinned copper)  
 Configuration: Interleaved 2000A & above

Minimum clearances shall be:

Phase to Phase	32mm	
Phase to Neutral		25mm
Phase to earth	25mm	
Neutral to earth	25mm	

**BUS BARS EARTH**

As per material of main busbar of size suitable to withstand fault level specified / as required. Continues length of earth bus to be provided.

UPS Output Panels shall have two earth bars of tinned copper of suitable rating. One of the earth buses shall be dedicated i.e. mounted on insulated supports.

**BUS BAR TEMP. RISE**

Ambient 45°C  
 Maximum bus bar temperature rise 40° C over ambient  
 No deration of Switchgear & Panels upto 45°C

**BUS BAR SIZING / CROSS-SECTION**

Bus bars to be sized to carry the full rated load current without exceeding maximum temperature rise as limited above. Bus bar size calculations to be submitted with shop drawings. Busbars to withstand the maximum short circuit current as specified / as per requirement.

**BUS BAR SUPPORTS**

Non Hygroscopic Epoxy/SMC/Nylon 6.6 supports at suitable distance to withstand forces of short circuit as per requirement.

**BUS BAR INSULATION**

Black heat shrinkable, fire retardant, self extinguishing type sleeves suitable to withstand 110°C  
 Colour coding to be followed as per IS codes. Phase sequences and polarity to be followed as per IS codes.

### SHROUDING

All live parts should be shrouded with IP2 protection Fire Retardant, Non Inflammable, Non Hygroscopic e.g. Polycarbonate, FRP.

### BUS BAR SLEEVING

Heat shrinkable sleeves rated for minimum 110 deg C for one hour.

### HARDWARE

#### C. For Internal Connections of switch gear, bus bars & cables etc.

- High Tensile MS Alloy, Zinc coated, Grade 8.8 (Minimum 10 micron coating thickness). (Trivalent Plating CR3+).
- Salt Mist spray test with stand: 120 Hours duration.

1.	Steel Hardware		
	Salt mist spray withstand	:	120 Hours
	Bolt and nuts		
	Hardware quality	:	8.8
	According to	:	EN 20898, EN ISO 3506-1, 4759-1 (=S=FT30860)
	Contact Washers		
	Washer quality	:	8.8
	Class	:	160 HV
	According to	:	EN 20898, EN ISO 3506-1, 4759-1

Note: Contact washer to be fixed on both sides (Plain Washer & Spring Washer).

- D. For External Body & Enclosure Construction: High Tensile MS Alloy, Zinc Coated Grade 8.8 (minimum 10 micron coating thickness). (Trivalent Plating CR3+).

### PANEL COOLING / VENTILATION:

110V 1phase, heavy duty/ sturdy, panel ventilation fans to be employed, which shall be controlled by a thermostat. Or in VFD motor modules, module ventilation fan to be linked with VFD operation i.e. "On" operation of fan through relay contacts of the VFD, so that ventilation fan for VFD will be "On" only when the particular VFD is "On". Relay contacts of any VFD are suitable for 230V, so 110V will not be any problem.

### PANEL SPACE HEATING /CONDENSATION CONTROL:

230V or 415V space heaters with humidistat to be employed for moisture condensation control.

### WIRING

1100V Fire retardant, virgin PVC color coded flexible wire

Voltage circuit            1.5 sq mm

Current circuit            2.5 sq mm

Earth circuit              2.5 sq mm

As per IS: 694

### WIRING IDENTIFICATION

Computerized ferrule on both ends as per IS: 375

### TERMINAL BLOCK

Power - Melamine stud type.

Control - Polyimide color coded screw less clamp fit type.

Not more than one wire connected to one terminal block.

Plug in type terminal block at each transport section.

**COMPONENT LEGEND**

Computerized labels for all control component & terminal block

**FEEDER DESCRIPTION PLATES**

Powder coated Al. Plate with computerized printing, size:

MDB = 150 x 50 min

S/DB = 100 x 40 min

**SPARE FEEDERS**

It shall be as per B.O.Q. / SLD. If B.O.Q / SLD does not specify anything, than an average of 20% of a mix of various ratings / feeders to be provided as spare feeders in each board / panel. Spare feeders must include a minimum one biggest and a minimum of one smallest rated feeders as spares along with other spares.

**CABLING**

Provision for top/ bottom/ top & bottom entry of cables, as per requirement / as per site. Adequately sized cable chambers. Easy and safe termination & maintenance facility.

**BUS TRUNKING TERMINATION**

Wherever specified in B.O.Q power connection arrangement at top suitable for bus trunking.

**SWITCHGEAR**

As per specification & Makes specified. IS: 13947 I- IV, 1993

Only one make of switchgear to be used in a board/panel. The switchgear selection shall be as per manufacturer's co-ordination tables. Type 2 coordination to be achieved as a minimum.

**CONTROL MCB'S / MPCB'S**

For control and metering circuit/wiring, these shall be of fault level as required.

**CONTROL COMPONENTS**

As per specification & Makes specified. IS: 13947 I - IV, 1993

**INDICATING INSTRUMENTS**

Analog/Digital as per specifications, notes, B.O.Q. & Makes specified. IS: 13779

BMS compatible multifunction meters shall be complete with communication card, shall be net-workable and shall be wired on to common RS 485 Bus and information from these meters to BMS to be released at one point.

**INDICATING INSTRUMENTS ACCESSORIES**

CT/PT-Cast resin as per specifications & make specified. IS: 2705, 1992

**SPACE HEATER**

All ACB Incomer & bus couplers shall be provided with Space Heater & Thermostat & 11 watt panel illumination. Heaters shall be controlled by a 6A MCB / MPCB as per the required fault level.

**PLC'S FOR LOAD MANAGEMENT & INTERLOCKING OF BREAKERS:**

Use separate PLC's for Load management and for separate for interlocking of breakers and bus couplers and closing of bus couplers.

**SHOP DRAWINGS**

Notes, General arrangement, Elevations, Single line diagram, Bill of material, Control and inter locking scheme to be submitted for approval prior to manufacturing and approval taken from PMC / Consultant / Owner.

**TESTING & PRE-DISPATCH QUALITY CONTROL**

**A.** Fabrication, Pre-treatment, painting, assembly and wiring.

**B. Tests:**

- Physical, Electrical, and Operational tests of all Breakers / Switches.
- Operational check of all meters and relays.
- Dielectric strength test for insulation at 2.5kV for 1 sec.
- Insulation resistance test at 1000V megger,
- Protective measures and continuity of circuits, as per IS: 8623-I, 1993.
- Testing of protection relays by secondary injection kit before commissioning.
- Interlocking Function Test.
- Earth continuity test between various Non-current carryings parts of equipment steel work etc. & the earth bus provided in the panel.

**INSPECTION**

To be offered at works to PMC / Owner.

**TEST CERTIFICATE TYPE AND ROUTINE**

Test results for routine tests conducted at works should be submitted. Type tests as per IS: 8623 - Part I for Short circuit, Temperature rise, Degree of protection to meet the specifications and B.O.Q must be furnished.

**PACKING**

Wooden Crates/ Wooden Cases/ Polythene & Water proof paper to be used.

**AS MANUFACTURED DRAWINGS**

To be submitted in CD format with catalogues and test certificates of switchgear, controlgear and other components used within MDB & PDB.

**AFTER SALES SERVICE**

Manufacturer to have an Independent department to render after sales support for Installation, commissioning & trouble shooting during and after warranty period.

**OPERATING CONDITIONS:**

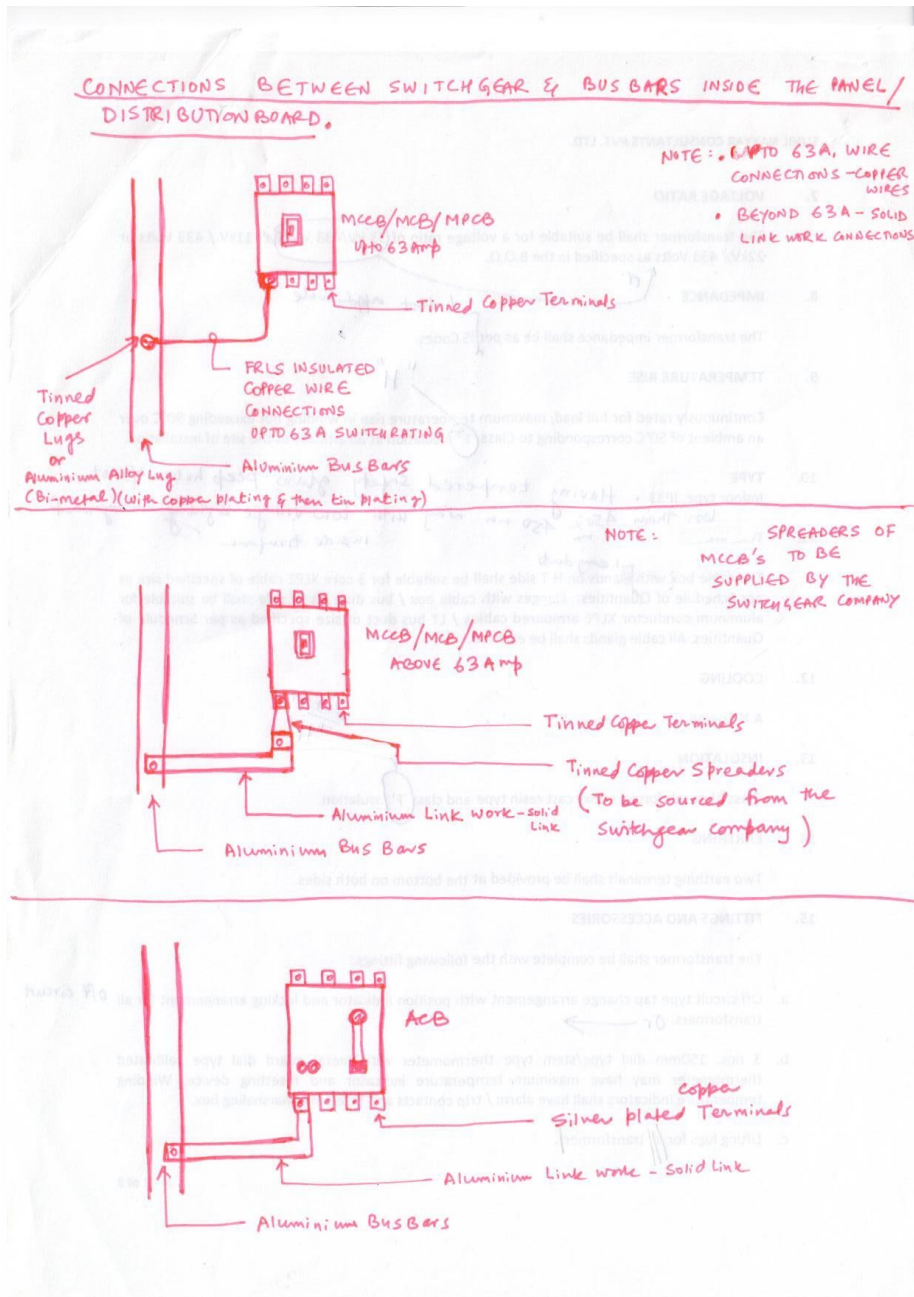
- No De-ration of panels, Switchgear/Equipment & Busbars upto 45 Deg. C & Altitude of 1000M above MSL for indoor panels.
- No De-ration of panels, Switchgear/Equipment & Busbars upto 50 Deg. C & Altitude of 1000M above MSL for outdoor panels / feeder pillars.

**CONNECTION BETWEEN BUSBARS & SWITCHGEAR**

- Upto 63Amp Switch rating with 1.1 KV grade FRLS PVC insulated flexible single core copper cables. Tinned copper or silver plated copper lugs shall be used on copper wires.
- Above 63Amp Switch rating, with solid aluminium / copper busbar links, to be used.
- Neutral Bus bars for four pole feeders shall be of the same size as phase.  
Neutral Bus bars for triple pole feeders shall be of 50% size of phase.  
Neutral Bus bars for UPS panels shall be of 200% size of phase.

**ROTARY HANDLES & LOTO FEATURES IN MCCB'S & MPCB'S:**

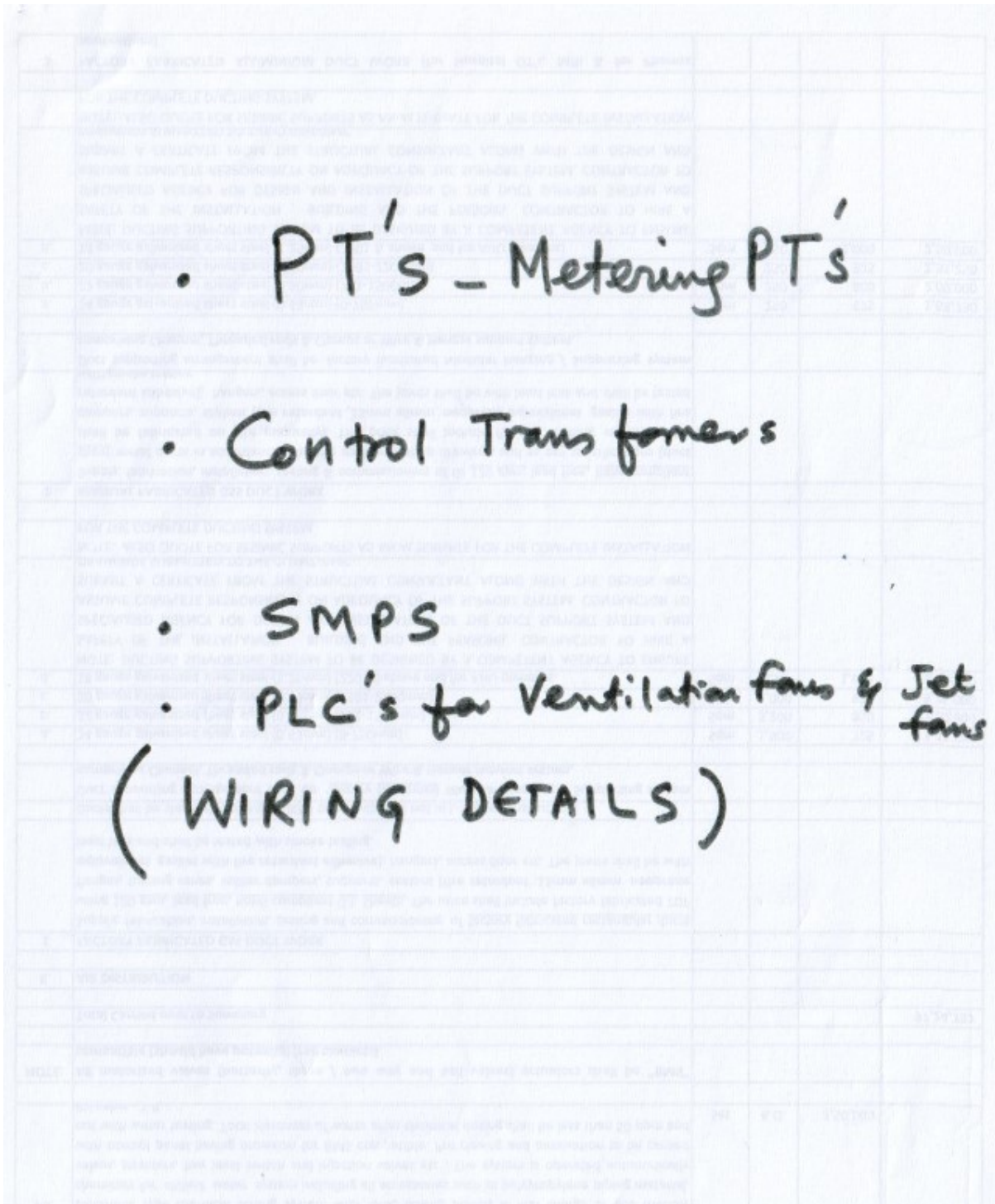
- ALL MCCB'S & MPCB'S SHALL BE WITH DIRECT / EXTENDED ROTARY HANDLES.
- ARRANGEMENT OF PAD LOCKING & FOOL PROOF LOTO (LOCKOUT & TAG OUT) TO BE AVAILABLE WITH ALL MCCB'S & MPCB'S FOR MAINTENANCE SAFETY REASONS ON MOTORS / EQUIPMENT.
- MAINTENANCE TEAM TO UTILIZE LOTO FEATURE BEFORE INITIATING ANY REPAIR / MAINTENANCE ON ALL ELECTRICAL EQUIPMENT / PUMPS / MOTORS / FANS / BLOWERS ETC.



23a. Construction Typology: Block set of Schneider /R2K of ABB if called for in the BOQ specifically.



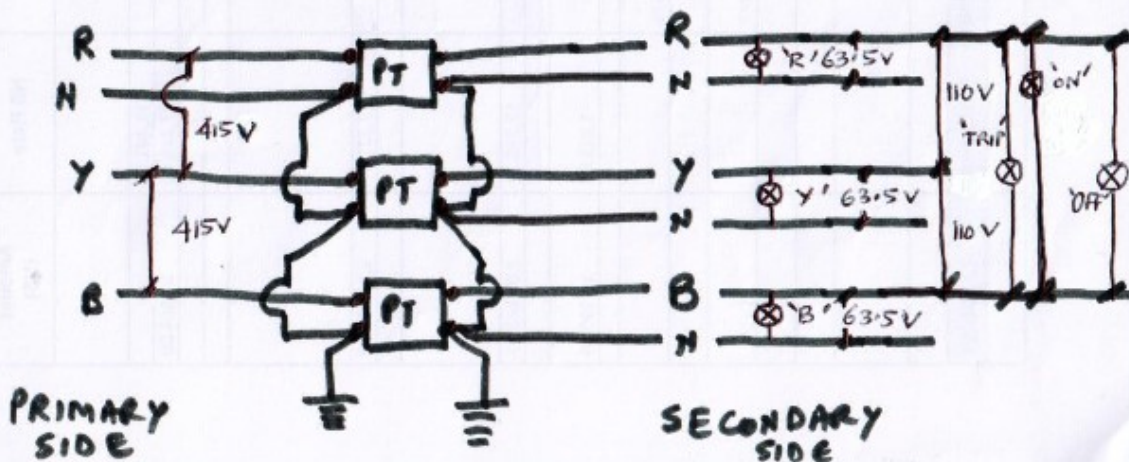
23b.



## 1. PT @ Panel's incomer: Metering PT

- $415\text{V}/\sqrt{3} \mid 110\text{V}/\sqrt{3}$
- 3 nos. Single Phase PT's.
- I put voltages : Primary side  
 Phase to Phase : 415V  
 Phase to Neutral : 230V
- Output Voltages : Secondary side  
 Phase to Phase : 110V  
 Phase to Neutral : 63.5V

- For :
- \* R, Y, B phase indication lamps : 63.5V (1 phase)
- \* MFM's : 3pl (110V)
- \* On/off/Trip indication lamps : 110V (2 phase)

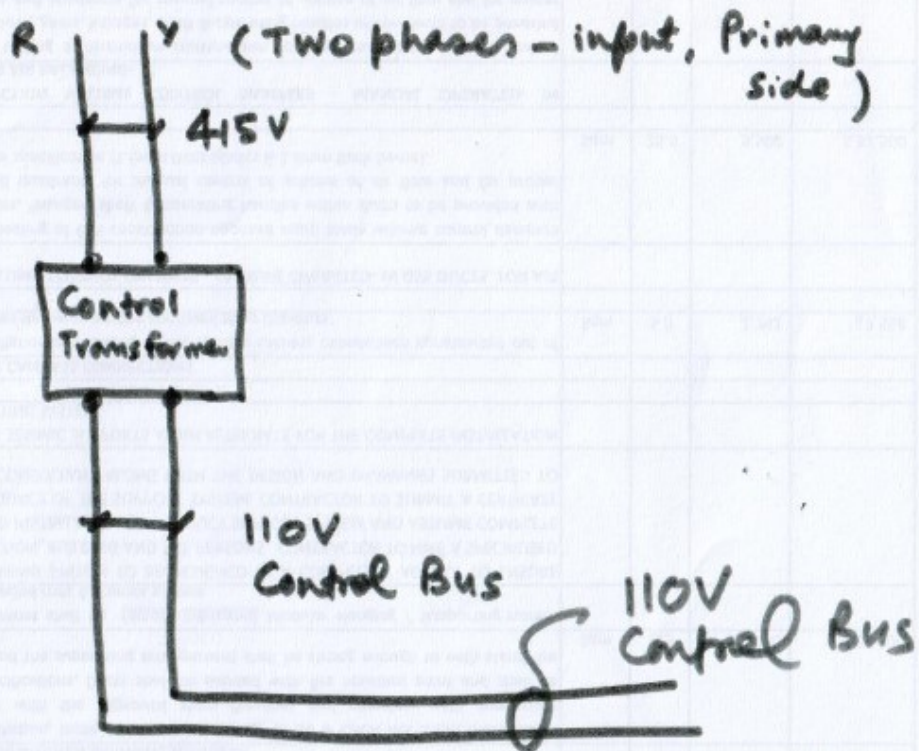




2. CONTROL TRANSFORMER : 415V (2Ph.) / 110V (1Ph.)

For : starter's / Contactor coils : 110V

: 'On', 'off', 'Trip' indication Lamps : 110V



- \* For 110V Contactors / starter coils
- \* For 'on' / off / Trip indications of feeders (outgoings) : 110V
- \* VFD module cooling fan : 110V
- \* Panel heaters : 110V





- v. Construction: Class 2
- vi. Insulation Material: Glass Mica tape as flame barrier + XLPE Insulation
- vii. Sheathing Material: Special Low Smoke Zero Halogen Compound
- viii. Armour: Galvanized Steel
- ix. Colour Codes: As per customer's requirement
- x. Fire test as per : BS 8491/ BS 8434-2/ BS EN 50200 , CWZ tests ( all three tests on one cable)
- xi. Low Smoke Emission: Light Transmittance > 60 % as per IEC 61034
- xii. Flame Retardant: As per IEC 60332
- xiii. Halogen Free: Acid Gas Less than 0.5 % as per IEC 60754
- xiv. Min. Bending Radius: 12 x O.D.
- xv. Suitable for 950°C for 3 hrs duty operation.

Fire Survival / Resistance circuit integrity armoured cable of 600/1000V rated with Copper Circular conductors having Glass Mica (Fire barrier) tape covered by crosslinked poly Ethylene insulation (XLPE) and LSZH as inner & outer sheaths. Basic design as per BS 7846 for copper cables, Should retain circuit integrity as per Category-3 of BS:8419 when tested in accordance to BS 8491 for power cables having overall diameter of 20mm and above & BS EN 50200 PH-120 for control cables having overall diameter less than 20mm. Type test reports of each lot from 3rd party inspection agency required prior to despatch. (Should be TUV/LPCB certified for required sizes)

The cables should meet circuit integrity at 1000 volts with simultaneous action of Fire, Impact & water on single sample when tested in accordance to BS 8491 & BS EN 50200 PH-120.

The cables should not emit toxic gases in case of fire. The toxicity index should be less than 3 (refer NES 713).

The cables should comply with the requirements of IEC-61034 Part 1&2 (Measurement of Smoke density of cables burning under defined conditions).

The cables should comply with the requirements of BS EN 60754 (Determination for amount of halogen acid gas content which shall not be greater than 0.5%)

Fire & type test reports of each lot from 3rd party inspection agency required prior to despatch.



## **5. CABLE LAYING AND HANDLING**

It should be ensured that both ends of the cable are properly sealed to prevent ingress / absorption of moisture.

## **6. CABLE HANDLING**

When cable drums have to be moved over short distance, they should be rolled in the direction of the arrow marked on the drum.

While removing cables, the drums shall be properly mounted on jacks or on a cable wheels or any other suitable means, making sure the spindle, jack etc. are strong enough to take the weight of the drum.

The cables shall not be given a sharp bend to a small radius. The minimum safe bending radius for all types of PVC/XLPE cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multicore cable shall not be less than 15 times its overall diameter.

Cable with kinks and straightened kinks, or with similar apparent defects like defective armoring etc. shall not be installed / laid.

Cables of different voltages as well as power and control cables should be kept in different trenches/racks with adequate separation. Where available space is restricted, LV/MV cable shall be laid above HV cables.

Where cables cross over cannot be avoided, the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

Installation of cables including jointing shall be carried out as per IS: 1255 amended and revised to date.

Power and communication cables shall, as far as possible cross at right angles. Where power cables are laid in proximity to communication cables, the horizontal and vertical clearances shall not normally be less than 60 cm.

Cables shall be laid direct in ground, in pipes / closed ducts, in open ducts or on surface depending on environmental conditions, and as required in schedule of quantities.

During the preliminary stages of laying the cable, consideration should be given to proper location of the joint position so that when the cable is actually laid, the joints are made in the most suitable places and as approved by Consultant. As far as possible, water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible places, ducts, pipes, racks, etc. shall be avoided.

The cable shall not in any circumstances be bent so as to form an abrupt right angle but must be rounded off at the corners to a radius not less than 12 times the overall diameter of the cable.

In case, where there are chances of any damage to the wiring/cables, such wiring/cables shall be covered with a sheet metal protective covering (not less than 16 SWG), the base of the covering being flush with the plaster or brickwork as the case may be, or the wiring /cables shall be drawn through a heavy gauge metal conduit pipe by complying with all the requirements of conduit wiring system.

Such protective covering shall, in all cases, be fitted on all down drops within 1.5 m from the floor or from floor level upto the switch board, whichever is less.

While cutting and stripping of the outer sheathing of the cable, care shall be taken that the sharp edge of the cutting instrument does not touch the inner insulation of the conductors. The protective outer covering of the cable shall be stripped off near connecting terminal and this protective covering shall be maintained upto close proximity of connecting terminals. The cables laid near junction boxes shall be made moisture proof with a plastic compound.

## **7. CABLE JOINTING & TERMINATION**

Jointing shall be as per the manufacturer's recommendations using standard kits. Cable joints shall be made in suitable, approved cable joint boxes, jointing of cables in the joint boxes and filling of compound shall be done as per manufacturer's recommendations. Heat shrinkable joints shall be made.

Cables shall be terminated onto the terminals of switchgear through crimping lugs of proper size and of heavy duty. Cable lugs shall be fitted onto the cable by crimping or compression jointing.

Continuity of cable armouring is to be maintained. Double compression glands to be used. Proper crimping tools to be used.

### **7a. CABLE GLANDS:**

Heavy duty Brass-Nickel plated Double compression glands to be employed for cable termination into the panels & boards.

See photos of glands as below:





- iv. Single compression gland, IP-68 rated, shall be used for flexible un-armoured copper cables.
- v. Double compression glands, weatherproof IP-67 rated, shall be used for all the armoured / un-armoured cables.
- vi. Double compression flame proof glands, IP-66 rated, shall be used for fire rated / fire survival cables.

**7b. CABLE LUGS & THIMBLES:**

Heavy duty lugs & thimbles to be employed for making cable & wire connections.

- Aluminium cables connection with aluminium bus bars shall be made with aluminium lugs / thimbles.
- Copper cables / copper wire connections with copper bus bars or with tinned copper witch gear terminations or with silver plated switchgear terminals shall be made with tinned copper lugs / thimbles.
- Copper cables / copper wire connections with aluminium bus bars shall be made with tinned copper lugs / thimbles or with bi-metal lugs / thimbles i.e. aluminium alloy lugs / thimbles with copper plating & then tinning.
- Hardware for cabling connections to panel's bus bars, to switch gear, to DB's and motors etc.: High tensile MS Alloy grade 8.8, Zinc coated (minimum 10microns coating). (Trivalent Plating CR3+).

Bolts, nuts & washers for cabling connections shall be:

1.	Steel Hardware		
	Salt mist spray withstand	:	120 Hours
	Bolt and nuts		
	Hardware quality	:	8.8
	According to	:	EN 20898, EN ISO 3506-1, 4759-1 (=S=FT30860)
	Contact Washers		
	Washer quality	:	8.8
	Class	:	160 HV
	According to	:	EN 20898, EN ISO 3506-1, 4759-1

Note : double washers to be employed. (plain and spring washers).

## **8. TRENCHING & CABLE LAYING**

The minimum width of trench shall be 45 cm and depth shall be 75cm for laying of cable. Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the minimum gap between the cables is one diameter of the cable unless specified otherwise.

The clearance between axis of the end cables and the sides of the trench shall be minimum 1.5 D (diameter) of the end cable.

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided.

Where gradients and changes in depth are unavoidable, these shall be gradual.

The bottom of the trenches shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 9 cm in depth.

Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 20 cms. above the base cushion of sand before the protective cover is laid.

In the case of vertical multi-tier formation, after the first cable has been laid, a sand cushion of 30 cms shall be provided over the initial bed before second tier is laid. If additional tiers are formed, each of the subsequent tiers shall have a sand cushion of 30 cms as stated above. The top-most cable shall have final sand covering not less than 17 cms before the protective cover is laid.

Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20 cm x 10 cm x 10 cm (nominal size) as per CPWD building specification, or protection covers placed on top of the sand, (brick to be laid breadth wise) for the full length of the cable to satisfaction of the owner. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5 cm over the sides of and cables.

The trenches shall be then back filled with excavated earth free from stone or other sharp-edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm. Unless otherwise specified, a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of earth, however, should not exceed 10 cms.

Where road bends or lawns have been cut or kerb stones displaced, the same shall be repaired to the satisfaction of the architect and all surplus earth or rock removed to places as specified.

In locations such as road crossing, entry to building in paved areas etc. cables shall be laid in pipes or closed ducts.

All cable entry/exit points into the building through pipe sleeves shall be properly sealed with water and fire safe sealants in an approved manner to avoid any seepage of water into the building.

Manholes of adequate size, as decided by the Architect, shall be provided to facilitate of adequate strength feeding/drawing in of cables and to provide working space for persons. Suitable manhole covers with frame of proper design shall cover Manholes.

CABLE LOOPS: Sufficient cable loop length shall be left at both ends.

## 9. CABLES ON HANGERS OR RACKS / TRAYS

The contractor shall provide and install all iron hangers racks, or racks with die-cast cleat, with fixing rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides ceiling and other concrete structures, the contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good the damages as required.

The hangers or racks shall be designed to leave at least 25 mm clearance between the cables and the face to which it fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 500 mm intervals. These shall be designed to keep provision of some spare capacity for future development. Minimum spacing between the cables shall be one diameter of the cable or as specified.

### **Cable Clamps , saddles and screws :**

Cable fixing clamps, saddles & screws on trays / walls / slabs	<u>Indoor Application:</u> <ul style="list-style-type: none"> <li>• Aluminium</li> <li>• Readymade type clamps or Made from 20mm x 3mm aluminium sheet / strips.</li> <li>• 8mm SS-304 Screws for cable size 90mm<sup>2</sup> and above.</li> <li>• 6mm SS-304 Screws for cable size less than 90mm<sup>2</sup>.</li> </ul> <u>Outdoor Application:</u> <ul style="list-style-type: none"> <li>• SS-304</li> <li>• Clamps Made from 20x1.8mm SS-304 sheet / strips.</li> <li>• 8mm SS-304 Screws for cable size 90mm<sup>2</sup> and above.</li> <li>• 6mm SS-304 Screws for cable size less than 90mm<sup>2</sup>.</li> </ul>
Clamps spacing	<ul style="list-style-type: none"> <li>• 600mm C/C in vertical fashion in shaft on vertical trays.</li> <li>• 1000mm C/C on horizontal tray or cable racks.</li> </ul>

## 10. TESTING OF CABLES

The Megger value in normal dry weather shall be 50 mega ohm for 1.1 KV grade cable. Cables shall be tested at works for the following tests before being dispatched to site by the project team:

- a. Insulation Resistance Test.
- b. Continuity resistance test.

- c. Sheathing continuity test.
- d. Earth test.(in armoured cables)
- e. Hi Pot Test.

Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner's site representative:

- a. Insulation Resistance Test( Sectional and overall)
- b. Continuity resistance test.
- c. Sheathing continuity test.
- d. Earth test.

All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the PMC / Owner representative.

## **11. CABLE TAGS**

Cable tags shall be made out of 2mm thick aluminum sheets. Each tag shall be 2" in dia or 3" x 3" square with one hole of 2.5mm dia, 6 mm below the periphery, or as approved by Consultant. Cable designations are to be punched with letters / number punches and the tags are to be tied to cables with piano wires of approve quality & size. Tags shall be tied inside the panels beyond the glanding as well as above the glands at cable entries. Along trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 meters.

Cables shall be secured to cable trays with 3mm thick x 25mm wide aluminum strips/suitable GI clamp, or as approved by Consultant, at 1000 mm intervals and screwed by means of rust proof screws, washers and bolts, of adequate but not excessive lengths. Cable trays for horizontal runs suspended from the ceiling will be supported with mild steel straps or brackets, at 1000 mm intervals and the overall tray arrangement shall be of a rigid construction. External cabling route marker with GI plate marked with "DANGER 1.1 kV CABLE" with 1 meter long GI angle iron grouting bracket including 1:3:6 ratio cement concrete base block of minimum size 200 x 200 x 350 mm to be provided or as approved by Elect. Supply Company.

## **12. CABLE TRAY**

- d) The MS cable trays should have undergone rigorous rust proofing process, which should comprise of alkaline, degreasing, descaling in diluted sulphuric acid and a recognized phosphating process. The sheet work shall then be given two coats of oxide primer before two coats of final painting. Cable trays & tray supports shall be either painted (Stove enameled) or hot dip galvanized as called for in the schedule of quantities.
- e) Cable trays shall be complete with bends, joints, coupler plates and accessories as may be required for joining the cable trays.
- f) Cable trays shall be either perforated or ladder type as called for in the schedule of quantities.

### 13. PERFORATED CABLE TRAYS

Standard Technical details of perforated cable tray shall be as follows:

S. No.	SIZE OF TRAY (Width)	THICKNESS & COLLAR HEIGHT
1.	150mm to 450mm width	2mm thick & 50mm collar
2.	600mm to 750mm width	2mm thick & 50mm collar
3.	900mm to 1200mm width	3mm thick & 50mm collar

**Note: Supports shall not be charged extra. It shall be considered to be included in the rate of the tray.**

### 13. LADDER TYPE CABLE TRAYS

Standard technical details of ladder type cable trays shall be as follows:

S. No.	SIZE OF TRAY	SIZE OF MAIN CHANNEL OR RUNNER	SIZE OF RUNG & SPACING	CABLE TRAY SUPPORT
1.	900mm to 1500mm	25 x 100 x 25 x 2.5mm	20 x 50 x 20 x 2.5mm @ 250 C/C	50 x 50x 5mm angle @ 1000mm spacing.
2.	450mm to 750mm	20 x 75 x 20 x 2.0mm	20 x 50 x 20 x 2mm @ 250 C/C	40 x 40 x 5mm angle @ 1250mm spacing.
3.	150mm to 300mm	20 x 75 x 20 x 2.0mm	15 x 35 x 15 x 2mm @ 250 C/C	40 x 40 x 3mm angle @ 1500mm spacing.

Hangers shall be minimum 10mm dia GI Round bar.

Fixing /supporting arrangement shall be as approved by the Consultant / Owner / PMC

Hardware to be used in cable tray system shall be hot dip galvanized.

**Note: Supports shall not be charged extra. It shall be considered to be included in the rate of the tray. All structural steel shall be according to the latest revision of IS: 226 & 808.**

**a. Quality of Zinc**

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1992.

**b. Coating Requirement**

Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs; rust stains bulky white deposits, blisters.

Mild steel flats / wires shall undergo a process of degreasing, pickling in acid, cold rinsing and then galvanizing.



**14. CABLE TRAY SUPPORT / INSTALLATION SYSTEM:**

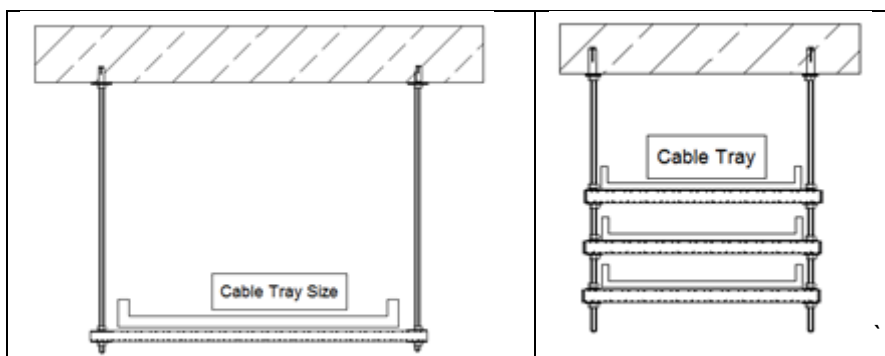
**14.1 FACTORY FABRICATED MODULAR SUPPORTING SYSTEM:**

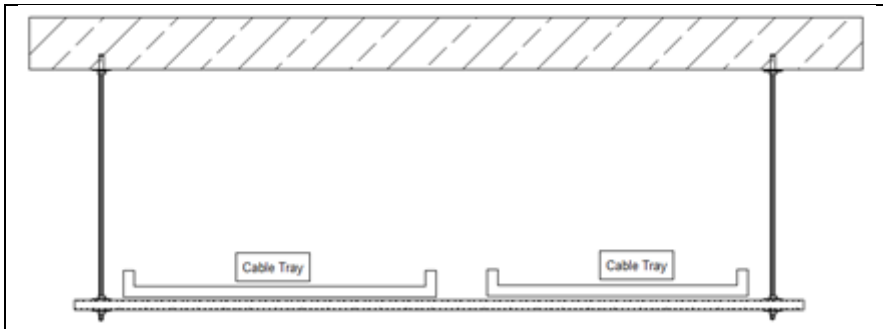
**f. Cable tray support from RCC slab**

Description
The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b>
The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b> .
The Threaded Rods used for the suspension of the Cable tray should be made up of partially annealed medium carbon steel of grade <b>4.8 strength class and as per DIN 976 standard</b> .
The Drop-in anchors used for the suspension of the rods should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.

Supporting DETA(European Technical Approval)ils for Cable Trays is given below			
Cable Tray Size	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig p. Typical Arrangement for cable tray support From RCC slab



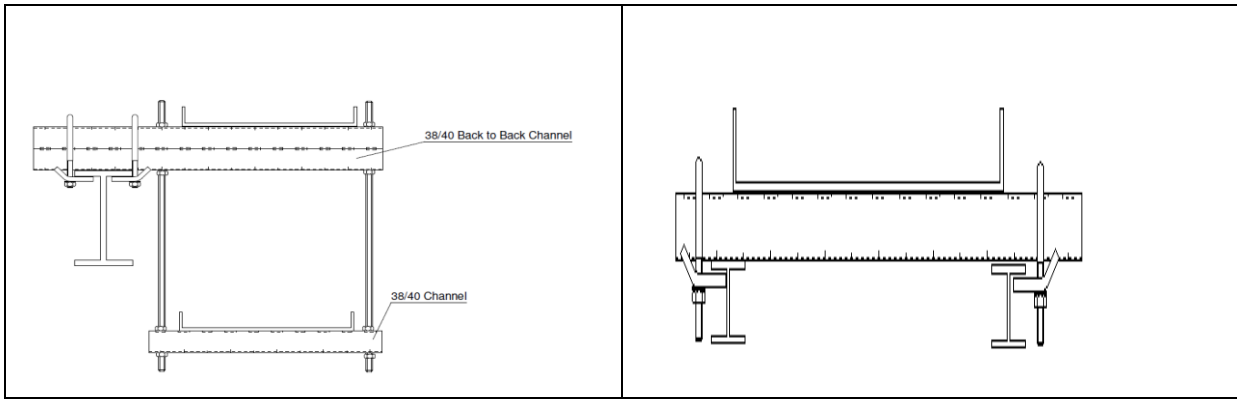


**g. Cable tray support from PEB Structure:**

Description
<p>The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b></p> <p>The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.</p> <p>The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b>.</p>
<p>The Threaded Rods used for the suspension of the Cable tray should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b>.</p> <p>For parallel to beam application. The Girder cleat for attachment of support channel to steel girder Girder cleat should be <b>Vds approved</b>.</p> <p>For perpendicular to beam application The Girder clamp for suspension of threaded pins and threaded rods for support channels. Girder clamps should be <b>FM and Vds Approved</b>.</p>
<p>The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.</p>

<b>Supporting DETA(European Technical Approval)ils for Cable Trays is given below</b>			
Cable Tray Size	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig q. Typical Arrangement for cable tray support From PEB structure

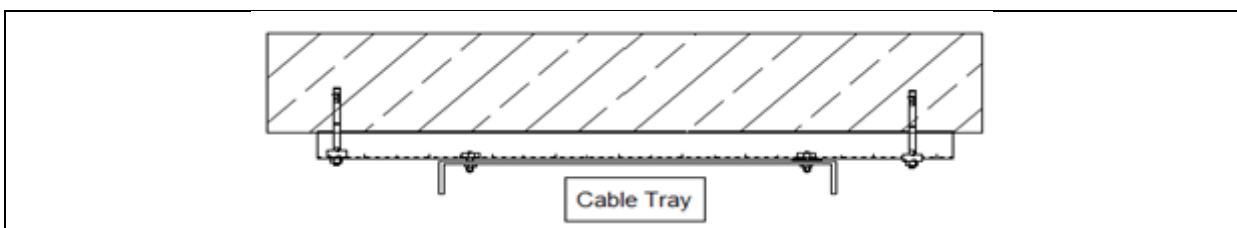


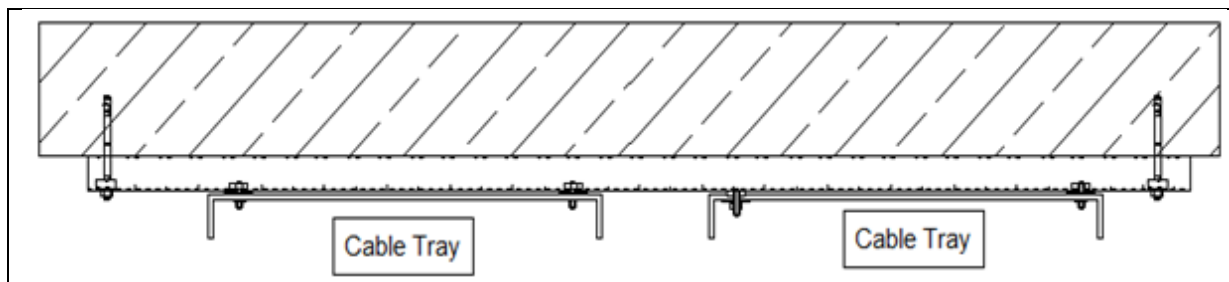
**h. Cable tray support from Building shaft**

Description
The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b>
The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b> .
The Threaded Rods used for the Channel fixing with shaft that should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b> .
The Drop-in anchors or stud anchor used for channel fixing with shaft that should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.

Supporting DETA(European Technical Approval)ils for Cable Trays is given below			
Cable Tray Size	Support Channel mm	Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig r. Typical Arrangement for cable tray support from building shaft



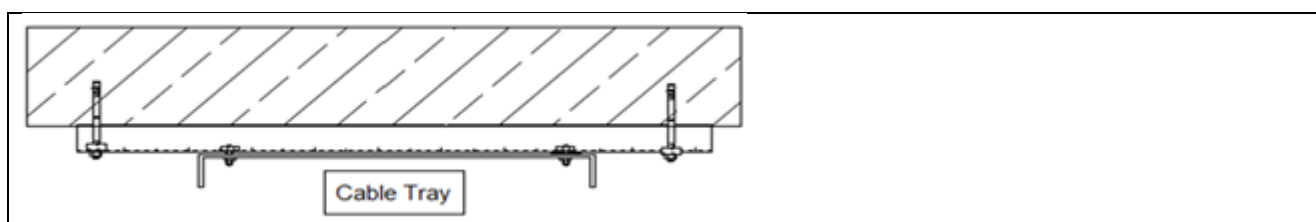


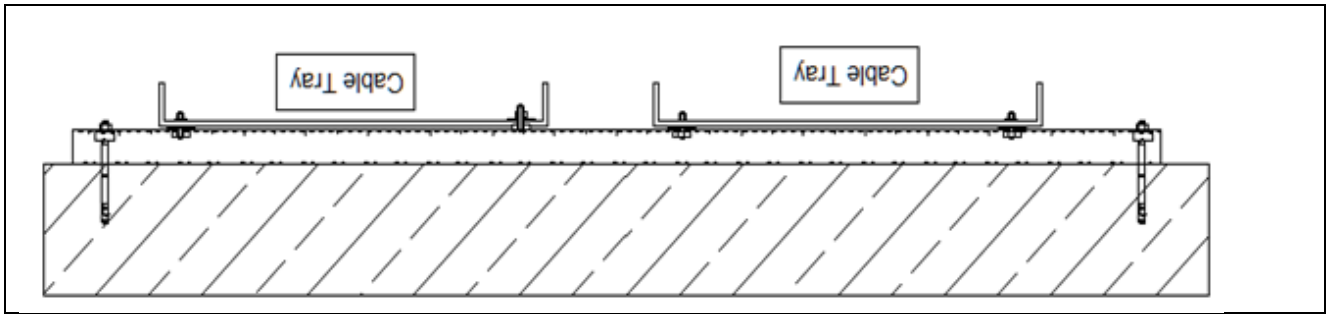
**i. Cable tray support from on terrace**

Description
The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b>
The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b> .
The Threaded Rods used for the Channel fixing with terrace that should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b> .
The Drop-in anchors or stud anchor used for channel fixing with terrace that should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.

Supporting DETA(European Technical Approval)ils for Cable Trays is given below			
Cable Tray Size	Support Channel mm	Vertical Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig s. Typical Arrangement for cable tray support from building terrace



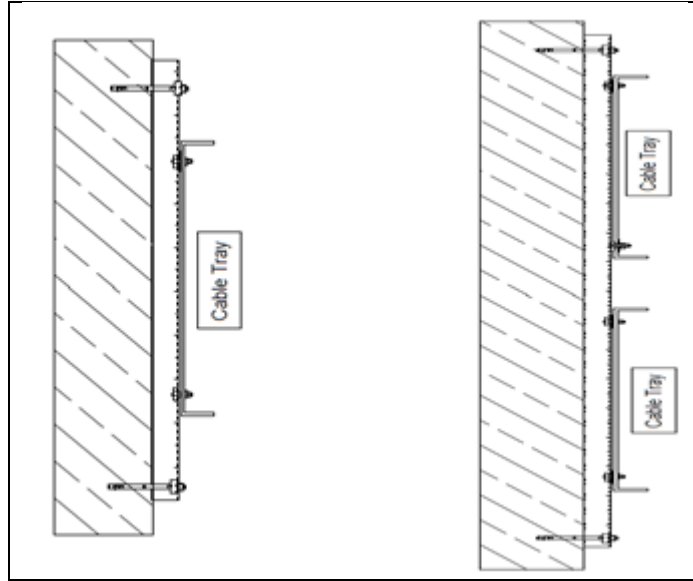


**j. Cable tray support from Building shaft**

Description
The Cable tray should be simply supported by Support Channel made up of cold rolled steel of quality <b>DX51 or greater and as per EC3(Eurocode 3) or DIN EN 1993-1-1</b>
The Support channel should be pre-galvanised with minimum <b>GSM of 275</b> and should have universal mounting slot on the front of the rail for accurate positioning of fasteners and system compatible <b>round and long holes</b> on back of the rail.
The Mounting according to static requirements should undertake into account the manufacturer's documents and should be monitored according to <b>RAL - GZ 655-C</b> .
The Threaded Rods used for the Channel fixing with wall that should be made up of partially annealed medium carbon steel of <b>grade 4.8 strength class and as per DIN 976 standard</b> .
The Drop-in anchors or stud anchor used for channel fixing with Wall that should be <b>ETA(EUROPEAN TECHNICAL APPROVAL) with CE mark</b> for cracked and un-cracked concrete. It should be divided into four expansion segments for uniform pressing force distribution in the borehole.
The load calculations should be as per Finite Element Method for the selection of the channels for suitable size of the Cable tray and should be provided by the contractor to the consultant for verification.

Supporting DETA(European Technical Approval)ils for Cable Trays is given below			
Cable Tray Size	Support Channel mm	Rod Dia mm	Maximum Spacing between supports mm
Upton 450 mm	27x18x1.2	M8	1500
451 - 600 mm	38x24x2	M10	1500
601 - 1200 mm	38x40x2	M10	1500
1201 mm and above	40x60x3	M12	1500

Fig t. Typical Arrangement for cable tray support from wall



## 14.2 SEISMIC RESTRAINTS & SEISMIC ISOLATION FOR ELECTRICAL SERVICES & EQUIPMENTS:

### 1.0 INTRODUCTION:

This Structural Design Basis Report's intent is to provide general guidelines for the Seismic Analysis and Structural design of MEP distribution & equipment supporting system.

### 2.0 SCOPE:

Seismic Analysis/Calculations shall be carried out based on NBC 2016 Part 6 Section 1. References from NBC 2016 Part 6 Section 1 are taken for seismic forces, SMACNA Seismic restraint manual for seismic bracing requirements.

Exceptions for Seismic supports as stated in ASCE7-05, SMACNA seismic restraint manual are to be considered.

### 3.0 DESIGN LOADS:

#### 3.1. DEAD LOADS

Dead load shall be in accordance with weight of materials and equipment to be followed as per IS875 (Part 1):1987

Materials	Unit weight (kN/m <sup>3</sup> )
Reinforced Cement Concrete	25
Structural steel	78.5

#### 3.2. SUPERIMPOSED DEAD LOAD

The super imposed dead load is to be assessed based on the weight of the MEP equipment / distribution system. For pipes containing water, weight of the water filled pipe is included in this load case.

### 3.3. EARTHQUAKE LOAD

Following parameters are to be considered for estimation of seismic forces in accordance with NBC 2016 Part 6 Section 1.

Appropriate references from ASCE 7-05 Chapter 13 is to be considered  
As per NBC 2016 Part 6 Section 1, following parameters are to be considered

Seismic zone - as per NBC 2016 Part 6 Section 1 Annexure K Clause 5.3.4.2  
Seismic zone factor, Z - as per NBC 2016 Part 6 Section 1 Annexure K Clause 5.3.4.2

Seismic Design Force is to be calculated as per NBC 2016, as follows

$$F_p = Z/2 (1+x/h) (a_p * I_p/R_p) W_p \geq 0.10 W_p \text{ (As per NBC 2016 Part 6 Section 1 Clause 5.3.4.2)}$$

Where,

Z = seismic zone factor given in Table 42 (Clause 5.3.4.2). Zone factor for some important towns are given at NBC 2016 Part 6 Section 1 Annexure K;

$I_p$  = importance factor for the corresponding services; when not specified, the minimum values of  $I$  shall be,

- a) 1.5 for critical and lifeline services;
- b) 1.2 for business continuity services; and
- c) 1.0 for the rest.

$R_p$  = response reduction factor for the corresponding services (As per table 13.6-1 in ASCE 7-05)

$S_a/g$  = design acceleration coefficient for different soil types (As per NBC 2016 Part 6 Section 1 Clause 5.3.4.2)

## 4.0 ANALYSIS METHOD

Linear static analysis is to be considered for gravity loads. Equivalent static method is to be considered for Earthquake loads.

## 5.0 DESIGN METHODOLOGY

The MEP equipment / distribution supporting structural steel system shall be designed according to Limit state method as specified in IS: 800-2007. Appropriate loads and its combinations, as per relevant clauses in IS codes for the most unfavorable effects are chosen for design. Based on equipment selection seismic support for the same will be provided in the shop drawings.

## 6.0 LOAD COMBINATION

The various loads are to be combined in accordance with the stipulations in IS 875 (Part 5): 1987 and NBC 2016 Part 6 Section 1.

Load combinations to be considered in design are as follows,

Type	Load Case	Load Details
Primary	1	Dead Load-DL
Primary	2	Superimposed dead Load at Terrace- SIDL
Primary	3	Earthquake Load along X-Direction EQ(+X)
Primary	4	Earthquake Load along Z-Direction EQ(+Z)
Primary	5	Earthquake Load along Y-Direction EQ(+Y)

### 6.1 LOAD FACTOR FOR DESIGN

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL	SIDL	EQ	DL	SIDL	EQ
DL+SIDL	1.5	1.5	—	1	1	—
DL+SIDL±EQ	1.5 or 0.9*	1.5 or 0.9*	1.5	1	1	1

Where,

\* This value is to be considered when stability against overturning or stress reversal is critical.

### FACTORED LOAD COMBINATION:

Factored Load Combination Equation					
Comb	DL	SIDL	Eqx	Eqy	Eqz
201	1.5	1.5	0	0	0
202	1.5	1.5	1.5	1.5	0
203	1.5	1.5	1.5	-1.5	0
204	1.5	1.5	-1.5	1.5	0
205	1.5	1.5	-1.5	-1.5	0
206	1.5	1.5	0	1.5	1.5
207	1.5	1.5	0	1.5	-1.5
208	1.5	1.5	0	-1.5	1.5
209	1.5	1.5	0	-1.5	-1.5

## 7.0 MATERIALS:

### 7.1 Structural Steel:



Sl. No	Materials	Specifications	Grade
1	Hot-Rolled Members		
	ISMC Channels	IS: 2062	Fy = 24.5 kN/cm <sup>2</sup>
	Angles	IS: 2062	Fy = 24.5 kN/cm <sup>2</sup>
2	Bolts & Nuts	IS: 1367	Grade 4.6
3	Anchor fasteners	Expansion	Grade 8.8

## 7.2 Seismic Wire Rope Kit:

Wire based seismic restraint system shall be used to restraint/brace all cable trays, rising mains and bus ducting.

Wire based seismic restraint kits consist of Break strength certified, pre-stretched seismic cable with a permanently fixed 45 degree eyelet or ferruled copper/copper plated loop fixed to single, double or retrofit seismic bracket, or any other end fixture type or size as per manufacturers recommendation and design. The end fixing, bracket and wire must be of the same manufacturer. The system should be secured and tensioned with a Seismic rated self-locking grip at the other end.

Only wire seismic restraints supplied and/or approved, shall be used with the system, the wire rope should not have colour coding applied to it and should only be supplied with separate colour coded tags.

Wire based Seismic restraint system has to be independently tested/certified/approved by UL/ UL NEBS and OSHPD for seismic application.

For seismic applications, seismic rated / approved products shall be used.

Cables shall have colour coded size identifiers as per seismic requirements.

The seismic cable used must be pre-stretched and conform to local / State / Provincial requirements for seismic restraints.

Cables shall be suspended 45 degrees (+/- 15 degrees Engineers allowances)

At the point of the seismic restraint installation, a ridged support is required (threaded rod + rod stiffener or appropriate as approved by a qualified engineer).

The location of all of all of the seismic restraint points shall be determined by a qualified engineer.

When attaching the seismic restraints to the slab/structure seismic rated anchor shall be used.

The seismic product to be used shall be determined by a qualified engineer, based on data supplied by the manufacturer.

The contractor shall select the seismic bracket for the attachment to the 'service' as either a standard or retrofit bracket. All parts and materials shall have been fully tested to conform to local/ state/provincial requirements and codes. The same manufacturer shall supply all parts and materials

The designer/contractor shall select the correct specification of wire based seismic restraints to use for restraining/bracing particular services mentioned in this specification; approved concrete anchors must be used by the designer/contractor. Refer to Table 1 below. Each size is designated with maximum system design strength with a minimum safety factor of 1.5:1.

The Seismic engineer shall select the correct length of wire rope required to restrain/brace the various services & applications. No in-line joints should be made in the rope.

Table 1:

<b>Wire based seismic restraint Safe Working Loads</b>	
<b>Kit Type</b>	<b>Design Strength (LRFD) (lbs)</b>
Type 1	350 lbs
Type 2	1050 lbs
Type 3	2100 lbs
Type 4	3800 lbs

All Seismic restraints must comply with manufacturer's load ratings and recommended installation procedures.

### 7.3 Threaded Rod:

<b>Size</b>	<b>Threaded Rod Diameter (mm)</b>	<b>Allowable Working Load (kN)</b>	<b>Allowable Working Load (kgs)</b>	<b>Max Unbraced Rod Length (mm) Table 7-5 ASHRAE Seismic Manual</b>
M10	10	2.7	275.23	457
M12	12	5	509.68	635
M 16	16	8	815.5	584
M 20	20	12	1223.24	610
M 22	22	16.7	1702.34	660

### 7.4 Rod Stiffeners:

Rod stiffener consisting of steel channel and attachment clips capable of bracing vertical suspension rods or made out of Polypropylene to avoid potential buckling due to vertical compression forces should be used. Braces shall be selected to be of sufficient strength to prevent support rod buckling. Brace shall be attached to the vertical suspension rod by a series of attachment clips.

## 8.0 SERVICABILITY REQUIREMENTS:

### 8.1 Deflection:

Deflection Limitations shall be as per Cl.23.2 of IS800:2007

## 9.0 DESIGN STANDARDS

The relevant Indian Standard Codes as given below and reference from design standards to be followed for Structural analysis & design:

S.No.	Code	Description
1	IS:875(Part-1)-1987 (Reaffirmed – 2003)	Code of Practice for Design Loads (Other than Earthquake)for Buildings and Structures - Unit Weights of Buildings Materials and Stored Material
2	IS:875(Part 5)-1987 (Reaffirmed – 2003)	Code of Practice for Design Loads (Other than Earthquake)for Buildings and Structures - Special Loads and Load Combinations
3	IS:1893-2002 (Part-1) (Reaffirmed – 2007)	Criteria for Earthquake Resistance Design of structures- General provisions and buildings
4	IS800: 2007	General construction in steel
5	IS456: 2000	Plain and reinforced concrete – Code of practice
6	NBC 2016	National Building Code 2016 Vol 1 & Vol 2
7	ASCE 7-05	Minimum design loads for buildings and other structures (Reference)
8	SMACNA Seismic restraint manual – 2003 Edition	association – Seismic restraint manual Guidelines for Mechanical system (Design intent)
9	ASHRAE Practical Guide to SEISMIC RESTRAINT- 2nd Edition	American Society of Heating,Refrigeration and Air Conditioning Engineers.
10	NFPA 13: 2013	Standard for the installation of Sprinkler system (Design intent)
11	IS2062	Specification for hot rolled low, medium and high tensile structural steel
12	IS808	Dimensions for hot rolled steel beam, column, channel and angle sections
13	IS1367	Technical supply conditions for threaded steel fasteners – Part 3 Mechanical properties of fasteners made of carbon and alloy steel – Bolts, screws and studs
14	IS5624	Foundation bolt specification
15	ETAG 001	European technical approval guideline – Metal anchors for use in concrete
16	ETAG 020	European technical approval guideline – Plastic anchors for use in concrete and masonry for non-structural application

## 10. Seismic bracing Design:

Equipment supporting system is to be analyzed for seismic forces as per NBC 2016 Part 6 Section 1 and design intent of SMACNA seismic restraint manual - Guidelines for Mechanical system; ASCE 7-05 Chapter 13 is used as a reference to calculate the seismic forces; ASHRAE Practical Guide to Seismic Restraint.

## 10.1 Project Design Criteria:

Description	Values	Standard
Seismic Zone		NBC 2016 Part 6 Section 1
Seismic Zone factor		NBC 2016 Part 6 Section 1
Spectral acceleration, short period (Sds)		NBC 2016 Part 6 Section 1
Soil Site class		NBC 2016 Part 6 Section 1
Importance Factor (Ip)		NBC 2016 Part 6 Section 1
Component response modification factor (Rp)		ASCE 7-05, Table 13.6-1
Component response modification factor (Rp) for base isolation		ASCE 7-05, Table 13.6-1

### For Calculations:

Description	Formula
Seismic Design force In horizontal direction (Fp')	
Vertical seismic force (Eqy')	

### Considering the exceptions & critical design basis given in SMACNA/ASHRAE seismic restraint manual for Electrical:

1. The supports shall be designed to handle the load and additional supports shall be provided, to take into account seismic consideration, as per seismic design. The support material should be galvanized steel/aluminium and facilitate ease of installation at site using alternatives such as fully threaded rod/angle section/wire support systems. Test Strength of the system should be adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed and shall also have adequate in-built safety factor. The wire based supporting system should only be used with self-locking lock, unlocking mechanism should not be an integral part of the self-locking lock for safety purpose.
2. Design supports for multiple raceways/cable trays/bus bars capable of supporting combined weight of supported systems and its contents.
3. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
4. Seismic braces being used shall be UL/UL NEBS approved for seismic application and arranged so that they limit motion of the equipment in all directions. Threaded rods/Angle/Channels supporting equipment/cable trays should be designed to resist vertical seismic loads and support equipment.
5. Sway braces should be arranged so that they limit motion of the equipment in all directions. Threaded rods supporting equipment/cable trays should be designed to resist vertical seismic loads and support equipment.
6. For  $I_p=1$  electrical distribution system weighing 5 lb/ft (7.45 kg/m) or less and flexible connectors are provided between the component electrical distribution system are exempted. Trapeze assemblies are used to support electrical distribution systems and the total weight of the system supported by trapeze assemblies is less than 10 lb/ft (146 N/m) are exempted.
7. Bracing the duct with cables keeps the maximum tension on the support rod to a minimum. Thus, only cable bracing should be used.
8. Cable tray (or conduits) is suspended by rod hangers 12" or less in length from top of conduit to supporting structure bottom or Cable tray suspended by trapeze support 12" or less in length from top of trapeze to supporting structure bottom are exempted.
9. All runs must have minimum two transverse and one longitudinal brace.
10. Transverse restraint for one run may also act as a longitudinal restraint for a run connected perpendicular to it, if the restraint is installed within 24 in. (610 mm) of the turn or combined stresses are within allowable limits.
11. Longitudinal braces shall be allowed to act as transverse braces if they are within 24 in. (610 mm) of the centreline of the cable tray braced laterally.

12. Conduit/Cable Tray greater than 2 1/2 in. (63.5 mm) trade size and attached to panels, cabinets, or other equipment and subject to seismic relative displacement must be provided with flexible connectors or designed for forces and displacements.
13. Light fixtures, lighted signs, and ceiling fans not connected to duct or pipe, where supported by chains or otherwise suspended, are not required to be braced for seismic if the support is designed for 1.4 x dead load and an equivalent simultaneous horizontal load. Failure cannot cause the failure of an essential component and the connection must allow a 360 degree motion.
14. The selection and installation has to be done as per Seismic design standards.

**NOTE: CABLE TRAY SUPPORTING SYSTEM TO BE DESIGNED BY A COMPETENT AGENCY TO ENSURE SAFETY OF THE INSTALLATION, BUILDING AND THE PERSONS. CONTRACTOR TO HIRE A SPECIALISED AGENCY FOR DESIGN AND INSTALLATION OF THE CABLE TRAY SUPPORT SYSTEM AND ASSUME COMPLETE RESPONSIBILITY ON ADEQUACY OF THE SUPPORT SYSTEM. CONTRACTOR TO SUBMIT A CERTIFICATE FROM THE STRUCTURAL CONSULTANT ALONG WITH THE DESIGN AND DRAWINGS SUBMITTED TO THE CLIENT/PMC.**

**C. EARTHING****1. SYSTEM OF EARTHING**

The system shall be TNS with 4 wires supply system (R, Y, B, N and 2 Nos. E) brought from the main LT Panel.

All non-current carrying metal parts of the electrical installation shall be earthed as per IS: 3043 – 2018 with latest amendment. All metal conduits, cable sheath, switchgear, DB's, light fixture, equipment and all other parts made of metal shall be bonded together and connected to earth electrodes. Earthing shall be in conformity with provisions of rules 32, 61, 62, 67 and 68 of Indian Electricity Rules, 1956.

All earthing conductors shall be of high conductivity copper or GI, as specified in the schedule of quantities & shall have protection against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor.

Main earthing conductors shall be taken from the earth connections at the main L T panel to an earth electrode with which the connection is to be made. All joints in tapes shall be with S.S. Straight through or cross connectors or copper brazing in case of copper tapes and by Exothermic welding or bolting or S.S. connectors (straight through or cross connectors) in case of GI tapes. Wires shall be connected with suitable crimping lugs, all bolts shall have plain and spring washers spring washers. Sub- mains earthing conductors shall run from the main distribution panel to the sub distribution panel. Final distribution panel earthing conductors shall run from sub-distribution panel.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed.

- a. All Lighting fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with copper wire as specified in schedule of quantities. The earth wire ends shall be connected with solderless/bottle type copper lugs.
- d. All the earth wires in switch boxes, sockets outlets, DB's and light fixtures shall be of green Colour (PVC insulated).
- e. Main earth bus shall be taken from the L.T. switch board to earth electrodes. The electrical resistance of earthing conductors shall be low enough to permit passage of fault current necessary to operate fuse or circuit breaker, and it shall not exceed 1 ohm.

## 2. SIZING OF EARTHING CONDUCTORS

The cross sectional area of earthing conductor shall not be smaller than half of the largest current carrying conductor subject to an upper limit of 80 Sq.mm. If the area of the largest current carrying conductor or bus bar exceeds 160 sq.mm then two or more earthing conductors shall be used in parallel, to provide at least half the cross sectional area of the current carrying conductor or bus bars. All fixtures, outlet boxes, junction boxes and power circuits upto 15 amps shall be earthed with FRLS PVC insulated copper wire.

All 3 phase switches and distribution panels upto 60 amps rating shall be earthed with 2 Nos. distinct and independent 4 mm dia copper / GI wires. All 3 phase switches and distribution panels upto 100 amps rating shall be earthed with 2 Nos. distinct and independent 6 mm dia copper / GI wires. All switches, bus bar, ducts and distribution panels of rating 200 amps and above shall be earthed with minimum of 2 nos separate and independent 25 mm x 3 mm copper / GI tape.

Earthing details given in Table – A & B shall be referred to as a general guidance. Exact sizes to be worked out by the contractor as per relevant IS Codes.

**TABLE - A**

- (a) Size of earth leads  
For Transformer/Generator Neutral Point Earthing:

Transformer/ DG Set Rating	Electrolytic Bare copper Conductor Wire or strip	Galvanized Iron Conductor wire or strip
50KVA & below/4mm dia	4mm dia	25mm x 6.0mm
75 KVA	25mm x 3.0mm	25mm x 6.0mm
100 KVA	25mm x 6.0mm	32mm x 6.0mm
150 KVA	25mm x 6.0mm	40mm x 6.0mm
200 KVA	25mm x 6.0mm	40mm x 6.0mm
250 KVA	25mm x 6.0mm	40mm x 6.0mm
300 KVA	25mm x 6.0mm	40mm x 6.0mm
500 KVA	40mm x 6.0mm	40mm x 6.0mm

750 KVA	40mm x 6.0mm	50mm x 6.0mm
1000 KVA	40mm x 6.0mm	50mm x 6.0mm
1250 KVA	50mm x 6.0mm	50mm x 6.0mm
1500 KVA	50mm x 6.0mm	75mm x 6.0mm
2000 KVA	50mm x 6.0mm	75mm x 6.0mm

**NOTE:** - EXACT SIZE OF EARTH LEAD TO BE DETERMINED AS PER LATEST IS CODES.



**TABLE – B**

(b) For Equipment Earthing (Applicable to Transformer, Generators, Switchgears, Panels, DB's, Motors etc.)

Rating of 400-V, 3ph 50 cy. Equipment In KVA	Bare Electrolytic Copper conductor Wire / Strip	Galvanised Iron Wire / Strip
upto 5	2mm dia	2mm dia
6 to 15	3mm dia	3mm dia
16 to 30	4mm dia	4mm dia
31 to 50	6mm dia	6mm dia
51 to 100	25mm x 3.0mm	25mm x 6.0mm
101 to 125	25mm x 3.0mm	32mm x 6.0mm
126 to 150	25mm x 3.0mm	32mm x 6.0mm
151 to 200	25mm x 6.0mm	40mm x 6.0mm
201 to 300	25mm x 6.0mm	50mm x 6.0mm
301 to 500	32mm x 6.0mm	50mm x 6.0mm
501 to 800	40mm x 6.0mm	50mm x 6.0mm
Above 800	50mm x 6.0mm	50mm x 6.0mm

**NOTE:** EXACT SIZE OF EARTH LEAD TO BE DETERMINED AS PER LATEST IS CODES.

**NOTE:** ALL THREE PHASE EQUIPMENT SHALL BE DOUBLE EARTHED

### 3. PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as an earthing conductor.

### 4. CONNECTION/JOINTS

#### C. GI Earth Tape Jointing shall be:

##### e. Bolted Joints for all exposed GI earth tape joints on cable trays:

Tape to tape bolted connections are to be made by sufficiently over lapping two tapes, one above the other and then making connection by not less than two sets of Nuts, bolts & washers. Washers shall be used at both sides. Overlapped joint with 2 sets of bolting arrangement per joint.

Zinc passivated / coated high tensile alloy MS grade 5.6 Hardware shall be used for making joint. (See attached sketches with the specifications).

High grade S.S. hard ware shall be used in coastal areas.

**f. Fixing of GI Earth tape on cable tray:**

Earth tape bolting on to GI cable trays shall be made by nuts, bolts & washers of same quality as mentioned earlier but at any fixing location on the tray, a small piece of GI tape shall be over lapped on the main earth tape so as to compensate for the area loss due to hole for fixing.

**g. Exo Thermic welding of GI earth tape for tape joints buried in ground or clamped on wall, floor, slab:**

'UL' listed exothermic welding to be employed for such joints.

**h. S.S. Cross / Straight through connectors for GI tape joints clamped on wall, floor, slab:**

Cross or straight through connectors may be used for making such joints.

**D. Copper Earth Tape Jointing shall be:**

- d. S.S. Cross or straight through connectors to be used for making such joints.
- e. By copper Brazing.
- f. S.S. 304 nuts, bolts, plain and spring washers. Overlapped joint with 2 sets of bolting arrangement per joint.

**5. EARTHING**

The following must always be ensured in earthing system:

- All earth pits should be at equi - potential. Main equipotential bonding conductors shall be provided.
- Extraneous conductive parts such as gas pipes, other service pipes and ducting risers and pipes of fire protection equipment and exposed metallic parts of the building structure shall be bonded to earth.
- The Contractor shall get the soil resistivity test done at his own cost of the area where earthing pits are to be located before starting the installation.

**6. RESISTANCE TO EARTH**

The resistance of earthing system shall be less than 1 ohm.

**SPECIFICATION FOR HOT DIP GALVANIZING PROCESS FOR MILD STEEL USED FOR EARTHING FOR ELECTRICAL INSTALLATION**

**7. GENERAL REQUIREMENTS**

a. **Quality of Zinc**

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1992 (refer latest codes).

b. **Coating Requirement**

Minimum weight of zinc coating for mild steel flats shall be in accordance with latest IS:6745-1972 (refer revised code) but shall not be less than 500 gsm & 70 microns coating.

The weight of coating expressed in grams per square meter shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.

The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs; rust stains bulky white deposits, blisters.

Recycled steel is not be used for making earth tapes.

Mild steel flats / wires shall undergo a process of degreasing, pickling in acid, cold rinsing and then galvanizing.

Wooden mallet to be used for straightening of GI tapes so that galvinsed coating is not damaged.

**8. MAINTENANCE FREE CHEMICAL EARTHING:**

Maintenance Free Chemical Earthing shall be done strictly as per manufacturer's recommendations. It shall be completely maintenance free, long life close to 25 years, environmentally safe, non corrosive & electrically conductive. The earth resistance results shall be less than one ohm.

Maintenance Free Earthing System consisting of 1 Nos. CPRI tested 'UL' Listed copper bonded carbon steel core electrode of 25 / 20 mm dia Electrode tested according to IEC 62561-2 and as specified in the BOQ, each with a minimum coating thickness of 250 microns and length of 3 meters. 25 kgs/Electrode of earth enhancing compound needs to be considered to fill the 100mm augered hole surrounding to the electrode.

SS Universal Clamp of Size 175X50X3 mm for Connection Terminal to be used..

Earth enhancing compound(OEC) tested as per IEC 62561-7 (mimumum 25 kg or more as per requirement) to be used.

Poly Propiline Heavy duty Pit cover to be employed.

9. Galvanic Corrosion between dissimilar materials:

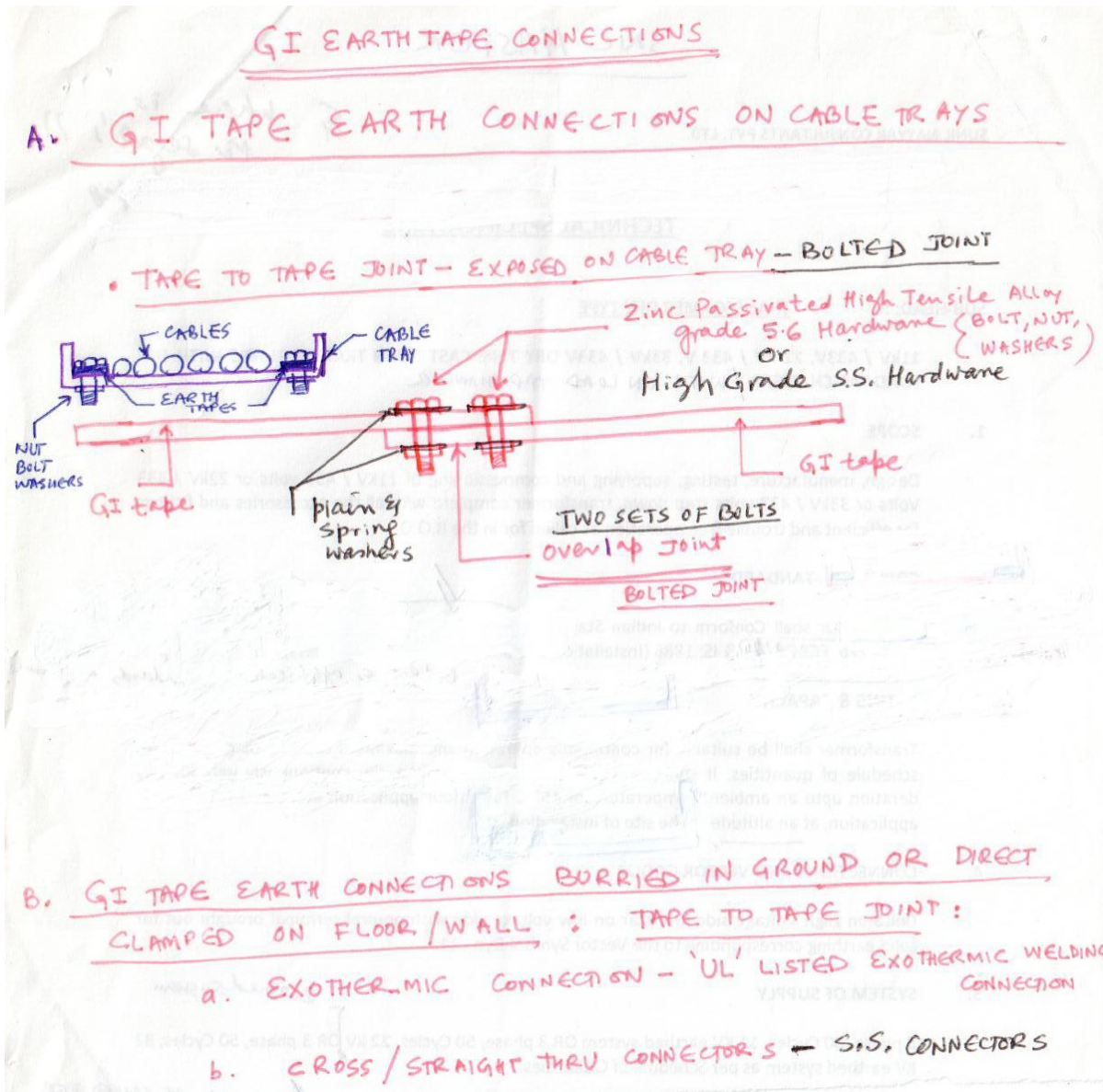
CONNECTIONS WITHOUT RISK OF GALVANIC CORROSION

**Material combinations without increased risk of corrosion**

	Steel, galvanised	Aluminium	Copper	Stainless steel	Titanium	Tin
Steel, galvanised (GI)	Yes	Yes	No	Yes	Yes	Yes
Aluminium	Yes	Yes	No	Yes	Yes	Yes
Copper	No	No	Yes	Yes	No	Yes
Stainless steel	Yes	Yes	Yes	Yes	Yes	Yes
Titanium	Yes	Yes	No	Yes	Yes	Yes
Tin	Yes	Yes	Yes	Yes	Yes	Yes

**10. GI EARTH TAPE CONNECTIONS**

**A. GI Tape Earth Connection on Cable Trays:**





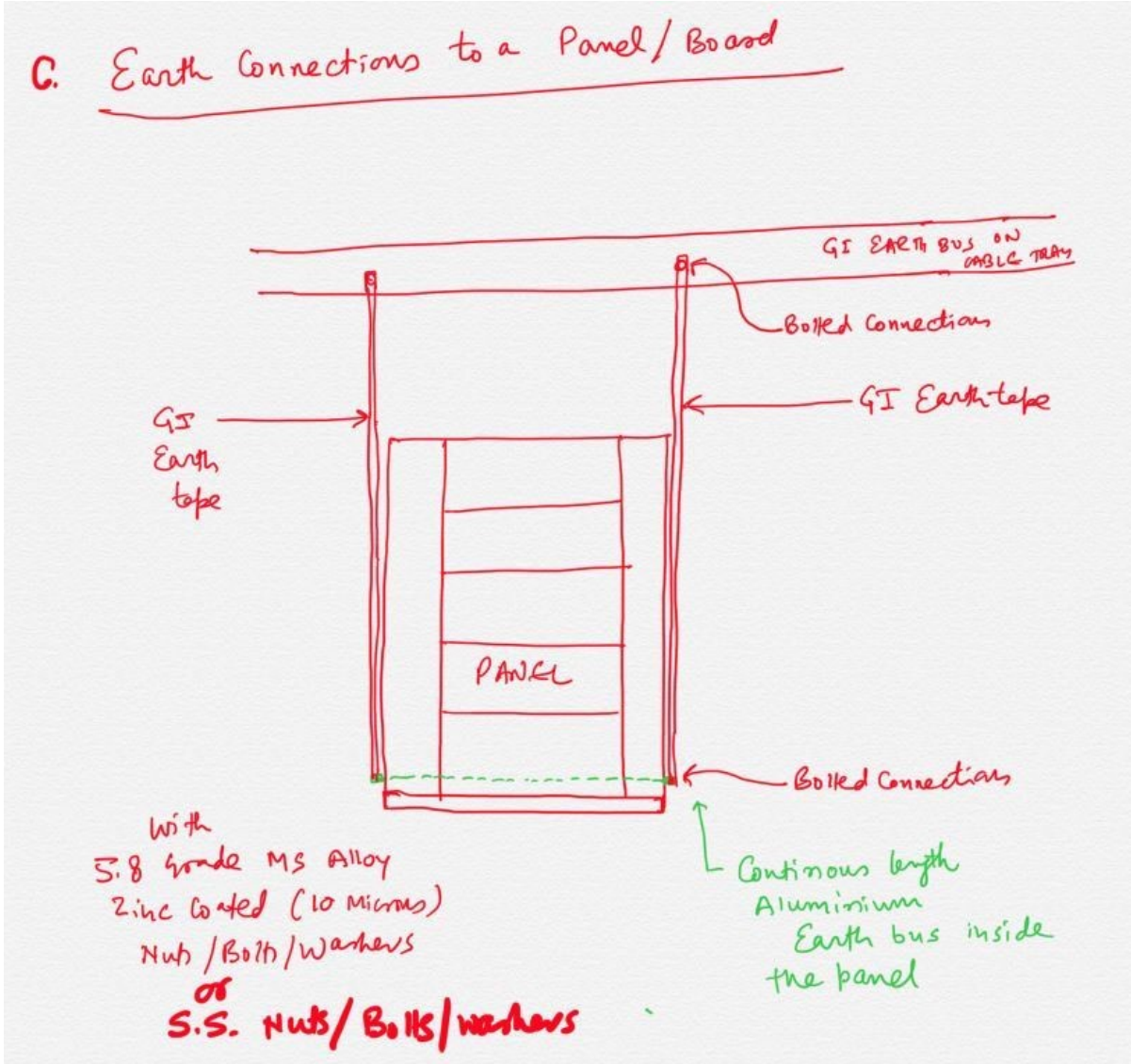
B. GI Earth Tape Fixing on GI Cable Tray:

B.

## GI Earth tape fixing On GI Cable tray

- Use a piece of Earth tape of same size to overlap with main tape to compensate for the area loss due to hole.
- Use high grade S.S. nuts/bolts/Washers or 5.6 grade high tensile Alloy Zinc coated (10 microns) nuts/bolts/washers.
- Use double washers i.e. plain & Spring.

**C. Earth Connection to a Panel / Board:**



**SUBHEAD-4. TECHNICAL DATA (TO BE FILLED BY BIDDERS):**
**1.1 All Fire Pumps:**

Quantity	
Make	
Model	
Fluid Handled	
Type	
Suction	
Delivery	
Impeller Type	
Coupling	
Base Plate with Foundation Bolt	
No. of Stage	
Flow Rate (m <sup>3</sup> /hr)	
Total Head (m) at	
i) High Pressure Outlet	
ii) Intermediate Pressure Outlet	
iii) Low Pressure Outlet	
Speed of Pump (rpm)	
Efficiency at rated duty point	
Material of construction (MOC)	
Casing material	
Impeller material	
Shaft material	
Shaft sleeve	
Casing Ring	



Impeller Ring	
---------------	--

## 1.2 **Engine for Diesel Pump:**

Quantity	
Make	
Model	
Horse Power	
Engine	
RPM	
Engine overspeed setting	
Operating Cycle	
Number of Cylinder	
Accessories	
Dynamically balanced fly wheel	
Flexible coupling and coupling guard	
Electrical standing equipment and starting system	
Governer	
Fuel pump and water pump	
Lubricating oil pump	
Fuel, Air and Lubrication Oil Filter	
Instrument and Protection Device complete as per Engine Model	
Lubricating oil pressure	
High Cooling Water Temperature	
High Lubricating Temperature	
Engine Cooling and Oil System	
Capacity of Diesel Tank	
Detail of Batteries	
Battery Charger	
Other necessary accessories as per Model No in order to make the Diesel Engine Functional	

**1.3 All Fire Pumps**

Description	Diesel engine Pump	Hydrant Pump	Sprinkler Pump	Jockey Pump for Hydrant	Jockey Pump for Sprinkler	Water Curtain Pump	Terrace Fire Pump
Quantity							
Make							
Model							
Fluid Handled							
Type							
Suction							
Delivery							
Impeller Type							
Coupling							
Base Plate with Foundation Bolt							
No. of Stage							
Flow Rate (m <sup>3</sup> /hr)							
Total Head (m) at							
i) High Pressure Zone							
ii) Intermediate Pressure Zone							
iii) Low Pressure Zone							
Speed of Pump (rpm)							
Efficiency at rated duty point							

Description	Diesel engine Pump	Hydrant Pump	Sprinkler Pump	Jockey Pump for Hydrant	Jockey Pump for Sprinkler	Water Curtain Pump	Terrace Fire Pump
Material of construction (MOC)							
Casing material							
Impeller material							
Shaft material							
Shaft sleeve							
Casing Ring							
Impeller Ring							

## ANNEXURE- A

### APPLICABLE CODES, STANDARDS AND PUBLICATIONS

1.0 All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices. All equipment and material being supplied by the Contractor shall meet the requirements of IS., Tariff advisory committee's regulation (fire insurance), electrical inspectorate and Indian Electricity rules and other Codes/Publications as given below.

**A) General :**

SP : 6 (1)	Structural steel sections
IS : 27	Pig lead
IS : 325	Three phase induction motors
IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 694	PVC insulated cables for working voltages up to and including 1100 V.
IS : 779	Specification for water meters (domestic type)
IS : 782	Specification for caulking lead
IS : 800	Code of Practice for general construction in steel
IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium
IS : 1172	Code of basic requirements for water supply drainage and sanitation
IS : 1367 (Part- 1)	Technical supply conditions for threaded steel fasteners : Part 1 introduction and general information.
IS : 1367 (Part- 2)	Technical supply conditions for threaded steel fasteners : Part 2 product grades and tolerances.
IS : 1554 (Part- 1)	PVC insulated (heavy duty) electric cables : Part 1 for working voltages up to and including 1100V.
IS : 1554 (Part- 2)	PVC insulated (heavy duty) electric cables : Part 2 for working voltages from 3.3 kV up to and including 11 kV.
IS : 1726	Specification for cast iron manhole covers and frames
IS : 1742	Code of practice for building drainage.
IS : 2064	Selection, installation and maintenance of sanitary appliances – Code of practice.
IS : 2065	Code of practice for water supply in buildings.

IS : 2104	Specification for water meter boxes (domestic type)
IS : 2373	Specification for water meters (bulk type)
IS : 2379	Colour code for identification of pipe lines
IS : 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS : 2629	Recommended practice for hot dip galvanizing on iron and steel
IS : 3114	Code of practice for laying of cast iron pipes
IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system : Part 1 manholes
IS : 4127	Code of practice for laying glazed stoneware pipes.
IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5455	Cast iron steps for manholes.
IS : 6159	Recommended practice for design and fabrication of material prior to galvanizing
IS : 7558	Code of practice for domestic hot water installations
IS : 8321	Glossary of terms applicable to plumbing work
IS : 9668	Code of practice for provision and maintenance of water supplies and fire fighting.
IS : 9842	Preformed fibrous pipe insulation
IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines
IS : 10234	Recommendations for general pipeline welding.
IS : 10446	Glossary of terms relating to water supply and sanitation.
IS : 11149	Rubber Gaskets
IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.
IS : 12183 (Part 1)	Code of practice for plumbing in multistoreyed buildings : Part 1 Water supply
IS : 12251	Code of practice for drainage of building basements
IS : 5572	Code of practice for sanitary pipe work
IS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilage.

IS : 8301	Code of practice for building drainage
BSEN : 274	Sanitary tapware, waste fittings for basins, bidets and baths. General technical specifications.

**B) PIPES AND FITTINGS :**

IS : 458	Specification for precast concrete pipes (with and without reinforcement)
IS : 651	Salt glazed stone-ware pipes and fittings
IS : 1239 (Part 1)	Mild steel tubes, tubulars and other wrought steel fittings Part 1 Mild Steel tubes
IS : 1239 (Part 2)	Mild steel tubes, tubulars and other wrought steel fittings : Part 2 Mild steel tubulars and other wrought steel pipe fittings.
IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast iron fittings for pressure pipes for water, gas and sewage
IS : 1729	Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 1879	Malleable cast iron pipe fittings
IS : 1978	Line pipe
IS : 1979	High test line pipe
IS : 2501	Copper tubes for general engineering purposes
IS : 2643 (Part 1)	Dimensions for pipe threads for fastening purposes : Part 1 Basic profile and dimensions.
IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes : Part 2 Tolerances
IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes : Part 3 Limits of sizes.
IS : 3468	Pipe nuts
IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter)
IS : 3989	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4346	Specifications for washers for use with fittings for water services.
IS : 4711	Methods for sampling steel pipes, tubes and fittings
IS : 6392	Steel pipe flanges
IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage.

**C) VALVES :**

IS : 778	Specification for copper alloy gate, globe and check valves for water works purposes
IS : 14846	Specification for sluice valves for water works purposes (50 mm to 1200 mm size)
IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings
IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
IS : 3950	Specification for surface boxes for sluice valves
IS : 5312 (Part 1)	Specification for swing check type reflux (non return) valves : Part 1 Single door pattern
IS : 5312 (Part 2)	Specification for swing check type reflux (non return) valves : Part 2 Multi door pattern
IS : 12992 (Part 1)	Safety relief valves, spring loaded : Part 1 – Design
IS : 13095	Butterfly valves for general purposes.

**D) FIRE FIGHTING EQUIPMENT:**

TAC	Tariff advisory committee fire protection manual Part I
TAC	Rules of Tariff Advisory Committee for Automatic Sprinkler system
NFPA : 12, 1993	Standards on Carbon Dioxide Extinguishing System
IS : 636	Non- percolating flexible fire fighting delivery hose
IS : 884	Specification for First Aid Hose Reel for fire fighting
IS : 901	Specification for first aid hose reel for fire fighting
IS : 902	Specification for couplings, double male and double female, instantaneous pattern for fire fighting
IS : 903	Suction hose coupling for fir fighting purposes
IS : 904	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner
IS : 905	Specification for 2-way and 3-way suction collecting heads for fire fighting purposes
IS : 907	Specification for delivery breechings, dividing and collecting instantaneous pattern for fire fighting purposes
IS : 908	Specification for suction strainers, cylindrical type for fire fighting purposes.

IS : 909	Specification for underground fire hydrant, sluice valve type
IS : 910	Specification for combined key for hydrant, hydrant cover and lower valve.
IS : 933	Specification for portable chemical foam fire extinguisher
IS : 1648	Code of practice for fire safety of building (general) : Fire fighting equipment and its maintenance.
IS : 2171	Specification for portable fire extinguishers dry powder (cartridge type)
IS : 2190	Selection installation and maintenance of first-aid fire extinguishers- Code of practice
IS : 2871	Specification for branch pipe, universal for fire fighting purposes.
IS : 2878	Specification for fire extinguishers, carbon dioxide type (portable and trolley mounted)
IS : 3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises
IS : 5290	Specification for landing valves
IS : 5714	Specification for hydrant, stand pipe for fire fighting
IS : 8090	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting
IS : 8423	Specification for controlled percolation type hose for fire fighting
IS : 10658	Specification for higher capacity dry powder fire extinguisher (trolley mounted)
IS : 11460	Code of practice for fire safety of libraries and archived buildings
IS : 13039	External hydrant system – provision and maintenance – Code of practice.
IS : 5514 (Parts 1 to 7)	Reciprocating internal combustion engines : performance.

**E) WATER QUALITY TOLERANCE :**

IS : 3025 (Part 1 to 44)	Method of sampling and test (physical and chemical) for water and waste water
IS : 4764	Tolerance limits for sewage effluents discharged into inland surface waters
IS : 10500	Drinking water

**F) PUMPS AND VESSELS :**

IS : 1520	Specification for horizontal centrifugal pumps for clear cold fresh water
IS : 2002	Steel plates for pressure vessels for intermediate and high temperature service including boilers
IS : 2825	Code for unfired pressure vessels



IS : 4682 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining
IS : 5600	Specification for sewage and drainage pumps
IS : 8034	Specification for submersible pump sets for clear, cold, fresh water
IS : 8418	Specification for horizontal centrifugal self priming pumps

## **G) QUALITY ASSURANCE AND QUALITY CONTROL :**

- 1.0 The work shall conform to high standards of design and workmanship, shall be structurally sound and aesthetically pleasing quality standards prescribed shall form the backbone for the quality assurance and quality control system.
- 2.0 At the site level the Contractor shall arrange the materials, their stacking/storage in appropriate manner to ensure the quality. Contractor shall provide equipment and manpower to test continuously the quality of materials, assemblies etc. as directed by the Engineer-in-Charge. The test shall be conducted continuously and the result of tests maintained. In addition the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of surface.
- 3.0 The Engineer- in-Charge shall be free to carry out tests as may be considered necessary by him at his sole discretion, from time to time, in addition to those specified in this document. The Contractor shall provide the samples and labour for collecting the samples nothing extra shall be payable to the Contractor for samples or for the collection of the samples.
- 4.0 The test shall be conducted at the site laboratory that may be established by Engineer-in-Charge or at any other standard Laboratory selected by Engineer- in-Charge.
- 5.0 The contractor shall transport the samples to the laboratory for which nothing extra shall be payable. In the event of Contractor failing to arrange transportation of the samples in proper time Engineer-in-Charge shall have them transported and recover two times the actual cost from the Contractor's bills.
- 6.0 Testing charges shall be borne by the Engineer-in-Charge.
- 7.0 Testing may be witnessed by the Contractor or his authorized representative. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.

### **ANNEXURE- B**

#### **Pipe Colour Code**

S.No.	Pipe lines	Colour Band		
1.	Fire Lines	Red		

This colour code is as per I.S. 2379-1983.



**ANNEXURE – C**

**SHEET FOR LISTING DEVIATIONS**

Although deviations are generally not acceptable, but in case it becomes pertinent as per Vendor, then he is requested to specifically give the details of deviations, if any on this sheet and continuation thereof in the below mentioned format only.

Sr. No.	Item Description	Specifications	Bidder's Specifications / Comments	Deviations

Deviation mentioned at any other place shall not be considered.

**-----: END OF SUBHEAD :-----**

**SECTION: 8**  
**LIST OF APPROVED MAKES**

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS

**A. PLUMBING SYSTEM**

S.NO.	DESCRIPTION	LIST OF APPROVED MAKES
1	WC Pan Connectors	Rehau/Viega/Supreme/Astral
2	Wash Basin P-Trap	McAlpine/Viega/Supreme/Astral
3	S.S Floor drain, floor trap gratings	GMGR/NEER/Camry
4	CI/DI Gratings	NECO/GMGR
5	CI/MS/DI Manhole Cover/Grating	NECO/SKF
6	GI/MS Pipes (IS: 1239 and IS: 3589)	Tata/Jindal Hissar
7	GI pipes fittings	Zoloto M/NVR/Unik
8	GI pipe sealant	Henkel (Loctite 55) / Pidilite (HOLDTITE)
9	UPVC Pipe and Fittings (IS: 13592, IS: 4985)	Astral/ Supreme/Truflow
10	UPVC Underground Drainage Pipe (IS: 15328)	Astral/Supreme/Truflow
11	Polypropylene (PP) Pipes	Wavin/Rehau
12	CPVC Pipes and Fittings	Astral/ Supreme/Truflow
13	PE-RT Pipes and Fittings	Viega/Kantherm
14	CI Hub less Pipes and Fittings	NECO/Saint Gobain
15	Multilayer PPR Pipes	Rehau/Kantherm
16	Butterfly Valve	SKS/NVR/ Zoloto
17	Check Valve – Wafer Type	SKS/NVR/ Zoloto
18	Check Valve – Dual Plate	SKS/NVR/ Zoloto
19	Y Strainer	SKS/NVR/ Zoloto
20	GM / Forged Brass Ball Valves	SKS/NVR/ Zoloto
21	Pressure Reducing Valve	SKS/NVR/ Zoloto
22	Air Vent	SKS/NVR/ Zoloto
23	Isolation Gate Valve	SKS/NVR/ Zoloto
24	Motorized Butterfly Valve	SKS/NVR/ Zoloto
25	Ball Float Valve	SKS/NVR/ Zoloto
26	Pressure Gauge	H.Guru/FIEBIG/SANT
27	Water Meter (Mechanical Type)	VTM/Lehry
28	Electronic/Electromagnetic Flow Meter	VTM/Lehry
29	Pump and Tank Automation System	Lehry/Advance Automation
30	MH Water Tank Plastic Coated Footsteps	KGM/Patel/Pranali Industries
31	Welding Rods	Esab/ADOR/Victor
32	Fire Sealant	Hilti/3M/Fischer
32	Prefab Drains (Polypropylene, Polymer Concrete)	MEA/Hauraton
33	Prefab Grease Traps	Kessel/Nu-Green
34	Roof Drains /Scupper Drains/Corner Drains/Dome Gratings/Balcony	GMGR/Neco

	drains/Parking Drains etc.	
35	Fasteners, Nuts, Bolts etc. (ETA Approved)	Mupro/Walraven/Gripple
36	Pipe Supports, Clamps, Hangers, Channels etc. (ETA Approved)	Mupro/Walraven/Gripple
37	Pipe Coat Material	Pypkote/Coaltek
38	Epoxy Paint	Asian Paints/Berger
39	Anti Corrosive Paints	Asian Paints/Berger
40	Filter	Ion Exchange/Pentair/Fabricated
41	Softener	Ion Exchange/Pentair/Fabricated
42	Rainwater Harvesting System	Furaat/InRain Systems
43	Anti Vibration Mounting & Flexible Connections	Resistoflex/Kanwal
44	Hydro pneumatic Pump Sets	Grundfos/CG/ Kirloskar
45	Horizontal End Suction, Vertical Inline, Split Case, Monobloc Pumps	Grundfos/CG/ Kirloskar
46	Submersible Drainage, Sewage Pumps	Grundfos/CG/ Kirloskar
47	Dosing Pumps	CG/Grundfos/ Kirloskar
48	Maxi Filtra/Maxi Vent	McAlpine/Studor
49	Mechanical Seal	Burgmann/Sealol
50	Couplings	Lovejoy/Dunlop

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LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS

**B. FIRE FIGHTING SYSTEM**

<b>S. NO.</b>	<b>DESCRIPTION</b>	<b>LIST OF APPROVED MAKES</b>
1	GI/MS Pipes (IS 1239 / 3589)	Jindal Hissar/TATA
2	Pressure Switch	Danfoss/Honeywell
3	Grooved Fittings and Couplings (Rigid, Flexible) UL/FM Approved	National / Victaulic
4	Threaded DI Fittings	National / Victaulic
5	GI Fittings	Zoloto/NVR/UNIK
6	Fabricated Butt-Welded Fittings	Industrial Valve & Company/VS/Jainson
7	Fire Hydrant Landing Valve	Newage Surendarnagar/Minimax
8	Fire Hose Branch Pipes	Newage Surendarnagar/Minimax
9	RRL Hoses	Newage Surendarnagar/Minimax
10	First Aid Hose Reel Drum	Newage Surendarnagar/Minimax
11	First Aid Hose Reel (LPCB Approved)	Newage Surendarnagar/Minimax
12	Fireman Axe	Newage Surendarnagar/Minimax
13	Fire Brigade Inlet and Draw Out Connections	Newage Surendarnagar/Minimax
14	Fire Extinguishers	Kanex/Ceasefire/Exflame
15	Water Test Flow Meter	Victaulic/Tyco/Exflame
16	Flow Switch	Victaulic/Potter
17	Installation Control valve	Victaulic/Rapidrop/Zoloto
18	Deluge Valve	Victaulic/Rapidrop/Zoloto
19	Water curtain nozzle	Victaulic/Tyco
20	SS (Braided) Flexible droppers	Victaulic/Flexhead
21	Concealed Sprinklers	Victaulic/Rapidrop
22	Sprinkler Rosette assembly	Victaulic/Rapidrop
23	Sprinkler Heads	Victaulic/Rapidrop
24	Sprinkler Test and Drain Assembly	Victaulic/Rapidrop
25	Window Sprinkler/Façade Sprinkler	Victaulic/Tyco
26	Annunciation Panel	Agni/PCD/Safeway/JVS Electronics/EMC Honey well
27	Pressure Gauge	H. Guru/FIEBIG
28	OS&Y Gate Valve	Newage Surendarnagar/Victaulic/Zoloto
29	Flanged/Screwed Butterfly Valve	SKS/NVR/Zoloto

S. NO.	DESCRIPTION	LIST OF APPROVED MAKES
30	Flanged/Screwed Motorized Butterfly Valve	SKS/NVR/Zoloto
31	Flanged/Screwed Butterfly with Tamper Switch	Newage Surendarnagar/Victaulic/Zoloto
32	Flanged/Screwed Check Valve – Wafer Type	SKS/NVR/Zoloto
33	Flanged/Screwed Check Valve – Dual Plate	SKS/NVR
34	Flanged/Screwed Y Strainer	SKS/Emerald/NVR
35	Flanged/Screwed GM/Forged Brass Valves	SKS/NVR
36	Grooved Valves/Strainers	Victaulic/Rapidrop/NVR
37	Air Release Valve	SKS/NVR/Zoloto
38	Pressure Reducing Valve (UL/FM Approved)	Victaulic/Claval
39	DI MH Cover & Frame	NECO/SKF
40	Welding Rods	Esab/Advani/Ador/Victor
41	Fire Sealant	Hilti/3M
42	Fasteners, Nuts, Bolts etc. (ETA Approved)	Mupro/Walraven
43	Pipe Supports, Clamps, Hangers, Channels etc. (ETA Approved)	Mupro/Walraven
44	Wire Rope Based Pipe Supports (ETA Approved)	Mupro/Gripple
45	Pipe Coat Material	Pypkote/Coaltek
46	Epoxy Paint	Asian Paints/Berger
47	Anti Corrossive Paints	Asian Paints/Berger
48	Kitchen Hood Suppression System	Kanex/Buckeye
49	Seismic Supports and Bracings (ETA Approved)	Mupro/Hilti/Caddy/Walraven
50	Fire Curtains	Orient/Kent
51	Mechanical Seal	Burgmann/Sealol
52	Anti Vibration Mounting Pads	Dunlop/Resistoflex/Easyflex
53	Foot Valve	HBD/Zoloto/RB



**C. FIRE PUMPS**

S. NO.	DESCRIPTION	LIST OF APPROVED MAKES
1	Electrical Fire Pumps – Horizontal Split Case, End Suction (Factory Fitted, Factory assembled)	Lubi/Grundfos
2	Diesel Fire Pumps – Horizontal Split Case, End Suction (Factory Fitted, Factory assembled)	Lubi/Grundfos
3	Fire Jockey Pumps – Horizontal Split Case, End Suction, Vertical Inline (Factory Fitted, Factory assembled)	Lubi/Grundfos
4	Diesel Engine	Greaves Cotton Ltd./Cummins/KFE/Eicher/Caterpillar/Volvo/Mahindra
5	Motor	Bharat Bijlee/Crompton/Siemens/ABB/Lubi/Kirloskar

**D. ELECTRICAL PANEL SUPPRESSION SYSTEM**

S. NO.	DESCRIPTION	LIST OF APPROVED MAKES
1	Panel Flooding System	Kanex/Firetrace
2	Clean Agent Gas	3M/Waysmos
3	DLP System with Cylinder	Kanex/Firetrace/Siemens/SEVO/Fike
4	UL Listed Fire Detection Tube	Kanex/Firetrace/Siemens/SEVO/Fike
5	End of Line Adaptor with Pressure Gauge	Kanex/Firetrace/Siemens/SEVO/Fike
6	End of Line Plug	Kanex/Firetrace/Siemens/SEVO/Fike
7	T Connection	Kanex/Firetrace/Siemens/SEVO/Fike
8	Master Control Unit with Hooter	Kanex/Firetrace/Siemens/SEVO/Fike

**E. KITCHEN HOOD SUPPRESSION**

S. NO.	DESCRIPTION	LIST OF APPROVED MAKES
1	Kitchen Hood Suppression	Kanex/Buckeye

**SECTION: 9**

**COMPLIANCE UNDER EIA**

### COMPLIANCE UNDER EIA

Contractor to comply with the provisions under EIA, but not limited to following provisions:

1. Contractor would not be permitted to store/dump construction material or debris on metalled road.
2. Beyond the metalled road the area where such the construction material or debris can be stored shall be physically demarcated by 'the Contractor ensuring that it would not cause any obstruction to the free flow of traffic/inconvenience to the pedestrians. It should be ensured that no accidents occur on account of such permissible storage.
3. Contractor shall ensure that the construction material is covered by tarpaulin and all other precaution should be taken to ensure that no dust particles are permitted to pollute air quality as a result of such storage.  
It shall also be ensured that appropriate protection measures are taken by raising wind breakers of appropriate height on all sides of the plot/area using plastic and for other similar material to ensure that no construction material dust fly outside the plot area and it will be the builder/contractor responsibility to ensure that their activity does not cause any air pollution during course of construction and/or storage of material or construction activity. This condition shall be strictly adhered to by every builder, contractor, person or authority. In the event of default they shall be liable to be prosecuted under the law in force, as well as for causing environmental pollution and will be liable to pay compensation which would be determined by Tribunal in accordance with law.
4. All the trucks or vehicles of any kind which are used for construction purposes/or are carrying construction material like cement, sand and other allied material should be fully covered. The vehicles should be properly cleaned, should be dust free and every necessary precautions is to be taken to ensure that enroute their destination, the dust, sand or any other particles are not permitted to be released in air/contaminate air. Any truck not complying with the above directions would not be permitted to enter the area.

And whereas Hon'ble National Green Tribunal in order dated 10.04.2015 interalia directed as follows:

- a. Contractor shall put tarpaulin on scaffolding around the area of construction and the building. No person including builder, owner can be permitted to store any construction material, particularly sand on any part of the street, roads in any colony.
- b. The construction material of any kind that is stored in the site will be fully covered in all respects so that it does not disperse in the Air in any form.
- c. All the construction material and debris shall be carried in the trucks or other vehicles which are fully covered and protected so as to ensure that the construction debris or the construction material does not get dispersed into the air or atmosphere, in any form whatsoever.
- d. The dust emissions from the construction site should be completely controlled and all precautions taken in that behalf.
- e. The vehicles carrying construction material and construction debris of any kind should be cleaned before it is permitted to ply on the road after unloading of such material.
- f. Every worker working on the construction site and involved in loading, unloading and carriage of construction material and construction debris shall be provided with mask to prevent inhalation of dust particles.
- g. Every owner and or builder shall be under obligation to provide all medical help, investigation and treatment to the workers involved in the construction of building and carry of construction material and debris relating to dust emission.
- h. It shall be the responsibility of every builder to transport construction material and debris waste to construction site, dumping site or any other place in accordance with rules and in terms of this order.
- i. All to take appropriate measures and to ensure that the terms and conditions of the earlier order and these

- orders should strictly comply with by fixing sprinklers, creations of green air barriers.
- j. Compulsory use of wet jet in grinding and stone cutting.
  - k. Wind breaking walls around construction site.
  - l. All the builders who are building commercial, residential complexes which are covered under the EIA Notification of 2006 shall provide green belt around the building that they construct. All Authorities shall ensure that such green belts are in existence prior to issuance of occupancy certificate.
  - m. All builders shall ensure that C&D waste is transported in terms of this order to the C & D Waste site only and due record in that behalf shall be maintained by the builders, transporters and NCR of Delhi.
  - n. Even if constructions have been started after seeking Environmental Clearance under the EIA notification 2006 and after taking other travel but is being carried out without taking the preventive and protective environmental steps as stated in this order and MoEF guidelines, 2010, the State Government, SPCB and any officer of any department as afore stated shall be entitled to direct stoppage of work.

And whereas, Environmental Impact Assessment Guidance Manual for Building, Construction, Township and area Development Projects of February, 2010 is available on the website of MoEF &CC envisaging the following guidelines for mitigation measures in respect of dust control from Building, Construction projects:

*"Adopting techniques like, air extraction equipment, and covering scaffolding, hosing down road surfaces and cleaning of vehicles can reduce dust and vapour emissions. Measures include appropriate containment around bulk storage tanks and materials stores to prevent spillages entering watercourses.*

*The other measures to reduce the air pollution on site are:*

- *Sprinkling of water and fine spray from nozzles to suppress the dust.*
- *On-Road- Inspection should be done for black smoke generating machinery.*
- *Promotion of use of cleaner fuel should be done.*
- *All DG sets should comply emission norms notified by MoEF.*
- *Vehicles having pollution under control certificate may be allowed to ply.*
- *Use of covering sheet to prevent dust dispersion at buildings and infrastructure sites, which are being constructed.*
- *Use of covering sheets should be done for trucks to prevent dust dispersion from the trucks, implemented by district offices.*
- *Paving is a more permanent solution to dust control, suitable for longer duration projects. High cost is the major drawback to paving.*
- *Reducing the speed of a vehicle to 20 kmph can reduce emissions by a large extent.*

*Speed bumps are commonly used to ensure speed reduction. In cases where speed reduction can't effectively reduce fugitive dust, it may be necessary to divert traffic to nearby paved area.*

***Material storages – care should be taken to keep all material storages adequately covered contained so that they are not exposed to situation where winds on site could lead to dust / particulate emissions. Fabric and plastics for covering piles of soil and debris is an effective means to reduce fugitive dust.***

## **SECTION: 10**

### **HSE GUIDELINES**

## **SAFETY**

This document sets out **GU** expectations from contractors on Environment, Health and Safety aspect of the construction workers deployed at the project site. It provides general EHS procedures for most, but not all, construction activities to prevent accidents and to monitor/correct violations of procedures through regular Safety meetings. However, a key requirement for EHS success is serious commitment from senior management and strong safety leadership at the project site with well-defined roles and responsibilities of the assigned individuals. Towards that, it is imperative that the selected Managing Contractor employs a well-qualified (relevant qualifications) and experienced Safety Officer responsible for implementing and continuously communicating and driving the procedures throughout the labour force. Being one of the key critical to quality (CTQ's) parameters, the contractors shall be required to submit with their tenders their organization safety policy, risk assessment along with brief summary of the safety performance on projects that they have managed in the last three years (i.e. number of man-hours, number of fatalities, accidents, near misses, type and cause of accidents, etc).

### **Scope of procedures and relationship with GU:**

The Contractor's Safety & Health Procedures applies to all contractor and its subcontractor employees and to all construction and maintenance activities on the job site. A close relationship and continuous interaction must be maintained with **GU** Project team by the construction manager of the contractor. **GU** does have specific safety and health requirements as per the **GU's** EHS policy to be observed and cooperation with its representative, Architects, consultant various audit teams and other contractors at site, throughout the contract period is essential.

### **Selection of sub-contractor:**

The main contractor shall select sub or works contractors, using the same criteria of practical safety policy. Again, it must be ensured that the terms of contract include adequate provision for safe working practices & for specified safety and health items.

### **Standards**

The prime contractor and all subcontractors are to comply with the Client specific rules and procedures, the national legislation and codes and in particular the following standards;

IS: 3696 (Part I) -1966 Safety code for scaffolds and ladders: Part I Scaffolds IS:  
3696 (Part II)-1966 Safety code for scaffolds and ladders: Part II Ladders IS: 3764-  
1966 Safety code for excavation work

IS: 4082-1977 Recommendations on stacking and storage of construction materials at site (first revision)IS:  
4130-1976 Safety code for demolition of building (first revision)

IS: 4912-1978 Safety requirements for floor and wall openings, railings and toe boards (first revision)IS:  
5121-1969 Safety code for piling and other deep foundations

IS: 5916-1970 Safety code constructions involving use of hot bituminous materialsIS:  
7205-1974 Safety code for erection of structural steel work

IS: 7969-1975 Safety code for handling and storage of building materialsIS:  
8989-1978 Safety code for erection of concrete framed structures

IS: 7293-1974 Safety code for working with construction machineryIS:

10291-1982 Code of dress in Civil Engineering works, safety

IS: 875-1964 Code of practice for structural safety of buildings and loading standardsIS:

1905-1980 Code of practice for structural safety of buildings, masonry walls

IS: 10386-1983 General aspects Part 1 – 1983, Part 2 – 1982, Part 6 – 1983, Part 10 – 1983 Amenities, protective clothing and equipment, construction, storage, handling, detection and safety measures for gases, chemicals and flammable liquids IS:

2925-1984 Safety helmet tests

IS: 5983-1980 Testing for Eye protectorsIS:

7524 (Part I)-1979 Safety goggles

IS: 1179-1967 Welding helmetsIS:

5914-1970 Safety shoes

IS: 4770-1991 Safety gloves

IS: 12254-1993 Rubber/ PVC knee boots/ gum boots

Client specific requirements for compliance with OSHA standards

## **SECTION 2: ELEMENTS OF CONSTRUCTION SAFETY**

### **Planning:**

Detailed planning should take the following matters in to account;

- Obtaining work specific permits like;
- Permit for work at Height

- Hot work permit
  - Disposal permit
  - Excavation permit
  - Night work permit
  - Permit for working in restricted areas
  - Confined space Entry permit
  - Shaft work permit
- 
- Know the hazardous operations eg. Use of cranes and site transport, structural erection, excavation and false work, scaffolding, roof work, demolition etc.
  - Requirement for plant and equipment to ensure safe working or ease of handling
  - Sequence of work and its phasing between contractors to minimize the possibility of one contractor placing another contractor's men at risk, where appropriate the segregation of contractors should be considered
  - Need to provide information, instruction and appropriate training, both on general site safety and hazardous specific in the site. The latter could range from restricted zones, Permit-to-work systems, lifting operation to the wearing of Personal protective equipment
  - Need for fire precautions and emergency procedures
  - Need for environmental monitoring and health surveillance
  - Site security and foreseeable risks to the public, including the need for directional and warning signs
  - Safe access across the site for persons, vehicles and equipment. Thought should be given to arrangements for keeping the site tidy, accommodation for site staff, safety welfare, first aid and other facilities
  - Provision of safe places of work at different stages of the job including the provision of scaffolding, ladders for a number of sub-contractors.

**Control:**

Sub and works contractors shall be briefed about the safety policy and site including site specific safety procedures of the prime contractor at the pre-bid meeting itself and further reiterated during the kick-off meeting. Responsibilities of all parties shall be clearly defined before contractors start work at site. Such matters should include:

- Appropriate precautions and methods for identified hazards or hazardous work
- Necessary plant, equipment and arrangements for its provision, maintenance use and inspection
- Question of trade union or other workforce safety representation and the need for a joint safety committee
- A formal joint safety committee must be appointed to review results and to initiate further actions (should be done either during kick-off meeting or subsequently)
- Arrangement for initiation of introduction training for new states on site
- Arrangements for any specialized training
- Arrangements for promulgating safety and health information e.g. On-site notice boards

It is important that such safety and health arrangements are reviewed at the Kick-off meeting as well as first project and first Safety meeting, where the site management can set the tone for the conduct of work by resolving at an early stage the difficulties which may arise at a later date. It is expected that each subcontractor will provide employees adequately licensed (if required for specific works), trained and capable of doing the specialty work.

**Coordination:**

The Site In-charge appointed by the prime contractor shall be totally responsible for compliance with this health and safety code. The contractor must appoint a Chief Safety Officer and form a "contractor safety committee" along with safety representatives from its sub-contractors. This committee will be chaired by the Site In-charge and meet at least once a week to review status on EHS issues. It is expected that each contractor and sub-contractor will participate in Daily "Tool Box Talks" and other safety meeting to co-ordinate project work for the day across trades. The site in-charge must make suitable arrangements to ensure the effective coordination of the work of all its sub-contractors on site. Clear lines of communication should be set up between each sub-contractor's Safety Officer and Safety officer of the prime Contractor. Effective co-



ordination will be enhanced by ensuring that 'Safety and Health' figures prominently on the agenda of regular project meetings, as well as Safety meetings. For better coordination on project related EHS issues, the safety meeting participants shall include Project Manager, Project Manager's Safety representative, all contractor's safety representatives along with 's safety rep. Project Manager's Safety officer shall convene this meeting and participants from all contractors safety representatives will be mandatory. Minutes of this meeting shall be circulated to all concerned.

**Monitoring:**

Arrangements must be made for safety and health monitoring of the site on a regular basis. This will include, not only ensuring the safety issues associated with working at heights, excavations, working with energy sources, etc. but also environmental matters such as hazardous dust, fumes, noise etc. In all cases, the contractor's Site- In-charge shall ensure that daily site inspections are carried out by the contractor's Safety Officer, more in depth inspection being done periodically

by visiting safety advisor. It may be necessary for arrangements to be made for specialist occupational health and hygiene advice. The checklist for daily inspection is provided which must be included in the Behaviour Observation Process (BOP).

**Records:**

The prime contractor should ensure that all statutory notification, examinations and inspections are carried out. Except for equipment used exclusively by individual contractors, all records should be kept & updated by the contractor’s Site In-charge. This individual shall also keep track of all Safety statistics and send report to **GU** Project team on periodic basis, as determined by **GU** Project Manager.

**Non-Compliance with Safety and Health Provisions:**

The compliance with Environmental Health and Safety provisions is of utmost importance to the. The contractors must note that the will take a serious view of any Safety non-compliance notices. The has a right to order stoppage of work till rectification is carried out to the satisfaction of the safety committee or safe arrangements are made for the execution of work and all stoppages on this account will be at the entire risk, costs and consequences of the contractor.

**Disciplinary action:**

Noncompliance of the Safety and Health Provisions will result in disciplinary action as per the procedure below:1st time violation: Written warning

2nd time violation: Imposition of penalty as deemed fit by **GU** Project Manager3rd time violation: Removal from site

In the event of the offender bringing itself or others in direct life-threatening situation or where he/she creates a large material damage, will result in immediate removal from site. Repeated violations by a contracting company shall lead to termination of contract and removal of contracting firm from the job site. Any losses incurred by the contracting company, whatsoever, shall be the responsibility of contracting company.

**Imposition of penalties for non-compliance with EHS guidelines:**

The contractor will be required to comply with all the requirements laid down in these EHS guidelines, Special safety conditions, General conditions of contract and any other safety requirements as a matter of general prudence. Upon failure to comply with any of these, Project Manager is authorized to impose penalty on the contractor as per the details below:

<b>Schedule of Charges to Contractors who are in breach of the employer’s Site Safety, Site Safety Cycle and Environmental Rules and Regulations:</b>		
<b>S No.</b>	<b>Nature of Offence</b>	<b>Amount of Safety or Environmental Charge to be levied against the Sub Contractor for each breach of the employer’s Rules &amp; Regulations (Indian Rs)</b>
1	Smoking in an unauthorized area and/or consumption of alcohol and/or use of illegal substances.	Rs 1000.00
2	Burning of waste or smoldering of combustible materials on site other than for heat treatment processes required for the execution of the Sub Contract works.	Rs 3000.00

3	Failure to wear personal protective equipment (P.P.E.) e.g. Safety helmets, safety boots, goggles etc. respirator, ear plugs, safety belts which shall include failure to anchor belt to a secure structure.	1) Rs.1000.00 per worker when lack of enforcement of the usage of P.P.E. by the Contractor/ Sub-contractor is observed by the employer.
	Where any site operation requires the use of PPE then all workmen must use the required PPE eg. grinding, welding, burning, unloading hazardous materials etc.	2) Rs. 2,000.00 where issuance of the required P.P.E. by the Sub Contractor equipment is not carried out.
4	Failure to attend general safety induction course conducted by the employer / the employer.	1) Rs.5000.00 per worker for not attending the course; and
		2) Workers to attend course within 2 working days or be dismissed.

5	Failure to attend a notified site safety meeting.	Rs 5,000.00
6	Failure to submit, within the specified time to the employer, safety supervisor reports which shall include other relevant statutory reports made under the F&IUO Cap. 59, tool box briefing records, weekly Labour return, issuance of personal protective equipment records, safety data sheets of toxic and harmful materials and others related certificates.	Rs 5,000.00
7	Failure to submit a written report for an accident and/or other dangerous occurrence, to the employer within 24 hours of its occurrence.	Rs 5,000.00
8	Failure to carry out within the specified time the necessary improvement action against any notified safety violation.	Rs 8,000.00
9	Damaged to or misuse of the employer's property.	1) Rs. 5,000.00; and 2) in addition the Sub Contractor to pay for the cost of items damaged.
10	Failure to maintain work area, facility storage and preparation yard, office premises and workers changing and rest area in a clean and orderly state and free from health and fire hazards.	1) Rs 3,000.00; And 2) in addition the Sub Contractor shall clean up the disorderly and untidy areas within 3 days.
11	Obstruction of passageways, entrance, door, way's, stairs, access to firefighting equipment etc. and /or the erection unsafe access and crossing's	Rs 5,000.00 In addition sub-contractor shall clean up the disorderly and untidy areas within 1 day.
12	Use of equipment that has not been examined by an approved person as required under the factories and industries undertaking ordinance and its related regulations.	Rs 7,000.00
13	Use of defective or uncertified sling's for lifting operations	Rs. 8,000.00;
14	Executing unsafe hoisting of materials and include unsafe use of lifting appliance.	Rs 10,000.00
15	Erecting and / or using unsafe or unstable scaffolding, working platforms and temporary structures.	Rs 7,000.00
16	Failure to provide and use proper working platforms and safe means of access to the work place, where work is required to be carried out beyond person's normal reach.	Rs 10,000.00
17	Allowing workers to occupy or work on unguarded elevated platforms, floor edges and without adopting adequate safety measures against the risk of person falling from height.	Rs. 7,000.00;

18	Not providing safety barricades / barriers to hazardous floor edge, openings, gaps and shafts.	Rs.7,000.00;
19	Rendering scaffold or working platform unsafe by tampering / alternation.	Rs.10,000.00;

20	Placing of heavy items unsafely on scaffold or working platforms.	Rs 5,000.00
21	Throwing or allowing objects to drop from heights.	Rs.10,000.00
22	Stacking or leaving materials include work in progress articles and tools in unstable condition and or along flooredges such they are likely to endanger workers.	Rs 8,000.00;
23	Failure to effectively cordon off guard and warn other workers from entering into the danger areas when they are likely to be affected by falling materials from the sub-contractor work.	Rs 8,000.00
24	Violating the permit to work system	Rs 10,000.00
25	Dismantling and rendering any safety guards or protective features of any part of a machine or any part of building structure to extend that such guards and protective features are not operational or are incapable of providing the necessary protection for its design and purpose.	Rs. 10,000.00
26	Adopting unsafe tapping, connections and termination of electrical lines and including the use of defective electrical fittings, power cables and electrical tools. Allowing cables / equipment to be merged into water.	Rs 5000.00;
27	Using any defective or unsafe equipment.	Rs 5,000.00
28	Unauthorized use of fire equipment provided for emergency purposes.	Rs.5,000.00
29	Failure to comply with an order issued by the employer's construction manager, safety officer in regard to safety/environment matters.	Rs.8,000.00
30	Threatening safety personal, misbehavior, fighting or intentional causing hurt to others.	Rs.10,000.00
		Person to be banned from the site and report will be made to the police.
31	Failure to wear safety harness and anchor to a secure structure, while working at height.	Rs 5,000.00 if there is 2nd time violation by the same person or group attract penalty Rs. 10,000 or more
32	Failure to provide valid certificates for lifting appliances and accessories including any lifting appliance / accessories on vehicles delivering goods to the site.	Rs.8,000.00
33	Failure to provide voltage reducing device on welding machine.	Rs 4,000.00;
34	Failure to attend site safety walk	Rs 5,000.00
35	Deploying under age or over age worker worker or staff	Rs. 10, 000.00
36	Pregnant women to be not engaged at the construction site	Rs. 10, 000.00

37	Failure to provide site safety officer as per the requirement of latest ordinance.	Rs 10,000.00
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Note:-

Procedure of Debit:-

- A debit Note will be issued to vendors with the backup records of Non-Conformity and the Penalty amount will be debited from the Running Bill.
- Prior to the above a 'non conformity notice' shall be issued to give last opportunity to the vendor to comply therequirements.
- Please ensure that all OHSE NON –Conformities with debits are in the notice of client with acceptance before taking forward to the contactors.

### **SECTION 3: SAFETY AUDITS**

- 1) It is essential to conduct formal periodic safety audits to prevent deviations from safety standards.
- 2) The audit should take the form of a full survey covering all aspects of safety throughout the project site. Reports should be submitted to the Safety Committee. Copies of the results of a survey should be sent to the persons in charge of the respective areas so that corrective measures can be taken. A copy of the Audit report should also be sent to the ProjectHead.
- 3) Audit team should cover the following aspects:
  - Organization
  - Accident control
  - Hygiene facilities
  - Electrical systems
  - Fire prevention
  - Demarcated areas
  - Mechanical equipment
  - Safe work practices
  - Storage areas
  - Material stacking
  - Housekeeping
  - Safety statistics
  - Display of emergency numbers
  - MSDS sheets
  - Personal Protective Equipment
  - Safety training
  - Safety meetings
  - First aid facilities
  - Traffic control, Signage, etc.
- 4) Findings of the safety audits shall be sent to Safety committee and also be discussed in the Safety committee meetings.
- 5) Work place audits should also be carried out at job site frequently (at least every week) conducted by representatives of respective contractors to make sure that all Safety provisions are getting complied with. These should primarily focus on Safe working systems, Housekeeping, Machine guarding and use of PPE. Results of these audits shall be reported to the Safety committee.



#### **SECTION 4: ACCIDENT PREVENTION, REPORTING AND INVESTIGATION**

**Definition:**

An accident is commonly defined as: “An unplanned event which may or may not result in injury or damage”. As is clear from the definition, an accident need not necessarily involve either injury or damage to person or property. A “near miss” is by definition an accident and should be regarded as a warning that a problem exists and that some action is required to avoid a possible accident/ incident in future.

**Causes of Accidents:**

88% of all accidents are caused by human error, 10% are caused by mechanical failures and the other 2% are considered outside human control eg. Earthquake etc. The likely causes of accidents should be identified in advance and the appropriate action taken to ensure that the accident never actually takes place. The most important and effective accident prevention technique is training the actions and attitudes of all personnel.

**Accident Recording and Investigation**

It is essential to have an effective management system for recording accidents. All accidents should be thoroughly investigated. A near miss or incident should be investigated as though an accident had occurred. The prime objective of all investigations of this type is to identify the causes in order to eliminate the risk. Such aspects as systems training and guarding should all be considered in addition to what actually happened and why. The accidents record should include accidents to employees and non employees on company premises i.e. Contractors, construction workers, maintenance workers, visitors etc. and to those using company vehicles. Supervisory staff and, when possible, department personnel should be involved in any investigation relating to their area of control and should be delegated in writing to conduct a detailed analysis of the causes. They should determine how best to prevent a recurrence and this should be taken into account in the report. The depth of the investigation and the effectiveness of the follow up action should be monitored. Records of all accidents must be kept to enable statistics to be analyzed and root causes determined.

#### **Incident Control System**

Unsafe acts & conditions and “near misses”, if they are not dealt with appropriately, can turn into accidents. It is essential that companies operate an incident control system to ensure that these potential hazards are reported and eliminated. The system should;

- Ensure that whenever possible safety representatives and other employees are involved
- Encourage any person to register an unsafe action or conditions
- Ensure that reports are recorded and acted upon
- Identify the responsibility for investigation and for carrying out corrective action
- Specify the time within which the corrective action should be completed or progress reported
- Ensure that a report is made to management and to the originator when
- corrective action has been completed

#### **Levels of Accident Investigation:**

The type or level of accident investigation depends on the nature and seriousness of the incident. In most cases, an “Accident and Incident investigation panel will be formed which will determine the appropriate level of investigation.

#### **Types of Investigation:**

- A full investigation which requires a panel including a Project Manager, Safety Officer and Contractor’s Safetyrepresentative and GU Corporation Pvt Ltd project team representative or a panel as determined by Project Manager.
- A departmental investigation involving the departmental manager(s) the safety officers and the appropriate supervisor
- An investigation by the supervisor involving, where appropriate, the employees concerned

#### **Lost Time Accidents (LTA):**

This refers to the total number of accidents of all types which result in lost man hours. Lost man hours occur if the person involved is unable to return to normal duties immediately after any treatment.

#### **Reportable Accidents:**

When an employee, as a result of a lost time accident, is absent from work for more than two days (48 hour), then this will be recorded not only as a lost time accident but also a reportable accident. Brief details of each reportable accident and the steps taken to avoid repetition should be given in the Project Mangers monthly Report.

#### **Serious Accident:**

This is an accident which causes death or serious injury e.g. a broken limb, amputation serious burns etc., or hospitalization for one or more nights. In addition any escape of gases/toxics substances, which affect the environment and the surrounding area / community even if it does not cause injury to people, is considered a serious accident. This definition applies to employees and non employees, the yardstick that defines whether it is a serious accident in site terms is whether the victim was on company premises on company business, or using company equipment or transport. Thus if an operating company is in any way involved in a serious accident then it must be fully investigated and reported to company management.

#### **Incident / Near Miss:**

This can be described as an undesired event which, under slightly different circumstances, could have resulted in an accident.

**Reporting Accidents/ Incidents/ Near Misses:**

All Accidents/ Near misses must be reported to Project managers of the company immediately, with brief details. A preliminary report will then be submitted by the Project Manager to the Zonal Associate Director and Executive Director, as per the procedure outlined in Project Management firm's Standard Operating Procedures. A full and final report will subsequently need to be prepared and submitted. The contractor shall submit the report in the standardized format attached with these EHS guidelines.

**Reporting Accident Statistics:**

Accident statistics reported to company should be based on employees at job site. Accidents to non-employees (vendors or sub-vendors) should be reported as separate statistics.

**Statistical formulae:**

*Lost time Accidents:* This is the total number of accidents including all reportable and serious accidents

*Reportable Accident:* This is the number of accidents where an employee is absent from work for more than 48 hours consecutively (excluding the day of accident).

*Percentage man hours lost:* This is the total number of hours lost expressed as a percentage of total man hours worked. Total man hours lost X 100%

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Total man hours worked

The lost time accidents, reportable accidents and percentage man hours lost should be reported on a monthly basis as part of the Project Manager's review. The figures given in each category should be for the month under review, the year to date and the previous year to date.

**Accident Frequency rate:**

This is the total number of lost time accidents per 1 million man hours worked by permanent and temporary employees. Total number of lost time accidents X 1,000,000

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Total number of man hours worked

**Accident incident rate:**

This is the total number of any accidents per 1000 employees. Total number of lost time accident X 1000

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Average number of persons employed

For this calculation the total number of employees should be averaged out over the year. Part time employees should be included in proportion to the time worked. The accident frequency rate and accident incidence rate should be calculated annually and reported in the year end results. In addition to the statistics referred to above, all data pertaining to incidents must also be kept at site.

**SECTION 5: MANAGEMENT RESPONSIBILITY FOR SAFETY**

Management has the responsibility to ensure that a well developed Safety program is in place. The contractors are obligated to provide;

- Safe place of work, which includes safe means of access and exit during normal daily work routine as well as in emergencies
- Safe plant and equipment including the maintenance of it
- Safe systems of work. This includes safe working practices and work instructions for all jobs taking particular account of hazardous situations
- Safe working environment and proper arrangements for employee welfare. This responsibility includes proper lighting, ventilation, fume and dust extraction, noise control, housekeeping, seating, drinking water, sanitary facilities and a wide range of other factors
- Safe methods for storing, handling and transporting goods and substances
- Such information instruction, training and supervision as are necessary to ensure efficient and safe working practices, which comply with national legislation and company rules.
- Basic and job related safety training for all its and as well its Sub contractor's
- Temporary and permanent employees.
- Consultation with employee with a view to making and maintaining adequate and effective arrangements for health safety and welfare
- A written statement with respect to the health, safety and welfare of the employees containing details of procedures which will put the policy into effect and define individual responsibilities for safety
- Where accommodation provided in the GU CORPORATION PVT LTD premises, this must conform to the same safety and hygiene standards as other company premises, in respect of the premises itself and the working of any staff.
- Safe and correct work procedures must be followed for carrying out any construction activity.

#### **SECTION 6: SAFETY ORGANISATION**

The contractor/ contracting company shall appoint in writing a person to direct and co-ordinate job site safety program. This person should be a full time, technically qualified safety officer and must have received formal training in Health and Safety. In addition, the contracting company shall also appoint required number of safety stewards, as per prevailing Laws and regulations, but in any event, a Safety steward shall be on the job site at all times when work is ongoing. The duties and responsibilities of contractor's safety manager should be clearly defined at the outset, which will include managing the company health and safety program in order to achieve an accident free environment.

#### **Duties of contractor's Safety Manager**

The precise duties of the manager responsible for health and safety will be determined by the contractor/ contracting company concerned and the following should only be taken as a minimum guideline. In general the duties shall include:

- To manage the company Health and Safety program

- To make recommendations on matters concerning health and safety to the Director responsible for the company health and safety program in order to achieve the company's health and safety objectives To inspect all or part of the premises daily to ensure the program is being complied with To carry out full inspection at least once every week for potential hazards To prepare Pre task plans and make necessary modifications till they are accepted by Project Manager's Safety representative
- To recommend any necessary health and safety rules including changes where appropriate
- To arrange adequate materials and publicity for the Health and Safety Program
- To arrange, attend and supply relevant material for Safety Committee Meetings and weekly safety meetings
- To conduct appropriate job related health and safety training for all new and existing staff whether temporary or permanent. Any job change should be accompanied by relevant retraining.
- To carry out specific health and safety training for managers, supervisors and safety representatives.
- To properly investigate all accidents, damage to property and near miss incidents and make sure that any corrective action is implemented
- To maintain accident records and make a weekly inspection of first aid records and implement any necessary subsequent action
- To prepare weekly summaries of injury/damage and inspection reports for senior management
- To ensure that all fire equipment is regularly inspected and serviced.
- To ensure the provision of safe tools, equipments and protective clothing where appropriate, and their safe use.

#### **SECTION 7: SAFETY COMMITTEE**

Formation of a site specific safety committee is one of the best methods of obtaining employee involvement in safety. The committee should have formal status and its members shall include;

- Project Manager's Safety representative
- GU's Safety representative
- Contractor's safety representative
- Subcontractor's safety representatives
- Head – Site security
- Fire officer
- Any other members the management may decide to include

#### **Objectives of Safety Committees:**

The prime objective of a safety committee is to promote co-operation between employers and employees in order to investigate, develop and carry out measures designed to ensure the health and safety at work of the company's employees, non employees and other project participants on job site.

#### **Functions of Safety Committees:**

The key functions of Safety Committee shall include;

- To study the accident statistics and trends within their area
- To report on unsafe or unhealthy conditions together with recommendations which can then be made to management and the safety group
- Examining safety audits relating to their area
- Considering reports comments and suggestions of safety representatives
- Giving assistance in the development of safety rules/ systems of work
- Commenting on the effectiveness of the safety content of staff training program
- Commenting on the adequacy of health and safety
- Communications in the workplace including on-the-job safety meetings
- Co-operating with management in carrying out regular safety inspection of departmental areas and reporting the results of these inspections to the main safety committee.
- Organize safety training and demonstrations etc to make to make everyone aware about the safety procedures.
- Organize safety competitions for motivating people at site

The safety committees can only assist Management in taking decisions; they cannot substitute for Management. Management must still take overall responsibility for executive action with a view to ensuring that health and safety arrangements are checked regularly and that the health and safety policy as a whole is being implemented properly.

**SECTION 8: CONTACTOR'S SAFETY INSPECTION CHECK LIST**

Contractor Contract No. /Purchase order no -----

Project-----

Location-----

Type of Work-----

Date Checked By-----

S	ITEM	STATUS	REMARKS
	<b>Accident prevention Organization</b> Trained First Aid person First Aid Kit Safety Material Posted Emergency Phone # Posted		
	<b>Housekeeping &amp; Sanitation</b> General neatness of working areas Daily disposal of waste and trash Passageways and walkways clear Adequate lighting Projecting nails removed Oil and grease removed Waste containers provided & used Sanitary facilities adequate and clean Drinking water tested and approved Adequate supply of water Drinking cups, Clean Dispensers Exit sign posted		
	<b>Fire Prevention</b> Fire extinguishers identified, checked, charged Hydrants clear access to public thoroughfare Open Good Housekeeping		
	<b>NO SMOKING</b> posted and enforced where needed		
	<b>Personal Protection</b> Hard-hats Noise Level Exposure / Ear protection Eye Protection Safety Lines & harnesses Life Jackets (If necessary) Safety shoes / Gum Boots Gloves		
	<b>Electrical Installation</b> Adequate well insulated wiring Fuses & GFI provided Fire hazards checked Electrical dangers posted Open wires without adaptors not used Lock out / Tag out procedures used for maintenance of Electrical system, Temporary wiring not used as permanent installation. Personal protective equipment and clothing provided.		
	<b>Gas Cutting</b> Flash back arrester in all the gas cutting nozzles. Use of DA or industrial LPG only no domestic cylinders. Availability of fire extinguishers / water close by		
	<b>Hand &amp; Power Tools</b> Tools and cords in good condition Proper grounding All mechanical safeguards in use Tools neatly stored when not in use Right tool being used for the job at hand Wiring properly installed Enough men used to handle material Use of GFCI for tools used outdoors		
	<b>Ladders</b> Stock ladders in good condition Stock ladders not spliced Properly secured, top and bottom Side rails on fixed ladders extend above top landing Built-up ladders constructed of sound materials Rungs not over 12 inches on center Stepladders fully open when in use Metal ladders not used around electrical hazards Proper maintenance and storage		
	<b>Hoists, Cranes &amp; Derricks</b> Inspect cables and sheaves Check slings and chains, hooks and eyes Equipment firmly supported Outriggers used if needed Power lines inactivated, removed, or at safe distance Proper Loading for capacity at lifting radius All equipment properly lubricated and maintained Signalmen where needed Hoisting plan. Test certificate of all the lifting equipments.		



	All equipments should display the last inspection date and the next due date		
	<b>Motor Vehicles</b> Brakes, lights, warning devices or barricaded Weight limits and load sizes controlled Personnel carried in safe manner. Seat belts provided and used. Reverse horn in working condition, PUC certificate available		
	<b>Barricades</b> Floor opening planked over or barricaded Roadways and sidewalks effectively protected Adequate lighting provided Traffic controlled		
	<b>Handling &amp; Storage of Materials</b> Neat storage area, clear passageway Stacks on firm footings, not too high Men picking up		

S	ITEM	STATUS	REMARKS
	loads, correctly Materials protected from heat and moisture Protection against falling intohoppers and bins Dust protection observed		
	<b>Excavation &amp; Shoring</b> Shoring of adjacent structures Shoring and sheathing as needed for soil and Depth Public roads and sidewalks supported and protected Materials not too close to the edge of excavation Lighting at night Water controlled Equipment at safe distance from edge		
	<b>Concrete Construction</b> Forms properly installed and braced Adequate shoring, plumbed and cross braced Shoring remains in place until strength is attained Proper curing period and procedures Check heating devices Adequate runways Protection from cement dust Hard-hats, safety shoes, shirts covering skin Nails and stripped form material removed from area		
	<b>Masonry</b> Proper scaffolding Masonry saws properly equipped, dust protection provided Safe hoistingequipment		
	<b>Hoists, Cranes &amp; Derricks</b> Inspect cables and sheaves Check slings and chains, hooks and eyes Equipment firmly supported Outriggers used if needed Power lines inactivated, removed, or at safe distance Proper Loading for capacity at lifting radius All equipment properly lubricated and maintained Signalmen where needed Hoisting plan. Test certificate of all the lifting equipments. All equipments should display the last inspection date and the next due date		
	<b>Motor Vehicles</b> Brakes, lights, warning devices or barricaded Weight limits and load sizes controlled Personnel carried in safe manner. Seat belts provided and used. Reverse horn in working condition, PUC certificate available		
	<b>Barricades</b> Floor opening planked over or barricaded Roadways and sidewalks effectively protected Adequate lighting provided Traffic controlled		
	<b>Handling &amp; Storage of Materials</b> Neat storage area, clear passageway Stacks on firm footings, not too high Men picking up loads, correctly Materials protected from heat and moisture Protection against falling intohoppers and bins Dust protection observed		
	<b>Excavation &amp; Shoring</b> Shoring of adjacent structures Shoring and sheathing as needed for soil and Depth Public roads and sidewalks supported and protected Materials not too close to the edge of excavation Lighting at night Water controlled Equipment at safe distance from edge		
	<b>Concrete Construction</b> Forms properly installed and braced Adequate shoring, plumbed and cross braced Shoring remains in place until strength is attained Proper curing period and procedures Check heating devices Adequate runways Protection from cement dust Hard-hats, safety shoes, shirts covering skin Nails and stripped form material removed from area		
	<b>Masonry</b> Proper scaffolding Masonry saws properly equipped, dust protection provided Safe hoistingequipment		

#### SECTION 9: FIRST AID AND EMERGENCIES

##### **Trained First Aid Person**

A contractor shall provide, or ensure that required number of suitable persons as adequate and appropriate are provided in the circumstances for rendering first aid to people deployed at site if they are injured or become ill at work. The trained first aid person should have undergone:

- a) Such training and has qualifications as the Health and Safety Executive may approve for the time being in respect of that case or the class of case, and
- b) Such additional training, if any, as may be appropriate in the circumstances of that case. In practice, (a) refers to a trained first aider and (b) to an occupational first aider. In addition, a person who holds a current first aid certificate issued by registered medical association or Indian Red Cross Society will be classed as a "Suitable Person" for the purposes of regulation. The contractors shall ensure that sufficient first aides are appointed to provide adequate coverage for each shift. Provisions for medical care must be made available by the contractor for every employee covered by the regulations. In the absence of dispensaries, clinics, or hospitals in proximity to the work site, properly trained and certified first aid personnel

must be available, and first aid supplies must be provided by the contractor. Appropriate equipment for transportation of injured personnel to a physician or hospital must be provided for. An emergency plan, medical care, firefighting and evacuation plan must be developed by the main contractor.

**First Aid Kit:**

Regardless of the number of people there must be at least one first-aid box on site. Every first aide and occupational first aider should have easy access to first-aid equipment, and provision should be made for every person to have reasonably rapid access to first aid. Each box should be placed in a clearly identified and readily accessible location, and contain asufficient quantity of suitable first-aid materials and nothing else. Boxes and kits should be checked frequently to ensure they are fully stocked and all items are in a usable condition. Sufficient quantities of each item should always be available in every first aid box or cabinet.

S.No	Item	Numbers of People working at Site				
		1-5	6-10	11-50	100	150
1	Guidance card individually wrapped	1	1	1	1	1
2	Sterile adhesive dressings	10	20	40	40	40
3	Sterile eye pads with attachment	1	2	4	6	8
4	Triangular bandages	1	2	4	5	8
5	Sterile coverings for serious wounds	1	2	4	5	8
6	Safety pins	6	6	12	12	12
7	Medium sized sterile un-medicated	3	6	8	10	12
8	large sterile un-medicated dressings	1	2	4	6	8
9	X-large sterile un-medicated dressing	1	2	4	6	8
10	Sterile water in 300 ml disposable containers, where tap water unavailable	1	1	3	6	6

The first-aid box or cupboard should protect the content from dampness and dust and be clearly marked with a white cross on green background

**First Aid Rooms:**

Where there are 250 or more persons at work on site, a suitably staffed and equipped first-aid room should be provided. In addition, where there is a large (over 150) number of employees divided into several dispersed working groups, or the location of the site makes access to places of treatment outside difficult, the contractor should consider whether a centralized first-aid room may be needed. A First aid room should:

- Be under the charge of an occupational first aider in most circumstances: names and locations of all first aiders should be displayed
- Be readily available and used only for the rendering of first aid
- Be clearly identified and of sufficient size to allow access for a stretcher, wheelchair, etc. And hold a couch withspace for people to work around it
- Contain in addition to the previously mentioned first aid materials: a sink with hot and cold running water, drinking water, paper towels, impermeable work surfaces, clean garments for use by first aiders and occupational first aider’s clinical thermometer a couch with pillow and blankets frequently cleaned
- Be heated, lighted, ventilated and cleaned regularly
- Be designed so that immediate contact can be made with the person on call, e.g radio, siren, and a telephone linkif feasible. It should be stressed that a sufficient number of first-aid boxes must be provided for any work area, which is not within easy reach of the first aid room.

**Emergency Phone # Posted**

Project name-----

Project No. -----

=

The following are the business telephone numbers where project key personnel can be reached at all times. In addition, the emergency telephone numbers of other vital agencies are listed:

**BUSINESS RESIDENCE**

Project Manager

GU Project Manager

Contractor Safety Officer

Fire/ Security officer

#### **OTHER EMERGENCY TELEPHONE NUMBERS**

Fire :

Ambulance :

Doctor :

Hospital :

Police :

Gas Company :

Electric Company :

Water Company :

Telephone Company :

Insurance Carrier :

#### **SECTION 10: HOUSEKEEPING AND SANITATION**

At the work site, an adequate supply of potable water must be provided, as well as clean drinking water dispensers. Potable water for clean up must be provided. Where non potable water is used for industrial or fire fighting purpose it must be identified by appropriate signs.

Apart from the above, the contractor has to adhere to general neatness of working areas, daily disposal of waste and trash, maintenance of clear passageways and walkways, providing adequate temporary lighting and ventilation (both natural as well as artificial) to perform the project related works, removal of projecting nails, removal of oil and grease, removal of loose unused construction material, provision for waste containers, and maintaining adequate sanitary facilities for the work force. The contractor and in turn its sub-contractors shall be responsible for cleaning behind them on daily basis. The accumulation of construction materials/ debris shall not be permitted at any location.

#### **SECTION 11: FIRE PREVENTION**

An emerging plan for firefighting and evacuation must be made. A training plan must be developed. Electrical wiring equipment for heating, light or power purposes must be installed in compliance with the statutory requirements. Internal combustion engine-powered equipment must be located with exhausts well away from combustible materials. Smoking is to be prohibited in the vicinity of fire hazards, and such areas must be conspicuously posted. Care shall be taken properly to ground nozzles, hoses or steam lines used in hazardous tanks or vessels. In location of temporary buildings and yard storage, appropriate care shall be taken for proper separation to allow an accumulation of fire potential. The contractor is responsible for maintaining the entire construction area, but particularly storage areas, free from accumulation of unnecessary combustible materials. Sufficient fire extinguishers must be installed in all temporary buildings and storerooms. The contractor must identify and maintain proper escape routes at the project site in the event of a fire emergency. The escape routes should be sufficient in number and free from any encumbrances. All the workers as well as others working at job site should be made aware of them through training, mock drills and posting of exit signs. The contractor, consultation with the Project Manager must identify a "Mustering point" where all the workers would be required to gather in the event of fire. The contractor must generate an "Evacuation Procedure" in the event of fire and post it at multiple locations on the project site. The assembly area should be clearly defined and marked out. The procedure should include what should be done to the ongoing activity when such a situation arises, which escape routes to follow, safe location to gather, who to call (with telephone numbers), how to inform the site security, etc.

#### **Site Fire Check List**

- Are safe ashtrays provided where smoking is permitted? And are fire extinguishers installed?
- Are heaters properly guarded?
- Are wet clothes kept clear of heaters?
- Are portable heaters secure from being knocked over?
- Is all temporary wiring well supported and protected?
- Are any circuits overloaded?
- Are all flammable liquids, gas cylinders and flammable materials separately and properly stored?
- Are all gas appliances fitted with control taps?
- No burning of rubbish is permitted outside
- Is all flame cutting and welding taking place with proper precautions?
- Are all blow lamps and blow torches being used correctly and all the hoses protected?
- Do all night watchmen and security patrols know the fire routines?

**Preventing the spread of fire:**

- Is waste accumulating in hoist shafts, under belts, in odd corners?

- Are separate metal waste containers supplied for each of the following : oily rags, paint rags, paint scrapings,waste flammable liquids, wood shavings and offcuts?
- Is all waste regularly cleared?
- Are all huts safely located?

**Means of escape:**

- Are all gangways, stair and platforms free from obstruction?
- Does everyone know what to do in an emergency?
- Is fire drill practiced, and is there a system to ensure that all persons have evacuated the area?

**Fire Fighting:**

- Have all extinguishers been checked and / or recharged?
- Are they clearly identified and easily accessible?
- Are operatives trained in their use?

**SECTION 12: PERSONNEL PROTECTION**

The required personnel protective equipment (PPE) should be worn at all times. The contractor is encouraged to supply comfortable personnel protective equipment to the site workers. All necessary personnel safety equipment as considered adequate by the Engineer-in-charge shall be available for use of persons employed on the site and maintained in a condition suitable for immediate use, and the contractor shall take adequate steps to ensure proper use of equipment by those concerned. Irrespective of the type of work being performed, contractor will have 100% compliance with Safety hard hats, safety glasses and safety shoes. In addition for specific works described below though not limited to these only, additional safety precautions as stated will be taken by the contractor. Workers employed on mixing asphalt materials, cement and lime mortars/ concrete shall be provided with protective footwear and protective gloves. Those engaged in handling any material which is injurious to eyes shall be provided with protective goggles. Special protective goggles must be used by graining,sawing and drilling. Those engaged in welding works shall be provided with welder's protective eye-shields. Stone workers are employed in sewer and manholes, which are in use, the contractor shall ensure that manholes are ventilated at least foran hour before workers are allowed to get into them. Manholes so opened shall be cordoned off with suitable railing andprovided with warning signals or boards to prevent accident to public

During these activities in sewers and manholes, regular monitoring of oxygen levels and the presence of explosive mixtures and toxic gases are to be controlled. Suitable face masks shall be supplied for use by workers during painting work. Overalls shall be supplied by the contractor to workmen and adequate facilities shall be provided to enable working painters to wash during and on cessation of work. Special care should be taken with regards to the hygiene of the temporary facilities.

**SECTION 13: ELECTRICAL INSTALLATION**

The National Indian electric codes and regulations shall apply to all permanent and temporary electrical installations. A temporary power distribution system shall be installed in accordance with the national codes All other temporary connections and sub distribution systems shall be connected to this main system. All temporary power systems shall be properly grounded. Circuit breakers (incl. fuses) shall be used in all temporary power connections for system and cable protection. All wires shall be colour coded in accordance with the national codes. All electrical cables shall consist of solid copper conductors (stranded wires shall not be used). Only certified electricians will be allowed to enter high tension station, transformer and low voltage areas. All electrical installation work and all connections to the main power distribution system shall be done by qualified electricians from certified contractors. Usage of 30Ma ELCB as per IE guidelines (or as stated inits subsequent revisions)



**SECTION 14: LADDERS**

Work activities situated above 2.5m from ground floor level Precautions shall be made to avoid workers from falling down. For work above 2.5m from ground level, proper scaffolds need to be erected. No metal ladders to be used around electrical hazards. Special attention shall be paid to the material of the ladder for the type of work to be performed i.e. whether the ladder shall be metal or wooden.

**Use of ladders and folding step ladders**

This regulation applies to all ladders and pairs of steps but not roof ladders and crawling boards. Ladders must:

- Be fixed near the top if practicable, or near the bottom if not: if suspended they must be secure.
- Be placed (except when suspended) on a firm level base; they must not stand on loose packing (eg. Bricks)
- Be intermediately secured, where necessary, to prevent swaying and sagging

- Be supported, or suspended, equally on each stile.
- When working on a ladder above 2.5m, fall protection must be used.
- Extend at least 1.05m above any landing place beyond the highest rung from which a person may be working or have a nearby handhold of equivalent height.
- Be placed so that there is space behind each rung for proper foothold (eg. No rung should coincide with a scaffold tube)

#### **SECTION 15: SCAFFOLDING**

##### **Work activities above 2.5m from the ground level:**

Precautions shall be made to avoid workers from falling down. For work **above 2.5m above a floor** level proper scaffolds need to be erected. Ladders properly secured can be used, but only for light work which can be done with one hand.

##### **Supervision of work and inspection of material:**

Scaffolds must be erected, altered or dismantled only under competent supervision and as far as possible, by experienced persons. All scaffolding materials must be inspected before use to check that they are up to standard. All inspected scaffolds must bear a sign "ready for use".

##### **Construction and material:**

Sufficient sound material must be provided for a scaffold to be strong and stable enough for the job. Wherever timber is used for any kind of scaffolding purpose, it must be of the right type for the job and must not be painted so that any defects are hidden. Scaffold tubes and fittings must not be bent, distorted or unduly rusty.

##### **Defective material:**

Scaffold tubes, couples or fittings that are bent unduly rusty or distorted should be rejected. Timber with dangerous splits and knots should always be rejected. Ropes and lashings showing signs of chafing through wear, or of being corroded, should be rejected. All scaffold components must be properly stored when not in use and kept separately from all other building materials

##### **Maintenance of scaffolds:**

Scaffolding must be kept in good order and every effort made to prevent the accidental displacement of any part.

##### **Partly erected or dismantled scaffolds:**

If any scaffold is either partly erected (or partly dismantled), but nevertheless is still capable of being used to some extent, it must have a bold warning notice fixed, or all access blocked off or barred, at the point beyond which it cannot be safely used.

##### **Standards or Uprights, Ledgers and Putlogs:**

Scaffold standards should be vertical and spaced closely enough for the intended use of the scaffold. Base plates must be used. Timber sole plates should also be used to distribute the

load from the standard over a wide area, as well as to offset possible local subsidence. Ledgers must be level and fixed to standards with right-angle couplers. Putlogs and transoms must be firmly fixed to ledgers or standards. The flattened end of the putlog must be pushed right into the wall to provide maximum support. Putlogs and transoms should be spaced according to the expected load and the thickness of the boards to be used in the platform. In normal use, putlogs and transoms should be spaced so that the spans of scaffold boards should not be greater than :

32mm boards: 1m 38mm

boards: 1.50 m 50mm

boards: 4.60 m

##### **Ladders used in Scaffolds:**

Ladders used as uprights must be:

- Strong enough to carry the load of both the work and the workers.
- Equally supported on each side.
- Secured to prevent slipping.

Ladders to be placed under an angle of 70 ° with the vertical and shall extend 1m above the railing. Ladders are only to be used to support a scaffold platform when the work is light, e.g., painting.

**Stability of Scaffolds:**

All scaffolds must be:

- On a solid, even base ; or suspended from a sound structure
- Braced to prevent failure, and
- Tied to the building or structure unless specially designed to be completely independent.
- Any building or structure which supports a scaffold must be strong enough to carry the scaffold and its load
- A scaffold only used as a working platform for workers when a scaffold also used to store material etc, a calculation is needed to check if that scaffold is safe to carry the total load. Mobile scaffolds must:
  - Be stable, weighted at the base if necessary
  - Be used only on a flat, level surface.
  - Have the wheels locked to prevent movement whilst being used for work,

- Be pushed, or pulled only at the base when being moved. Scaffolds must not be built on loose bricks, drain pipes, chimney pots, etc. Bricks or blocks can be used to support a platform no higher than 600mm from the ground or floor.

#### **Slung Scaffolds**

- Be strong enough
- Be properly secured to be overhead anchor-ages and to be platform frame,
- Be spaced so as to keep the platform stable,
- Be vertical, and
- Be kept straight
- No rope other than wire rope may be used for suspension
- Packing must be used to prevent damage to suspension ropes or chains at any point where sharp or rough-edged protrusions could cause chafing.
- The platform must be secured to prevent swaying whilst in use.

#### **Cantilever, Jib figure and Bracket scaffolds:**

Cantilever or jib scaffolds must be anchored to a structure which is strong enough to carry the total load Outriggers must be long enough and strong enough and the scaffold must be braced to ensure stability. Figure or bracket scaffolds supported by dogs or spikes must not be used if there is any danger of these pulling out of the brickwork or stone-work.

#### **Support for Scaffolds:**

No part of the building may be used to support scaffolding unless it is strong enough to do so. Unless gutters have been designed as walkways and are strong enough to bear the weight, they must not be used to support scaffolding or ladders.

#### **Suspended Scaffolds (Not Power Operated)**

The ropes, winches, block and tackle must be strong enough and correctly rigged. A safe anchorage for the suspension must be provided.

#### **Winches or similar lifting devices must:**

- a. have brakes which apply when the operating lever is released, and
- b. be protected from the weather, falling dirt, etc.

#### **Outriggers must:**

- a. be long enough and strong enough,
- b. be horizontal (light cradles are excepted)
- c. have stops at their outer ends (light cradles excepted)
- d. be tied down or properly counter-weighted at the tail, and
- e. be close enough together to support the rails and scaffolds properly .

#### **Counterweight Must**

- a. be bolted or securely attached to the outriggers, and

#### **Runways must:**

be strong enough and in good condition, have stops at each, and be bolted or tied securely to their supports

**Platforms of suspended scaffolds must:** be closely boarded be at least 430mm wide on light weight cradles and be atleast 600mm wide on all other types, if used only for workmen, or be at least 800mm wide, if used for workmen and materials Never be used to carry higher platform

Platforms should be as close as possible to the face of the building but where persons sit on the edge of the platform to carry out their work then the distance between platform and building can be upto 300mm

**Winches must:**

Have at least two full turns of rope on the drum when the platform is in its lowest position and

Be marked with the length of rope on the drum Suspended scaffolds and associated equipment must be maintained in good conditions. Platforms must be prevented from tipping or swaying whilst in use. Steel wire rope must be used for the suspension for all platforms other than light weight cradles Light cradles may be suspended by fibre ropes and pulley blocks which should not be more than 3.20m apart. (Only ropes recommended by manufacturers for this purpose should be used)

**Boatswain's Chair's Cages, Skips etc. (Not Power Operated)**

Hand-operated boatswain's chairs, skip etc. must:

- Be well constructed, strong enough, and properly maintained
- Have outriggers strong enough and firmly anchored,
- Have chains, ropes and lifting gear firmly secured to the outriggers above and to the chair, skip etc. The construction (lifting operations) regulations apply to the lifting gear,
- Be designed so that the occupant cannot fall out
- Carry no loose materials which could interfere with the safety of occupant
- Have means of preventing spinning and tipping (a swivel connection at the suspension points is strongly advised)
- In the case of skips, be at least 910 mm deep
- Be under the supervision of a competent person during installation and use, and
- A boatswain's chair may only be used as a workplace when the work would not take long enough to make the use of a suspended (or standard) scaffold reasonably practicable.
- Persons working in these must wear fall protection harnesses connected to a rope or chain separate from the chair or skip suspension rope or chain.

## **SECTION 16: HOISTS, CRANES AND DERRICKS**

### **Safety of Hoist ways, Platform and Cage:**

Hoist ways must be enclosed wherever access is provided or wherever persons could be struck by the platform or other moving parts. Gates must be fitted in the enclosure at all landing places and must normally be at least 2m high, but gates 910 mm high are acceptable where persons are not at the risk of falling down the hoist ways or coming into contact with moving parts. Gates must be kept closed except for the movement of men and materials; it is the duty of all persons to ensure it is done. Hoists platforms and cages must be fitted with a device capable of supporting them, fully loaded, should hoists, ropes or driving gear fail. Hoists must be fitted with verrun stops at the top.

### **Operation of Hoists**

- a) Hoists must only be capable of being operated from one position at a time, whether by rope, lever or switch. Hoists must not be operated from the cage.
- b) Where the hoist driver cannot see the platform or cage during its movement, a signaling system, which covers all landing places, must be used.
- c) All hoists, prior to their use, have to be inspected by a competent person

### **Safe Working Load and Marking of Hoists**

- a) The platform of materials or goods hoists must carry a notice stating
  - (i) the safe working load and
  - (ii) that the passenger must not ride on platform

The safe working load must not be exceeded except for test purposes.

- b) Cages for passengers hoists must carry a notice stating
  - (i) the safe working load and
  - (ii) the number of passengers permitted.

No greater number of passengers may be carried and safe working load must not be exceeded except for the test purposes.

## **SECTION 17: MOTOR VEHICLES**

A site traffic plan must be developed at the beginning of the project to control all traffic on site and movement of materials, parking etc. Motor equipment left unattended at night near areas where work is in progress must have appropriate lights, reflectors or barricades to identify the locations of the equipment. A safety tie rack, cage, or equivalent protection must be used

when a worker is inflating, mounting, tires installed on split rims or rims equipped with locking rings. Heavy machinery that is suspended or held aloft by the use of slings, hoists, or jacks must be blocked or cribbed to prevent falling or shifting before employees are permitted to work under them. Bulldozer and scraper blades and similar equipment shall be either fully lowered or blocked when being repaired or when not in use. All controls must be in the neutral position and the motor stopped and brakes set, unless work being performed requires otherwise. Parked equipment must be checked and parking brakes set. All cab glass shall be safety glass. All vehicles must have a service brake system, an emergency brake system, and a parking brake system. Vehicles that require additional light shall have at least two headlights, as well as brake lights. The vehicles must also be equipped with back horn which automatically sets off as and when the vehicle is in reverse gear. Other standard vehicles equipment such as seat belts, rear-view mirrors and safety latches on operating levers shall be in accordance with standard vehicle codes, and state-inspected where appropriate. The authorized individuals with valid driving license only shall be allowed to drive.

**SECTION 18: BARRICADES**

- (i) Contractor shall erect and maintain barricades required in connection with its operation to guard or protect,

- a) Hoisting areas.
- b) Areas adjudged hazardous by contractor's safety management and/ or Project Manager's Inspectors
- c) 's existing property subject to damage by the contractor's operations
- (ii) Contractor's employees and those of his subcontractors shall become acquainted with Project Managers barricading practice and shall respect the provisions thereof.

**Guarding of floor opening and floor holes:**

Every temporary floor opening shall have railings, or shall be constantly attended by Supervisors appointed by Contractor's safety officer / Manager. Every floor hole into which persons can accidentally fall shall be guarded by either:

- a) A railing with toe board on all exposed sides, or
- b) A floor hole cover of adequate strength and it should be hinged in place. When the cover is not in place, the place the floor hole shall be constantly attended by some one or shall be protected by a removable railing. Barricades must be strong enough to carry the weight of people. Every stairway floor opening shall be guarded by a railing on all exposed sides, except at entrance to stairway. Every ladder way floor opening or platform shall be guarded by a guard railing with toe board on all exposed sides (except at entrance to opening) with the passage through the railing either provided with a swinging gate or so offset that a person can not directly into the opening.

**Guarding if open-side floors and platform**

Every open-sided floor or platform 120cm or more above adjacent floor or ground level shall be guarded by a railing (or the equivalent) or all open sides except where there is entrance to ramp, stairway or fixed ladder. The railing shall be provided with a toe board beneath the open sides wherever,

- (a) Persons may pass,
- (b) there is moving machinery and
- (c) there is equipment with which failing materials could create a hazard

**SECTION 19: HANDLING AND STORAGE OF MATERIALS**

**Cement:**

Storage and stacking: Cement shall be stored at the work site in a building or a shed which is dry, leak proof and moisture proof. The building or shed for storage should have minimum number of windows and close fitting doors and these should be kept closed. Cement received in bags shall be kept in such a way that the bags are kept free from the possibility of any dampness or moisture coming in contact with them. Cement bags shall be stacked off the floor on wooden planks in such a way as to keep them 150 to 200mm clear from the floor and space of 450mm minimum shall be left all round between the exterior walls and in the stacks. In the stacks the cement shall be kept close together to reduce circulation of air as much as possible. Owing to pressure on bottom layer of bags sometimes 'warehouse pack' is developed in these bags. This can be removed easily by rolling the bags when cement is taken out for use. The height of stack shall not be more than 15 bags to prevent the possibility of lumping up under pressure. The width of the stack shall be not more than four bags length or 3m. In stacks more than eight bags high, the cement bags shall be

arranged alternately lengthwise and crosswise so as to tie the stacks together and

minimize the danger of toppling over. For extra safety during monsoon or when it is expected to store for an unusually long period, the stack shall be completely enclosed by a water proofing membrane such as polyethylene, which shall close on the top of the stack. Care shall be taken to see that the waterproofing membrane is not damaged any time during the use. Drums or other heavy containers of cement shall not be stacked more than two



layers high. The manner of storage shall facilitate the requirement that lots of cement received are removed and used more or less in the order in which they are received.

Handling – Hooks shall not be used for handling cement bags unless specifically permitted by the engineer-in-charge.

**Polyethylene pipes**

(a) Storage & stacking:

Black polyethylene pipes may, be stored either under cover or in the open. Natural polyethylene pipes however, should be stored under cover and protected from direct sunlight. Coils may be stored either on edge or stacked flat one on top of the other, but in either case they should not be allowed to come into contact with hot water or steam pipes and should be kept away from hot surface. Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set. Storage of pipes in heated areas exceeding 270 C should be avoided.

(b) Handling: Removal of pipe from a pile shall be accomplished by working from the ends of the pipe.

**Pipes of conducting materials:**

(a) Storage and stacking: Pipes shall be stacked on solid level sills and contained in a manner to prevent spreading or rolling of the pipe. Where quantity storage is necessary suitable packing shall be placed between succeeding layers to reduce the pressure and resulting spreading of the pile. In stacking and handling of pipes and other conducting materials the following minimum safety distances shall be ensured from the overhead power line:

11KV and below 40m

Above 11 and below 33KV 60m Above

33 and below 132KV 70m Above 132

and below 275KV 70m Above 275 and

below 400KV 50m

(b) Handling: Removal of pipes from a pile shall be accomplished by working from the ends of the pipe. During transportation, the pipes shall be so secured as to ensure against displacement.

#### **Paints, Varnishes and Thinners:**

(a) Storage and stacking: Paints, varnishes lacquers, thinners and other flammable materials shall be kept in properly sealed or closed containers. The containers shall be kept in a well ventilated location, free from excessive heat, smoke, sparks or flame. The floor of the paint stores shall be made up of 10cm thick loose sand and stored in a collection drip pan to prevent leakage's to the ground and/or the soil.

Paint materials in quantities other than required for daily use shall be kept stocked under regular storage place. Where the paint is likely to deteriorate with age the manner of storage shall facilitate removal and use if lots in the same order in which they are received. Temporary electrical wiring / fittings shall not be installed in the paint store. When electric lights, switches or electrical equipment are necessary, they shall be of explosion proof design.

(b) Handling: Ventilation shall be adequate to prevent the accumulation of flammable vapors to hazardous levels of concentration shall be provided in all areas where painting is done.

When painting is done in confined spaces where flammable or explosive vapors may develop any necessary heat shall be provided through duct work remote from the source of flame. Sources of ignition such as open flame and exposed heating elements shall not be permitted in area or rooms where spray painting is done nor shall smoking be allowed there. Care should be taken not to use any naked flame inside the paint store. Buckets containing sand shall be kept ready for use in case of fire. Fire extinguisher when required shall be of foam type conforming to accepted standards.

#### **Bitumen, Road Tar, Asphalt etc.:**

(a) Storage and stacking: Drums or containers containing all types of bitumen, road tar, asphalt etc. shall be stacked vertically on their bottoms in upto 3 tiers. Leaky drums shall be segregated and either their contents shall be emptied into intact drums or contained in larger containers. All spillages or leakages onto natural soil shall be immediately cleaned up and placed in a contained area. Empty drums shall be stored in pyramidal stacks neatly in rows.

(b) Handling: Bitumen / Tar – Bitumen / tar shall not be heated beyond the temperature recommended by the manufacturer of the product. While discharging heated binder from the boiler, workers shall not stand opposite to the jet so as to avoid the possibility of hot binder falling on them. The container shall be handled only after closing the control valve. While handling hot bitumen / tar, workers shall exercise scrupulous care to prevent accidental spillage thereof. The buckets and cans in which the hot material is carried from boiler shall be checked before use to ensure that they are intact and safe. Mops and other applicators contaminated with bituminous materials shall not be stored inside buildings

#### **Bituminous roofing felts:**

(a) Storage and stacking: Bituminous roofing felts shall be stored away from other combustible, flammable materials. For long storage it shall be kept under shade.

(b) Handling: Bituminous roofing felts should be handled in a manner to prevent cracking and other damages

**Flammable materials:**

(a) Storage and stacking: In addition the following provisions shall also apply: Outdoor storage of drums required some care to avoid contamination because moisture and dirt in hydraulic brake and transmission fluid, gasoline or lubricants may cause malfunction of failure or equipment with possible danger to personnel. The storage area should be free of accumulations of spilled products, debris and other hazards and Compressed gases and petroleum products shall not be stored in the same building or close to each other.

(b) Handling: Petroleum products delivered to the job site and stored there in drums shall be protected during handling to prevent loss of identification through damage to drum markings, tag, etc. Unidentifiable petroleum products may result in improper use with possible fire hazard damage to equipment or operating failure. Workmen shall be required to guard carefully against any part their clothing becoming contaminated with flammable fluids. They shall not be allowed to continue work when their clothing becomes so contaminated. All flammable and toxic liquids shall be stored in suitable collecting drip pans to avoid spill contamination into the ground/soil. All workers shall be provided training as part of the induction as to how to correctly handle and lift materials and the maximum load they can lift or handle at any point.

**SECTION 20: EXCAVATION AND SHORING**

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Excavation and Trenching: All trenches, 1.5m or more in depth, shall at all times be supplied with at least one ladder for each 30m in length or fraction thereof. Ladder shall be extended from bottom of trench to at least 1meter above surface of the ground. Sides of a trench which is 1.5m 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. Excavated material shall not be placed within 1.5m of edge of trench of half of depth of trench, whichever is more cutting undermining or undercutting be done. Safety procedures for the operation of the excavation and grading equipment (such as the safe distance from excavations) should be developed.

## **SECTION 21: CONCRETE CONSTRUCTION**

### **Handling of plant**

Mixers: All gears, chains and rollers of mixers shall be properly guarded. If the mixer has a charging skip the operator shall ensure that the workmen are out of danger before the skip is lowered. Railings shall be provided on the ground to prevent anyone walking under the skip while it is being lowered. All cables, clamps, hooks, wire ropes, gears and clutches etc. of the mixer, shall be checked and cleaned, oiled and greased and service once a week. A trial run of the mixer shall be made and defects shall be removed before operating a mixer. When workmen are cleaning the inside of the drums and operating power of the mixer shall be locked in the off position and all fuses shall be removed and a suitable notice hung at the place.

### **Trucks:**

When trucks are being used on the site, traffic problems shall be taken care of. A reasonably smooth traffic surface shall be provided. If practicable, a loop road shall be provided to permit continuous operation of vehicles and to eliminate their backing. If a continuous loop is not possible a turnout shall be provided. Backing operations shall be controlled by a signalman positioned so as to have a clear view of the area behind the truck and to be clearly visible to the truck driver. Movement of workmen and plant shall be routed to avoid crossing as much as possible the truck lanes.

### **Formwork:**

Formwork shall be designed after taking into considering spans, setting temperature of concrete, dead load and working load to be supported and safety factor for the material used for formwork. All timber formwork shall be carefully inspected before use and members having cracks and excessive knots shall be discarded The vertical supports shall be adequately braced or otherwise secured in position that these do not fall when the load gets released or the supports are accidentally hit. Tubular steel centering shall be used in accordance with the manufacturer's instructions. When tubular steel and timber centering isto be used in combination necessary precautions shall be taken to avoid any unequal settlement under load.

### **All centering shall be finally inspected to ensure that:**

- a) Footings or sills under every post of the centering are sound
- b) All tower adjustment screws or wedges are snug against the legs of the panels.
- c) All upper adjustment screws or heads of jacks are in full contact with the formwork.
- d) Panels are plumb in both directions.
- e) All cross braces are in place and locking devices are in closed and secure position.
- f) In case of chajjas and balconies the props shall be adequate to transfer the load to the supporting point.

### **Ramps and gangways:**

Ramps and gangways shall be of adequate strength and evenly supported. They shall either have a sufficiently flat slope or shall have cleats fixed to the surface to prevent slipping of workmen. Ramps and gangways shall be kept free from grease, mud, snow or other slipping hazards or other obstructions leading to tripping and accidental fall of workman. Ramps and gangways meant for transporting materials shall have even surface and be of sufficient width and provided with skirt boardson open sides.

---

**Pre-stressed concrete:**

In pre-stressing operations, operating, maintenance and replacement instructions of the supplier of the equipment shall be strictly adhered to. Necessary shields should be put up immediately behind the pre-stressing jacks during stressing operations. Wedges and other temporary anchoring devices shall be inspected before use. The pre-stressing jacks shall be periodically examined for wear and tear. A spreader beam shall be used wherever possible so that the cable can be as perpendicular to the members being lifted as practical. The angle between the cable and the members to be lifted shall not be less than 60°. Methods of assembly and erection specified by the designer, shall be strictly adhered to at site. Immediately on erecting any unit in position, temporary connections or supports as specified shall be provided before releasing the lifting equipment. The permanent structural connections shall be established at the earliest opportunity.

**Heated concrete:**

When heaters are being used to heat aggregates and other materials and to maintain proper curing temperatures, the heaters shall be frequently checked for functioning and precautions shall be taken to avoid hazards in using coal, liquid, gas or any fuel.

## **SECTION 22: MASONARY WORK**

### **Walls**

General: Depending on the type of wall to be constructed the height of construction per day shall be restricted to ensure that the newly constructed wall does not come down due to lack of strength in the lower layers. Similarly, in long walls adequate expansion / crumple joints shall be provided to ensure safety.

Opening in walls: Whenever making of an opening in the existing walls is contemplated, adequate supports against the collapse or cracking of the wall portion above or roof or adjoining walls shall be provided. Guarding of wall openings and Holes: Wall opening barriers and screens shall be of such construction and mounting that they are capable of withstanding the intended loads safely. For detailed information reference may be made to good practice. Every wall opening from which there is a drop of more than 120mm shall be one of the following: Rail, roller, picket fence, half door or equivalent barrier: The guard may be removable but should be preferable be hinged or otherwise mounted so as to be conveniently replaceable. Where there is danger to persons working or passing below on account of the falling materials, a removable toe board or the equivalent shall also be provided. When the opening is not in use for handling materials the guards shall be kept in position regardless of a door in the opening. In addition a grab handle shall be provided on each side of the opening. The opening should have a sill that projects above the floor level at least 2.5cm. Extension platform into which materials may be hoisted for handling, shall be of full length of the opening shall be of full length of the opening and shall have side rails or equivalent guards. Every chute wall opening from which there is a drop of more than 120mm shall be guarded by one or more of the barriers specified in 16.2.1 or as required by the conditions.

## **SECTION 23: HEALTH & HYGIENE STANDARDS**

### **Drinking water:**

- a) 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.
- b) 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.
- c) Every water supply or storage shall be at a distance of not less than 50 feet from any latrine drain or any other source of pollution.

### **Washing facilities:**

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

### **Latrines and Urinals**

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

- b. 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 upto first 100 and one for every 50 thereafter.
- c. Every latrine shall be under cover and so partitioned off as to secure privacy and shall have proper door and fastenings.
- d. 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 standard lower than borehole system.
  - (i) Where workers of both sexes are employed, there shall be displayed out side 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.
  - (ii) The notice shall also bear the figure of man or woman as the case may be.
- e. There shall be at least one urinal for male workers upto 50 and for female workers upto 50 employed at a time, provided that where the number of male or female workers as the case may exceed 50 it shall be sufficient if there is one urinal for every 50 males or females upto the first 500 and one for every 100 or part thereafter.

- (i) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times
- (ii) Latrines and urinals other than those connected with flush sewage system shall comply with the requirements of Public Health Authorities.
- f. Water shall be provided by means of tap or otherwise so as to conveniently accessible in or near the latrines and urinals.
- g. Disposal of excreta: Unless otherwise arranged 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 of by putting a layer of night soil at the bottom of pucca tank prepared for the purpose and covering it with 15cm layer of waste or refuse and then covering it with a layer of earth for a fortnight (then it will turn to manure)
- (i) 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 of the site. The contractor shall be responsible for payment of any charges which may be levied by the municipal or cantonment authority for execution of such on behalf.

**Provision of shelter during rest:**

At every place there shall be provided free of cost, for suitable sheds two for meals and other two for rest separately for the use of men and women labour. The height of each shelter shall not be less than 3m from the floor level to the lowest part of the of the shed roof. These shall be kept clean and the space provided shall be on the basis of 0.6sqm per head. Provided that the engineer-in-charge may permit subject to its satisfaction, a portion of building under construction or other alternative accommodation to be used for the purpose.

**Café/Eating place:**

- a. 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 100 or more are ordinarily employed an adequate place shall be provided by the contractor for the use of such labour.
- b. The café shall be maintained by the contractor in an efficient manner.
- c. The café shall consist of at least a dining hall, cafe, storeroom, pantry and washing places separately for workers and utensils.
- d. The floor shall be made of smooth and impervious materials and inside walls shall be lime washed or colour washed at least once a year. Provided that the inside walls of the cafe shall be lime washed every four months.
- e. The premises of the cafe shall be maintained in a clean and sanitary condition
- f. Suitable arrangements shall be made for the collection of disposal of garbage.
- g. Waste water shall be carried away in suitable covered drains and shall not be allowed to accumulate so as to cause nuisance.
- h. The dining hall shall accommodate at a time 30% of the contract labour working at a time.
- i. The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chairs shall not to be less than 1sqm per diner to be accommodated as prescribed in sub-rule (i)
- j. There shall be provided and maintained sufficient utensils crockery, furniture and any other equipment necessary for efficient running of cafe
- k. The furniture, utensils and other equipment shall be maintained in clean and hygienic condition.
- l. Suitable clean clothes for the employees serving in the café shall be provided and maintained.
- m. A service counter, if provided shall have top of smooth and impervious material.
- n. Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipment.
- o. A portion of the dining hall and service counter shall be partitioned off and reserved for women workers in proportion to their number.



- p. Sufficient tables stools or benches shall be available for the number of diners to be accommodated as prescribed in subrule (i)
- q. The food stuff and other items to be served in the cafe shall be in conformity with the normal habits of the contract labour.
- r. The charges of food stuffs, beverages and other items served in the cafe shall be based on 'No profit no loss' and shall be conspicuously displayed in the cafe.
- s. In arriving at the price of the foodstuffs and other article served in the cafe, the following items shall not be taken in toconsideration as expenditure namely:
  - t. The rent of land and building
  - u. The depreciation and maintenance charges for the building and equipment provided for the cafe.
  - v. The purchase, repairs and replacement of equipment including furniture, crockery, cutlery and utensils.

- w. The water charges and other charges incurred for lighting and ventilation
- x. The interest and amount spend on the provision and maintenance of equipment provided for the cafe.
- y. The accounts pertaining to the cafe shall be audited once every 12months
- z. by registered accountants and auditors.

**Anti-malarial precautions:**

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

**SECTION 24: RESPONSIBILITIES**

**S&H –coordinators:**

In connection with (Indian Regulations and standards) the tasks and responsibilities of the S&H coordinator(s) as well as the design- as the construction phase, are as follows:

**Design phase:**

- ☒Co-ordination of the general aspects with respect to Safety, Health and Welfare.
- ☒Taking care of the set-up of a S&H-plan 'in draft'.
- ☒Putting together the S&H-file.
- ☒Keep up and actualize the S&H-plan 'in draft' -and file.
- ☒Hand-over the S&H-plan 'in draft' -and file to the S&H-coordinator(s) for the construction phase.

**Construction phase:**

- ☒Organizing and coordinating the cooperation between employers.
- ☒Coordinating the Safety, Health and Welfare measures by the employers.
- ☒Coordinating supervision to meet the joint facilities.
- ☒Give indications to the .
- ☒Coordinating the information to the employees.
- ☒Take measures to assure that only persons which are entitled to can come in at the works.
- ☒Keep up and actualize the S&H-plan 'in draft' -and file.
- ☒Handover the S&H-file to the principal.

**SECTION 25: COMMUNICATION**

**Kick-off meeting**

The kick-off meeting should be seen as a start up meeting, preliminary to the general or project oriented activities. In the kick-off meeting, besides technical relevant information, pay attention to the aspects of safety and health in general sense. The Contractor will be required to provide their job site safety program either at kickoff meeting or within a time period as determined by Project Manager after the kickoff meeting along with other pre-start documentation.

**Pre-job meeting**

The Pre-job meeting is meant for consultation before the activities may start. A part of this meeting is reserved to make detail appointments for specific Plant or Location directed safety- and health matters and 'actual' deviations of the normal situation. This meeting is meant as a supplement to the general information which already has been handed over during the kick-off meeting. At this meeting the **Pre-job Checklist** should be handled and worked out with all persons involved.

**Progress Meeting:**

The progress meeting is meant to get an update from contractors on project progress and resolve any construction/ coordination issues. It is normally held on weekly basis. This meeting will have EHS component and following items shall be discussed under this head.

Major safety issues at site Actions being taken to resolve them

**Toolbox meeting:**

Toolbox meetings are company (contractor) internal matters. With this kind of meeting, employees supposed to execute the job are informed about the most actual state of the activities. This information can be appointments, instructions which are the result of above mentioned meetings. A toolbox meeting is a medium to inform 'executing employees'. Copies of these toolbox meetings (incl. registration forms) should be attached to this chapter.

**Safety Meeting:**

Safety meetings shall be held on weekly basis to be attended by Project Manager's Safety representative and safety officer from all contractors as well as their subcontractors. The meeting shall be chaired by Project Manager's safety representative and Project Manager may also like to attend the meetings randomly. The topics to be covered shall broadly include:

- a. Safety issues at job site
- b. Review pre task plans
- c. Discuss safety statistics
- d. Review safety committee reports/ recommendations
- e. Discuss safety training initiatives
- f. Review overall job site safety

**SECTION 26: INFORMATION**

**General S&H-instructions**

Everyone, who is doing activities at the Client site, should be registered at the job site. After registration, everyone get a Contractor Safety Instruction (video presentation). This presentation shows an explanation on the S&H policy, the most important emergency measures (Fire and Gas alarms) and shows general behavior rules and procedures.

**Site Specific S&H-instructions**

These instructions can be given when the common interest is served (equal for all facilities and departments) and the necessity exists. Examples are: LoTo, shutdown, etc. Site specific, S&H instructions, needed for this project to follow are as under;

\_\_\_\_\_.

**SECTION 27: PRE TASK PLANS (PTP)/ JOB TASK HAZARD ANALYSIS (JTHA)**

PTP/ JTHA is the process of systematic investigation of a task and its subtasks, ascertaining the risks associated with carrying out activities associated with those tasks, listing preventive measures to avoid potential hazards associated with executing that activity and developing contingency plan in case of emergencies. The Standard Operating Procedure of the Project Manager will serve as reference guidelines for the tasks which require development of PTP/ JTHA. However, the list is not all inclusive and if the Project Manager/ Project Manager's safety representative/'s safety representative determine that the PTP/ JTHA is

required for some other tasks too, the contractor will be obligated to provide that as per the procedure and in the format as indicated by Project Manager (copy of format attached with these guidelines). Subsequent to the kick-off meeting, within the specified time period, the contractor will also provide the list of tasks against which PTP/ JTHA shall be submitted along with the expected time, when it would be submitted. This listing shall be done on the format shown below;

<b>LIST OF PRE-TASK PLANS TO BE SUBMITTED ON THE <i>Project Name</i></b> <b>Contractor:</b>	<b>Trade Package:</b>
--	-----------------------

<b>TASK</b>	<b>TIME OF EXECUTION</b>	<b>TARGET PTP SUBMISSION DATE</b>

**SECTION 28: ENVIRONMENT**

**Waste Disposal**

Waste originated from activities at the project site should be dumped at the designated location in the designated manner as indicated by / PM. Chemical waste (air-sprays, oil, paint etc.) should be collected separately and, if property of client, shall be offered to the facility / department. This in conjunction with the waste-coordinator of the department concerned, or the In & out Clean department. In case the waste coordinator does not require the chemical waste for re-usage, the contractor will

dispose it off at its own expense at the designated location in the designated manner as directed by Project Manager and in accordance with all Indian Environmental Laws. Chemical waste which originates from Contractor’s works should be collected and carried away by Contractor according to the legal regulations. The In & Out Clean department should be informed before carrying away the waste.

**Material Safety Data Sheets (MSDS)**

The Contractor is obligated to inform about the risks and dangers associated with handling of chemical and hazardous substances at site. Therefore, the information transfer in the form of Material Safety Data Sheets is necessary. The contractor shall list all materials to be used at project site that require submission of MSDS and submit those. The material shall be brought to the site only after obtaining prior approval from ’s representatives on the MSDS.

Contractor is required to provide Material Safety Data sheets (MSDSs) for any chemical brought on site. An index of MSDSs for all products proposed to be used on site must be provided. In so far as possible, “environmentally friendly” products should be used (e.g. detergent or citrus based cleaners rather than solvent based cleaners). Low-Volatile Organic Compound (VOC) products should be used at all times. Chlorinated solvents should not be brought on site except on a pre-approved case-by-case basis. The Client/ reserves the right to reject any chemical proposed to be brought on site. Any regulated wastes generated on site (e.g. hazardous, residual or special waste, including regulated wastewaters, waste oil, waste paint), in must be disposed of by Contractor in strict accordance with federal, provincial and municipal or and local standards. No wastes may be disposed of down the drain or in the Client installed dumpster without prior written consent. Contractor must have appropriate training for the work to be done. Training records must be produced upon demand. Contractors must bring appropriate tools, equipment, safety devices and clothing to the job site. No tools or equipment maybe borrowed from the Client without prior written consent.

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<b>Material</b>	<b>MSDS sheet to be submitted by</b>

**SECTION 29: REPORTING**

The contractor will submit the Monthly man-hour & safety report on the format enclosed in EHS guidelines. The report will be submitted by\_ hrs. on\_day of every month. In addition, should the Project Manager require any interim man-hourreports on weekly basis or any other frequency determined by Project Manager, those will also be submitted by the contractor. Safety reports submitted are in no way linked with the requirement for submission of Daily report on the part of contractor.

<b>CONTRACTOR HEALTH AND SAFETY</b> <b>Sl. No..... Date.....</b>
<b>General information ( To be Completed by Safety officer )</b>
Contractor Name : Project Name : On site contractor Representative / Supervisor / Safety
Location of Infraction : Description of Infraction: Observed By : Date : Time :
Status of Project : Project Stopped until correctionProject Continuing W/infraction Corrective Actions Required by ( Date/time)
<b>CORRECTIVE ACTION ( To be Completed by the Contractor )</b>
Corrective Action : Corrective Action Performed by :Date / time : Name : Signature :
Return to GU
<b>CORRECTIVE ACTION FOLLOW UP ( To be completed by Project Manager )</b>
Received / Certified By : GU Date : Remarks :

**EHS DECLARATION**

From:

Name of the Contractor

Name of the organization To:

Project Manager

*Location – Pin code*

**Subject: EHS Declaration**

I/ we hereby declare to accept the responsibility to carry out the work safely. I/ we have understood the hazards associated with site activity and developed the relevant safety procedures, trained the man power and provided required PPE and equipment. I/ we or the workers working under my/our control will adhere to the site safety rules and EHS

guidelines as stated in this document. The following are the safety practices that will be followed in addition to any other requirements as recommended by Project Manager's EHS Manager/ Site safety officer to work safely at site.

1. Wear safety helmet, safety shoes, eye protection with side shields.
2. Wear safety harness and hooking to the life line rope.
3. Wear appropriate hand gloves like cotton, leather, PVC, rubber or surgical hand gloves.
4. Proper tools will be used and checked for defects and replaced whenever required.
5. Welding torch with ring guard, welding shield, leather hand gloves required.
6. No steel rod will be used as earthing on to the welding machine.
7. Proper working platform with hand rail will be used while working at heights.
8. a) Housekeeping will be done on daily basis and the debris, sand, concrete materials and mortar will be removed and stored at identified place.
9. b) Papers, plastic sheets, rubber materials and wooden pieces have to be put in recycle bin from the work place and this will be sent outside the site.
10. I/ we will be appointing one safety officer, safety stewards and group leader of safety.
11. My/ our workmen and I/ we will not create any problem, quarreling with other agents.
12. I/ we will be providing fire extinguishers, fire buckets with water and sand in work place.
13. First aid facility and hospital facility will be provided to my/ our workman.
14. I/ we will be conducting the safety training programs for my/ our workmen, like first aid, fire fighting and safety.
15. I/ we will obtain work permits to work for hazardous area.
16. As per the contract document, we agree with imposition of penalty on us should we violate
17. any safety norms/ practices at the project site, which can be deducted from our invoices.
18. I/ we will submit all the required insurance policies as per the contract documents.

Signature of the contractor



**PERSONAL PROTECTIVE EQUIPMENTS CHECKLIST**

**SL.NO PARTICULARS YES / NO**

- 1 Do the Workers Wear Helmet in such a way to protect their head?
- 2 Are they wearing hand gloves, Rubber gloves (IS 4770 for electrical purpose), Leather hand gloves of required quality for the job
- 3 Do the workers using appropriate Footwear?
- 4 Is there any need for Safety harness (IS 3521-1965) use? If so, are they hooked properly?
- 5 Is there any need for Ear protection? If so, are they using the device external or internal type?
- 6 Are the workers wearing Safety glasses / Safety screens /Safety goggles for the work being done? If so, are they using appropriate equipment?
- 7 Do the Workers have respirator/ protection from inhalation hazards?
- 8 Are the helpers also using proper PPE or not?
- 9 Have the Workers been briefed about the Hazards associated with the job and the emergency action to be followed whenever there is requirement?

EHS Manager/ Site Safety Officer Contractor's Site In-charge/ Safety In-charge

**PERMIT FOR WORKING AT HEIGHTS**

Permit No.:

Date:

Project Name:

Location:

Contractor:

Sub-contractor:

Job description:

Area/ location:

A	SCAFFOLDING & RELATED PROTECTION	Y	N	N/A
A.1	Scaffolding good construction, adequate strength with 50 cm clear walk ways toeboards with wide screens,			
A.2	Scaffold well secured with stair ways, hand rails. Should be wide enough to pass two persons at a time			
A.3	Maintained good Housekeeping at work location / site			
B	<b>OVERHEAD CLEARANCE</b>			
B.1	Required clearance available from all overhead electrical cables			
B.2	<b>LADDERS</b>			
B.3	Strong material, well maintained ladders			
B.4	Ladder not placed against loose boxes materials, sound objects, near electrical installation.			
B.5	Ladder of sufficient height used, on top tied down and man positioned at the foot at ladder.			
B.6	Safety Footwear provided			
B.7	Ladder placed at an angle of 70 to 75 degrees			
B.8	Area of work barricaded so no person can walk under the ladder.			
C	<b>PERSONAL PROTECTION EQUIPMENT</b>			
C.1	Safety harness provided and worn			
C,2	Safety helmet, safety shoes and any other PPE required to perform the job at hand is provided and worn properly			

**A. Permission:**

Permission granted from \_\_\_\_\_ to \_\_\_\_\_ hrs. on \_\_\_\_\_

Time \_\_\_\_\_ Date \_\_\_\_\_ Signature of permit issuing authority

**B. Receipt:**

I hereby declare that I accept the responsibility for carrying out the work as detailed on this permit and no attempt will be made by me or men under my control to carry out any other work.

Time \_\_\_\_\_ Date \_\_\_\_\_ Signature of Person Receiving Permit

**C. Clearance certificate:**

Work completed by taking all precautionary steps as approved by permit issuing authority.

Time \_\_\_\_\_ Date \_\_\_\_\_ Signature of Person completing jobs

**D. Cancellation:**

This permit to work is hereby cancelled.

Time \_\_\_\_\_ Date \_\_\_\_\_ Signature of permit issuing authority/Shift in-charge

**HOT WORK PERMIT**

Permit No.: Date:

Name of the Project: Location:

Name of the Contractor: Sub-Contractor:

**A) Person taking permit /permittee to fill up:**

- 1) Exact location where hot work is being planned \_\_\_\_\_
- 2) Approximate duration of work From: Date: \_\_\_\_\_ Start Time \_\_\_\_\_ Finish Time \_\_\_\_\_  
Revalidated To: Date: \_\_\_\_\_ Start Time \_\_\_\_\_ Finish Time \_\_\_\_\_
- 3) Description of work:
- 4) Tools & Tackles used:

Points to be checked

SL No	Details	Y	N	N/A
1	Has the area immediately below and adjacent to the work spot been cleared/removed of oil, grease and waste cotton etc?			
2	In case of Gas welding, proper hose pipes and pressure gauges are used?			
3	Have fire extinguishers been kept handy at site?			
4	Has tin sheet / wet gunny bag / fire retardant cloth/ sheet been placed to prevent sparks from causing fire?			
5	Have fire sand buckets been kept handy at site?			
6	Whether cylinders are kept in upright positions?			
7	Whether Proper PPE's are available?			
8	In Electrical Welding whether proper Earthing is provided.			

The above points have been complied with and conditions rendered safe / hazards innocuous to undertake the hot work.

Name of \_\_\_\_\_ Signature \_\_\_\_\_

Designation \_\_\_\_\_

Permittee (Site engineer)

Name & Signature of Safety Officer \_\_\_\_\_

**B) The person giving permit (Issuing Authority) to fill up:**

After checking all the above precautions the hot work can be carried out in the above area.

1. Date: \_\_\_\_\_ Time: \_\_\_\_\_ Signature of safety Officer \_\_\_\_\_ Permit is revalidated for the Period
2. Date: \_\_\_\_\_ Time: \_\_\_\_\_ Signature of Safety Officer \_\_\_\_\_

**C) Time \_\_\_\_\_ Date: \_\_\_\_\_ at which the permit closed & filed**

**DISPOSAL PERMIT FORM****PERMIT NO.:** \_\_\_\_\_ **DATE:** \_\_\_\_\_

Mr. \_\_\_\_\_ Foreman, is authorized to dispose of the following materials in the manner indicated:

**MATERIAL METHOD LOCATION**

The procedures posted at the burning ground and disposal area must be followed in detail during these operations.

Personnel Authorized \_\_\_\_\_

Time: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_

(Supervisor)

**EXCAVATION PERMIT**

Permit No: \_\_\_\_\_ Date: \_\_\_\_\_

Project Name: \_\_\_\_\_ Location: \_\_\_\_\_

Contractor: \_\_\_\_\_ Sub-contractor: \_\_\_\_\_

**Excavation details:**

Purpose:

\_\_\_\_\_

Area/ Location: \_\_\_\_\_

Proposed date and time for start of work: \_\_\_\_\_

Proposed date and time for completion of work: \_\_\_\_\_

Tools and equipment involved: \_\_\_\_\_

\_\_\_\_\_

Length \_\_\_\_\_ m Width \_\_\_\_\_ m Depth \_\_\_\_\_ m

**Preparation**

1. Underground cables, pipelines, electrical lines etc checked Yes/No
2. Personnel protective equipments to be used to include;
  - A. Safety Shoe Yes/No
  - B. Safety Helmet Yes/No
  - C. Gloves Yes/No
  - D. Eye Protection Yes/No
  - E. Ear Protection Yes/No
  - F. Nose Mask Yes/No

**Safety Precautions**

1. The proper approach arrangement to be made with required no. of exit points
2. Wear proper PPEs
3. Barricade area and Display Warning boards
4. Ensure good housekeeping before and after the work
5. Ensure the presence of supervisor during the execution of work
6. Use certified machinery
7. Check for possible interference with any underground utilities
8. Check reverse horn for vehicles and driver license
9. Any special safety precautions (specify) \_\_\_\_\_

Checked By:

Contractor's Safety Officer Signature Date

PERMIT ISSUING AUTHORITY (Permit is granted & valid up to)

1. Date: \_\_\_\_\_ Time: \_\_\_\_\_ Signature of Safety Officer \_\_\_\_\_ Permit is revalidated for the Period
2. Date: \_\_\_\_\_ Time: \_\_\_\_\_ Signature of Safety Officer \_\_\_\_\_

**NIGHT WORK PERMIT FORM**

PERMIT NO.: \_\_\_\_\_ DATE: \_\_\_\_\_

Project name: \_\_\_\_\_ Location: \_\_\_\_\_

Contractor name: \_\_\_\_\_ Trade Package: \_\_\_\_\_

Activities scheduled for night work with location:  
\_\_\_\_\_Reason for conducting these activities at night:  
\_\_\_\_\_

Name of the Supervisor:

Name of workers and designation:

**S.No NAME DESIGNATION**Sufficient lighting provided: YES/NO Area  
to be cleaned after work: YES/NO

Emergency vehicle available: YES/NO Vehicle No.:

Any other special precautions:

Signature: \_\_\_\_\_ Signature: \_\_\_\_\_ Signature: \_\_\_\_\_

Supervisor (Contractor) Site In charge (Main Contractor) EHS Manager

Note: CONCERNED AGENCIES ARE RESPONSIBLE FOR ANY UNSAFE ACT/  
CONDITIONS

**PERMIT FOR WORKING IN AHU/ ELECT/ UPS/ SERVER/ BATTERY ROOMS**

**A.**

Date: \_\_\_\_\_ Permit number: \_\_\_\_\_

Project: \_\_\_\_\_ Location: \_\_\_\_\_

Agency requesting permit: \_\_\_\_\_

Location of work: \_\_\_\_\_

Permit to work on (date): \_\_\_\_\_ From: \_\_\_\_\_ To: \_\_\_\_\_

Description of work: \_\_\_\_\_

\_\_\_\_\_

Names of Individuals who will work in the area along with the name of supervisor:

\_\_\_\_\_

\_\_\_\_\_

LOTO required or not? \_\_\_\_\_

Hot work/ Height work permit taken, if required. \_\_\_\_\_

Any other precautions, if required: \_\_\_\_\_

\_\_\_\_\_

Signatures of requestor

**B.**

Permit granted to work on \_\_\_\_\_ from \_\_\_\_\_ to \_\_\_\_\_.

Signatures of authorized representative

**C.**

Area cleared after work: \_\_\_\_\_

Signature of rep of agency which Signatures of representative

Performed work

Copy to: 1. Workers working at site

2. representative

3. Contractor records

**CONFINED SPACE ENTRY PERMIT****A.**

Date: \_\_\_\_\_ Permit no.: \_\_\_\_\_

Project Name and Location: \_\_\_\_\_

Permit Requested by: \_\_\_\_\_

Confined space location: \_\_\_\_\_ Confined space description: \_\_\_\_\_

Purpose of entry and description of work: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Duration of permit: From: \_\_\_\_\_ To: \_\_\_\_\_

Potential hazards (Mark all that apply):

Oxygen deficiency/ Toxic gases Fire/ explosion /Mechanical hazards

**B.**No. Item Yes Not Required<sup>1</sup>

Proper lighting provided

2 Proper ventilation provided (natural/ artificial)<sup>3</sup>

Full body harness with lifeline provided

4 Proper access for exit provided<sup>5</sup>

Entrance barrier provided

6 Method of isolation/ control, purge, flush, etc.<sup>7</sup>

Lockout provided

8 Respiratory protection provided

9 Rescue team with devices put on stand

by<sup>10</sup> Proper PPE provided

11 Tests required (Attach reports):

Oxygen level (19.5% - 23%) Carbon

Monoxide level (&lt;25 ppm)

Name of Entrants Name of Attendants (stand by team)

I have checked the above points and found the conditions compliant to undertake the abovementioned work.

\_\_\_\_\_

Name of permittee Signature of permittee Designation

**C.**

The precautions and safe conditions mentioned above have been verified and the work can be started.

\_\_\_\_\_

Name of Issuing authority Signatures of Issuing authority Designation

**D.**

Time \_\_\_\_\_ Date \_\_\_\_\_ Permit closed and filed.

Signature of safety supervisor: \_\_\_\_\_



**SHAFT WORK PERMIT**

Date: \_\_\_\_\_ Permit no.: \_\_\_\_\_

Project name and Location: \_\_\_\_\_

Name of the agency requesting permit: \_\_\_\_\_

Location of work: Shaft number: \_\_\_\_\_ Floor: \_\_\_\_\_

Task to be performed: \_\_\_\_\_

Start date and time: \_\_\_\_\_ Finish date and time: \_\_\_\_\_

Safety Precautions required:

No. Item Yes Not required

1 All personnel are wearing proper PPE

2 Workers have been briefed about

hazards3 Safe access to shaft available

4 Safe working platform erected

5 Safety harness with lifeline provided

6 Fire extinguisher provided for hot

work7 Shaft appropriately barricaded

Names of workmen entering shaft: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

I have ensured that the safety precautions as listed above for the task to be performed have been taken for this shaft work.

\_\_\_\_\_

Name of permittee Signature of permittee Designation

\_\_\_\_\_

Name of Issuing authority Signature of Issuing authority Designation Notes:

1. Separate permit required for work in each shaft.

2. Work permit is valid for the prescribed date, time and in prescribed location

only. Time \_\_\_\_\_ Date \_\_\_\_\_ Permit is closed.

Name and Signature of the Issuing authority: \_\_\_\_\_

**CONTRACTOR INCIDENT/ NEAR MISS REPORTING FORMAT**

Project: \_\_\_\_\_ Location: \_\_\_\_\_

Name of Contractor: \_\_\_\_\_

Name of Contractor Employee: \_\_\_\_\_ Age: \_\_\_\_\_ Sex: \_\_\_\_\_

Incident Date: \_\_\_\_\_ Incident Time: \_\_\_\_\_ Incident Location: \_\_\_\_\_

Injuries: \_\_\_\_\_

Treated by: \_\_\_\_\_ Treated at: \_\_\_\_\_

Type of Incident (First aid/ Recordable/ Lost Work day/ Fatal/ Near Miss): \_\_\_\_\_

Task assigned to person at the time of incident: \_\_\_\_\_

\_\_\_\_\_

Description of the Incident: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Primary Root cause for the Incident: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Contributory factors: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Date when latest safety training was given to employee: \_\_\_\_\_

Subject of training: \_\_\_\_\_ Given by: \_\_\_\_\_

Was a Pre task plan required/ submitted for this task: \_\_\_\_\_

Is there a standard procedure developed to perform this task? \_\_\_\_\_

If yes, was it reviewed with the worker and when? \_\_\_\_\_

Preventive measures proposed to avoid recurrence in future: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Contractor Site In-Charge Contractor Safety In-Charge

**PEP TALK REPORT FORM**

*(To be filled by the person conducting pep talk)*

Project: \_\_\_\_\_ Location: \_\_\_\_\_

Name of Contractor: \_\_\_\_\_ Trade: \_\_\_\_\_

Name of Site In-Charge: \_\_\_\_\_

Name of Contractor Safety coordinator: \_\_\_\_\_

Number of Workmen present in Pep talk: \_\_\_\_\_

Date and Time of Pep talk: \_\_\_\_\_

Topics discussed: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Any significant problems/ issues identified: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Remarks (if any): \_\_\_\_\_

\_\_\_\_\_

Contractor Safety Representative Safety Representative

**MONTHLY EHS STATISTICS REPORT – Month, Year**

*(To be filled and submitted by contractor)*

Project: \_\_\_\_\_ Report No: \_\_\_\_\_ Date: \_\_\_\_\_

Name of Contractor: \_\_\_\_\_ Trade: \_\_\_\_\_

**S.No Description Status**

1 No. of Man-hours worked over last month<sup>2</sup>

Cumulative Man-hours worked till date

3 No. of Reportable Accidents on project<sup>4</sup>

No. of Near Misses

5 No. of Lost Work Day (LWD) cases<sup>6</sup>

No. of Safety Pep talks conducted

7 Infraction Notices/ Safety Inspection Reports received<sup>8</sup>

Infraction Notices/ Safety Inspection Reports closed

9 No. of Fire extinguishers available at site (all

types)<sup>a</sup> Foam Type (Last serviced on \_\_\_\_\_)

b CO<sub>2</sub> Type (Last refilled on \_\_\_\_\_)

c Others

10 No. of Training sessions conducted

a Fire fighting training

b First Aid training

c PPE Usage training<sup>d</sup>

Others

11 Safety Permits Issued

12 No. of Safety sign boards displayed at site

13 Housekeeping practices (Excellent/ V Good/ Good/ Average/

Poor)<sup>14</sup> No. of times Equipment, Machinery and Tools inspected

15 Physical condition of the PPE in usage (Good/ Average/ Poor)<sup>16</sup>

License and vehicle documents available (if applicable)

17 Percentage compliance on the usage of PPE by workers

Submitted by:

Contractor Safety Representative/ Site In-Charge

Safety Representative Comments (if any):

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Reviewed by:

Safety Representative Copy

to: Project Manager

## MONTHLY EHS STATISTICS REPORT – Month, Year

*(To be prepared by contractor for submission to Client)*

Project: \_\_\_\_\_ Report No: \_\_\_\_\_ Date: \_\_\_\_\_

**Sl# Description Status**

1 No. of Man-hours worked over last month<sup>2</sup>

Cumulative Man-hours worked till date

3 No. of Reportable Accidents on project<sup>4</sup>

No. of Near Misses

5 No. of Lost Work Day (LWD) cases<sup>6</sup> No.

of Safety Inspections conducted<sup>7</sup> No. of

Safety Audits conducted

8 No. of Safety Infraction Notices/ Inspection Reports issued<sup>9</sup>

No. of Fire extinguishers available at site (all types)

a Foam Type (Last serviced on \_\_\_\_\_)

b CO2 Type (Last refilled on \_\_\_\_\_)

c Others

10 No. of Training sessions conducted

a Fire fighting training

b First Aid training

c PPE Usage training<sup>d</sup>

Others

11 No. of Safety pep talks conducted

12 Total number of Safety Permits Issued

13 No. of Safety sign boards displayed at site

14 Housekeeping practices (Excellent/ V Good/ Good/ Average/

Poor)<sup>15</sup> Equipment, Machinery & Tools inspection (Satisfactory/

Not)

16 Physical condition of the PPE in usage (Good/ Average/ Poor)<sup>17</sup>

License and vehicle documents available (if applicable)

18 Percentage compliance on the usage of PPE by workers

19 Overall EHS implementation ((Excellent/ V Good/ Good/ Average/

Poor)Additional Comments (if any):

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Safety Representative

**MONTHLY EHS REPORT – Month, Year**

**A. MAN-HOUR LOG**

SI# Contractor	Up to Last report	Man-hoursthis report	CumulativeManhours
1			
2			
3			
4			
5			
<b>Grand Total:</b>			

**B. INCIDENT REPORT**

SI# Description	Up to Last report	This report	Cumulative	Remarks
-----------------	-------------------	-------------	------------	---------

1 Near Misses

2 Recordable Incidents

3 Lost Work Day cases

SI#	Safety inspection conducted on	No. of Non conformances	No. of Open Non conformances	Remarks

SI#	Safety Audit Conducted on	Safety Rating/ Score

**Average Safety Score:**

**E. OVERALL JOB SITE SAFETY AND COMPLIANCE WITH EHS STANDARDS**

*EHS representative to indicate whether Excellent/ V Good/ Good/ Average/ Poor, as the over job site safety and compliancewith EHS Standards and also provide comments (if any).*

Attachments: Monthly EHS statistics report

**PENALTY FOR NON COMPLIANCE WITH EHS GUIDELINES**

**A.**

Project: \_\_\_\_\_ Location: \_\_\_\_\_ Date: \_\_\_\_\_

Penalty notice issued to: \_\_\_\_\_

Contractor Site In-charge: \_\_\_\_\_

Contractor Safety representative: \_\_\_\_\_

Description of Non-compliance: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Location of non-compliance: \_\_\_\_\_

Have there been similar non-compliances in the past? \_\_\_\_\_

Have any Safety Infraction Notices been issued in the past? If yes, provide details

\_\_\_\_\_

S. No.	Degree of violation	Type of violation	Penalty for violation	No. of violations	Penalty Amount
				Total	Penalty Amount

Signature of the Safety Officer/ representative generating this notice

**B.**

Billing department to proceed with deduction of INR \_\_\_\_\_ as penalty amount from contractor's next running bill, for non-compliance with EHS guidelines, duly accepted by contractor as part of tender document as well as through acceptance on EHS Declaration

form.

Signatures of Project Manager CC

to: Client Project Manager



**CHECKLIST FOR BUILDING HOIST/ WINCH**

Project: \_\_\_\_\_ Location: \_\_\_\_\_

Name of Contracting agency: \_\_\_\_\_

**S. No Description OK/ Not OK Remarks**

**A. SUPPORTING STRUCTURE:**

- 1 Condition of steel tubes<sup>2</sup>
- Condition of the Base
- 3 Bracing (diagonal/horizontal)<sup>4</sup>
- Anchorage with structure
- 5 Any obstructions to the movement of rope?

**B. WINCH MACHINE:**

- 1 Condition of brakes and accessories<sup>2</sup>
- Functioning of brake with load
- 3 Oil level and condition<sup>4</sup>
- Gear box and motor
- 5 Coupling bolts and nuts<sup>6</sup>
- Condition of wire rope
- 7 Anchorage of drum and wire rope<sup>8</sup>
- Pawl arrangement for locking
- 9 Condition of diversion pulleys, idlers pulleys and fleet angle<sup>10</sup>
- Limit Switches
- 11 Electrical connection, earthing and insulation

**C. UNLOADING PLATFORM:**

- 1 Area Barricaded
- 2 Stability
- 3 Sagging
- 4 Any Over
- loading<sup>5</sup> Hand
- railing
- 6 Staging

**D. OTHERS**

- 1 Is the person authorized/experienced to Operate?
- 2 Does the person at unloading point use Safety
- belt?<sup>3</sup> Is the bucket overloaded?
- 4 Is the Signaling Man present?<sup>5</sup> Is
- the work permit Obtained?

Signature of Contractor Site In-charge Signatures of Safety Officer/ Rep.

Print Name: \_\_\_\_\_ Print Name: \_\_\_\_\_

**CHECKLIST FOR SCAFFOLDING**

Project: \_\_\_\_\_ Project number: \_\_\_\_\_

Name of Contractor: \_\_\_\_\_ Trade: \_\_\_\_\_

S. N.	Description	Observation	Yes/ NO/ NA	Remarks / Recommendation
1	Does the site has a practice of providing suitable and sufficient scaffolds so that the work could be safely done at a height?			
2	Is site engaging suitable/ properly trained/ experienced workmen for constructing / dismantling / shifting scaffolding works?			
3	Are scaffold platforms designed / constructed with a minimum safety factor of four?			
4	Is there a safe means of access to the working platform?			
5	Are scaffold structures on a solid base avoiding pavements & manhole covers?			
6	Is the scaffolding structure free from excavation pit / proper distance is maintained?			
7	Is verticality of the structure being properly maintained?			
8	Are ties for scaffold structure properly maintained (vertical as well as horizontal position)?			
9	Is there a provision of toe boards/guard rails and are they secured?			
10	Whether planks used for working platforms are wooden /metallic?			
11	If wooden plank, whether thickness is maintained as per standard or not, viz.			
12	a. For 1.5 M span -1.5" thick			
13	b. For 2.6 M span -2.0" thick			
14	Is there a system of inspecting scaffolds by a competent person at least once a week and also after every prolonged interruption in the work?			
15	Is there a system of inspecting materials of scaffolds on each occasion before erection?			
16	Is there a system of inspecting scaffolds at every spell of bad weather/ heavy wind condition?			
17	Is over hang of the working platform restricted to less than 50 mm/ four times the thickness of the board?			
18	Is their awareness among workmen on the importance of load distribution on a given working platform?			
19	Is there a check for the condition and correct usage of fittings for scaffolds?			

20	Is the width of a working platform properly maintained according to usage, viz.			
21	a) Minimum 600 mm for footing and not for deposit of materials.			
22	b) Minimum 800 mm for footing and deposit of materials.			
23	c) Minimum 1050 mm when used for heavier loads or to support higher platforms.			
24	Are all the materials stored on the platforms properly secured or not?			

S. N.	Description	Observation	Yes/ NO/ NA	Remarks / Recommendation
25	Whether planks are tied using proper binding wires?			
26	Are openings in working platform kept safely covered / fenced?			
27	Are the scaffolds being erected on firm and level surface?			
28	Does the height of mobile scaffolds exceed four times the smaller base dimension?			
29	Are all materials stacked on platform properly secured while in motion?			
30	Is the safety rule: Not to ride on a scaffold while in motion, violated.			
31	Is there a system of checking for obstructions before the tower is moved?			
32	Are suitable / correct lifting tackles (wire rope/ chains/ shackles) selected for suspension & used?			
33	Are all the suspension gears correctly spaced and connected?			
34	Is there a system of using manila rope/coir rope for suspension at any place where such rope would be liable to damage by heat/flames/sharp edges etc.			
35	Are all precautionary measures taken to prevent contact between arc welding apparatus and suspension ropes?			
36	Is there a provision of guardrails and toe boards?			
37	Is hanging platform secured?			
38	Is there a provision of anchoring safety belt. Lanyards to be tied to guy ropes?			

EHS Manager/ Site Safety Officer

Contractor Site Safety In-charge

**SAFETY INSPECTION REPORT**

Project: \_\_\_\_\_ Report No.: \_\_\_\_\_ Date: \_\_\_\_\_

Name of Contractor: \_\_\_\_\_

Number of non-conformities observed (as per details below): \_\_\_\_\_

**Details of Non-Conformities observed:**

The following non-conformances with reference to project EHS guidelines were observed during routine EHS round of the project site;

**Sl. # Description of non-conformity Target date**

- 1
- 2
- 3
- 4

**Note:**

Please take serious note of the above listed non-conformities and initiate corrective action immediately, so as to remove the non-conformity by the Target dates indicated above, failing which shall proceed with imposition of penalty for the observed non-conformities.

Safety Representative

**Contractor's Corrective Action Response (To be filled by contractor):**

All the above listed non-conformities have been rectified. The work is now being executed in compliance with EHS guidelines and applicable Safety Standards. The disposition of the non conformances is listed as under;

**S.No Disposition Description Status**

- 1
- 2
- 3
- 4

Contractor's Site In-Charge Contractor's Safety Representative

Dated: \_\_\_\_\_

Copy to: Project Manager

**PRE TASK PLAN FORMAT**

**PROJECT NAME AND LOCATION:**  
**CONTRACTOR:**                      **TASK:**

**SCHEDULED ON:**

**PTP No.:**  
**SUBMITTED ON:**

S.No	Activity Description	Potential Hazard	Preventive Action	Contingency Plan
				Briefly describe the contingency plan in case the preventive actions associated with potential hazards fail to yield results and Accident/ Incident still happens. Contingency plan must list the immediate contact number of Security, Emergency, and Safety representative.

- To be
- resubmitted
- Reviewed

Prepared By:  
 Safety officer (Contractor)

Approved By:

Signature: Safety Officer

## Schedule I

### Performance Bank Guarantee

(On non-judicial paper of appropriate value)

(By any Nationalized Indian Bank or else obtain confirmation from ARG Outlier Media Pvt. Ltd.)

THIS GUARANTEE made on this [ ] day [ ] of [ ] between [ ] ("**Bank**") which expression shall, unless repugnant to the context or contrary to the meaning thereof, include its successors and assigns on the one part and [ ], a Company incorporated in India and having its registered office at [ ] ("**Client**") which expression shall, unless repugnant to the context or contrary to the meaning thereof, include its successors and assigns, of the other part.

WHEREAS Client has entered into a contract agreement ("**Contract**") at a total value of Rs. [ ] with M/s. [ ] (hereinafter called Contractor) which expression shall, unless repugnant to the context or contrary to the meaning thereof, includes its successors and assigns.

AND WHEREAS one of the conditions of Contract entered into, is that the Contractor make a payment of Rs. [ ] being [5% (five percent)] of Contract Price in the form of a bank guarantee from a bank and in a form acceptable to the Client.

AND WHEREAS THE Contractor has requested the Bank to issue a guarantee of Rs. [ ] and the Bank, through its branch at [ ], has agreed to furnish this Guarantee in the manner hereunder.

NOW THIS GUARANTEE WITNESSETH that,

1. In consideration of Client, at the request of the Contractor, advancing a sum of Rs. [ ], to the Contractor as and by way of Performance Guarantee, the Bank hereby unconditionally and irrevocably guarantees to the Client for due performance of the Contractor's obligations under the Contract and indemnifies the Client in respect of the amount of the Rs. [ ] ("**Guarantee Amount**"). The Bank hereby undertakes, without recourse to Contractor and notwithstanding any dispute between the Client and the Contractor under the Contract or any objection by the Contractor, to pay the Client, on its mere demand in the enclosed format a sum upto and not exceeding the Guarantee Amount, being the amount of the 100% (hundred percent) of the payment or such other unadjusted amount of the said Performance Guarantee. If the Client notifies to the Bank that the Contractor has failed to observe, perform and fulfill the terms of the said Contract then the Bank shall immediately pay to the Client, on Client's mere demand in the enclosed format, such sum or sums of money to the extent of Rs. [ ] being 5% (five percent) of the value of the Contract Price (as defined in the Contract) as may be claimed by the Client by reason of non-fulfillment by the Contractor of his obligations under the Contract as aforesaid / and shall also indemnify the Client against all losses and damages which may be suffered by the Client as aforesaid and against all costs, charges, expenses which may be incurred by the Client in connection herewith. The Bank shall pay the said amount without demur or protest or without recourse to the Contractor. Any such demand placed in the enclosed format on the Bank shall be conclusive proof with respect to the amount due and payable by the Bank under this Guarantee. The decision of Client as to whether the terms and conditions of this Guarantee or Contract have been observed or not shall be final and binding on Bank and the Bank will not have the discretion to withhold payment to the Client if letter in enclosed format is delivered by the Client to the Bank on or before [ ] ("**Claim Period**").
2. This Guarantee is a continuing Guarantee and not revocable except with the previous written consent of the Client and as aforesaid, it will continue in force until the Contractor has maintained the schedule of delivery of the said work under the Contract and observed and fulfilled the terms and conditions of the Contract. The Client has an irrevocable and unconditional right to claim under the Guarantee in case the Guarantee required to be extended in its opinion is not extended by the Contractor or the Bank within the time frames and for the time frames stipulated by the Client.

3. The Client may, without affecting Bank's liabilities and obligations hereunder and without reference to the Bank grant time or other indulgence to or compound with the Contractor or enter into any agreement or agree to forbear to enforce any of the terms and conditions of the Contract.
4. This Guarantee shall not be affected by any change in the Constitution of the Bank, Contractor or the Client or by absorption / merger of the Client, Contractor or the Bank with any other body or corporation or otherwise and this Guarantee will be available to or enforceable by such body or corporation.
5. All composition and payments received by the Client from or on behalf of the Contractor shall be regarded as payments in gross and in the event of the Contractor being wound-up, the Client will be entitled to prove against the properties of the Contractor in respect of the whole of the contractor's indebtedness to the Client without any right on the part of the Bank to stand in the Client's place in respect of or to claim the benefits of such composition and payment or any security held by the Client until the Client shall have received the full amount of the claims against the Contractor.
6. In order to give effect to this Guarantee, the Client will be entitled to act as if the Bank were the principal debtor and the Bank hereby waives all and any of its rights of surety ship.
7. It shall not be necessary, and the Bank hereby waives any necessity, for the Client to proceed against the Contractor before presenting to the Bank its demand under this Guarantee.
8. The Guarantee herein contained is unconditional and irrevocable during its currency and will remain in full force for a period of [ ] years from the date hereof ("**Expiry Date**"), or if full payment has been made to the Client by BANK, which is earlier. The Bank's liability under this Guarantee is restricted to the Guarantee Amount, i.e. Rs. [ ] (Rupees [ ]). The Client may claim the full or part of the amount under the Guarantee entirely at its sole discretion and make this claim at one or more times before the expiry of the Claim Period under this Guarantee. The total amount of claims is restricted to the Bank's liability under the Guarantee. The Bank is required to make a payment immediately on receipt of the claim in the enclosed format.
9. This Guarantee shall continue to be in force notwithstanding the discharge of Contractor by operation of law and shall cease only on payment of the full amount by Bank to Client of the amount hereby secured and on the claim of Client against Contractor in respect of Contract being satisfied.
10. This Guarantee shall be in addition to and not in substitution for any other guarantee or security for the Contractor given or to be given to the Client in respect of the Contract by the Bank whether alone or jointly with others.
11. In the event of force majeure, according to the Contract, the validity of the present guarantee shall be extended for a period to be mutually agreed upon by the Client and the Contractor.
12. Unless demand or claim under this Guarantee is made within the Claim Period of this Guarantee, or unless the Guarantee is renewed, or extended in writing by the Bank, all the rights of the Client hereunder shall be forfeited and the Bank shall be relieved and discharged of all liabilities.
13. Any notice by way of request, demand or otherwise hereunder may be sent by post to the Bank, addressed as aforesaid, and if sent by post, it shall be deemed to have been given at the time when it would be delivered in due course of post, and in proving such notice, when given by post, it shall be sufficient to prove that the envelope containing the notice was posted and a certificate of posting from postal Authorities / Agencies, to the effect that the envelope was so posted shall be conclusive.
14. These presents shall be governed by and construed in accordance with Indian Law as applicable.
15. The Bank hereby declares that it has the power to issue this Guarantee and the undersigned has full power to do so.



Notwithstanding anything contained hereinabove our liability under this guarantee is restricted to the Guarantee Amount i.e. Rs. [ ] (Rupees [ ]). This guarantee is valid upto the Expiry Date i.e. [ ]. Any claim arising out of the guarantee must be lodged with the bank at its office at [ ] on or before the Claim Period i.e. [ ], after which the liability of the bank would be extinguished.

In witness thereof the Bank has executed these present the day and year first above written.

Signed and delivered for and on behalf of the above named.

#### **IMPORTANT NOTE**

Following points shall be taken care of while submitting the Bank Guarantee: -

1. The Bank Guarantee shall be on non-judicial stamp paper having a value of Rs. 200/- or as per requirement stamp paper should be purchased in the name of the Bank, who gives the guarantee and not in the name of the supplier/ sub-contractor.
2. The Bank Guarantee shall be strictly as per the pro-forma.
3. Bank Guarantee should be from any of the Nationalized Banks or its subsidiaries only.
4. Correction made on the Guarantee should be endorsed by the Bank with its official seal.

**NOTE: The BG format shall not be modified or changed**

**Schedule II****Contract Agreement**

**[To be executed on a stamp paper of appropriate value]**

This Contract agreement ("**Agreement**") is entered into on this [ ] day of [ ] month, 2023 ("**Execution Date**") at Noida, by and among:

- A. **Galgotias University, located at Plot No. 2, Sector 17A, Yamuna Expressway, Gr. Noida, Gautam Buddh Nagar, UP, India running under Smt. Shakuntla Educational & Welfare Society**, a society incorporated under the societies Act, 1860 and having its registered office at 4405/6, Prakash Appt. – 2, 5, Ansari Road, Daryaganj, New Delhi - 110002 (hereinafter referred to as the "**Client**" which expression shall unless repugnant to the meaning or context, be deemed to mean and include, its successors and permitted assignees);
- B. [ ], a company incorporated under the Companies Act, [1956/2013] and having its registered office at [ ] (hereinafter referred to as the "**Contractor**" which expression shall, where the context so admits, include its successors in office and assignees.

The Client and the Contractor are collectively referred to as the "**Parties**" and individually as "**Party**".

**WHEREAS:**

- A. The Client had invited Bidders (as defined in the Instruction to Bidders ("**ITB**")) with requisite technical capability and sound financial position to bid for Works (as defined in the ITB) required to be undertaken for building the New admin. & Engg. Block (as defined in the ITB) including but not limited to construction activities required to be undertaken for building the New admin. & Engg. Block including but not limited to **ELECTRICAL AND ELV** activities required for development of the Project (as defined in the ITB).
- B. The Client is desirous of having provided and executed certain Works mentioned, enumerated or referred to in the Bidding Documents (as defined in the ITB).
- C. The Contractor is the successful bidder in respect of the Works to be undertaken pursuant to the Tender issued by the Client.
- D. In accordance with the process agreed in the Bidding Documents, the successful bidder will undertake the Works at the Site in accordance with the terms and conditions set out in this Agreement. Accordingly, the Parties have agreed to enter into this Agreement for undertaking the Works for **ELECTRICAL AND ELV** of the New admin. & Engg. Block at the Site.

**NOW THEREFORE THE PARTIES AGREE AS FOLLOWS:****1. DEFINITIONS & INTERPRETATIONS****1.1. Definitions**

All capitalized terms used in this Agreement, but not defined herein shall have the meaning given to it in Clause 1 of the General Conditions of Contract ("**GCC**") which have been attached hereto as **Schedule A**.

The rules of interpretation as set forth in Clause 1 of the GCC shall apply *mutatis- mutandis* to this Agreement.

2. **SCOPE OF WORK**

The Works to be carried out by the Contractor, as part of its scope of work with regard to the ELECTRICAL AND ELV of the New admin. & Engg. Block shall be as specified in Clause 2 of the GCC, Schedule I (*Scope of Works*) of the GCC (attached separately as detailed BOQ), and the Technical Specifications.

3. **CONTRACTOR PERFORMANCE BANK GUARANTEE**

The Contractor Performance Bank Guarantee to be submitted to the Client by the Contractor shall be as specified in Clause 3 of the GCC.

4. **[ ] OF NEW ADMIN. & ENGG. BLOCK**

The ELECTRICAL AND ELV of New admin. & Engg. Block by the Contractor shall be as specified in Clause 4 of the GCC.

5. **CONTRACTOR'S OBLIGATIONS**

The Contractor's Obligations shall be as specified in Clause 5 of the GCC.

6. **CLIENT'S OBLIGATIONS**

The Client's Obligations shall be as specified in Clause 6 of the GCC.

7. **TIME FOR COMMENCEMENT AND COMPLETION**

The time for Commencement and Completion of the Works shall be as specified in Clause 7 of the GCC.

8. **MATERIALS AND WORKMANSHIP**

The Materials and Workmanship to be provided by the Contractor shall be as specified in Clause 8 of the GCC.

9. **PERFORMANCE PARAMETERS**

The Performance Parameters to be conducted by the Contractor in the presence of Client in order to ensure the operation of the New admin. & Engg. Block shall be as specified in Clause 9 of the GCC.

10. **LIQUIDATED DAMAGES**

The Liquidated Damages to be paid by the Contractor shall be as specified in Clause 10 of the GCC.

11. **COMPLETION AND ACCEPTANCE OF WORKS**

The Completion and Acceptance of Works to the satisfaction of the Client shall be as specified in Clause 11 of the GCC.

12. **PROJECT MANAGER**

The obligations of the Project Manager shall be as specified in Clause 12 of the GCC.

13. **ARCHITECT**

The obligations of the Architect shall be as specified in Clause 13 of the GCC.

14. **DOCUMENTS**

The Documents to be provided by the Contractor shall be as specified in Clause 14 of the GCC.

15. **CONTRACTOR TO INFORM ITSELF FULLY**

The obligation of the Contractor to inform itself fully shall be as specified in Clause 15 of the GCC.

16. **SUB-CONTRACTORS**

The engagement of Sub-Contractors shall be as specified in Clause 16 of the GCC.

17. **TRANSFER OF OWNERSHIP**

The transfer of ownership of the New admin. & Engg. Block shall be as specified in Clause 17 of the GCC.

18. **REPRESENTATIONS AND WARRANTIES**

The representations and warranties of the Parties shall be as specified in Clause 18 of the GCC.

19. **CONTRACTOR'S WARRANTIES**

The Contractor's Warranties shall be as specified in Clause 19 of the GCC.

20. **INSURANCE**

The Insurance to be obtained by the Contractor shall be as specified in Clause 20 of the GCC.

21. **DEFECT LIABILITY PERIOD**

The Defect Liability Period shall be as specified in Clause 21 of the GCC.

22. **VARIATION AND CHANGE IN CONTRACT ELEMENTS**

The Variation and Change in Contract Elements shall be as specified in Clause 22 of the GCC.

23. **CONTRACT PRICE AND INVOICING**

The Contract Price and Invoicing shall be as specified in Clause 23 of the GCC.

24. **TERMS OF PAYMENT**

The Terms of Payment shall be as specified in Clause 24 of the GCC.

25. **SITE OFFICE, SECURITY AND FACILITIES**

The obligation of the Contractor with respect to the Site Office, Security and Facilities shall be as specified in Clause 25 of the GCC.

26. **SAFETY REQUIREMENTS**

The Safety Requirements to be adhered to by the Contractor shall be as specified in Clause 26 of the GCC.

**27. LIMITATION OF LIABILITY**

The Limitation of Liability shall be as specified in Clause 27 of the GCC.

**28. INDEMNITY**

The Indemnification and payment of indemnities shall be as specified in Clause 28 of the GCC.

**29. CONFIDENTIAL INFORMATION**

The obligations of the Parties with respect to the Confidential Information shall be as specified in Clause 29 of the GCC.

**30. INTELLECTUAL PROPERTY RIGHTS**

The ownership of the Intellectual Property Rights shall be as specified in Clause 30 of the GCC.

**31. FORCE MAJEURE**

The Force Majeure event shall be as specified in Clause 31 of the GCC.

**32. CHANGE IN LAW**

The occurrence of events comprising Change in Law shall be as specified in Clause 32 of the GCC.

**33. SUSPENSION**

The Suspension of Works shall be as specified in Clause 33 of the GCC.

**34. TERMINATION**

The right of Parties to terminate the Agreement shall be as specified in Clause 34 of the GCC.

**35. GOVERNING LAW AND DISPUTE RESOLUTION**

The Governing Law and Dispute Resolution mechanism shall be as specified in Clause 35 of the GCC.

**36. MISCELLANEOUS**

The miscellaneous provisions of the Agreement shall be as specified in Clause 36 of the GCC.

**[signature page follows]**

**IN WITNESS WHEREOF** the parties have executed this Contract as of the date first recorded above.

**CLIENT**

SHAKUNTALA EDUCATIONAL & WELFARE SOCIETY

\_\_\_\_\_  
Name:

Title:

**CONTRACTOR**

[ ]

\_\_\_\_\_  
Name:

Title: